APPENDIX PA

ATTACHMENT PAR

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ACRONYMS AND ABBREVIATIONS

AIS	***Air Intake Shaft***
AMM	***Asphalt mastic mix***
CCA	***Compliance Certification Application***
CCDF	***Complementary cumulative distribution function***
CDF	***Cumulative distribution function***
CH	***Contact-handled***
DOE	***Department of Energy***
DRZ	***Disturbed rock zone***
EPA	***Environmental Protection Agency***
ERMS	***Electronic Records Management System***
FMT	***Fracture matrix transport***
GTFM	***Graph Theoretic Field Model***
ID	***Identification number***
LANL	***Los Alamos National Laboratory***
LHS	***Latin hypercube sample***
MB	***Marker bed***
MU	***Map unit***
PAVT	***Performance Assessment Verification Test***
PDF	***Probability distribution function***
PNL	***Pacific Northwest Laboratory***
QA	***Quality Assurance***
QAP	***Quality Assurance Procedure***
RH	***Remote-handled***
SMC	***Salado Mass Concrete***
SNL	***Sandia National Laboratories***
SSSPT	***Small Scale Seal Performance Tests***
SWCF	***Sandia WIPP Central Files***
TRU	***Transuranic***
TWBIR	***Transuranic Waste Baseline Inventory Report***
WES	***Waterways Experiment Station***
WIPP	***Waste Isolation Pilot Plant***

PAR 1.0 INTRODUCTION

This attachment contains information for the parameters used by performance assessment (PA) codes. Documentation, in the form of parameter sheets, is provided for the 64 parameters sampled by the Latin hypercube sample (LHS) code during the PA (see also Section 6.1.5 for discussion on probabilistic analyses and Section 6.1.5.2 for discussion on LHS). In addition, this attachment includes a listing of the sampled values for LHS sampled parameters (see Tables PAR-8 through PAR-11), four parameters sampled by LHS for the Spall model (see Tables PAR-12), the fixed-value parameters used in the PA codes (see Tables PAR-13 through PAR-49) and the parameters relating to the TRU waste inventory (see Tables PAR-50 through PAR-61). Additional information relevant to the use of these parameters in the PA is contained in Appendix PA; Appendix TRU WASTE provides details on the waste inventory.

For additional information regarding all parameters, readers are referred to the parameter records packages, which are contained in the Sandia National Laboratories (SNL) Waste Isolation Pilot Plant (WIPP) Central Files (SWCF) located at the SNL office in Carlsbad, New Mexico.

PAR 2.0 PARAMETER DEVELOPMENT PROCESS

The development of parameter values is controlled by the application of Quality Assurance Procedure (QAP) Quality Assurance Requirements for the Selection and Documentation of Parameter Values used in WIPP PA (QAP 9-2). The process includes documentation of parameter development by those responsible for completion of a particular experimental investigation, development of a system design, or by staff involved in the PA modeling process. All of the references pertaining to parameter selection are contained within the three levels of parameter and data documentation: (1) WIPP Data Entry Form 464, (2) parameter records packages, and (3) supporting data records packages.

The WIPP Data Entry Form 464 is the highest-level record documenting parameter development that includes application of statistics and interpretations. The WIPP Data Entry Form 464s include a source section, which is a pointer to supporting information including, where applicable, the parameter records package(s). All values provided in this attachment were derived from the WIPP PA parameter database. The numbers from the WIPP PA parameter database may differ slightly from those contained in the Form 464s because of rounding.

The parameter records packages include a data and distribution summary, quality assurance (QA) status of the data and related interpretive numerical codes, references to related information, such as SAND reports, test plans, and related SWCF file codes, and, where applicable, a summary on the experimental data collection (that is, method used, assumptions made in testing, and interpretation). The parameter records packages point to the supporting data records packages. The data records packages contain information such as the raw data, analysis, and data interpretation.

Each WIPP Data Entry Form 464, parameter records package, and supporting data records packages are assigned unique Electronic Records Management System) numbers. Copies of the Form 464s, parameter records package, and supporting data records packages are maintained in the SWCF.

PAR 3.0 PARAMETER DISTRIBUTIONS

Probability distributions are used to characterize the uncertainty concerning the value of a parameter. Numbers that characterize a particular distribution include the range, the mean, median, and mode.

- ***Range. The range of a distribution can be denoted by (a,b), a pair of numbers in which a and b are minimum and maximum values of the parameter, respectively.***
- ***Mean. Analogous to the arithmetic average of a series of numbers, the mean value of a probability distribution is one measure of the central tendency of a distribution. For nonsymmetrical distributions that are considerably skewed, the mean value may not lie near the median or mode (see below).***
- ***Median. The median value of a probability distribution (denoted here by $x_{0.5}$) is the 50th percentile, the value in the distribution range at which 50 percent of all values lie above and below.***
- ***Mode. The mode is the most probable value of the uncertain parameter; that is, the maximum value of the associated probability density function (PDF).***

PAR 3.1 Distribution Types And Applications

Distributions used to characterize uncertainty in parameters of the PA include: uniform, cumulative, triangular, Student's-t, delta, normal, log uniform, log cumulative, lognormal, and constant.

PAR 3.1.1 Uniform Distribution

Density Function:

$$f(x) = \frac{1}{B - A} \qquad A \le x \le B \tag{1}$$

Distribution Function:

$$F(x) = \frac{x - A}{B - A} \qquad A \le x \le B \tag{2}$$

Expected Value and Variance:

$$E(X) = \frac{A + B}{2} \qquad V(X) = \frac{(B - A)^2}{12} \tag{3}$$

Median:

$$X_{0.5} = mean$$

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).

PAR 3.1.2 Cumulative Distribution

A cumulative distribution (also called a constructed distribution) is described by a set of N ordered pairs:

$$(x_1, 0), (x_2, P_2), (x_3, P_3), \ldots, (x_N, 1) \{ \text{i.e., } P_1 = 0 \text{ and } P_N = 1 \text{ always} \} \qquad (4)$$

where $x_1 < x_2 < x_3 < \ldots < x_N$ *and* $0 < P_2 < P_3 < \ldots < P_{N-1} < 1$

Because of the nature of the data, the PDF for this distribution takes the form:

$$P(\xi) = \begin{cases} 0 & \text{if } \xi < x1 \\ \dfrac{P_n - P_{n-1}}{x_n - x_{n-1}} & \text{if } x_{n-1} \le \xi \le x_n,\ n = 2, 3, \_, N \\ 0 & \text{if } \xi \ge x_N \end{cases} \qquad (5)$$

and so the cumulative distribution function (CDF) takes the form:

$$P_r[X \le \xi] \approx \Pi(\xi) = \begin{cases} 0 & \text{if } \xi < x_1 \\ P_{n-1} + \dfrac{(P_n - P_{n-1})(\xi - x_{n-1})}{(x_n - x_{n-1})} & \text{if } \dfrac{x_{n-1} \le \xi \le x_x}{n = 2, 3, \_, N} \\ 1 & \text{if } \xi > x_N \end{cases} \qquad (6)$$

Expected Value:

$$E(X) = \sum_{n=2}^{N} (P_n - P_{n-1}) \frac{(x_n + x_{n-1})}{2} \qquad (7)$$

Variance:

$$V(X) = \sum_{n=2}^{N} (P_n - P_{n-1}) \frac{(x_n^2 + x_n x_{n-1} + x_{n-1}^2)}{3} - \{E(X)\} \qquad (8)$$

Median:

$$x_{0.50} = x_{m-1} + (x_m - x_{m-1}) \frac{(0.50 - P_{m-1})}{(P_m - P_{m-1})} \text{ where } P_{m-1} \le 0.50 < P_m. \qquad (9)$$

The cumulative distribution takes its name from the fact that it closely resembles the empirical CDF obtained by plotting the empirical percentiles of the data set ($x_1, x_2, x_3, \ldots, x_N$) *(Blom 1989, p. 216). The cumulative distribution used here is the result of plotting the subjectively determined percentile points* (x_1, P_1), (x_2, P_2), (x_3, P_3) *… , that arise in a formal elicitation of* *expert opinion concerning the form of the distribution of the parameter in question. A simple form of the cumulative distribution is used when the range (a,c) of the parameter is known and the analyst believes that his or her 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_1,P_1), (x_2,P_2), ..., (x_N, P_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).

PAR 3.1.3 Triangular Distribution

Density Function:

$$f(x) = \frac{2(x-a)}{(c-a)(b-a)} \qquad a \le x \le b$$

$$= \frac{2(c-x)}{(c-a)(c-b)} \qquad b \le x \le c \qquad (10)$$

Distribution Function:

$$F(x) = \frac{(x-a)^2}{(c-a)(b-a)} \qquad a \le x \le b$$

$$= \frac{(b-a)}{(c-a)} - \frac{(x+b-2c)(x-b)}{(c-a)(c-b)} \qquad b \le x \le c \qquad (11)$$

Expected Value:

$$E(X) = \frac{a+b+c}{3} \qquad (12)$$

Variance:

$$V(X) = \frac{a(a-b)+b(b-c)+c(c-a)}{18} \qquad (13)$$

Median:

$$X_{0.5} = a + \sqrt{\frac{(c-a)(b-a)}{2}} \quad \text{if } b \ge \frac{a+c}{2}$$

$$= c - \sqrt{\frac{(c-b)(c-a)}{2}} \quad \text{if } b \le \frac{a+c}{2} \qquad (14)$$

The triangular distribution is defined on the range (a,c) and has mode b. The mode can equal either of the two boundary values, which may simplify the computations above (Iman and Shortencarier 1984).

Use of the triangular distribution is appropriate when the range, (a,c), of the parameter is known and the analyst believes that his or her best estimate value, b, is also the mode (or most probable value) of the unknown distribution.

PAR 3.1.4 Student's-t Distribution

A Student's-t distribution is a Bayesian distribution for the unknown mean value of a parameter. Its use is appropriate when one has measured values of the parameter available (in contrast to values obtained subjectively through elicitation of professional opinion). If N denotes the number of measurements available, and $X_1, X_2, X_3, \ldots, X_N$ denote the values of the measurements, then the expected value or mean of the Student's-t distribution is the sample standard deviation divided by $\sqrt{N}$; the median value is equal to the mean value.

The Student's-t distribution applies when there are few measurements, say $3<N<10$. For large N, say $N>20$, there is little difference between the t-distribution and a normal distribution (see below) with the same mean and standard deviation.

In WIPP PA data characterized by Student's-t distribution are equally weighted. In other words, each measured value X_i is assigned a weight of 1/N, where N is the number of measurements.

PAR 3.1.5 Delta Distribution

The delta distribution is used to assign probabilities to the elements of some set of objects. For example, if the set consists of four alternative mathematical models of some phenomena and each model is labeled with one of the integers {1,2,3,4}, in other words,

$$M_1, M_2, M_3, M_4$$

then we might assign the vector of probabilities (p_1, p_2, p_3, p_4), where each p_i is a number between 0 and 1 and

$$p_1 + p_2 + p_3 + p_4 = 1. \tag{15}$$

The CDF associated with this delta distribution can be symbolically expressed by

$$F(x) = \sum_{n=1}^{4} p_n u(x-n). \tag{16}$$

The graph of this CDF can be visualized as an ascending staircase starting at zero level for x less than one, and having steps of height p_n at the points $x = 1, 2, 3, 4$.

The notion of mean value and variance still apply to a delta distribution, but the meanings of these quantities may require careful interpretation. If the M_n represents four different functions (say, discharge as a function of pressure), then it makes sense to talk about mean and variance functions. For the example of the four alternative mathematical models, the mean mathematical model is the linear combination

$$\overline{M} = \sum_{n=1}^{4} p_n M_n \qquad (17)$$

and the variance of the models is similarly defined:

$$\Sigma^2 = \sum_{n=1}^{4} p_n \left(\overline{M} - M_n \right)^2 \qquad (18)$$

The notion of median value is meaningless for a delta distribution.

PAR 3.1.6 Normal Distribution

Density function:

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left\{ \frac{-(x-\mu)^2}{2\sigma^2} \right\} \quad -\infty < x < \infty \qquad (19)$$

Distribution function:

$$F(x) = \int_{-\infty}^{x} f(t)\,dt \quad -\infty < x < \infty \qquad (20)$$

Expected value and variance: $E(X) = \mu$ ***and*** $V(X) = \sigma^2$. ***(21)***

The WIPP PA Program employs a truncated normal distribution where data are concentrated within an interval (lowrange, hirange) (Iman and Shortencarier 1984). The parameters of the truncated distribution can be expressed as follows:

$$E(X) = \mu = \frac{(lowrange + hirange)}{2} \qquad V(X) = \sigma^2 = \left(\frac{hirange - lowrange}{6.18} \right)^2 \qquad (.22)$$

Median = mean (μ) and lowrange = 0.01 quantile, hirange = 0.99 quantile. The range of the random variable is arbitrarily set to (lowrange, hirange). Alternatively, the expected value μ and the standard deviation σ can be specified by the user of this distribution; in this case, the random variable takes on the range $(-\infty, \infty)$ and will need to be truncated to a finite interval and renormalized.

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 ($N > 10$) to make accurate, unbiased estimates of the mean (μ) and variance (σ^2) (Sandia WIPP Project 1992; Tierney 1990).

PAR 3.1.7 Log uniform Distribution

If X has a log uniform distribution on the interval from A to B where B > A > 0, then $Y = \log_{10} X$ has a uniform distribution from $\log_{10} A$ to $\log_{10} B$ (Iman and Shortencarier 1984).

Density Function:
$$f(x) = \frac{1}{x}(\ln B - \ln A) \quad A < x < B \qquad (23)$$

Distribution Function:
$$F(x) = \frac{\ln x - \ln A}{\ln B - \ln A} \quad A < x < B \qquad (.24)$$

Expected Value:
$$E(X) = \frac{B - A}{\ln B - \ln A} \qquad (25)$$

Variance:
$$V(X) = (B - A)\left[\frac{(\ln B - \ln A)(B + A) - 2(B - A)}{2(\ln B - \ln A)^2}\right] \qquad (26)$$

Median:
$$X_{0.5} = \sqrt{AB} \qquad (27)$$

Use of the log uniform distribution is appropriate when all that is known about a parameter is its range (a,b) and B/A » 10; that is, the range (a,b) spans many orders of magnitude.

PAR 3.1.8 Log Cumulative Distribution

In this case, 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:

$$(y_1, 0), (y_2, P_2), (y_3, P_3), \ldots, (y_N, 1) \quad \{\text{that is, } P_1 = 0 \text{ and } P_N = 1 \text{ always}\} \qquad (28)$$

where $y_1 < y_2 < y_3 < \ldots < y_N$ and $0 < P_2 < P_3 < \ldots < P_{N-1} < 1$

Because of the nature of the data, the PDF for this distribution takes the form:

$$P(\xi) = \begin{cases} 0 & \text{if } \xi < x_1 \\ \dfrac{P_n - P_{n-1}}{\ln x_n - \ln x_{n-1}} \dfrac{1}{\xi} & \text{if } x_{n-1} \le \xi \le x_n, \ n = 2, 3, \ldots, N \\ 0 & \text{if } \xi \ge x_N \end{cases} \qquad (29)$$

and so the CDF takes the form:

$$P_r\, X \le \xi = \begin{cases} 0 & \text{if } \xi < x_1 \\ P_{n-1} + \dfrac{(P_n - P_{n-1})(\ln \xi - \ln x_{n-1})}{(\ln x_n - \ln x_{n-1})} & \text{if } \dfrac{x_{n-1} \le \xi \le x_x}{n = 2, 3, \_, N} \\ 1 & \text{if } \xi > x_N \end{cases} \qquad (30)$$

Expected Value: $$E(X) = \sum_{n=2}^{N} (P_n - P_{nl}) \frac{(x_n - x_{n-1})}{\ln x_n - \ln x_{n-1}} \qquad (31)$$

Variance: $$V(X) = \sum_{n=2}^{N} \frac{1}{2}(P_n - P_{n-1}) \frac{(x_n^2 - x_{n-1}^2)}{\ln x_n - \ln x_{n-1}} - \{E(X)\}^2 \qquad (32)$$

Median:

$$X_{0.5} = 10^{**} \left\{ x_{m-1} + (x_m - x_{m-1}) \frac{(0.50 - P_{m-1})}{P_m - P_{m-1}} \right\} \text{ where } P_{m-1} \le 0.50 \le P_m. \qquad (33)$$

PAR 3.1.9 Lognormal Distribution

If X ~ normal distribution with mean, μ, and variance, σ^2, and $Y = e^X$, the Y has a lognormal distribution. ***(34)***

Density function: $$f(y) = \frac{1}{y\sigma\sqrt{2\pi}} \exp\left\{ \frac{-(\ln y - \mu)^2}{2\sigma^2} \right\} \quad y > 0 \qquad (35)$$

Distribution function: $$F(x) = \int_0^y f(t)\, dt \quad y > 0 \qquad (36)$$

Expected value and variance:

$$E(Y) = \exp\left(\mu + \frac{\sigma^2}{2}\right) \quad V(Y) = \exp(2\mu + \sigma^2)\left[\exp(\sigma^2) - 1\right] \qquad (37)$$

Median: $$X_{0.5} = e^{\mu} \qquad (38)$$

As with the normal distribution, the lognormal distribution requires lowrange and hirange values. These values are in logarithmic form and are utilized in a normal distribution to determine a mean (μ) and a variance (σ^2), which in turn are used to identify the expected value and variance for the lognormal distribution (Iman and Shortencarier 1984).

PAR 3.1.10 Constants

Parameters may also be assigned a constant value in the PA parameter database. These parameters are tabulated at the end of the appendix.

PAR 4.0 PARAMETER CORRELATION

Parameter correlations used in PA are exclusively in LHS. Consequently, parameter correlations affect only sampled parameters described in the attached parameter sheets. Two types of parameter correlations are used. They are defined as explicit parameter correlation and induced parameter correlation. This section addresses the following criteria concerning parameter correlations, as specified in 40 CFR § 194.23(c)(6):

> ***(c) Documentation of all models and computer codes included, as part of any compliance application performance assessment calculation shall be provided. Such documentation shall include, but shall not be limited to:***
>
> ***(6) An explanation of the manner in which models and computer codes incorporate the effects of parameter correlation.***

Explicit parameter correlations are introduced or prohibited in LHS by the restricted pairing technique of Iman and Conover (1982). Three parameter correlations are specified in this PA through this technique. These correlations are all related to rock compressibility and permeability. In the Marker Bed (MB) 139 material region in BRAGFLO, rock compressibility (COMP_RCK, ID # 580) and intrinsic permeability (PRMX_LOG, ID # 591) are inverse-correlated with a correlation coefficient of -0.99. In the Salado Formation impure halite material region in BRAGFLO, rock compressibility (COMP_RCK, ID #541) and intrinsic permeability (PRMX_LOG, ID # 547) are inverse correlated with a correlation coefficient of -0.99. In the Castile brine reservoir material region in BRAGFLO, rock compressibility (COMP_RCK, ID # 61) and intrinsic permeability (PRMX_LOG, ID # 67) are inverse correlated with a correlation coefficient of -0.75. Explicit parameter correlation is not used to correlate other sampled parameters.

Rock compressibilities and intrinsic permeabilities are correlated to be most consistent with interpretations of the hydraulic tests that have been performed in these units. In hydraulic testing, hydraulic diffusivity (the ratio of permeability to compressibility) is determined more precisely than either permeability or compressibility alone. Introducing the correlation of the permeability and compressibility parameters in PA better represents the knowledge of the formation gained from hydraulic testing than specifying no correlation whatsoever.

An induced correlation in PA is created when a parameter sampled in LHS (the underlying variable) is used to define the values of other parameters (defined variables). This is a prevalent method of correlation in this PA. For example, uncertainty in dissolved actinide oxidation states is represented in LHS by sampling the OXSTAT parameter (ID #3417). The results of this sampling are used in part to determine actinide solubilities (NUTS and PANEL), colloidal actinide concentrations (NUTS and PANEL), and K_D ***values (SECOTP2D)***

used for a particular vector. Selected examples of other induced parameter correlations include:

- ***the underlying variable x-direction permeability and the defined variables y- and z-direction permeabilities in many materials (BRAGFLO),***
- ***the underlying variable x-direction permeability and defined variable threshold pressure in many materials (BRAGFLO),***
- ***the underlying variable Lower Salado Clay permeability and the defined variable permeabilities of other clay members of the shaft seal system (BRAGFLO), and***
- ***the underlying variable residual gas saturation (or other two-phase flow parameters) in many materials and the defined variable residual gas saturation (or other two-phase flow parameters) in other materials (BRAGFLO).***

Where relevant, parameter sheets in this attachment contain information related to parameter correlation.

No correlations were used in this PA for certain parameters used to describe transport in the Culebra for which the possibility of correlation might be suspected. The treatment in PA is most consistent with available information, because, as discussed in CCA Appendix MASS (Attachments MASS 15-10 and 15-6, 14), correlation of well-to-well transmissivity versus well-to-well advective porosity and matrix block length is not evident in existing data, nor is the correlation between advective porosity and matrix block length.

There are four additional ways in which parameter correlations may be considered to be used in this PA, although they are not typically discussed as correlations per se. In a given LHS sample element, there is a correlation of 1 (100 percent) between the single observation of subjective uncertainty (the LHS sample for a complementary cumulative distribution function (CCDF)) with all of the sequences of random future events (scenarios) used to construct a CCDF. This is discussed in Section 6.1.

A correlation is made between the scenario being considered and the chemical properties (chemical composition) of brine in the repository (the physical properties viscosity and density are assumed to be the same for all scenarios). Brine composition affects actinide solubility. For undisturbed performance and E2 scenarios, brine composition is considered to be that of Salado brine. For the E1 and E1E2 scenarios, the brine composition is considered to be that of Castile brine. This is discussed in Section 6.4.3.4.

There are some correlations made in the construction of a CCDF regarding the similarity of events in a sequence of random future events. For example, the direct releases resulting from a third or later intrusion are determined from the calculated conditions following the second intrusion. This is discussed in Section 6.4.13.

Finally, there are also correlations among model parameters developed explicitly by the governing equations of computational models used. For example, the porosity of nodal blocks

in BRAGFLO is a function of the initial porosity, pressure change, and compressibility. These types of relationships among parameters are documented in the Appendix PA.

PAR 5.0 KEY TO PARAMETER SHEETS

The parameter sheets included in this attachment contain a variety of information, some of which is extracted from the WIPP PA parameter database. Parameters are listed in the order in which they are retrieved from the WIPP PA parameter database. Eleven of the parameters retrieved from the database are dummy parameters and are not actually utilized by the code. Those parameters are therefore not are not listed or discussed in this section. Breaks in the numerical sequence of the parameters are due to dummy parameters.

Information presented in the parameter sheets is grouped into boxes labeled as follows:

PAR 5.1 Parameter(s)

The name of the parameter and the disposal system feature with which it is associated.

PAR 5.2 Parameter Description

The Parameter Description box defines the parameter and, where appropriate, explains the role of the parameter in the modeling.

PAR 5.3 Material and Property Name(s)

This box provides a link to the PA parameter database. The parameter label listed first is taken from the PA model parameter database and identifies the type of material in the disposal system being modeled (for example, S_MB139 means Salado MB139). The second label describes the PA model parameter name for the property of the material physical or operational meaning for the parameter (for example, SAT_RBRN means residual brine saturation). The number associated with a parameter is the unique identification number (ID) established in the WIPP PA parameter database.

PAR 5.4 Computational Code(s)

A list of the current computational models used by the PA Department that use this parameter.

PAR 5.5 Parameter Statistics

This box identifies the minimum and maximum for uniform distributions, the mode, minimum and maximum for Triangular distributions, the probability and the value associated with that probability for cumulative and delta distributions, and the measured values for the student's-t distribution. All values provided in this attachment were derived from the WIPP PA parameter database. These numbers may differ slightly from those contained in the Form 464s because of rounding.

PAR 5.6 Units

The physical units of the parameters (usually expressed in metric units).

PAR 5.7 Distribution Type

This box identifies the type of parameter distribution (see PAR 3.1).

Data: The basis for the parameter values or parameter distribution is provided in this section. All values provided in this attachment were derived from the WIPP PA parameter database. These numbers may differ slightly from those contained in the Form 464s because of rounding. The parameters are derived from the following kinds of data and information:

- ***Site-specific or waste-specific experimental data. These data includes information obtained from in situ experiments and research conducted at off-site laboratories (for example, permeability data, microbial gas generation). This category also includes simulated waste experiments and may indicate correlations made with other material regions based on professional judgment.***

- ***Waste-specific observational data. This category includes data obtained through observation or empirical analysis, such as semi-quantitative and qualitative visual characterization or acceptable knowledge of transuranic (TRU) waste (for example, waste components).***

- ***Professional judgment. This category of information may involve the use of experimental or observational data from other non-WIPP contexts; interpreting information obtained from the general literature; or may be based on general engineering knowledge (see below).***

- ***General Literature Data. This category of information includes that obtained from reports, journal articles, or handbooks relevant to systems or processes being modeled in the PA. It is often employed in conjunction with professional judgment.***

- ***General Engineering Knowledge. This category of information identifies parameter values obtained from knowledge of standard engineering principles.***

Readers are referred to parameter records packages and associated data packages maintained in the SWCF for additional information.

PAR 5.8 Discussion

This box identifies the source(s) of parameter value(s) and the rationale for the parameter distribution and may clarify use of a particular parameter. Other relevant background information is also included in this section, where clarification is appropriate.

PAR 5.9 References

This box contains the references pertaining to parameter selection. The references are contained within the three levels of parameter and data documentation: (1) WIPP Data Entry Form 464, (2) parameter records packages, and (3) supporting data records packages. Selected references cited in the parameter records packages are included in the parameter sheets to establish data quality.

PAR 6.0 EPAUNI OUTPUT DATA

Tables PAR-50 – 61 represent output files from the code EPAUNI Version 1.15A (for more information regarding EPAUNI output files, see Fox [2003]).

Table PAR-50 contains data from the EPAUNI output files EPU_CRA1_CH_UNIT2.OUT and EPU_CRA1_RH_UNIT2.OUT. The table contains waste stream volume and EPA units per m^3 for each of the CH-TRU and RH-TRU waste streams over each of the 10 time periods after closure (0, 100, 125, 175, 350, 1000, 3000, 5000, 7500, and 10,000 years). It also contains the probability of hitting each waste stream during a drilling intrusion at each of the 10 time periods after closure.

Tables PAR-51 – 60 contains data from the EPAUNI output file EPU_CRA1_CH_ ACTIVITY.DIA. The table contains activity information for each of the seven isotopes of concern for EPA unit calculations (^{241}Am, ^{244}Cm, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, and ^{234}U), the total activity used to calculate EPA units (called Total EPA Curies), and the EPA units for each CH-TRU waste stream. The code calculates these activities for each of the 10 time periods after closure (0, 100, 125, 175, 350, 1000, 3000, 5000, 7500, and 10,000 years) based on build-up and decay.

Table PAR-61 contains data from the EPAUNI output file EPU_CRA1_RH_ACTIVITY.DIA. The table contains activity information for each of the nine isotopes of concern for EPA unit calculations (^{241}Am, ^{244}Cm, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{234}U, ^{137}Cs, and ^{90}Sr), the total activity used to calculate EPA units (called Total EPA Curies), and the EPA units for each RH-TRU waste stream. The code calculates these activities for each of the 10 time periods after closure (0, 100, 125, 175, 350, 1000, 3000, 5000, 7500, and 10,000 years) based on build-up and decay.

PAR 7.0 PARAMETER SHEETS

Index of LHS Sampled Parameters:

Parameter #	Material Name	Property Name
Parameter 1	STEEL	CORRMCO2
Parameter 2	WAS_AREA	PROBDEG
Parameter 3	WAS_AREA	GRATMICI
Parameter 4	WAS_AREA	GRATMICH
Parameter 5	CELLULS	FBETA
Parameter 6	WAS_AREA	SAT_RGAS
Parameter 7	WAS_AREA	SAT_RBRN
Parameter 8	WAS_AREA	SAT_WICK
Parameter 9	DRZ_PCS	PRMX_LOG
Parameter 10	CONC_PCS	PRMX_LOG
Parameter 11	SOLU4	SOLCIM
Parameter 12	SOLTH4	SOLCIM
Parameter 14	CONC_PCS	SAT_RGAS
Parameter 15	CONC_PCS	SAT_RBRN
Parameter 16	CONC_PCS	PORE_DIS
Parameter 17	S_HALITE	POROSITY
Parameter 18	S_HALITE	PRMX_LOG
Parameter 19	S_HALITE	COMP_RCK
Parameter 20	S_MB139	PRMX_LOG
Parameter 21	S_MB139	COMP_RCK
Parameter 22	S_MB139	RELP_MOD
Parameter 23	S_MB139	SAT_RBRN
Parameter 24	S_MB139	SAT_RGAS
Parameter 25	S_MB139	PORE_DIS
Parameter 26	S_HALITE	PRESSURE
Parameter 27	CASTILER	PRESSURE
Parameter 28	CASTILER	PRMX_LOG
Parameter 29	CASTILER	COMP_RCK
Parameter 30	BH_SAND	PRMX_LOG
Parameter 31	DRZ_1	PRMX_LOG
Parameter 32	CONC_PLG	PRMX_LOG
Parameter 34	SOLAM3	SOLSIM
Parameter 35	SOLAM3	SOLCIM
Parameter 36	SOLPU3	SOLSIM
Parameter 37	SOLPU3	SOLCIM
Parameter 38	SOLPU4	SOLSIM

Index of LHS Sampled Parameters (continued):

Parameter #	Material Name	Property Name
Parameter 39	SOLPU4	SOLCIM
Parameter 40	SOLU4	SOLSIM
Parameter 41	SOLU6	SOLSIM
Parameter 42	SOLU6	SOLCIM
Parameter 43	SOLTH4	SOLSIM
Parameter 44	PHUMOX3	PHUMCIM
Parameter 45	GLOBAL	OXSTAT
Parameter 46	CULEBRA	MINP_FAC
Parameter 47	GLOBAL	TRANSIDX
Parameter 48	GLOBAL	CLIMTIDX
Parameter 49	CULEBRA	HMBLKLT
Parameter 50	CULEBRA	APOROS
Parameter 51	CULEBRA	DPOROS
Parameter 52	U+6	MKD_U
Parameter 53	U+4	MKD_U
Parameter 54	PU+3	MKD_PU
Parameter 55	PU+4	MKD_PU
Parameter 56	TH+4	MKD_TH
Parameter 57	AM+3	MKD_AM
Parameter 58	BOREHOLE	TAUFAIL
Parameter 60	GLOBAL	PBRINE
Parameter 61	BOREHOLE	DOMEGA
Parameter 62	SHFTU	SAT_RBRN
Parameter 63	SHFTU	SAT_RGAS
Parameter 64	SHFTU	PRMX_LOG
Parameter 65	SHFTL_T1	PRMX_LOG
Parameter 66	SHFTL_T2	PRMX_LOG
Parameter 75	SPALLMOD	RNDSPALL

Index of DRSPALL Sampled Parameters:

Material Name	*Property Name*
SPALLMOD	*REPIPORE*
SPALLMOD	*REPIPERM*
SPALLMOD	*TENSLSTR*
SPALLMOD	*PARTDIAM*

Refer to Table PAR-12 for the LHS Sampled Values for the Spall Model.

1 ***Parameter 1: Inundated Corrosion Rate for Steel Without CO_2 Present***

Parameter Description:

This parameter is used to describe the rate of anoxic steel corrosion under brine-inundated conditions and with no CO_2 present (Appendix PA, Section PA-4.2).

2 ***Material and Property Name(s):***

STEEL CORRMCO2 (#2907)

3 ***Computational Code: BRAGFLO***

4

minimum	***maximum***
0.0	3.17×10^{-14}

5 ***Units: Meters/second***

6 ***Distribution Type: Uniform***

7 ***Data: Site- Specific Experimental Data***

A discussion of the data associated with this parameter for the initial application may be found in Appendix PAR (DOE 1996). Justification for the change of this parameter for CRA may be found in the following parameter records package: Analysis Reports Relating to Analysis Plan AP-086 (ERMS #520523), specifically Summary of parameter changes adopted from the PA Verification Test for the Technical Baseline Migration (ERMS #522016).

8 ***Discussion:***

Based on experimental results (Telander and Westerman 1993; 1997), steel is expected to corrode in the repository via the following reaction (Wang and Brush, 1996a, 1996b):

$$Fe^0 + 2H_2O \rightarrow Fe(OH)_2 + H_2$$

The rate of this reaction under a brine-inundated condition (no CO_2 present at all) is estimated to be 0 - 0.5 μm/year (0 - 1.59×10^{-14} m/s). This steel corrosion rate was estimated by DOE based on long-term anoxic steel corrosion experiments. Because of its uncertainty, this parameter was treated as a sampled variable in the CCA with a uniform distribution ranging from 0.0 to 1.59×10^{-14} m/s (see CCA Appendix PAR).

Subsequent to the CCA, the EPA questioned both the upper and lower bounds on DOE's assigned range of values for CORRMCO2. After evaluating the values DOE assigned to the steel corrosion rate, the EPA carefully examined experimental results. In all cases, except for the case of high pressure, the EPA, like the DOE, concluded that the steel corrosion rate used in the CCA was appropriate.

However, the EPA questioned the upper bound for the steel corrosion rate in the case of high pressures in the repository. Some experiments of six months duration conducted on

steel immersed in brine under a hydrogen atmosphere indicated that the steel corrosion rate first decreased at pressures from 2 to 70 atm and then increased at pressures from 70 to 127 atm (Telander and Westerman 1993). Because the repository may approach or exceed lithostatic pressure and because of the increase in the experimental corrosion rates at higher pressures, the EPA requested that DOE double the upper bound of the inundated corrosion rate to 3.17×10^{-14} ***m/s (EPA 1998). DOE has adopted this revised range for the rate of anoxic steel corrosion (Hansen and Leigh 2003).***

WIPP Data Entry Form #464 ERMS: #522016

References:

Hansen, C., Leigh, C. 2003. A Reconciliation of the CCA and PAVT Parameter Baselines, Rev. 3. Carlsbad, NM. Sandia National Laboratories. ERMS 528582

Telander M. R. and Westerman, R.E. 1993. Hydrogen Generation by Metal Corrosion in Simulated Waste Isolation Pilot Plant Environments: Progress Report for the Period November 1989 through December 1992. SAND92-7347. Sandia National Laboratories. Albuquerque, NM.

Telander M. R. and Westerman, R.E. 1997. Hydrogen Generation by Metal Corrosion in Simulated Waste Isolation Pilot Plant Environments. SAND96-2538. Sandia National Laboratories. Albuquerque, NM.

U.S. Department of Energy (DOE). 1996. Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant. DOE/CAO-1996-2184. Carlsbad, NM: United States Department of Energy, Waste Isolation Pilot Plant, Carlsbad Area Office. Vols 1-XXI.

U.S. Environmental Protection Agency (EPA). 1998. Technical Support Document for Section 194.23:Parameter Justification Report. Docket No. A-93-02, V-B-14. U.S. Environmental Protection Agency. Washington, D.C. ERMS 525158.

Wang Y., and Brush L. H. 1996a. "Estimates Of Gas-Generation Parameters For The Long-Term WIPP PA" Memorandum to M. Tierney, 1/26/1996.. Sandia National Labs. Albuquerque, NM. ERMS 231943

Wang Y., and Brush L. H. 1996b. "Modify The Stoichiometric Factor Y In The BRAGFLO To Include The Effect Of MgO Added To WIPP Repository As A Backfill". Memorandum to M. Tierney, 2/23/1996. Sandia National Labs. Albuquerque, NM. ERMS 232286.

Parameter 2: Probability of Microbial Degradation of Plastics and Rubbers in the Waste in the Event of Significant Microbial Gas Generation

Parameter Description:

This parameter is used to index alternative models of microbial degradation of plastics and rubbers in the waste in the repository in the event of significant microbial gas generation. It is a sampled parameter for the waste emplacement area and the waste, and the values are then applied to the repository regions outside of the panel region.

Material and Property Name(s):

WAS_AREA PROBDEG (#2823)

Computational Code: BRAGFLO

Value	***0***	***1.0***	***2.0***
Percentiles	***.50***	***.25***	***.25***

Units: None

Distribution Type: Delta (see Figure PAR-1 for values.)

Data: General Engineering Knowledge - Professional Judgment

A discussion of the data associated with this parameter may be found in Tierney (1996) and the following parameter records package: Estimates of Gas Generation Parameters Required for BRAGFLO (ERMS #230819).

Discussion:

Cellulosics, plastics, and rubbers have been identified as the major organic materials to be emplaced in the WIPP repository (Appendix TRU WASTE) and could be degraded by microbes in 10,000 years. The occurrence of significant microbial gas generation in the repository will depend on: (1) whether microbes capable of consuming the emplaced organic materials will be present and active; (2) whether sufficient electron acceptors will be present and available; and (3) whether enough nutrients will be present and available. Considering uncertainties in evaluation of these factors and also in order to bracket all possible effects of gas generation on the WIPP PA, a probability of 50 percent is assigned to the occurrence of significant microbial gas generation (Wang and Brush 1996).

There are two factors that may potentially increase the biodegradability of these materials: long time scale and cometabolism. Over a time scale of 10,000 years, plastics and rubbers may change their chemical properties and therefore their biodegradability.

Cometabolism means that microbes degrade an organic compound, but do not use it or its constituent elements as a source of energy; these are derived from other substrates (Alexander 1994). In the WIPP repository, plastics and rubbers, which are resistant to biodegradation, may still be cometabolized with cellulosics and other more biodegradable

organic compounds. Because of these uncertainties, a probability of 50 percent is assigned to the biodegradation of plastics and rubbers in the event of significant microbial gas generation (Wang and Brush 1996).

The distribution for PROBDEG parameter is illustrated in Figure PAR-1. The parameter value ranges over the integers from 0 (no significant microbial gas generation) to 2 (significant microbial gas generation with degradation of plastics and rubbers); the third choice, a parameter value of 1, represents significant microbial gas generation without degradation of plastics and rubbers.

WIPP Data Entry Form #464 ERMS: #234881

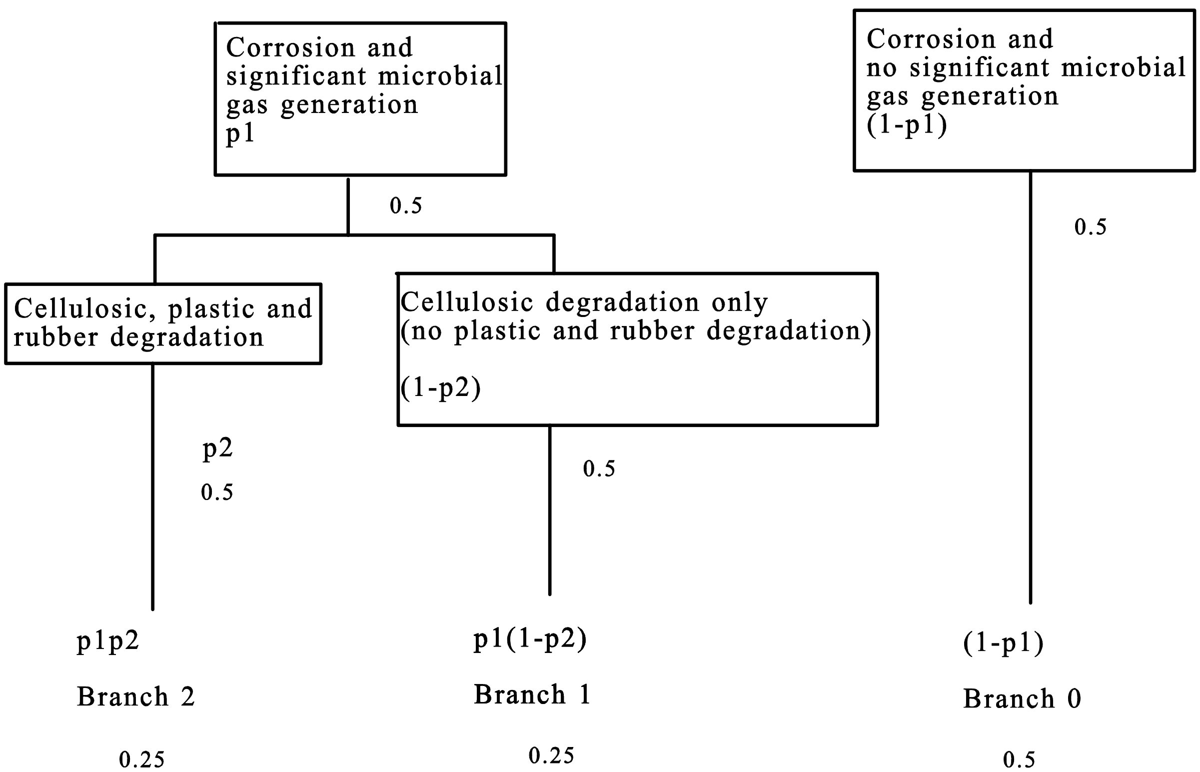
References:

Alexander, M. 1994. Biodegradation and Bioremediation. Academic Press, N.Y.

DOE/CAO. 1996. Transuranic Waste Baseline Inventory Report (Rev. 2). DOE/CAO-95-1121.

Tierney, M. 1996. Memorandum to File, Re: Reasons for choice of the PROBDEG parameter (id nos. 2824 and 2823) on February 22, 1996, March 29, 1996 (contained in ERMS 234881).

Wang, Y., and Brush, L. 1996. Memorandum to Martin Tierney, Re: Estimates of Gas-Generation Parameters for the Long-Term WIPP Performance Assessment, January 26, 1996. ERMS 231943.



p1 = probability of occurrence of significant microbial gas generation (=50 percent)

p2 = probability of occurrence of plastics and rubber biodegradation in the event of significant gas generation (=50 percent)

Figure PAR-1. Logic Diagram for Possible Outcomes and Probabilities for the Parameter PROBDEG (modified from Tierney 1996)

Parameter 3: Biodegradation Rate of Cellulosics Under Brine-Inundated Conditions

Parameter Description:

This parameter is used to describe the rate of cellulosics biodegradation under anaerobic, brine-inundated conditions (see Appendix PA, Section PA-4.2). It is a sampled parameter for the waste emplacement area and the waste, and the values are then applied to the repository regions outside of the panel region.

Material and Property Name(s):

WAS_AREA GRATMICI (#657)

Computational Code: BRAGFLO

minimum	***maximum***
3.171×10^{-10}	9.5129×10^{-9}

Units: Moles/(kilograms*second)

Distribution Type: Uniform

Data: Site-Specific Experimental Data

A discussion of the data associated with this parameter may be found in the parameter records package: Estimates of Gas Generation Required for BRAGFLO (ERMS #230819).

Discussion:

The maximum rate is estimated using the data obtained from both NO_3 - and nutrients-amended experiments, whereas the minimum rate is derived using the data obtained from the inoculated-only experiments without any nutrient and NO_3 amendment. The rates were calculated from the initial linear part of the experimental curve of CO_2 vs. time by assuming that cellulosics biodegradations in those experiments were nitrate- or nutrient-limited (Wang and Brush 1996).

WIPP Data Entry Form #464 ERMS: #234928

References:

Wang, Y. and Brush, L. 1996. Memorandum to Martin Tierney, Re: Estimates of Gas-Generation Parameters for the Long-Term WIPP Performance Assessment, January 26, 1996. ERMS 231943.

Parameter 4: Biodegradation Rate of Cellulosics Under Humid Conditions

Parameter Description:

This parameter is used to describe the rate of cellulosics biodegradation under anaerobic, humid conditions (see Appendix PA, Section PA-4.2). It is a sampled parameter for the waste emplacement area and the waste, and the values are then applied to the repository regions outside of the panel region.

Material and Property Name(s):

WAS_AREA GRATMICH (#656)

Computational Code: BRAGFLO

minimum	*maximum*
0.0	1.2684×10^{-9}

Units: Moles/(kilograms*second)

Distribution Type: Uniform

Data: Site-Specific Experimental Data

A discussion of the data associated with this parameter may be found in the parameter records package: Estimates of Gas Generation Required for BRAGFLO (ERMS #230819).

Discussion:

The maximum rate was estimated from cellulosics biodegradation experiments under anaerobic, humid conditions. The minimum rate is set to zero, corresponding to the cases where microbes become inactive because of water or nutrient stresses (Wang and Brush 1996).

WIPP Data Entry Form #464 ERMS: #234923

References:

Wang, Y. and Brush, L. 1996. Memorandum to Martin Tierney, Re: Estimates of Gas-Generation Parameters for the Long-Term WIPP Performance Assessment, January 26, 1996. ERMS 231943.

Parameter 5: Factor β for Microbial Reaction Rates

Parameter Description:

Factor β is an index that characterizes the stoichiometry used to calculate the microbially generated gas, accounting for interaction with gases reacting with steel and steel corrosion products (see Appendix PA, Section PA-4.2).

Material and Property Name(s):

CELLULS FBETA (#2994)

Computational Code: BRAGFLO

minimum	***maximum***
0.0	***1.0***

Units: None

Distribution Type: Uniform

Data: Site-Specific Experimental Data

A discussion of the data associated with this parameter may be found in the parameter records package: Estimates of Gas Generation Required for BRAGFLO (ERMS #230819).

Discussion:

Microbially generated gases CO_2 and H_2S may react with steel and steel corrosion products. Factor β characterizes the extent of CO_2 and H_2S consumption by those reactions: see Equation (18) in Wang and Brush 1996.

WIPP Data Entry Form #464 ERMS: #231826

References:

Wang, Y. and Brush, L. 1996. Memorandum to Martin Tierney, Re: Estimates of Gas-Generation Parameters for the Long-Term WIPP Performance Assessment, January 26, 1996. ERMS #231943.

Parameter 6: Residual Gas Saturation - Repository

Parameter Description:

The residual (critical) gas saturation (S_{gr}) is required in the two-phase flow model to define the relative permeability and capillary pressure curves. S_{gr} corresponds to the degree of waste-generated gas saturation necessary to create an incipient interconnected pathway in porous material, a condition required for porous rock to be permeable to gas. Below values of the S_{gr}, gas is immobile. It is a sampled parameter for the waste emplacement area and the waste. The values are then applied to the repository regions outside of the panel region.

Material and Property Name(s):

WAS_AREA SAT_RGAS (#671)

Computational Code: BRAGFLO

minimum	*maximum*
0	*0.15*

Units: None

Distribution Type: Uniform

Data: General Literature and Professional Judgment

The parameter values are based on a November 15, 1995 Solutions Engineering letter report to D.M. Stoelzel of Sandia National Laboratories entitled "Critical (residual) Gas Saturation Recommendations for WIPP."

Discussion:

Under conditions of chemical and biochemical gas generation and repository closure, gas saturation may increase to a level where the pore network in repository material regions becomes connected and gas permeability begins to increase. The lowest gas saturation at which continuous gas flow will occur is the residual (critical) gas saturation (S_{gr}). In a review of studies involving S_{gr}, Solutions Engineering (1996) reports values ranging from 0 to 27 percent. The assigned range for S_{gr} between 0 to 15 percent is consistent with recommendations in the Solutions Engineering report.

WIPP Data Entry Form #464 ERMS: #234905

References:

Solutions Engineering. 1996. "Critical Gas Saturation Recommendations for WIPP." Letter Report to D.M. Stoelzel, Sandia National Laboratories, November 15, 1995, Albuquerque, New Mexico. ERMS # 238769.

Parameter 7: Residual Brine Saturation – Waste Area

Parameter Description:

The residual brine saturation (S_{br}) is required in the two-phase flow model to define the relative permeability and capillary pressure curves. Referred to also as S_{wr} (wetting phase) or S_{lr} (liquid phase), residual brine saturation is the point reached under high gas saturation conditions when brine is no longer continuous throughout the pore network and relative brine permeability becomes zero. Below the value of the S_{br}, brine is immobile. It is a sampled parameter for the waste emplacement area and the waste, and the values are then applied to the repository regions outside of the panel region.

Material and Property Name(s):

WAS_AREA SAT_RBRN (#670)

Computational Code: BRAGFLO

minimum	*maximum*
0	*0.55*

Units: None

Distribution Type: Uniform

Data: General Literature and Professional Judgment

Two-phase flow parameters have not been measured for materials representing a collapsed empty, back-filled, or waste-filled room. Therefore, the parameter values are based on literature values for unconsolidated materials.

Discussion:

Brooks and Corey evaluated their two-phase characteristic equations against capillary pressure and relative permeability data obtained in laboratory experiments (Brooks and Corey 1964). Mualem (1976) proposed a modified procedure to that of Brooks and Corey for determining the wetting phase (S_{wr}) permeability curve by adding the constraint that the extrapolated curve should pass through the highest capillary pressure data point. Although their wetting phase relative permeability predictions are similar to each other and to the data, the Mualem procedure, in some cases, results in S_{wr} values less than those predicted by the Brooks and Corey model. Consequently, Table PAR-1 lists the Mualem (1976) residual wetting phase saturations to ensure that the potential for brine mobility is not underestimated. As indicated in Table PAR-1, single-phase liquid permeabilities of the Brooks and Corey materials are of the same order of magnitude as those assigned to waste disposal regions (10^{-13} m^2).

Table PAR-1. Brooks and Corey (1964) Materials Parameters - Unconsolidated Media[a]

Material	Permeability $(m^2)^b$	Porosity	$S_{wr}{}^c$
Volcanic Sand	1.1×10^{-11}	0.365	0.137
Fine Sand	2.85×10^{-12}	0.360	0.140
Glass Beads	1.05×10^{-11}	0.383	0.0783
Fragmented Mixture	1.50×10^{-11}	0.441	0.275
Fragmented Fox Hill Sandstone	1.61×10^{-11}	0.503	0.318
Touchet Silt Loam	5.00×10^{-13}	0.469	0.277
Poudre River Sand	2.26×10^{-11}	0.364	0.0824
Amarillo Silty Clay Loam	2.34×10^{-12}	0.455	0.242
Consolidated Berea Sandstone	4.81×10^{-13}	0.206	0.243
Consolidated Hygiene Sandstone	1.78×10^{-13}	0.250	0.560

a - Consolidated materials are identified in the material column
b - Single-phase liquid permeability
c - Mualem S_{wr} corrected for comparison to Brooks and Corey (1964)
S_{wr} - Wetting phase residual saturation

WIPP Data Entry Form #464 ERMS: #234902

References:

Brooks, R.H., and Corey, A.T. 1964. Hydraulic Properties of Porous Media. Hydrology Paper No. 3. Fort Collins, CO: Colorado State University. NWM Library.

Mualem, Y. 1976. A New Model for Predicting the Hydraulic Conductivity of Unsaturated Porous Media. Water Resources Research. Vol. 12, no. 3, 513-522.

Vaughn, Palmer. 1996. Memo to Martin Tierney. RE: WAS_AREA and REPOSIT/SAT_RBRN Distribution, February 13, 1996. ERMS 234902.

Parameter 8: Wicking Saturation – Waste Area

Parameter Description:

The wicking saturation in the waste is used in the gas generation model (see Appendix PA, Section PA-4.2). It is a sampled parameter for the waste emplacement area and the waste, and the values are then applied to the repository regions outside of the panel region.

Material and Property Name(s):

WAS_AREA SAT_WICK (#2231)

Computational Code: BRAGFLO

minimum	*maximum*
0.0	*1.0*

Units: None

Distribution Type: Uniform

Data: Professional Judgment

The wicking parameter value varies from 0 (0 percent saturation) to 1.0 (100 percent saturation) and the parameter is assumed to be uniformly distributed.

Discussion:

Wicking is the ability of a material to carry a fluid by capillary action above the level it would normally seek in response to gravity. The use of a two-phase Darcy flow model in BRAGFLO includes possible effects of capillary action, but uncertainty remains about the extent to which the assumed homogeneous properties of the waste adequately characterize wicking. Because estimated rates of gas generation are higher for waste that is in direct contact with brine, brine saturation in the repository is adjusted in BRAGFLO to account for the possibility of wicking in the waste.

The adjustment is done as follows:

$$S_{b,eff} = S_b + S_w,$$

and

$$S_{b,eff} \leq 1.0,$$

where S_b ***is the brine saturation in the waste calculated by BRAGFLO,*** S_w ***is the wicking saturation that describes the additional amount of brine that may be present and in contact with the waste because of wicking, and*** $S_{b,eff}$ ***is the effective brine saturation used to determine the gas generation rates used in the analysis.***

WIPP Data Entry Form #464 ERMS: #234908

References:

N/A

Parameter 9: Log of Intrinsic Permeability – DRZ directly above the concrete portion of the panel closure

Parameter Description:

This parameter describes the permeability of cells immediately above the concrete part of the panel closures in the upper DRZ (see CCA Appendix PA, Figure 4.2.1). It is a sampled parameter for the x-direction and the values are then applied to the y- and z-directions. The permeability of these cells will be sampled to reflect the range expected for healed DRZ. This will capture the effect of rigid panel closures that include excavation of the DRZ immediately surrounding the concrete monolith that is emplaced quickly to prevent the further local development of DRZ, and healing of the DRZ due to compressive stresses imposed by creep closure around the rigid structure. In this way the panel closures are modeled as effective seals, including healing effects, in accordance with their design.

Material and Property Name(s):

DRZ_PCS PRMX_LOG (# 3542)
DRZ_PCS PRMY_LOG (#3543)
DRZ_PCS PRMZ_LOG (#3544)

Computational Code: BRAGFLO

mode	*minimum*	*maximum*
-18.75	*-20.70*	*-17.0*

Units: Log(meters squared)

Distribution Type: Triangular

Data: Site-Specific Experimental Data

A discussion of the data associated with this parameter may be found in the following parameter records packages: Analysis Reports Relating to Analysis Plan AP-086 (ERMS 520523) and Analysis Reports for AP-094 (ERMS #525186).

Discussion:

Option D panel closures are designed to remove the DRZ above and below the panel entry drifts. Loose salt in the roof would also be taken down just prior to construction of the concrete monolith. The remaining salt surrounding the panel closure concrete would be subjected to compressive stresses, which would tighten any disturbed zones. Owing to the rounded configuration of Option D, the compressive stress state creates a situation very favorable for concrete: high compressive stresses and low stress differences. In turn, the compressive stresses developed within the salt will quickly heal any damage caused by construction excavation, thereby effectively eliminating the DRZ along the length of the panel closure. The volume of salt immediately above and below the rigid concrete monolith will likely approach the intrinsic permeability of Salado salt.

Undisturbed Salado salt is essentially impermeable. A low-end permeability would be immeasurably low (10^{-23} m^2, for example). The salt above and below the rigid monolith would assume relatively impermeable conditions. Permeability values employed are the same range as described for the concrete (2×10^{-21} to 10^{-17} m^2) (Stein 2002). The reason this range was selected rather than using the range approved for use with the intact halite is twofold. First, because the healed DRZ zone is relatively thin (9.06-m-thick in the model) small-scale heterogeneities including thin clay seams introduce uncertainties to how well this DRZ will impede flow. Second, the Panel Closure System will perform as a composite system that includes the healed DRZ, the concrete monolith, and the surrounding marker beds. In this system any flow will be focused through the highest permeability component of the system. In order that the PA calculations represent the uncertainties of exactly where any flow will occur during the regulatory period, we set the permeability range of the healed DRZ equal to the concrete so that there will be an equal probability of potential flow in either material. The permeability distributions can be implemented in PA by fitting a triangular distribution to the log of the permeability values described for concrete.

WIPP Data Entry Form #464 ERMS: #520524

References:

Stein, J. 2002. Analysis Plan for Calculations of Salado Flow: Technical Baseline Migration (TBM), AP-086, February 13, 2002, ERMS #520612.

1 ***Parameter 10: Log of Intrinsic Permeability– Concrete portion of PCS***

Parameter Description:

Log of the vertical and horizontal intrinsic permeability for the concrete portion of the Option D panel closure (see CCA Appendix PA, Figure 4.2.1). It is a sampled parameter for the x-direction and the values are then applied to the y- and z-directions.

2

Material and Property Name(s):

CONC_PCS PRMX_LOG (# 3525)
CONC_PCS PRMY_LOG (# 3526)
CONC_PCS PRMZ_LOG (# 3527)

3

Computational Code: BRAGFLO

4

mode	***minimum***	***maximum***
-18.75	***-20.70***	***-17.0***

5

Units: Log (meters squared)

6

Distribution Type: Triangular

7

Data: Site- Specific Experimental Data

A discussion of the data associated with this parameter may be found in the following parameter records packages: Analysis Reports Relating to Analysis Plan AP-086 (ERMS #520523) and Analysis Reports for AP-094 (ERMS #525186).

8

Discussion:

The distribution of permeability values for the concrete portion of the Option D panel closure is the same as were used for the concrete portion of the shaft seal in the original CCA (DOE 1996) shaft seal model (Stein 2002). The following justification is provided for permeability values used for the shaft seal concrete (see material CONC_T1, Appendix PAR in DOE 1996)

As reported by Repository Isolation Systems Department (1996), traditional freshwater concrete has been widely used for hydraulic applications such as water storage tanks, water and sewer systems, and massive dams because it has exceptionally low permeability (less than 10^{-20} m^2 ***upon hydration). Salado Mass Concrete (SMC) is a specially-designed, salt-saturated concrete mix (Wakeley et al. 1994; Wakeley et al. 1995).***

Pfeifle, et al. (1996) performed two permeability tests on concrete specimens prepared from cores recovered from the WIPP SSSPT field experiments and one test on an SMC specimen prepared from a sample batched by the Waterways Experiment Station (WES). The specimens were tested as received with no attempts made to dry the specimens or to determine their moisture contents. Each test was performed using nitrogen gas as the permeant, flowmeters to measure gas flow, and fluid pressure gradients of 0.3, 0.6, or 0.75

megapascals. Attempts were made to apply Klinkenberg corrections to measured values of permeability, but the range in pressure gradients used in the testing was not large enough to establish any particular trend when the permeability data were plotted as a function of reciprocal mean fluid pressure.

A total of 18 permeability measurements were made on the three specimens. Measured permeabilities of the specimens were all very low with a range from 2.1×10^{-21} m^2 to 7.51×10^{-21} m^2 with an average of 4.71×10^{-21} m^2. Knowles and Howard (1996) presented results of field permeability tests performed in the WIPP SSSPT boreholes during 1985-1987 and 1993-1995. Although individual seal system component material permeabilities for concrete, DRZ salt, and salt were not determined, overall seal system permeabilities were determined and ranged from 1.0×10^{-20} m^2 to 1.0×10^{-17} m^2 and from 1.0×10^{-23} m^2 to 1.0×10^{-19} m^2 for the 1985–1987 tests and the 1993-1995 tests, respectively. These ranges encompass the laboratory values measured by Pfeifle, et al. (1996).

The data described above were derived from gas permeability measurements in which no Klinkenberg corrections were applied to the measured values. The Klinkenberg corrections were expected to be small because of the low mean pressure gradients used in the tests.

The interface between the Salado salt and the SMC components may provide a flow path around the SMC components. This flow path is possible if a small aperture develops as the concrete is curing or if the interface degrades because of corrosive brines. If such a flow path occurs, the effective permeability of the SMC will increase. Because of this uncertainty, the upper bound permeability was assigned to a value of -17, which corresponds to a permeability of 1.0×10^{-17} m^2. This value was selected after an effective permeability calculation was performed. In this calculation, the interface zone was assumed to have a permeability of 1.0×10^{-14} m^2 and concrete permeabilities were varied from 1.0×10^{-23} to 1.0×10^{-19} m^2. Assuming the interface zone had a thickness of 0.001 times the shaft radius or smaller, the effective permeability of the concrete was about 1.0×10^{-17} m^2 regardless of the value selected for the permeability of the SMC seal.

WIPP Data Entry Form #464 ERMS: #520524

References:

Knowles, M.K. and Howard, C.L. 1996. "Field and Laboratory Testing of Seal Materials Proposed for the Waste Isolation Pilot Plant," Proceedings of the Waste Management 1996 Symposium. Tucson, AZ, February 25-29, 1996. SAND95-2082C. Albuquerque, NM: Sandia National Laboratories. ERMS #230945.

Pfeifle, T.W., Hansen, F.D., and Knowles, M.K. 1996. "Salt-Saturated Concrete Strength and Permeability," Proceedings of the ASCE Fourth Materials Engineering Conference, Washington, DC, November 1996 (accepted for publication).

Repository Isolation Systems Department. 1996. Waste Isolation Pilot Plant Shaft Sealing System Compliance Submittal Design Report. SAND96-1326. Sandia National Laboratories. Albuquerque, NM. August 1996.

Stein, J. 2002. Analysis Plan for Calculations of Salado Flow: Technical Baseline Migration (TBM), AP-086, February 13, 2002, ERMS #520612.

U.S. Department of Energy (DOE). 1996. Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant. DOE/CAO-1996-2184. Carlsbad, NM: United States Department of Energy, Waste Isolation Pilot Plant, Carlsbad Area Office. Vols 1-XXI.

Wakeley, L.D., Poole, T.S. and Burkes, J.P. 1994. Durability of Concrete Materials in High-Magnesium Brine. SAND93-7073. Albuquerque, NM: Sandia National Laboratories. WPO 10674.

Wakeley, L.D., Harrington, P.T., and Hansen, F.D. 1995. Variability in Properties of Salado Mass Concrete. SAND94-1495. Albuquerque, NM: Sandia National Laboratories. WPO 22744.

Parameter 11: Log of the Distribution of Solubility of U(IV) in Castile Brine

Parameter Description:

This parameter represents the distribution (log_{10}) of the uncertainty about the modeled solubility value for uranium in the +IV oxidation state in Castile brine.

Material and Property Name(s):

SOLU4 SOLCIM (#3626)

Computational Code: PANEL

Value	***-2.0***	***-1.0***	***-0.50***	***-0.25***	***0***	***0.25***	***0.50***	***1.0***	***1.40***
Percentiles	***0***	***0.04***	***0.13***	***0.27***	***0.63***	***0.84***	***0.89***	***0.99***	***1.0***

Units: None (see PPR-04-2002, ERMS #524651)

Distribution Type: Cumulative

Data: General Literature Data

For the CCA, solubilities were calculated using the Fracture Matrix Transport (FMT) code (Novak 1996). Bynum (1996) compared 150 modeled and experimentally determined solubilities and provided a distribution of the differences between them. The parameter records package associated with this parameter is located at: Solubility Parameters for Actinide Source Term Look-up Tables (ERMS #235835).

Discussion:

FMT calculates the solubility of U(IV) in Castile brine assuming equilibrium conditions. The uncertainty in solubilities was determined by Bynum (1996) by comparing modeled solubilities for all oxidation states with the experimentally determined solubilities.

Further information on this parameter is provided in Attachment SOTERM.

WIPP Data Entry Form #464 ERMS: #529447

References:

Bynum, R.V. 1996. Memorandum to Martin Tierney and Christine Stockman, Re: Revised Update of Uncertainty Range and Distribution for Actinide Solubility to be used in CCA NUTS Calculations, May 23, 1996. ERMS #237791.

Novak, C.F. 1996.Memorandum to J.T. Holmes Re: Release of FMT Data Base Files HMW_3456_960318.CHEMDAT and HMW_345_960325.CHEMDAT, March 27, 1996. ERMS #235923.

Parameter 12: Log of the Distribution of Solubility of Th(IV) in Castile Brine

Parameter Description:

This parameter represents the distribution (log_{10}) of the uncertainty about the modeled solubility value for thorium in the +IV oxidation state in Castile brine.

Material and Property Name(s):

SOLTH4 SOLCIM (# 3627)

Computational Code: PANEL

Value	***-2.0***	***-1.0***	***-0.50***	***-0.25***	***0***	***0.25***	***0.50***	***1.0***	***1.40***
Percentiles	***0***	***0.04***	***0.13***	***0.27***	***0.63***	***0.84***	***0.89***	***0.99***	***1.0***

Units: None (see PPR-04-2002, ERMS #524651)

Distribution Type: Cumulative

Data: General Literature Data

For the CCA, solubilities were calculated using the Fracture Matrix Transport (FMT) code (Novak 1996). Bynum (1996) compared 150 modeled and experimentally determined solubilities and provided a distribution of the differences between them. The parameter records package associated with this parameter is located at: Solubility Parameters for Actinide Source Term Look-up Tables (ERMS #235835).

Discussion:

FMT calculates the solubility of Th(IV) in Castile brine assuming equilibrium conditions. The uncertainty in solubilities was determined by Bynum (1996) by comparing modeled solubilities for all oxidation states with the experimentally determined solubilities.

Further information on this parameter is provided in Appendix PA, Attachment SOTERM.

WIPP Data Entry Form #464 ERMS: #529448

References:

Bynum, R.V. 1996. Memorandum to Martin Tierney and Christine Stockman, Re: Revised Update of Uncertainty Range and Distribution for Actinide Solubility to be used in CCA NUTS Calculations, May 23, 1996. ERMS #237791

Novak, C.F. 1996.Memorandum to J.T. Holmes Re: Release of FMT Data Base Files HMW_3456_960318.CHEMDAT and HMW_345_960325.CHEMDAT, March 27, 1996. ERMS #235923.

Parameter 14: Residual Gas Saturation – Concrete Portion of PCS

Parameter Description:

The residual (critical) gas saturation (S_{gr}) is required in the two-phase flow model to define the relative permeability and capillary pressure curves (see CCA Appendix PA, Figure 4.2.1). S_{gr} corresponds to the degree of waste-generated gas saturation necessary to create an incipient interconnected pathway in porous material, a condition required for porous rock to be permeable to gas.

Material and Property Name(s):

CONC_PCS SAT_RGAS (# 3532)

Computational Code: BRAGFLO

minimum	*maximum*
0	*0.40*

Units: None

Distribution Type: Uniform

Data: General Literature Data

A discussion of the data associated with this parameter may be found in the following parameter records packages: Analysis Reports Relating to Analysis Plan AP-086 (ERMS #520523) and Analysis Reports for AP-094 (ERMS #525186).

Discussion:

This distribution is the same as were used in the original CCA shaft seal model. The initial gas saturation in the simplified shaft is a volume-weighted average of the initial gas saturations in the original shaft's subcomponents (James and Stein 2002; 2003). The following justification is provided for gas saturation values used for the CCA shaft seal subcomponents (see material SALT_T1, in ***Appendix PAR) DOE*** (***1996)***.

A literature search was conducted to obtain residual saturation values for consolidated geologic materials, concrete, and asphalt in support of the CCA.

A single value of 0.18 was found for normal concrete (Mayer et al. 1992). Based on this value, a distribution was assumed for the seal components. The recommended value was 0.2, and the recommended range was 0.0 to 0.4 with a uniform distribution for all shaft seal materials.

WIPP Data Entry Form #464 ERMS: #520524

References:

James, S.J., and Stein, J. 2002. Analysis Plan for the Development of a Simplified Shaft Seal Model for the WIPP Performance Assessment. AP-094. Carlsbad, NM: Sandia National Laboratories. ERMS #524958.

James, S.J., Stein, J. 2003. Analysis Report for: Development of a Simplified Shaft Seal Model for the WIPP Performance Assessment, Rev. 1. January 23, 2003. Carlsbad, NM: Sandia National Laboratories. ERMS #525203.

Mayer, G., Jacobs, F., and Wittmann, F.H. 1992. "Experimental Determination and Numerical Simulation of the Permeability of Cementitious Materials," Nuclear Engineering and Design. Vol. 138, no. 2, 171-177.

U.S. Department of Energy (DOE). 1996. Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant. DOE/CAO-1996-2184. Carlsbad, NM: United States Department of Energy, Waste Isolation Pilot Plant, Carlsbad Area Office.

1 ***Parameter 15: Residual Brine Saturation – Concrete Portion of PCS***

Parameter Description:

The residual brine saturation (S_{br}) is required in the two-phase flow model to define the relative permeability and capillary pressure curves (see CCA Appendix PA, Figure 4.2.1). Referred to also as S_{wr} (wetting phase) or S_{lr} (liquid phase), residual brine saturation is the point reached under high gas saturation conditions when brine is no longer continuous throughout the pore network and relative brine permeability becomes zero.

2

Material and Property Name(s):

CONC_PCS SAT_RBRN (# 3531)

3

Computational Code: BRAGFLO

4

Value	***0.0***	***0.20***	***0.60***
Percentiles	***0***	***0.50***	***1***

5

Units: None

6

Distribution Type: Cumulative

7

Data: General Literature Data

A discussion of the data associated with this parameter may be found in the following parameter records packages: Analysis Reports Relating to Analysis Plan AP-086 (ERMS #520523) and Analysis Reports for AP-094 (ERMS #525186).

8

Discussion:

This distribution is the same as were used for the original 1996 CCA shaft seal model. Recall that the initial brine saturation in the simplified shaft is a volume-weighted average of the initial brine saturations in the original shaft's subcomponents (James and Stein 2002, 2003). The following justification is provided for the residual brine saturation used for the CCA shaft components (see Material SALT_T1, CCA Appendix PAR in DOE [1996]).

A literature search was conducted to obtain residual liquid saturation values for consolidated geologic materials, concrete, and asphalt in support of the CCA. Residual liquid saturations for geologic materials were found in four references (Brooks and Corey 1964; Lappala et al. 1987; Parker et al. 1987; and Rawls et al. 1982). Brooks and Corey (1964) determined residual saturations for five unconsolidated samples based on measured values of liquid saturation as a function of capillary pressure. Lappala et al. (1987) determined residual moisture content for 11 soils by obtaining best fits to measured moisture content versus pressure head data using three models. The residual moisture contents determined for each soil using the three models were averaged and divided by the reported porosity to obtain a residual liquid saturation for each soil. Parker et al. (1987) fit their saturation-pressure relationship to observed data to obtain residual saturations for a

sandy and clayey porous media. Residual water contents reported by Rawls et al. (1982) for 11 soil texture classes were divided by the reported porosity to obtain residual saturations.

Mayer et al. (1992) reported a residual liquid saturation for normal concrete of 0.30. Data regarding residual liquid saturations in asphalt materials were not found in the literature.

The literature values of residual liquid saturation for geologic materials and concrete fall within the range of 0.0 to 0.6 with all but two values falling within the range of 0.0 to 0.4. It was recommended that a value of 0.2 be used for the residual liquid saturation of all seal components.

WIPP Data Entry Form #464 ERMS: #520524

References:

Brooks, R.H., and Corey, A.T. 1964. Hydraulic Properties of Porous Media. Hydrology Paper No. 3. Fort Collins, CO: Colorado State University.

Lappala, E.G., Healy, R.W., and Weeks, E.P. 1987. Documentation of Computer Program VS2D to Solve the Equations of Fluid Flow in Variably Saturated Porous Media. Water-Resources Investigations Report 83-4099. Denver, CO: U.S. Geological Survey. Tech Library books collection: PC173.4.P67L31987.

James, S.J., and Stein, J. 2002. Analysis Plan for the Development of a Simplified Shaft Seal Model for the WIPP Performance Assessment. AP-094. Carlsbad, NM: Sandia National Laboratories. ERMS #524958.

James, S.J., Stein, J. 2003. Analysis Report for: Development of a Simplified Shaft Seal Model for the WIPP Performance Assessment, Rev. 1. January 23, 2003. Carlsbad, NM: Sandia National Laboratories. ERMS #525203.

Mayer, G., Jacobs, F., and Wittmann, F.H. 1992. "Experimental Determination and Numerical Simulation of the Permeability of Cementitious Materials," Nuclear Engineering and Design. Vol. 138, no. 2, 171-177.

Parker, J.C., Lenhard, R.J., and Kuppusamy, T. 1987. "A Parametric Model for Constitutive Properties Governing Multiphase Flow in Porous Media," Water Resources Research. Vol. 23, no. 4, 618-624.

Rawls, W.J., Brakensiek, D.L., and Saxton, K.E. 1982. "Estimation of Soil Water Properties," Transactions of the ASAE. St. Joseph, MI: American Society of Agricultural Engineers. 1316-1328.

U.S. Department of Energy (DOE). 1996. Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant. DOE/CAO-1996-2184. Carlsbad, NM: United States Department of Energy, Waste Isolation Pilot Plant, Carlsbad Area Office. Vols 1-XXI.

1 ***Parameter 16: Pore Distribution Parameter in the Concrete portion of PCS***

Parameter Description:

The Brooks-Corey pore size distribution parameter (λ) is used to calculate capillary pressure and relative permeabilities for gas and brine flow in the two-phase flow model (see CCA Appendix PA, Figure 4.2.1). It is a sampled parameter.

2

Material and Property Name(s):

CONC_PCS PORE_DIS (#3522)

3

Computational Code: BRAGFLO

4

Value	***0.11***	***0.94***	***8.1***
Percentiles	***0***	***0.50***	***1***

5

Units: None

6

Distribution Type: Cumulative

7

Data: General Literature Data

A discussion of the data associated with this parameter may be found in the following parameter records packages: Analysis Reports Relating to Analysis Plan AP-086 (ERMS #520523) and Analysis Reports for AP-094 (ERMS #525186).

8

Discussion:

This distribution of pore size values for the concrete portion of the Option D panel closure is the same as were used for the concrete portion of the shaft seal in the original 1996 CCA shaft seal model. (Stein, 2002) The following justification is provided for pore size distribution values used for the shaft seal (see material SALT_T1, CCA Appendix PAR)

A literature search was conducted to find pore distribution (that is, lambda) values for geologic materials and concrete. For geologic materials, 81 lambda values were found in 5 references (Brooks and Corey 1964; Mualem 1976; Rawls et al. 1982; Haverkamp and Parlange 1986; and Lappala et al. 1987). In addition, 38 lambda values were calculated from values of the van Genuchten parameter n found in 6 references (van Genuchten 1980; van Genuchten and Nielsen 1985; Hopmans and Overmars 1986; Parker et al. 1987; Stephens et al. 1988; and Wösten and van Genuchten 1988).

The total number of lambda values found in the literature or calculated from n values found in the literature was 119. In a few cases, different literature sources reported different values of lambda and/or n for the same materials. For this situation, the different lambda values were arithmetically averaged to obtain a single value for the material. This procedure yielded lambda values for a total of 85 different geologic materials.

The lambda values range from 0.11 to 11.67 and have a median of 0.94. Based on the shape of the histogram and CDF, it appears that the lambda values are log normally distributed. The Lilliefors test for normality (Iman and Conover 1983) was applied to the data to verify that the logarithm of the lambda values can be described by a normal distribution. The mean of the log lambda values was found to be -0.064 with a standard deviation of 1.08. The Lilliefors bounds represent the region within which 95 percent of normally distributed values will fall.

For concrete, a literature search yielded only one reference (Mayer et al. 1992). This reference indicates that the Corey (1954) relationships are appropriate for describing the two-phase characteristic curves for the normal concretes they tested. For asphalt materials, data regarding lambda values were not found in the literature.

Both a lognormal and cumulative distribution for this parameter was recommended for the seal components constructed from granular earth materials (that is, earthen fill, compacted clay, and reconsolidated crushed salt). A cumulative distribution is appropriate when the range (a, c) of the parameter is known and the best estimate value, b, is the median. The value recommended was 0.94, which is the median of the literature values for geologic materials. The recommended range for the distribution was 0.11 to 8.1. Consequently, a cumulative distribution is assigned. In the absence of literature data, the same lambda distribution type, value, and range were also recommended for the concrete and asphalt seal components.

WIPP Data Entry Form #464 ERMS: #520524

References:

Brooks, R.H., and Corey, A.T. 1964. Hydraulic Properties of Porous Media. Hydrology Paper No. 3. Fort Collins, CO: Colorado State University.

Corey, A.T. 1954. "The Interrelation Between Gas and Oil Relative Permeabilities," Producer's Monthly. Vol. XIX, no. 1, 38-41.

Haverkamp, R., and Parlange, J.Y. 1986. "Predicting the Water-Retention Curve From Particle-Size Distribution: 1. Sandy Soils Without Organic Matter," Soil Science. Vol. 142, no. 6, 325-339.

Hopmans, J.W., and Overmars, B. 1986. "Presentation and Application of an Analytical Model to Describe Soil Hydraulic Properties," Journal of Hydrology. Vol. 87, no. 1-2. 135-143.

Iman, R.L., and Conover, W.J. 1983. Modern Business Statistics. New York, NY: John Wiley & Sons, Inc.

Lappala, E.G., Healy, R.W., and Weeks, E.P. 1987. Documentation of Computer Program VS2D to Solve the Equations of Fluid Flow in Variably Saturated Porous Media. Water-Resources Investigations Report 83-4099. Denver, CO: U.S. Geological Survey.

Mayer, G., Jacobs, F., and Wittmann, F.H. 1992. "Experimental Determination and Numerical Simulation of the Permeability of Cementitious Materials," Nuclear Engineering and Design. Vol. 138, no. 2, 171-177.

Mualem, Y. 1976. "A New Model for Predicting the Hydraulic Conductivity of Unsaturated Porous Media," Water Resources Research. Vol.12, no. 3, 513-522.

Parker, J.C., Lenhard, R.J., and Kuppusamy, T. 1987. "A Parametric Model for Constitutive Properties Governing Multiphase Flow in Porous Media," Water Resources Research. Vol. 23, no. 4, 618-624.

Rawls, W.J., Brakensiek, D.L., and Saxton, K.E. 1982. "Estimation of Soil Water Properties," Transactions of the ASAE. St. Joseph, MI: American Society of Agricultural Engineers. 1316-1328.

James, S.J., and Stein, J. 2002. Analysis Plan for the Development of a Simplified Shaft Seal Model for the WIPP Performance Assessment. AP-094. Carlsbad, NM: Sandia National Laboratories. ERMS #524958.

Stephens, D.B., Unruh, M., Havlena, J., Knowlton, R.G., Jr., Mattson, E., and Cox, W. 1988. "Vadose Zone Characterization of Low-Permeability Sediments Using Field Permeameters," Ground Water Monitoring Review. Vol. 8, no. 2, 59-66.

U.S. Department of Energy (DOE). 1996. Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant. DOE/CAO-1996-2184. Carlsbad, NM: United States Department of Energy, Waste Isolation Pilot Plant, Carlsbad Area Office. Vols 1-XXI.

van Genuchten, M. Th. 1980. "A Closed-form Equation for Predicting the Hydraulic Conductivity of Unsaturated Soils," Soil Science Society of America Journal. Vol. 44, no. 5, 892-898.

van Genuchten, M. Th., and Nielsen, D.R. 1985. "On Describing and Predicting the Hydraulic Properties of Unsaturated Soils," Annales Geophysicae. Vol. 3, no. 5, 615-628.

Wösten, J.H.M., and van Genuchten, M. Th. 1988. "Using Texture and Other Soil Properties to Predict the Unsaturated Soil Hydraulic Functions," Soil Science Society of America Journal. Vol. 52, no. 6, 1762-1770.

1 ***Parameter 17: Effective Porosity - Halite***

Parameter Description:

The effective porosity of Salado Formation halite and polyhalite refers to the ratio of the interconnected pore volume to the bulk volume.

2

Material and Property Name(s):

S_HALITE POROSITY (#544)

3

Computational Code: BRAGFLO

4

Value	***1.0×10^{-3}***	***0.01***	***0.03***
Percentiles	***0***	***0.50***	***1***

5

Units: None

6

Distribution Type: Cumulative

7

Data: Site-Specific Experimental Data

The effective porosity distribution of Salado halite is supported by three separate porosity calculations: (1) Skokan et al. (1989; p. 15) determined from electromagnetic and DC resistivity experiments, (2) drying experiments described in Powers et al. (1978; p. 7-30), and (3) drying experiments reported in Deal et al. (1993). The parameter records package associated with this parameter is: Halite Porosity (ERMS #230601).

8

Discussion:

The high value (0.03) for the range of porosity is suggested in Skokan et al. (1989; p.6,13), based on the low end (10 ohm) of the DC resistivity measurements registered in the underground repository. The low value (0.001) is suggested in Powers et al. (1978) based on drying experiments. The median value of 0.01 is suggested in Skokan et al. (1989; p.15). Deal et al. (1993) found an average value of 0.016 for total porosity from a different series of drying experiments.

9

WIPP Data Entry Form #464 ERMS: #234387

10

References:

Deal, D.E., Abitz, R.J., Myers, J., Martin, M.L., Millgan, D.J., Sobocinski, R.W., Lipponer, P.P.J., and Belski, D.S. 1993. Brine Sampling and Evaluation Program, 1991 Report. DOE-WIPP-93-026. Carlsbad, NM: Westinghouse Electric Corporation, Waste Isolation Division.

Powers, D.W., Lambert, S.J., Shaffer, S.E., Hill, L.R., and Weart, W.D., eds. 1978. Geological Characterization Report, Waste Isolation Pilot Plant (WIPP) Site, Southeastern

New Mexico. SAND78-1596. Albuquerque, NM: Sandia National Laboratories. Vols. 1-2. V. 1 - ERMS #205448; V.2 - ERMS #226829 – #226830, original photos - ERMS #226859.

Skokan, C.K., Pfeifer, M.C., Keller, G.V., and Andersen, H.T. 1989. Studies of Electrical and Electromagnetic Methods for Characterizing Salt Properties at the WIPP Site, New Mexico. SAND87-7174. Albuquerque, NM: Sandia National Laboratories. ERMS #224033.

1 ***Parameter 18: Log of Intrinsic Permeability - Halite***

Parameter Description:

The Salado Formation halite is assigned an intrinsic permeability intended to reflect the stratigraphic variability of Salado halite and far-field hydraulic conditions (see CCA Appendix PA, Figure 4.2.1). It is a sampled parameter for the x-direction and the values are then applied to the y- and z-directions.

2

Material and Property Name(s):

S_HALITE PRMX_LOG (#547)
S_HALITE PRMY_LOG (#548)
S_HALITE PRMZ_LOG (#549)

3

Computational Code: BRAGFLO

4

minimum	maximum
-24.0	-21.0

5

Units: Log (m^2)

6

Distribution Type: Uniform

7

Data: Site-Specific Experimental Data

The reported permeability range of undisturbed impure halite is based on four selected in situ hydraulic tests: three flow tests believed representative of far-field permeability and one flow test that measured permeability in a zone which included a range of halite lithologies. Computer-derived permeabilities based upon brine inflow data from Room Q fall within the range derived from flow tests. The reader is referred to the relevant parameter record package for more detail: Halite Permeability (ERMS #231218) Salado Halite Permeability from Room Q Analysis (ERMS #230721).

8

Discussion:

Impure halite denotes a broad range of lithologic types ranging from pure halite to lithologies with various degrees of impurities, including polyhalite, argillaceous and anhydrite halite. Far-field tests of the pure halite exist; however, far-field hydraulic tests data do not exist for relatively impure halites, which tend to show higher permeabilities in the near-field. Thus a range of permeability is specified, bounded by rounded low and high permeability values determined from the testing program.

Three hydraulic tests believed representative of far-field pure halite permeability were conducted in the present location of Room Q in map units with relatively low impurities: a halite with less than 0.5 percent impurity, a halite containing approximately one percent impurity and a halite and polyhalite zone with a one to two percent impurity. These tests are believed to represent the lower end of the permeability range for Salado halite (see Table

PAR-2). These units were tested before the large-scale brine inflow excavation was mined and at stratigraphic intervals located over 20 m (66 ft) from the excavation.

Although probably located within the influence of the DRZ, one flow test (C2H01-BGZ) was performed within map units 0-4. This permeability value in conjunction with Room Q model analysis determination of far-field permeability are used to bound the maximum permeability of Salado halite containing relatively high impurities.

A summary of selected interpretative results of these four flow and pressure tests is compiled in the attached table. A schematic representation of Salado map units near the disposal area horizon, adapted from Deal et. al. (1989), is attached for information purposes (see Figure PAR-2).

1

WIPP Data Entry Form #464 ERMS: #234397

2

References:

Beauheim, R.L., Saulnier, G.J., Jr., and Avis, J.D. 1991. Interpretation of Brine-Permeability Tests of the Salado Formation at the Waste Isolation Pilot Plant Site: First Interim Report. SAND90-0083. Albuquerque, NM: Sandia National Laboratories. ERMS #226033.

Beauheim, R.L., Roberts, R.M., Dale, T.F., Fort, M.D., and Stensrud, W.A. 1993. Hydraulic Testing of Salado Formation Evaporites at the Waste Isolation Pilot Plant Site: Second Interpretive Report. SAND92-0533. Albuquerque, NM: Sandia National Laboratories. ERMS #223378.

Davies, Peter and Rick Beauheim. 1996. Memo to Martin Tierney. RE: Changes to the parameter records package and form #464 for far-field permeability of Salado halites (id#s: 547, 548, and 549; idmtrl: S_HALITE; idpram: PRMX_LOG, PRMY_LOG, and PRMZ_LOG, respectively). March 7, 1996. ERMS #236772.

Deal, D.E., Abitz, R.J., Belski, D.S., and Case, J.B. 1989. Brine Sampling and Evaluation Program, 1988 Report. DOE-WIPP-89-015. Carlsbad, NM: Westinghouse Electric Corporation.

Jensen, A.L., Howard, C.L., Jones, R.L., and Peterson, T.P. 1993. Room Q Data Report: Test Borehole Data from April 1989 through November 1991. SAND92-1172. Albuquerque, NM: Sandia National Laboratories. ERMS #223548.

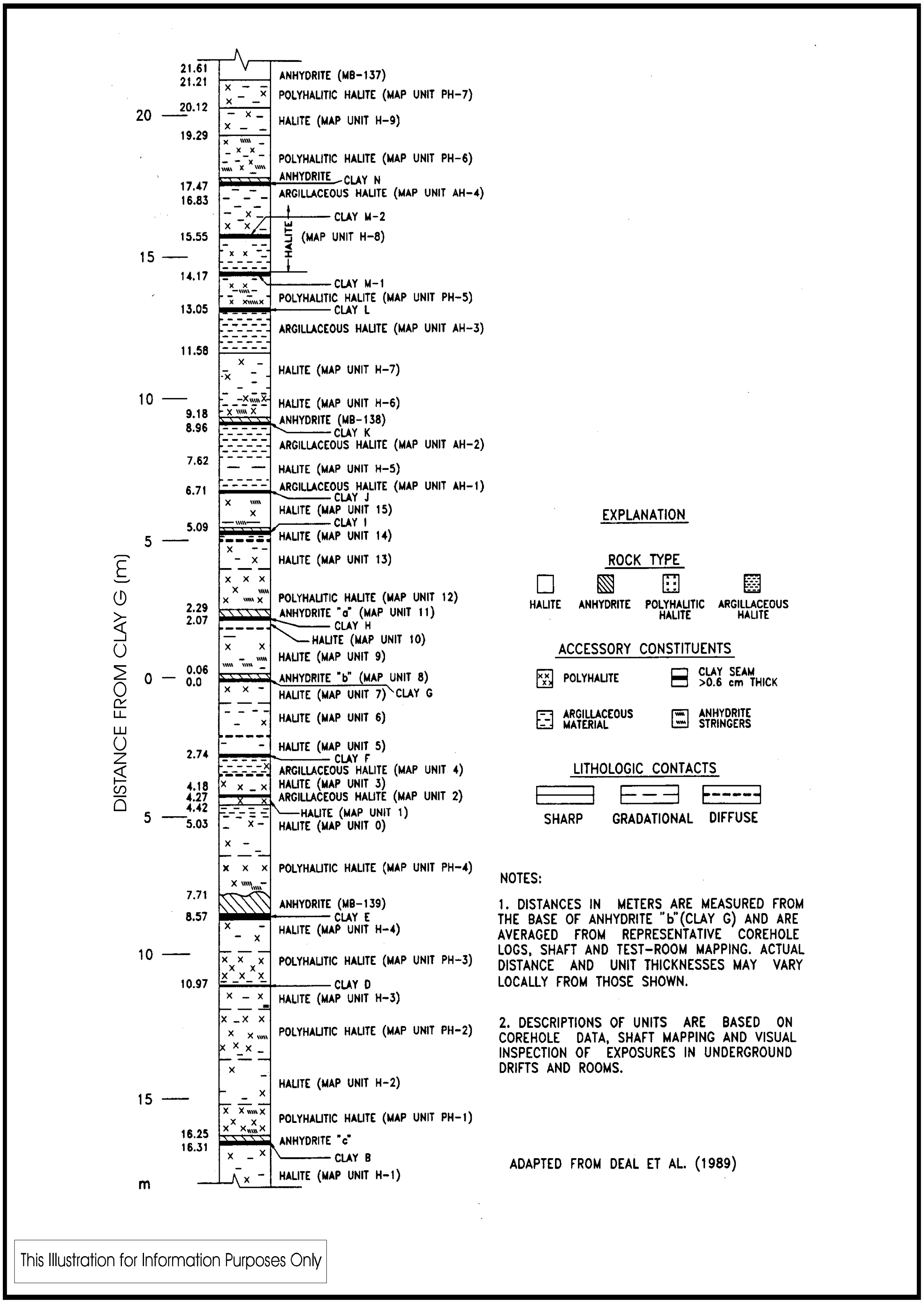
Saulnier, G.J., Jr., Domski, P.S., Palmer, J.B., Roberts, R.M., Stensrud, W.A., and Jensen, A.L. 1991. WIPP Salado Hydrology Program Data Report #1. SAND90-7000. Albuquerque, NM: Sandia National Laboratories. ERMS #225746

Stensrud, W.A., Dale, T.F., Domski, P.S., Palmer, J.B., Roberts, R.M., Fort, M.D., Saulnier, G.J., Jr., and Jensen, A.L. 1992. Waste Isolation Pilot Plant Salado Hydrology Program Data Report #2. SAND92-7072. Albuquerque, NM: Sandia National Laboratories. ERMS #226432.

3

Table PAR-2. Summary of Permeability Test-Interpretations Results from In Situ Permeability Tests Representing Undisturbed Impure Halite

Test Interval (meters from excavation)	Hole	Map unit(s)	Analysis Method	Permeability k (m^2)
20.13-21.03	QPPO5	MU 6	GTFM6.0	1.12×10^{-24}
23.35-24.20	QPP12	H3	GTFM6.0	2.69×10^{-22}
20.19-21.09	QPP15	MU O - MU PH-4	GTFM6.0	5.5×10^{-24}
4.50-5.58	C2H01-BGZ	MU O - MU 4	GTFM6.0	1.38×10^{-21}



NMVP-6342-164-0

Figure PAR-2. Salado Map Units Near the Disposal Area Horizon

Parameter 19: Rock Compressibility - Halite

Parameter Description:

The rock (or bulk) compressibility of the Salado Formation halite is used to calculate the pore compressibility that is used in BRAGFLO. Pore compressibility is used to predict the effect of material compressibility on porosity and mass storage in the equation of state for flow through porous media as follows:

$$\varphi = \varphi_o \exp(c_p(p - p_o))$$

where,

φ = ***porosity of solid matrix (cubic meters/cubic meters)***
φ_o = ***porosity at reference pressure*** p_o
c_p = ***pore compressibility (pascals***$^{-1}$***)***
p = ***pore pressure (pascals)***
p_o = ***reference pore pressure (pascals)***

The rock compressibility is divided by effective porosity to calculate pore compressibility.

Material and Property Name(s):

S_HALITE COMP_RCK (#541)

Computational Code: BRAGFLO

minimum	***maximum***
2.94×10^{-12}	1.92×10^{-10}

Units: Pascals^{-1}

Distribution Type: Uniform

Data: Site-Specific Experimental Data

The parameter distribution for halite rock compressibility is based upon data from two hydraulic tests in Room Q: QPP05 and QPP15. Another data point calculated from sensitivity studies using brine inflow data from Room Q is within the range driven from the hydraulic tests. Parameter records packages associated with this parameter are: Halite Rock Compressibility (ERMS #231220) and Salado Halite Rock Compressibility from Room Q ANALYSIS (ERMS #230598).

The two in-situ hydraulic tests were conducted in the location of Room Q before the large-scale brine inflow excavation was mined* (see Table *PAR*-3)*. Test intervals were located over 20 m (65 ft) from the excavation. Map units (MU) represented included MU 6 (halite) and MU 0 (halite)/MU PH-4 (polyhalite) within a radius of about 1 m (3.3* ft*) of each borehole. Raw data included pressure, fluid volume, temperature, axial test-tool movement, and radial borehole closure.

Interpretation of all flow tests in the WIPP facility is based on the assumption that Darcy flow and borehole closure are the only forms of pressure/flow transmission during hydraulic tests. References related to data collection and interpretation are listed in the references section.

WIPP Data Entry Form #464 ERMS: #234210

References:

Beauheim, R.L., Saulnier, G.J., Jr., and Avis, J.D. 1991. Interpretation of Brine-Permeability Tests of the Salado Formation at the Watts Isolation Pilot Plant Site: First Interim Report. SAND90-0083. Albuquerque, NM: Sandia National Laboratories. ERMS #226003.

Beauheim, R.L., Roberts, R.M., Dale, T.F., Fort, M.D., and Stensrud, W.A. 1993. Hydraulic Testing of Salado Formation Evaporites at the Waste Isolation Pilot Plant Site: Second Interpretive Report. SAND92-0533. Albuquerque, NM: Sandia National Laboratories. ERMS #223378.

Jensen, A.L., Howard, C.L., Jones, R.L., and Peterson, T.P. 1993. Room Q Data Report: Test Borehole Data from April 1989 through November 1991. SAND92-1172. Albuquerque, NM: Sandia National Laboratories. ERMS #223548

Saulnier, G.J., Jr., Domski, P.S., Palmer, J.B., Roberts, R.M., Stensrud, W.A., and Jensen, A.L. 1991. WIPP Salado Hydrology Program Data Report #1. SAND90-7000. Albuquerque, NM: Sandia National Laboratories. ERMS #225746

Stensrud, W.A., Dale, T.F., Domski, P.S., Palmer, J.B., Roberts, R.M., Fort, M.D., Saulnier, G.J., Jr., and Jensen, A.L. 1992. Waste Isolation Pilot Plant Salado Hydrology Program Data Report #2. SAND92-7072. Albuquerque, NM: Sandia National Laboratories. ERMS #226432.

Table PAR-3. Summary of Rock Compressibility Test-Interpretations Results from In Situ Permeability Tests for Undisturbed Halite and Polyhalite Map Units

Test Interval (meters from excavation)	Hole	Zone	Map Unit(s)	Analysis Method	Rock Compressibility C_r (1/pascal)	Formation Pore Pressure (megapascal)[1]
20.13-21.03 down	QPPO5 Room Q	undisturbed	MU 6	GTFM6.0	2.94×10^{-12}	13.89
20.19-21.09 down	QPP15 Room Q	undisturbed	MU 0 MU PH-4	GTFM6.0	1.92×10^{-10}	11.04

[1] Mean

Note: See Record Parameter Package for additional detail.

1 ***Parameter 20: Log of Intrinsic Permeability - Marker Bed 139***

Parameter Description:

This parameter represents the intrinsic permeabilities for MB139.

2

Material and Property Name(s):

S_MB139   PRMX_LOG   (#591)
S_MB139   PRMY_LOG   (#592)
S_MB139   PRMZ_LOG   (#593)

3

Computational Code: BRAGFLO

4

Measured Values:	***-21.0***	***-19.2***	***-19.1***	***-18.8***	***-18.1***	***-17.1***

5

Units: Log (meters squared)

6

Distribution Type: Student's-t

7

Data: Site-Specific Experimental Data and Laboratory-Measured Data

The reported parameter range of undisturbed Salado anhydrite permeabilities is based upon selected data collected from *the following* ***in situ hydraulic tests and measurements conducted in the laboratory: (1) five hydraulic tests conducted in the underground experimental area; and (2) 31 Klinkenberg-corrected gas permeabilities measured in the laboratory on specimens collected from MB139 core samples. Summary data tables are attached for both in situ and laboratory tests (see Table PAR-4 and Table PAR-5). Parameter records packages associated with this parameter are Anhydrite Permeability (x,y,z) (ERMS #231217); Salado Anhydrite Permeability in the X-Direction (ERMS #230603); Salado Anhydrite Permeability in the Y-Direction (ERMS 2 #30605); Salado Anhydrite Permeability in the Z-Direction (ERMS #230606).***

Out of 15 borehole and field permeability tests conducted in MB140, MB139, MB138 and anhydrites a and b, *5* ***in situ hydraulic tests are considered representative of undisturbed anhydrite permeability. Located from about 10 to 24 m (33 to 79 ft) from the excavation, the test intervals for these five boreholes were outside of the DRZ. The radius of visibility ranged from 4 to 25 m (13 to 82 ft). The five successful tests are summarized as follows:***

Borehole	***Location***	***Map Unit***	***Testing Period***
QPP03	***Room Q***	***Anhydrite b***	***4/89 11/91***
QPP13	***Room Q***	***MB 139***	***4/89 11/91***
C2H02	***Room C2***	***MB 139***	***4/89 12/89***
L4P51-C1	***Room L4***	***MB 140***	***4/92 6/94***
SCP01-A	***Core Storage***	***MB 139***	***4/90 10/90***

Klinkenberg-corrected gas permeability measured in the laboratory can be used as an equivalent measure of liquid permeability. Klinkenberg-corrected test specimen data exist

from six whole cores taken from MB139 in the northern experimental area: E1X07, E1X08, E1X10, E1X11 (E140 Drift), P3X10, and P3X11 (Room L3).

For purposes of parameterization, in situ test data are treated differently than laboratory-derived data. Uncertainty exists in regards to the spatial representativeness of the core samples. In situ hydraulic tests are considered representative of expected permeability conditions on the scale of the grid system used in the BRAGFLO mesh. Consequently, for the parameter distribution above, laboratory data from the 6 megapascals net effective stress are averaged as one data point, whereas each of the five hydraulic tests is considered an individual data point.

WIPP Data Entry Form #464 ERMS: #234865

References:

Beauheim, R.L., Saulnier, G.J., Jr., and Avis, J.D. 1991. Interpretation of Brine-Permeability Tests of the Salado Formation at the Waste Isolation Pilot Plant Site: First Interim Report. SAND90-0083. Albuquerque, NM: Sandia National Laboratories. ERMS #2 26003.

Beauheim, R.L., Roberts, R.M., Dale, T.F., Fort, M.D., and Stensrud, W.A. 1993. Hydraulic Testing of Salado Formation Evaporites at the Waste Isolation Pilot Plant Site: Second Interpretive Report. SAND92-0533. Albuquerque, NM; Sandia National Laboratories. ERMS #223378.

Howarth S.M., and Christian-Frear, T. 1996. Porosity, Single-Phase Permeability, and Capillary Pressure Data from Preliminary Laboratory Experiments on Selected Samples from Marker Bed 139 at the Waste Isolation Pilot Plant. Albuquerque, NM: Sandia National Laboratories. ERMS #238019

Jensen, A.L., Howard, C.L., Jones, R.L., and Peterson, T.P. 1993. Room Q Data Report: Test Borehole Data from April 1989 through November 1991. SAND92-1172. Albuquerque, NM: Sandia National Laboratories. ERMS #223548.

Saulnier, G.J., Jr., Domski, P.S., Palmer, J.B., Roberts, R.M., Stensrud, W.A., and Jensen, A.L. 1991. WIPP Salado Hydrology Program Data Report #1. SAND90-7000. Albuquerque, NM: Sandia National Laboratories. ERMS #225746.

Stensrud, W.A., T.F. Dale, P.S. Domski, J.B. Palmer, R.M. Roberts, M.D. Fort, G.J. Saulnier, Jr., and A.L. Jensen. 1992. Waste Isolation Pilot Plant Salado Hydrology Program Data Report #2. SAND92-7072. Albuquerque, NM: Sandia National Laboratories. ERMS #226432.

Table PAR-4. Summary of Test-Interpretations Results from In Situ Permeability Tests for Undisturbed Anhydrite Map Units

Test Interval (meters from excavation)	Hole	Zone	Map Unit	Analysis Method	Permeability k (m^2)	Formation Pore Pressure (megapascals)[1]
10.68-14.78 down	SCP01-A	undisturbed	MB139	GTFM6.0	1.4×10^{-19}	12.27
9.47-10.86 down	C2H02	undisturbed	MB139	GTFM6.0	1.0×10^{-21}	11.11
20.50-21.40 up	QPPO3	undisturbed	anhydrite b	GTFM6.0	7.6×10^{-20}	12.9
20.62-21.52 down	QPP13	undisturbed	MB139	GTFM6.0	6.0×10^{-20}	12.43
17.44-22.20 down	L4P51-C1	undisturbed	MB140	GTFM6.0	8.7×10^{-18}	9.38

[1] *Mean*

Note: See Record Parameter Package for additional detail.

Table PAR-5. Summary of MB139 Permeability Laboratory Test Results

	Permeability (pressure values are net effective stress)					
	Gas (Klinkenberg Corrected)			Log of Permeability		
	3.4 megapascals (m^2)	6 megapascals (m^2)	10 megapascals (m^2)	2 megapascals (m^2)	6 megapascals (m^2)	10 megapascals (m^2)
Minimum	1.5E-19	5.9E-20	5.0E-20	-18.84	-19.23	-19.30
Maximum	8.3E-16	3.0E-16	1.5E-16	-15.08	-15.52	-15.82
Sum	9.0E-16	3.4E-16	1.8E-16	-552.29	-524.43	-402.17
Points	31	29	22	31	29	22
Mean	2.9E-17	1.2E-17	8.0E-18	-17.82	-18.08	-18.28
Median	1.3E-18	5.7E-19	3.1E-19	-17.89	-18.24	-18.51
Std Deviation	1.5E-16	5.6E-17	3.2E-17	0.67	0.69	0.83
Variance	2.2E-32	3.2E-33	1.1E-33	0.45	0.48	0.69

1 ***Parameter 21: Rock Compressibility - Marker Bed 139***

Parameter Description:

The rock (or bulk) compressibility of the Salado Formation Anhydrite Layers a and b MB139 is used to calculate the pore compressibility that is used in BRAGFLO. Pore compressibility is used to predict the effect of material compressibility on porosity and mass storage in the equation of state for flow through porous media as follows:

$$\varphi = \varphi_o \exp(c_p(p-p_o))$$

where,

φ	=	*porosity of solid matrix (cubic meters/cubic meters)*
φ_o	=	*porosity at reference pressure p_o*
c_p	=	*pore compressibility (pascals^{-1})*
p	=	*pore pressure (pascals)*
p_o	=	*reference pore pressure (pascals)*

The rock compressibility is divided by effective porosity to calculate pore compressibility. It is a sampled parameter for MB139 and the values are then applied to MB138 and Anhydrite Layers a and b.

2 ***Material and Property Name(s):***

S_MB139 COMP_RCK (#580)

3 ***Computational Code: BRAGFLO***

4

Measured Values:	1.09×10^{-11}	1.09×10^{-11}	3.37×10^{-11}	2.75×10^{-10}

5 ***Units: Pascals^{-1}***

6 ***Distribution Type: Student's-t***

7 ***Data: Site-Specific Experimental Data***

The parameter distribution for anhydrite rock compressibility is based upon data from four hydraulic tests in the underground WIPP facility (see Table PAR-6). The boreholes and map units tested include: C2H02 (MB139); QPP03 (Anhydrite b); QPP13 (MB139); and SCP01 (MB139). The parameter records package associated with this parameter is located at: WIPP: 1.2.07.1:PDD: QA:SALADO:PKG 19:Rock Compressibility (ERMS #231186).

The four successful tests include:

Borehole	Location	Start Date of Testing	End Date of Testing
QPP03	Room Q	4/89	11/91
QPP13	Room Q	4/89	11/91
C2H02	Room C2	4/89	11/89
SCP01-A	Core Storage	4/90	10/90

Raw data collected during hydraulic tests include pressure, fluid volume, temperature, axial test-tool movement, and radial borehole closure. Pressure/flow transmission during hydraulic tests is assumed to be a result of Darcy flow and borehole closure. The reader is referred to the anhydrite rock compressibility parameter record package for more detail.

WIPP Data Entry Form #464 ERMS: #234574

References:

Beauheim, R.L., Saulnier, Jr., G.J., and Avis, J.D. 1991. Interpretation of Brine-Permeability Tests of the Salado Formation at the Waste Isolation Pilot Plant Site: First Interim Report. SAND90-0083. Albuquerque, NM: Sandia National Laboratories. ERMS #226003.

Beauheim, R.L., Roberts, R.M., Dale, T.F., Fort, M.D., and Stensrud, W.A. 1993. Hydraulic Testing of Salado Formation Evaporites at the Waste Isolation Pilot Plant Site: Second Interpretive Report. SAND92-0533. Albuquerque, NM: Sandia National Laboratories. ERMS #223378.

Jensen, A.L., Howard, C.L., Jones, R.L., and Peterson, T.P. 1993. Room Q Data Report: Test Borehole Data from April 1989 through November 1991. SAND92-1172. Albuquerque, NM: Sandia National Laboratories. ERMS #223548.

Saulnier, Jr., G.J., Domski, P.S., Palmer, J.B., Roberts, R.M., Stensrud, W.A., and Jensen, A.L. 1991. WIPP Salado Hydrology Program Data Report #1. SAND90-7000. Albuquerque, NM: Sandia National Laboratories. ERMS #225746.

Stensrud, W.A., Dale, T.F., Domski, P.S., Palmer, J.B., Roberts, R.M., Fort, M.D., Saulnier, G.J., Jr., and Jensen, A.L. 1992. Waste Isolation Pilot Plant Salado Hydrology Program Data Report #2. SAND92-7072. Albuquerque, NM: Sandia National Laboratories. ERMS #226432.

Table PAR-6. Summary of Rock Compressibility Test-Interpretations Results from In Situ Permeability Tests for Undisturbed Anhydrite Marker Beds

Test Interval (meters from excavation)	Hole and Location	Zone	Map Unit(s)	Analysis Method	Rock Compressibility C_r (1/pascals)	Formation Pore Pressure (megapascals)[1]
9.47-10.86 down	C2H02	undisturbed	MB 139	GTFM6.0	1.09×10^{-11}	11.11
20.62-21.52 down	QPP13	undisturbed	MB 139	GTFM6.0	3.37×10^{-11}	12.43
10.68-14.78 down	SCP01	undisturbed	MB 139	GTFM6.0	1.09×10^{-11}	12.27
20.50-21.40 up	QPP03	undisturbed	Anhydrite b	GTFM6.0	2.75×10^{-10}	12.94

[1] *Mean*

Note: See Record Parameter Package for additional detail.

Parameter 22: Relative Permeability – Marker Bed 139

Parameter Description:

The relative permeability model number parameter is the flag used to select two-phase flow model for use in BRAGFLO. It is a sampled parameter for MB139 (see CCA Appendix PA, Figure 4.2.1).

Material and Property Name(s):

S_MB139 RELP_MOD (#596)

Computational Code: BRAGFLO

Value	***1.0***	***2.0***	***3.0***	***4.0***
Percentiles	***.50***	***0***	***0***	***.50***

Units: None

Distribution Type: Delta

Data: Site-Specific Experimental Data

Site-specific experimental data was collected from whole core taken from six underground boreholes at the WIPP. The specimens first underwent permeability and porosity testing, then subsequent capillary pressure tests. Test data from MB 139 was applied to MB 138 and Anhydrite Layers a and b. All other material regions use the second modified Brooks-Corey two-phase flow model.

Assumptions made during testing were:

1) ***Cores were 100 percent saturated at initiation of capillary pressure tests.***
2) ***Use of a 140° contact angle was appropriate for correcting mercury-air data to brine-air repository conditions.***
3) ***Although tests were conducted at ambient conditions (no stress), the data are adequate to describe two-phase conditions at stress.***

The following parameter records package is associated with the tests: Anhydrite Two-Phase Parameters, Appendix E for SAND94-0472 (ERMS #230643).

There are several two-phase relative permeability models described in Appendix BRAGFLO (DOE 1996), including the van Genuchten-Parker and the second modified Brooks-Corey. Interpretation of the experimental test results showed that either the second modified Brooks-Corey or the van Genuchten-Parker two-phase flow models could be used to describe the data.

WIPP Data Entry Form #464 ERMS: #234500

References:

Howarth S.M., and Christian-Frear, T. 1996. Porosity, Single-Phase Permeability, and Capillary Pressure Data from Preliminary Laboratory Experiments on Selected Samples from Marker Bed 139 at the Waste Isolation Pilot Plant. Albuquerque, NM: Sandia National Laboratories. (ERMS #238019).

Webb, S.W. 1991. "Sensitivity Studies for Gas Release from the Waste Isolation Pilot Plant," Chapter 4.0 in Waste-Generated Gas at the Waste Isolation Pilot Plant: Papers Presented at the Nuclear Energy Agency Workshop on Gas Generation and Release from the Radioactive Waste Repositories, P.B. Davies et al., eds., SAND91-2378, November 1991. Albuquerque, NM: Sandia National Laboratories. (ERMS #228772).

Parameter 23: Residual Brine Saturation - Marker Bed 139

Parameter Description:

The residual brine saturation (S_{br}) is required in the two-phase flow model to define the relative permeability and capillary pressure curves. Referred to also as S_{wr} (wetting phase) or S_{lr} (liquid phase), residual brine saturation is the point reached under high gas saturation conditions when brine is no longer continuous throughout the pore network and relative brine permeability becomes zero. It is a sampled parameter for MB139 (see CCA Appendix PA, Figure 4.2.1).

Material and Property Name(s):

S_MB139 SAT_RBRN (#598)

Computational Code: BRAGFLO

Measured Values:	***7.78×10^{-3}***	***0.069***	***0.070***	***0.073***	***0.109***	***0.174***

Units: None

Distribution Type: Student's-t

Data: Site-Specific Experimental Data

Residual brine saturation parameter values for the marker beds are based on curve fit parameter values predicted from laboratory measurements of capillary pressure. The parameter records package associated with this parameter is: Anhydrite Two-Phase Parameters, Appendix E for SAND94-0472 (ERMS #230643).

Discussion:

Parameter values are based on curve fit capillary pressure data measured using a mercury injection technique. The two-phase flow program reports the results of curve-fitted measurements of capillary pressure on six MB samples (Howarth and Christian-Frear 1996). Specimens were collected from intact MB139 core samples taken from the experimental area of the repository.

WIPP Data Entry Form #464 ERMS: #234506

References:

Howarth S.M., and Christian-Frear, T. 1996. Porosity, Single-Phase Permeability, and Capillary Pressure Data from Preliminary Laboratory Experiments on Selected Samples from Marker Bed 139 at the Waste Isolation Pilot Plant. Albuquerque, NM: Sandia National Laboratories. (ERMS #238019).

Parameter 24: Residual Gas Saturation - Marker Bed 139

Parameter Description:

The residual (critical) gas saturation (S_{gr}) is required in the two-phase flow model to define the relative permeability and capillary pressure curves. S_{gr} corresponds to the degree of waste-generated gas saturation necessary to create an incipient interconnected pathway in porous material, a condition required for porous rock to be permeable to gas. It is a sampled parameter for MB139 (see CCA Appendix PA, Figure 4.2.1).

Material and Property Name(s):

S_MB139 SAT_RGAS (#599)

Computational Code: BRAGFLO

Measured Values:	***0.014***	***0.025***	***0.032***	***0.078***	***0.116***	***0.197***

Units: None

Distribution: Student's-t

Data: Site-Specific Experimental Data

Residual gas saturation parameter values for the marker beds are based on curve-fitted laboratory measurements of capillary pressure. The parameter records package is associated with this parameter is: Anhydrite Two-Phase Parameters, Appendix E for SAND 94-0472 (ERMS #230643).

Discussion:

The two-phase flow program reports the results of curve-fitted measurements of capillary pressure on six marker bed samples tested using mercury injection (Howarth and Christian-Frear 1996). The samples were taken from intact MB139 core samples collected from the northern experimental area of the repository. The measurements were conducted at ambient conditions (no stress) and were assumed to be 100 percent saturated at the initiation of capillary pressure tests.

WIPP Data Entry Form #464 ERMS: #234508

References:

Howarth S.M., and Christian-Frear, T. 1996. Porosity, Single-Phase Permeability, and Capillary Pressure Data from Preliminary Laboratory Experiments on Selected Samples from Marker Bed 139 at the Waste Isolation Pilot Plant. Albuquerque, NM: Sandia National Laboratories. ERMS #238019.

Parameter 25: Pore Distribution - Marker Bed 139

Parameter(s) Description:

The Brooks-Corey pore size distribution parameter (λ) is used to calculate capillary pressure and relative permeabilities for gas and brine flow in the two-phase flow model. It is a sampled parameter for MB139 (see CCA Appendix PA, Figure 4.2.1).

Material and Property Name(s):

S_MB139 PORE_DIS (#587)

Computational Code: BRAGFLO

Measured Values:	***0.491***	***0.558***	***0.652***	***0.655***	***0.665***	***0.842***

Units: None

Distribution Type: Student's-t

Data: Site-Specific Experimental Data

Pore size distribution parameter values for all anhydrite units are based on curve fit values predicted from laboratory measurements of capillary pressure. The parameter records package associated with this parameter is retained in Anhydrite Two-Phase Parameters, Appendix E for SAND94-0472 (ERMS #230643).

Discussion:

Curve fit parameter values are derived from six specimens cut from intact MB139 core samples collected from the northern experimental area of the repository. Reported data and parameters are based on mercury injection capillary pressure tests (Howarth and Christian-Frear 1996).

WIPP Data Entry Form #464 ERMS: #234859

References:

Howarth S.M., and Christian-Frear, T. 1996. Porosity, Single-Phase Permeability, and Capillary Pressure Data from Preliminary Laboratory Experiments on Selected Samples from Marker Bed 139 at the Waste Isolation Pilot Plant. Albuquerque, NM: Sandia National Laboratories. (ERMS #238019).

1 ***Parameter 26: Initial Pressure - Salado Halite***

Parameter Description:

The initial brine far-field (undisturbed) pore pressure in the Salado halite is applied at an elevation consistent with the intersection of MB139 (see CCA Appendix PA, Figure 4.2.1).

2

Material and Property Name(s):

S_HALITE PRESSURE (#546)

3

Computational Code: BRAGFLO

4

minimum	***maximum***
1.10×10^7	1.39×10^7

5

Units: Pascals

6

Distribution Type: Uniform

7

Data: Site-Specific Experimental Data

Two hydraulic tests were performed in boreholes in undisturbed halite in the underground WIPP repository. Both tests were performed in the area where Room Q would later be mined. The tests were undertaken in April-July, 1989. Pressure, fluid volume, temperature, axial test-tool movement, and radial borehole closure were measured during the hydraulic tests in undisturbed rock. The following parameter records package is associated with the tests: Halite Pressure (ERMS #231221).

8

Discussion:

It was assumed that Darcy flow and borehole closure were the only forms of pressure/flow transmission during the hydraulic tests in undisturbed halite. The uncertainty associated with the estimated parameter values is high. The distribution is based on the two data points provided in the data package and the calculated median is 1.247×10^7 ***pascals.***

9

WIPP Data Entry Form #464 ERMS: #234394

10

References:

Beauheim, R.L., Saulnier, G.J., Jr., and Avis, J.D. 1991. Interpretation of Brine-Permeability Tests of the Salado Formation at the Waste Isolation Pilot Plant Site: First Interim Report. SAND90-0083. Albuquerque, NM: Sandia National Laboratories. ERMS #226003.

Beauheim, R.L., Roberts, R.M., Dale, T.F., Fort, M.D., and Stensrud, W.A. 1993. Hydraulic Testing of Salado Formation Evaporites at the Waste Isolation Pilot Plant Site:

Second Interpretive Report. SAND92-0533. Albuquerque, NM: Sandia National Laboratories. ERMS #223378.

Jensen, A.L., Howard, C.L., Jones, R.L., and Peterson, T.P. 1993. Room Q Data Report: Test Borehole Data from April 1989 through November 1991. SAND92-1172. Albuquerque, NM: Sandia National Laboratories. ERMS #223548.

Saulnier, G.J., Jr., Domski, P.S., Palmer, J.B., Roberts, R.M., Stensrud, W.A., and Jensen, A.L. 1991. WIPP Salado Hydrology Program Data Report #1. SAND90-7000. Albuquerque, NM: Sandia National Laboratories. ERMS #225746.

Stensrud, W.A., Dale, T.F., Domski, P.S., Palmer, J.B., Roberts, R.M., Fort, M.D., and Saulnier, G.J., Jr. 1992. Waste Isolation Pilot Plant Salado Hydrology Program Data Report #2. SAND92-7072. Albuquerque, NM: Sandia National Laboratories. ERMS #226432.

1 ***Parameter 27: Initial Pressure - Castile Brine Reservoir***

Parameter Description:

Initial brine pore pressure in the Castile brine reservoir (see CCA Appendix PA, Figure 4.2.1).

2

Material and Property Name(s):

CASTILER PRESSURE (#66)

3

Computational Code: BRAGFLO

4

mode	*minimum*	*maximum*
1.27×10^7	1.11×10^7	1.70×10^7

5

Units: Pascals

6

Distribution Type: Triangular

7

Data: Site-Specific Experimental Data and Professional Judgment

The parameter records package associated with this parameter is as follows: Castile Brine Reservoir Pressure (ERMS #231072).

8

Discussion:

All pressure measurements were adjusted to reflect formation pressure of the WIPP-12 reservoir. Pressure adjustments were made as follows:

$$P_a = P + \rho\, g\, (h - 140)\; 1 \times 10^{-6}$$

where: P_a = ***adjusted pressure (megapascals)***
P = ***measured/estimated pressure (megapascals)***
ρ = ***assumed density (kilograms per cubic meter)***
g = ***gravitational constant (9.8 Newtons per kilogram)***
h = ***brine reservoir elevation (meters above sea level)***

Observed (measured and interpreted) Castile brine reservoir fluid pressures were compared with their corresponding lithostatic pressures; four locations (shown in Table PAR-7) were found to best represent the formation pressure. The measured values in Table PAR-7 are adjusted to reflect formation pressure at the depth of WIPP-12, which is representative of the depth of the BRAGFLO Castile Brine Reservoir. The pressure adjustment requires an assumption about pressure variation with depth in the Castile. Two bounding cases were used, hydrostatic and 85 percent of lithostatic; the adjusted pressure was calculated using the equation provided above. A brine density of 1,240 kg/m³ (Reeves et al. 1989) was assumed for the hydrostatic variation; an average formation density of 2,040 kg/m³ (Sandia WIPP Project 1992) was assumed for the lithostatic variation. The best-measured value

(that is, the mode) is the brine reservoir pressure reported for WIPP-12 (12.7 megapascals). The maximum brine reservoir pressure is 85 percent of lithostatic at WIPP-12 depth (17 megapascals). The minimum value is the lowest measured hydrostatic pressure (11.1 megapascals). Freeze and Larson (1996), attached to CCA Appendix MASS, Section 18 , provide more detail.

WIPP Data Entry Form #464 ERMS: #231612

References:

Freeze, Geoff, and Larson, K. 1996. Memorandum to Martin Tierney Re: Initial Pressure in the Castile Brine Reservoir, March 20, 1996. ERMS #237148.

Lappin, A.R., Hunter, R.L., Garber, D.P., and Davies, P.B., eds. 1989. Systems Analysis, Long-Term Radionuclide Transport, and Dose Assessments, Waste Isolation Pilot Plant (WIPP), Southeastern New Mexico, March 1989. SAND89-0462. Albuquerque, NM: Sandia National Laboratories. ERMS #224125.

Popielak, R.S., Beauheim, R.L., Black, S.R., Coons, W.E., Ellingson, C.T., and Olsen, R.L. 1983. Brine Reservoirs in the Castile Formation, Waste Isolation Pilot Plant (WIPP) Project, Southeastern New Mexico, DOE Report TME-3153.

Reeves, M., Freeze, G.A., Kelley, V.A., Pickens, J.F., Upton, D.T., and Davies, P.B. 1989. Regional Double-Porosity Solute Transport in the Culebra Dolomite under Brine-Reservoir-Breach Release Conditions: An Analysis of Parameter Sensitivity and Importance. SAND89-7069. Albuquerque, NM: Sandia National Laboratories. ERMS #224048.

Sandia WIPP Project. 1992. Preliminary Performance Assessment for the Waste Isolation Pilot Plant, December 1992: Volume 3, Model Parameters. SAND92-0700/3. Albuquerque, NM: Sandia National Laboratories. ERMS #223529.

Table PAR-7. Measured Castile Brine Reservoir Formation Pressures

Location	Pressure at Reservoir Depth (megapascals)	Pressure at WIPP-12 Depth with Hydrostatic Adjustment (megapascals)	Pressure at WIPP-12 Depth with 85% Lithostatic Adjustment (megapascals)
WIPP-12	12.7[1]	12.7	12.7
ERDA-6	14.1[2]	15.5	16.4
Belco	14.3[2]	14.5	14.5
Gulf Covington	13.6[2]	12.1	11.1

[1] from Reeves et al. 1989, Appendix A
[2] from Popielak et al. 1983, Table H.1

Parameter 28: Log of Intrinsic Permeability - Castile Brine Reservoir

Parameter Description:

The log of the intrinsic permeability of the Castile Brine Reservoir. It is a sampled parameter for the x-direction and the values are then applied to the y- and z-directions.

Material and Property Name(s):

CASTILER PRMX_LOG (#67)
CASTILER PRMY_LOG (#68)
CASTILER PRMZ_LOG (#69)

Computational Code: BRAGFLO

mode	***minimum***	***maximum***
-11.80	***-14.70***	***-9.80***

Units: Log (meters squared)

Distribution Type: Triangular

Data: Site-Specific Experimental Data and Professional Judgment

Although several shorter flow tests were conducted to measure permeability of Castile brine reservoirs, only one test is considered representative of the long-term behavior of the brine reservoir behavior: the WIPP-12 Flow Test 3 (24,800 bbl produced, nine months recovery). The Graph Theoretic Field Model (GTFM) analysis of WIPP-12 Flow Test 3 (Reeves et al. 1989) is considered better than the Horner analysis because it considers the effects of pre-test borehole pumping history. The GTFM interpreted hydraulic conductivity from WIPP-12 Flow Test 3 therefore provides the basis for the mean permeability for the Castile brine reservoir. The other values from WIPP-12 and ERDA-6 were used to establish the permeability distribution.

Professional judgment was used to better define the data mean and range because of the shortage of directly relevant data points. The parameter records package associated with this parameter is as follows: Castile Brine Reservoir Permeability (ERMS #231070).

The GTFM analysis from WIPP-12 Flow Test 3 consists of a match to pressure response data and a match to flow rate data. The late time match to the pressure data are controlled primarily by the formation pressure and is not very sensitive to the hydraulic conductivity or the specific storage. To match the flow rate data, the GTFM interpreted hydraulic conductivity (K) is strongly correlated with the specified specific storage (S_s), where:

$$S_s = \rho g (C_R + \Phi\beta)$$

For Castile brine reservoir properties, specific storage is proportional to the bulk rock compressibility (C_R). The correlation between K and S_s is such that their product is

approximately a constant. For example, if the assumed specific storage (or rock compressibility) in GTFM is reduced by an order of magnitude, the interpreted hydraulic conductivity must increase by an order of magnitude to produce the same flow rate. The new combination of K and S_s will produce a different early-time pressure response, but will not impact the late-time match. For the GTFM analyses of the WIPP-12 Flow Tests, a rock compressibility of 1×10^{-9} pascals^{-1} was assumed. Because the mean rock compressibility for the Castile brine reservoir is 1×10^{-10} pascals^{-1}, the hydraulic conductivity required to reproduce the WIPP-12 flow is approximately 1×10^{-5} m/s ***(permeability of -11.81 log (square meters)). For all triangular distributions, the mode is the best estimate. GTFM analysis determines a hydraulic conductivity (with units of meters per second) based on pressure change, flow rate, and assumptions about fluid and formation properties. Conversions from meters per second to square meters were based on a conversion factor of 1.7×10^{-7}*** m^2 ***per (meters per second). The conversion factor is based on the assumed GTFM fluid properties.***

WIPP Data Entry Form #464 ERMS: #231613

References:

Popielak, R.S., Beauheim, R.L., Black, S.R., Coons, W.E., Ellingson, C.T., and Olsen, R.L. 1983. Brine Reservoirs in the Castile Formation, Waste Isolation Pilot Plant (WIPP) Project, Southeastern New Mexico. DOE Report TME-3153.

Reeves, M., Freeze, G.A., Kelley, V.A., Pickens, J.F., Upton, D.T., and Davies, P.B. 1989. Regional Double-Porosity Solute Transport in the Culebra Dolomite under Brine-Reservoir-Breach Release Conditions: An Analysis of Parameter Sensitivity and Importance. SAND89-7069. Albuquerque, NM: Sandia National Laboratories. ERMS #224048.

Parameter 29: Rock Compressibility - Castile Brine Reservoir

Parameter Description:

The rock (or bulk) compressibility of the Castile Brine Reservoir is used to calculate the pore compressibility, which is required for running BRAGFLO (see CCA Appendix PA, Figure 4.2.1). Pore compressibility is used to predict the effect of material compressibility on porosity and mass storage in the equation of state for flow through porous media as follows:

$$\phi = \phi_o \exp\left(c_p\left(p - p_o\right)\right)$$

where,

φ = ***porosity of solid matrix (cubic meters per cubic meters)***
φ_o = ***porosity at reference pressure*** p_o
c_p = ***pore compressibility (pascals***$^{-1}$***)***
p = ***pore pressure (pascals)***
p_o = ***reference pore pressure (pascals)***

The rock compressibility is divided by effective porosity to calculate pore compressibility.

Material and Property Name(s):

CASTILER COMP_RCK (#61)

Computational Code: BRAGFLO

mode	*minimum*	*maximum*
4.00×10^{-11}	2.00×10^{-11}	1.00×10^{-10}

Units: Pascals^{-1}

Distribution Type: Triangular

Data: Site-Specific Experimental Data and Professional Judgment

A discussion of the data associated with this parameter may be found in the following parameter records package: Analysis Reports Relating to Analysis Plan AP-086 (ERMS #520523), specifically Summary of parameter changes adopted from the Performance Assessment Verification Test for the Technical Baseline Migration (ERMS #522016).

Discussion:

In CCA Appendix PAR in DOE (1996), parameter values were based on an analysis of data from WIPP-12. Rock compressibility values were determined by calculating the bulk modulus of anhydrite from the acoustic log of the Castile Anhydrite III unit found in WIPP-12. The DOE chose to use the acoustic log because it measures compressive wave

travel time over short distances through relatively intact, undisturbed rock, then uses a correlation between wave velocity and elastic rock properties to estimate bulk modulus. Various laboratory compression tests on anhydrite from other WIPP locations produced similar results for the bulk modulus (Popielak et al., 1983).

The estimated bulk modulus, K, for the intact Anhydrite III at WIPP-12 was 6.9×10^{10} pascals (10×10^{6} psi). Assuming uniaxial strain, the rock compressibility (C_R) can be estimated from the bulk modulus (K) and the shear modulus (G) of the rock:

$$C_R = \frac{1}{K + 4G/3}$$

No estimates for shear modulus for Anhydrite III were available. Beauheim et al. (1991) reported a value for G that was approximately 1/3 of K for Salado anhydrite. Using this estimate for G, the calculated intact rock compressibility is 1×10^{-11} pascals^{-1}.

The bulk modulus may be 2 to 10 times smaller for fractured rock (Popielak et al. 1983), corresponding to a 2 to 10 times increase in compressibility (assuming G changes accordingly). Beauheim et al. (1991) suggest that fracturing might result in a fourfold increase in rock compressibility. Using these adjustments for fractured rock, the calculated rock compressibility ranges from 2×10^{-11} pascals^{-1} to 1×10^{-10} pascals^{-1}, with an average value of 5×10^{-11} pascals^{-1}.

Hydraulic testing was performed in transition-zone (disturbed) Salado anhydrite and halite. Interpreted rock compressibilities for transition zone anhydrite ranged from 5×10^{-12} pascals^{-1} to 3×10^{-9} pascals^{-1}. Freeze and Cherry (1979) report a range for rock compressibility for fractured or jointed rock of 1×10^{-8} to 1×10^{-10} pascals^{-1} (DOE 1996).

Subsequent to the CCA PA calculations, EPA reviewed the CCA, and supporting information and references, and concluded that the compressibility parameter for the Castile Formation brine reservoir was not consistent with available information (EPA, 1998). Subsequent to the CCA, the field test data for the WIPP-12 borehole was re-examined and arrived at a revised range for rock compressibility. EPA regarded the re-analysis as a better estimate of the rock compressibility parameter than the value used in the CCA.

The Sandia National Laboratories Technical Library and Records Center undertook a key word-based (Castile rock compressibility) literature and records search to identify documentation/research that addresses the brine reservoir rock compressibility. Titles of all recent documents identified by the search were reviewed for relevancy; following this, abstracts and/or complete documents were reviewed to determine if information more recent than that cited in the CCA or PAVT was available. The literature and records search and review did not identify new information that would offer further support of, or otherwise refute the distributions and parameter ranges presented above. Consequently, rock compressibility is treated as a sampled variable having a triangular distribution and a revised range of 2×10^{-11} to 1×10^{-10} Pa^{-1} and a revised mode of 4×10^{-11} Pa^{-1}.

WIPP Data Entry Form #464 ERMS: #522016

References:

Beauheim, R.L., Saulnier, G.J., Jr., and Avis, J.D. 1991. Interpretation of Brine-Permeability Tests of the Salado Formation at the Waste Isolation Pilot Plant: First Interim Report. SAND90-0083. Albuquerque, NM: Sandia National Laboratories. ERMS #226003.

Freeze, R.A., and Cherry, J.A. 1979. Groundwater. Prentice-Hall, Inc., Englewood Cliffs, NJ.

Hansen, C., Leigh, C. 2003. A Reconciliation of the CCA and PAVT Parameter Baselines, Rev. 3. Carlsbad, NM. Sandia National Laboratories. ERMS #528582

Popielak, R.S., Beauheim, R.L., Black, S.R., Coons, W.E., Ellingson, C.T., and Olsen, R.L. 1983. Brine Reservoirs in the Castile Formation, Waste Isolation Pilot Plant (WIPP) Project, Southeastern New Mexico. DOE Report TME-3153.

Reeves, M., Freeze, G.A., Kelley, V.A., Pickens, J.F., Upton, D.T., and Davies, P.B. 1989. Regional Double-Porosity Solute Transport in the Culebra Dolomite Under Brine-Reservoir-Breach Release Conditions: An Analysis of Parameter Sensitivity and Importance. SAND89-7069. Albuquerque, NM: Sandia National Laboratories. ERMS #224048.

U.S. Environmental Protection Agency (EPA). 1998. Response to Comments, Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with 40 CFR 191 Disposal Regulations: Certification Decision. Docket No. A-93-02, V-C-1. U.S. Environmental Protection Agency. Washington D.C.

Parameter 30: Log of Intrinsic Permeability - Intrusion Borehole Filled With Silty Sand

Parameter Description:

This parameter represents the log of the intrinsic permeability of the silty-sand-filled borehole in the human-intrusion scenario (see CCA Appendix PA, Figure 4.2.1). This permeability is representative of degraded concrete or material which may sluff into the borehole or spall from the sides. It is a sampled parameter for the x-direction and the values are then applied to the y- and z-directions.

Material and Property Name(s):

BH_SAND PRMX_LOG (#3184)
BH_SAND PRMY_LOG (#3190)
BH_SAND PRMZ_LOG (#3191)

Computational Code: BRAGFLO

minimum	***maximum***
-16.30	***-11.00***

Units: Log (meters squared)

Distribution Type: Uniform

Data: Site-Specific Experimental Data

A discussion of the data associated with this parameter may be found in the following parameter records package: Analysis Reports Relating to Analysis Plan AP-086 (ERMS #520523), specifically Summary of parameter changes adopted from the Performance Assessment Verification Test for the Technical Baseline Migration (ERMS #522016).

Discussion:

In CCA Appendix PAR, this parameter represented the permeability of the silty-sand-filled borehole in the human-intrusion scenario. The permeability was representative of degraded concrete or material which may sluff into the borehole or spall from the sides. Three plug configurations with different permeabilities were associated with each configuration. Borehole materials and plug configurations were based on a review of regulations and practices, and the permeability predictions are based on models and data for steel corrosion and concrete alteration found in the literature (Thompson et al. 1996). Wherever possible, the predictions were calibrated by comparing predicted behavior to field data (Thompson et al. 1996).

The three plug configurations consisted of: a continuous concrete plug through the Salado and Castile which was assigned a probability of 0.015 (see Section 6.4.7.2.1), a two-plug configuration (a lower plug located between the Castile brine reservoir and underlying formations and an upper plug located in the Rustler immediately above the Salado), which

was assigned a probability of 0.696 (see Section 6.4.7.2.2), and a three-plug configuration (two plugs same as two-plug configuration and third plug located in the Castile above the brine reservoir and below the waste-disposal panel) which was assigned a probability of 0.289 (see Section 6.4.7.2.3).

The plugs were initially expected to have a tight permeability of 5×10^{-17} m^2 (Thompson et al. 1996). The continuous concrete plug was assumed not to degrade and had a permeability of 5×10^{-17} m^2 for the entire regulatory period. For the two-plug configuration, the permeability between the repository and the surface is 5×10^{-17} m^2 for the first 200 years and 10^{-14} to 10^{-11} m^2 after that; the permeability between the Castile and the repository is 10^{-14} to 10^{-11} m^2 up to 1,200 years and 10^{-15} to 10^{-12} m^2 after that. The three-plug configuration had the same material properties as the corresponding regions in the two-plug configuration and the third plug was assumed to behave as the lower plug in the two-plug configuration (DOE 1996).

Subsequent to the CCA PA calculations, EPA questioned the range of borehole sand permeabilities and the assumption that concrete borehole plugs would degrade to a more permeable material. The EPA (1997a) concluded that the lower bound for long-term borehole sand permeability proposed (10^{-14} m^2) should be closer to that of an undegraded borehole plug (5×10^{-17} m^2). The lower value was of interest to EPA because a lower permeability could result in increased gas pressures with consequent increases in brine and spallings releases during a human intrusion event.

The EPA also investigated drilling practices used in the petroleum industry and found literature values for cement permeability ranging from 9×10^{-21} to 1×10^{-16} m^2 (EPA 1997b). The EPA also found that filter cake and compacted, clay-based drilling muds could yield permeabilities of less than 9.9×10^{-22} m^2. In their considerations, the EPA noted that drilling mud used in the Delaware Basin boreholes might not have the permeability of clay-based solids; however, they noted that natural cuttings could contribute to lower borehole permeabilities than those assumed by the DOE. The EPA also postulated that the effective average permeability over an abandoned borehole could remain in the range of 9×10^{-21} to 1×10^{-16} m^2 over a period of hundreds of years or more if complete degradation does not occur throughout a plug configuration or if natural materials or mud were to provide additional layers with sealing properties.

With these findings, the EPA decided that the borehole sand permeabilities assigned in the CCA, while consistent with the broad range of available data, did not adequately represent the total range of permeability conditions that could exist. As a result, lower borehole sand permeabilities values are used. (Hansen and Leigh 2003)

WIPP Data Entry Form #464 ERMS: #522016

References:

Hansen, C., Leigh, C. 2003. A Reconciliation of the CCA and PAVT Parameter Baselines, Rev. 3. Carlsbad, NM. Sandia National Laboratories. ERMS #528582

Thompson, T.W., Coons, W.E., Krumhansl, J.L., and Hansen, F.D. 1996. Inadvertent Intrusion Borehole Permeability, Final Draft, July 8, 1996.

U.S. Department of Energy (DOE). 1996. Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant. DOE/CAO-1996-2184. Carlsbad, NM: United States Department of Energy, Waste Isolation Pilot Plant, Carlsbad Area Office. Vols 1-XXI.

U.S. Environmental Protection Agency (EPA). 1997a. Technical Support Document for Section 194.23:Parameter Justification Report. Docket No. A-93-02, III-B-14, U.S. Environmental Protection Agency. Washington D.C.

U.S. Environmental Protection Agency (EPA). 1997b. Compliance Application Review Documents for the Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations: Proposed Certification Decision. Docket No. A-93-02, III-B-2. U.S. Environmental Protection Agency. Washington D.C.

U.S. Environmental Protection Agency (EPA). 1998a. Technical Support Document for Section 194.23:Parameter Justification Report. Docket No. A-93-02, V-B-14. U.S. Environmental Protection Agency. Washington, D.C. ERMS #525158.

1 ## *Parameter 31: Log of Intrinsic Permeability - Disturbed Rock Zone*

Parameter Description:

This parameter represents the log of the intrinsic permeability of the disturbed rock zone (DRZ), 0-10,000 yrs (see CCA Appendix PA, Figure 4.2.1). It is a sampled parameter for the x-direction and the values are then applied to the y- and z-directions.

2 ***Material and Property Name(s):***

DRZ_1 PRMX_LOG (#198)
DRZ_1 PRMY_LOG (#199)
DRZ_1 PRMZ_LOG (#200)

3 ***Computational Code: BRAGFLO***

4

minimum	*maximum*
-19.40	*-12.50*

5 ***Units: Log (meters squared)***

6 ***Distribution Type: Uniform***

7 ***Data: Site-Specific Experimental Data***

A discussion of the data associated with this parameter may be found in the following parameter records package: Analysis Reports Relating to Analysis Plan AP-086 (ERMS #520523), specifically Summary of parameter changes adopted from the Performance Assessment Verification Test for the Technical Baseline Migration (ERMS #522016).

8 ***Discussion:***

The grid used in CCA calculations implemented a DRZ of constant permeability (10^{-15} m^2) over a region 12 m above and 2.23 m below the disposal rooms. The grid was continuous above panel closure systems, such that the same permeability and thickness existed above and below the simulated panel closures. A more realistic representation of the DRZ over disposal rooms would include high permeability near the free surface of rooms, and reduction of permeability as a function of depth into the surrounding rock. Generally speaking, the DRZ extends greater distances above a room than below, and is relatively shallow into the ribs.

Subsequent to the CCA PA calculations, the EPA determined an alternate lower bound for DRZ permeability from measured gas permeability in anhydrite cores from MB139 (Howarth 1996; Beauheim 1996; Howarth and Christain-Frear 1994). The EPA concluded that a value of -19.4 for the log of the permeability was a more appropriate lower bound for the range of likely values. The EPA selected a value of -12.5 as an upper bound on the log of DRZ permeability based upon a sensitivity analysis (EPA 1998). The EPA also assigned

a uniform distribution for the range of -19.4 to -12.5 based on the supposition that all the values are equally likely. The geometric dimensions of the DRZ are the same in the CCA and the PAVT. The DOE has adopted this revised range for the DRZ permeability (Hansen and Leigh 2003).

WIPP Data Entry Form #464 ERMS: #522016

References:

Beauheim, R.L. 1996. "Salado Package #16, (X, Y, Z) DRZ Permeability." Revision 1. Records Package. Sandia National Laboratories. Albuquerque, NM. ERMS #232038.

Hansen, C., Leigh, C. 2003. A Reconciliation of the CCA and PAVT Parameter Baselines, Rev. 3. Carlsbad, NM. Sandia National Laboratories. ERMS #528582

Howarth, S.M. 1996. "[Salado Package #13], Salado Anhydrite Permeability in the X-Direction." Records Package. Sandia National Laboratories. Albuquerque, NM. ERMS #230603.

Howarth, S.M., and Christain-Frear, T. 1996. Porosity, Single-Phase Permeability, and Capillary Pressure Data from Preliminary Laboratory Experiments on Selected Samples from Marker Bed 139 at the Waste Isolation Pilot Plant. SAND94-0472 (Draft). Sandia National Laboratories. Albuquerque, NM. ERMS #238367.

U.S. Environmental Protection Agency (EPA). 1998. Technical Support Document for Section 194.23:Parameter Justification Report. Docket No. A-93-02, V-B-14. U.S. Environmental Protection Agency. Washington, D.C.

1 ***Parameter 32: Log of Intrinsic Permeability – Concrete Plug***

Parameter Description:

This parameter represents the log of the intrinsic permeability of the concrete plug, at the surface of the repository and in the Rustler (see CCA Appendix PA Figure 4.2.1). It is a sampled parameter for the x-direction and the values are then applied to the y- and z-directions.

2

Material and Property Name(s):

CONC_PLG PRMX_LOG (#3185)
CONC_PLG PRMY_LOG (#3192)
CONC_PLG PRMZ_LOG (#3193)

3

Computational Code: BRAGFLO

4

minimum	***maximum***
-19.00	***-17.00***

5

Units: Log (meters squared)

6

Distribution Type: Uniform

7

Data: Site-Specific Experimental Data

A discussion of the data associated with this parameter may be found in the following parameter records package: Analysis Reports Relating to Analysis Plan AP-086 (ERMS #520523), specifically Summary of parameter changes adopted from the Performance Assessment Verification Test for the Technical Baseline Migration (ERMS #522016).

8

Discussion:

In preparation for the CCA, DOE developed a set of assumed plug configurations for boreholes drilled and abandoned in the future. Each assumed plug configuration involved several materials with varying degrees of integrity over the lifetime of the repository. One material used in the CCA PA borehole models was a concrete material. The DOE assumed that initially, the concrete plugs would be effective in limiting fluid flow in the borehole. However, for purposes of the CCA PA calculation, some plugs above the repository were assumed to degrade after 200 years of emplacement. From that point on, the borehole was assumed to be filled with a silty, sand-like material containing degraded concrete, corrosion products resulting from degradation of the casing, and material that sloughs off of the walls of the borehole.

In CCA Appendix PAR, borehole concrete permeability was set at a constant 5×10^{-17} m^2, based on results reported by Thompson et al. (1996). This value was directly measured for a concrete borehole plug at the WIPP site (Christensen and Hunter 1980).

Subsequent to the CCA PA calculations, EPA required the DOE to consider a range of values for the borehole concrete permeability (EPA 1998). The lower bound of the range chosen by EPA, – 1 × 10^{-19} m^2 – is more than two orders of magnitude lower than the lowest value measured for a WIPP borehole plug grout (5 × 10^{-17} m^2) as reported by Christensen and Hunter (1980). The EPA considered this to be a more conservative lower bound because a less permeable borehole plug may result in higher repository gas pressures and hence greater releases during a human intrusion event. The EPA chose an upper bound, 1 × 10^{-17} m^2, which was equal to the permeability of the concrete in the shaft seal systems. The EPA specified a uniform distribution over the permeability range (from 10^{-19} to 10^{-17}) (Froehlich 1997). The DOE has adopted this revised range for the borehole concrete permeability. (Hansen and Leigh 2003)

WIPP Data Entry Form #464 ERMS: #522016

References:

Christensen, C.L. and Hunter, T.O. 1980. The Bell Canyon Test Results. SAND80-2414C. Sandia National Laboratories. Albuquerque, New Mexico.

Froehlich, G. 1997. "PAV1 Parameter Values." Memorandum to C. Lattier. ERMS #246087. Sandia National Laboratories. Albuquerque, NM.

Hansen, C., Leigh, C. 2003. A Reconciliation of the CCA and PAVT Parameter Baselines, Rev. 3. Carlsbad, NM. Sandia National Laboratories. ERMS #528582

Thompson, T.W., Coons, W.E., Krumhansl, J.L., and Hansen, F.D. 1996. Inadvertent Intrusion Borehole Permeability. Final Draft. Sandia National Laboratories. Carlsbad, NM.

U.S. Environmental Protection Agency (EPA). 1998a. Technical Support Document for Section 194.23:Parameter Justification Report. Docket No. A-93-02, V-B-14. U.S. Environmental Protection Agency. Washington, D.C. ERMS #525158.

Parameter 34: Log of the Distribution of Solubility of Am(III) in Salado Brine

Parameter Description:

This parameter represents the distribution (log_{10}) of the uncertainty about the modeled solubility value for americium in the +III oxidation state in Salado brine.

Material and Property Name(s):

SOLAM3 SOLSIM (#3262)

Computational Code(s): PANEL

Value	***-2.0***	***-1.0***	***-0.50***	***-0.25***	***0***	***0.25***	***0.50***	***1.0***	***1.40***
Percentiles	***0***	***0.04***	***0.13***	***0.27***	***0.63***	***0.84***	***0.89***	***0.99***	***1.0***

Units: None (see PPR-04-2002, ERMS #524651)

Distribution Type: Cumulative

Data: Site-Specific Experimental Data and Thermodynamic Calculations

For the CCA, solubilities were calculated using the Fracture Matrix Transport (FMT) code (Novak 1996). Bynum (1996) compared 150 modeled and experimentally determined solubilities and provided a distribution of the differences between them. The parameter records package associated with this parameter is located at: Solubility Parameters for Actinide Source Term Look-up Tables (ERMS #235835).

Discussion:

FMT calculates the solubility of Am (+III) in Salado brine assuming equilibrium conditions. The uncertainty in solubilities was determined by Bynum (1996) by comparing modeled solubilities for all oxidation states with the experimentally determined solubilities.

Further information on this parameter is provided in Appendix PA, Attachment SOTERM.

WIPP Data Entry Form #464 ERMS: #237105

References:

Bynum, R.V. 1996. Memorandum to Martin Tierney and Christine Stockman, Re: Revised Update of Uncertainty Range and Distribution for Actinide Solubility to be used in CCA NUTS Calculations, May 23, 1996. ERMS #237791

Novak, C.F. 1996.Memorandum to J.T. Holmes Re: Release of FMT Data Base Files HMW_3456_960318.CHEMDAT and HMW_345_960325.CHEMDAT, March 27, 1996. ERMS #235923.

Parameter 35: Log of the Distribution of Solubility of Am(III) in Castile Brine

Parameter Description:

This parameter represents the distribution (log_{10}) of the uncertainty about the modeled solubility value for americium in the +III oxidation state in Castile brine.

Material and Property Name(s):

SOLAM3 SOLCIM (#3263)

Computational Code(s): PANEL

Value	***-2.0***	***-1.0***	***-0.50***	***-0.25***	***0***	***0.25***	***0.50***	***1.0***	***1.40***
Percentiles	***0***	***0.04***	***0.13***	***0.27***	***0.63***	***0.84***	***0.89***	***0.99***	***1.0***

Units: None (see PPR-04-2002, ERMS #524651)

Distribution Type: Cumulative

Data: Site-Specific Experimental Data and Thermodynamic Calculations

For the CCA, solubilities were calculated using the FMT code (Novak 1996). Bynum (1996) compared 150 modeled and experimentally determined solubilities and provided a distribution of the differences between them. The parameter records package associated with this parameter is located at: Solubility Parameters for Actinide Source Term Look-up Tables (ERMS #235835).

Discussion:

FMT calculates the solubility of Am (+III) in Castile brine assuming equilibrium conditions. The uncertainty in solubilities was determined by Bynum (1996) by comparing modeled solubilities for all oxidation states with the experimentally determined solubilities.

Further information on this parameter is provided in Appendix PA, Attachment SOTERM.

WIPP Data Entry Form #464 ERMS: #237106

References:

Bynum, R.V. 1996. Memorandum to Martin Tierney and Christine Stockman, Re: Revised Update of Uncertainty Range and Distribution for Actinide Solubility to be used in CCA NUTS Calculations, May 23, 1996. ERMS #237791.

Novak, C.F. 1996.Memorandum to J.T. Holmes Re: Release of FMT Data Base Files HMW_3456_960318.CHEMDAT and HMW_345_960325.CHEMDAT, March 27, 1996. ERMS #235923.

Parameter 36: Log of the Distribution of Solubility of Pu(III) in Salado Brine

Parameter Description:

This parameter represents the distribution ($\log_{10}$) of the uncertainty about the modeled solubility value for plutonium in the +III oxidation state in Salado brine.

Material and Property Name(s):

SOLPU3 SOLSIM (#3265)

Computational Code(s): PANEL

Value	***-2.0***	***-1.0***	***-0.50***	***-0.25***	***0***	***0.25***	***0.50***	***1.0***	***1.40***
Percentiles	***0***	***0.04***	***0.13***	***0.27***	***0.63***	***0.84***	***0.89***	***0.99***	***1.0***

Units: None (see PPR-04-2002, ERMS #524651)

Distribution Type: Cumulative

Data: Site-Specific Experimental Data and Thermodynamic Calculations

In the CCA, solubilities were calculated using the FMT code (Novak 1996). Bynum (1996) compared 150 modeled and experimentally determined solubilities and provided a distribution of the differences between them. The parameter records package associated with this parameter is located at: Solubility Parameters for Actinide Source Term Look-up Tables (ERMS #235835).

Discussion:

FMT calculates the solubility of Pu (+III) in Salado brine assuming equilibrium conditions. The uncertainty in solubilities was determined by Bynum (1996) by comparing modeled solubilities for all oxidation states with the experimentally determined solubilities.

Further information on this parameter is provided in Appendix PA, Attachment SOTERM.

WIPP Data Entry Form #464 ERMS: 237109

References:

Bynum, R.V. 1996. Memorandum to Martin Tierney and Christine Stockman, Re: Revised Update of Uncertainty Range and Distribution for Actinide Solubility to be used in CCA NUTS Calculations, May 23, 1996. ERMS #237791

Novak, C.F. 1996.Memorandum to J.T. Holmes Re: Release of FMT Data Base Files HMW_3456_960318.CHEMDAT and HMW_345_960325.CHEMDAT, March 27, 1996. ERMS #235923.

Parameter 37: Log of the Distribution of Solubility of Pu(III) in Castile Brine

Parameter Description:

This parameter represents the distribution (log_{10}) of the uncertainty about the modeled solubility value for plutonium in the +III oxidation state in Castile brine.

Material and Property Name(s):

SOLPU3 SOLCIM (#3264)

Computational Code(s): PANEL

Value	*-2.0*	*-1.0*	*-0.50*	*-0.25*	*0*	*0.25*	*0.50*	*1.0*	*1.40*
Percentiles	*0*	*0.04*	*0.13*	*0.27*	*0.63*	*0.84*	*0.89*	*0.99*	*1.0*

Units: None (see PPR-04-2002, ERMS #524651)

Distribution Type: Cumulative

Data: Site-Specific Experimental Data and Thermodynamic Calculations

In the CCA, solubilities were calculated using the FMT code (Novak 1996). Bynum (1996) compared 150 modeled and experimentally determined solubilities and provided a distribution of the differences between them. The parameter records package associated with this parameter is located at: Solubility Parameters for Actinide Source Term Look-up Tables (ERMS #235835).

Discussion:

FMT calculates the solubility of Pu (+III) in Castile brine assuming equilibrium conditions. The uncertainty in solubilities was determined by Bynum (1996) by comparing modeled solubilities for all oxidation states with the experimentally determined solubilities.

Further information on this parameter is provided in Appendix PA, Attachment SOTERM.

WIPP Data Entry Form #464 ERMS: #237108

References:

Bynum, R.V. 1996. Memorandum to Martin Tierney and Christine Stockman, Re: Revised Update of Uncertainty Range and Distribution for Actinide Solubility to be used in CCA NUTS Calculations, May 23, 1996. ERMS #237791.

Novak, C.F. 1996.Memorandum to J.T. Holmes Re: Release of FMT Data Base Files HMW_3456_960318.CHEMDAT and HMW_345_960325.CHEMDAT, March 27, 1996. ERMS #235923.

Parameter 38: Log of the Distribution of Solubility of Pu(IV) in Salado Brine

Parameter Description:

This parameter represents the distribution (log_{10}) of the uncertainty about the modeled solubility value for plutonium in the +IV oxidation state in Salado brine.

Material and Property Name(s):

SOLPU4 SOLSIM (#3266)

Computational Code(s): PANEL

Value	***-2.0***	***-1.0***	***-0.50***	***-0.25***	***0***	***0.25***	***0.50***	***1.0***	***1.40***
Percentiles	***0***	***0.04***	***0.13***	***0.27***	***0.63***	***0.84***	***0.89***	***0.99***	***1.0***

Units: None (see PPR-04-2002, ERMS #524651)

Distribution Type: Cumulative

Data: Site-Specific Experimental Data and Thermodynamic Calculations

In the CCA, solubilities were calculated using the FMT code (Novak 1996). Bynum (1996) compared 150 modeled and experimentally determined solubilities and provided a distribution of the differences between them. The parameter records package associated with this parameter is located at: Solubility Parameters for Actinide Source Term Look-up Tables (ERMS #235835).

Discussion:

FMT calculates the solubility of Pu(+IV) in Salado brine assuming equilibrium conditions. The uncertainty in solubilities was determined by Bynum (1996) by comparing modeled solubilities for all oxidation states with the experimentally determined solubilities.

Further information on this parameter is provided in Appendix PA, Attachment SOTERM.

WIPP Data Entry Form #464 ERMS: 237110

References:

Bynum, R.V. 1996. Memorandum to Martin Tierney and Christine Stockman, Re: Revised Update of Uncertainty Range and Distribution for Actinide Solubility to be used in CCA NUTS Calculations, May 23, 1996. ERMS #237791.

Novak, C.F. 1996.Memorandum to J.T. Holmes Re: Release of FMT Data Base Files HMW_3456_960318.CHEMDAT and HMW_345_960325.CHEMDAT, March 27, 1996. ERMS #235923.

Parameter 39: Log of the Distribution of Solubility of Pu(IV) in Castile Brine

Parameter Description:

This parameter represents the distribution (log_{10}) of the uncertainty about the modeled solubility value for plutonium in the +IV oxidation state in Castile brine.

Material and Property Name(s):

SOLPU4 SOLCIM (#3389)

Computational Code(s): PANEL

Value	***-2.0***	***-1.0***	***-0.50***	***-0.25***	***0***	***0.25***	***0.50***	***1.0***	***1.40***
Percentiles	***0***	***0.04***	***0.13***	***0.27***	***0.63***	***0.84***	***0.89***	***0.99***	***1.0***

Units: None (see PPR-04-2002, ERMS #524651)

Distribution Type: Cumulative

Data: Site-Specific Experimental Data and Thermodynamic Calculations

In the CCA, solubilities were calculated using the FMT code (Novak 1996). Bynum (1996) compared 150 modeled and experimentally determined solubilities and provided a distribution of the differences between them. The parameter records package associated with this parameter is located at: Solubility Parameters for Actinide Source Term Look-up Tables (ERMS #235835).

Discussion:

FMT calculates the solubility of Pu(+IV) in Castile brine assuming equilibrium conditions. The uncertainty in solubilities was determined by Bynum (1996) by comparing modeled solubilities for all oxidation states with the experimentally determined solubilities.

Further information on this parameter is provided in Appendix PA, Attachment SOTERM.

WIPP Data Entry Form #464 ERMS: #237111

References:

Bynum, R.V. 1996. Memorandum to Martin Tierney and Christine Stockman, Re: Revised Update of Uncertainty Range and Distribution for Actinide Solubility to be used in CCA NUTS Calculations, May 23, 1996. ERMS #237791.

Novak, C.F. 1996.Memorandum to J.T. Holmes Re: Release of FMT Data Base Files HMW_3456_960318.CHEMDAT and HMW_345_960325.CHEMDAT, March 27, 1996. ERMS #235923.

Parameter 40: Log of the Distribution of Solubility of U(IV) in Salado Brine

Parameter Description:

This parameter represents the distribution (log_{10}) of the uncertainty about the modeled solubility value for uranium in the +IV oxidation state in Salado brine.

Material and Property Name(s):

SOLU4 SOLSIM (#3390)

Computational Code(s): PANEL

Value	*-2.0*	*-1.0*	*-0.50*	*-0.25*	*0*	*0.25*	*0.50*	*1.0*	*1.40*
Percentiles	*0*	*0.04*	*0.13*	*0.27*	*0.63*	*0.84*	*0.89*	*0.99*	*1.0*

Units: None (see PPR-04-2002, ERMS #524651)

Distribution Type: Cumulative

Data: Site-Specific Experimental Data and Thermodynamic Calculations

In the CCA, solubilities were calculated using the FMT code (Novak 1996). Bynum (1996) compared 150 modeled and experimentally determined solubilities and provided a distribution of the differences between them. The parameter records package associated with this parameter is located at: Solubility Parameters for Actinide Source Term Look-up Tables (ERMS #235835).

Discussion:

FMT calculates the solubility of U(+IV) in Salado brine assuming equilibrium conditions. The uncertainty in solubilities was determined by Bynum (1996) by comparing modeled solubilities for all oxidation states with the experimentally determined solubilities.

Further information on this parameter is provided in Appendix PA, Attachment SOTERM.

WIPP Data Entry Form #464 ERMS: 237112

References:

Bynum, R.V. 1996. Memorandum to Martin Tierney and Christine Stockman, Re: Revised Update of Uncertainty Range and Distribution for Actinide Solubility to be used in CCA NUTS Calculations, May 23, 1996. ERMS #237791.

Novak, C.F. 1996. Memorandum to J.T. Holmes Re: Release of FMT Data Base Files HMW_3456_960318.CHEMDAT and HMW_345_960325.CHEMDAT, March 27, 1996. ERMS #235923.

1 ***Parameter 41: Log of the Distribution of Solubility of U(VI) in Salado Brine***

Parameter Description:

This parameter represents the distribution (log_{10}) of the uncertainty about the modeled solubility value for uranium in the +VI oxidation state in Salado brine.

2

Material and Property Name(s):

SOLU6 SOLSIM (#3391)

3

Computational Code(s): PANEL

4

Value	***-2.0***	***-1.0***	***-0.50***	***-0.25***	***0***	***0.25***	***0.50***	***1.0***	***1.40***
Percentiles	***0***	***0.04***	***0.13***	***0.27***	***0.63***	***0.84***	***0.89***	***0.99***	***1.0***

5

Units: None (see PPR-04-2002, ERMS #524651)

6

Distribution Type: Cumulative

7

Data: Site-Specific Experimental Data and Thermodynamic Calculations

Data on U(+VI) solubility in Salado brine was compiled by Hobart and Moore (1996), both from ongoing WIPP-directed research and from published literature. Project experimental data was from Reed et al. (1996) (see CCA Appendix SOTERM). Published data was from Yamazaki, et al (1992) and Pashalidas et al (1993). Based on these data, Hobart and Moore recommend a value for U(+VI) for use in performance assessment. Bynum (1996) compared 150 modeled and experimentally determined solubilities and provided a distribution of the differences between them. The parameter records package associated with this parameter is located at: Solubility Parameters for Actinide Source Term Look-up Tables (ERMS #235835).

8

Discussion:

The solubility of U(+VI) in Salado brine is a function of pH, CO_2 fugacity, and other brine components. The uncertainty in solubilities was determined by Bynum (1996) by comparing modeled solubilities for all oxidation states with the experimentally determined solubilities.

Further information on this parameter is provided in Appendix PA, Attachment SOTERM.

9

WIPP Data Entry Form #464 ERMS: #237113

10

References:

Bynum, R.V. 1996. Memorandum to Martin Tierney and Christine Stockman, Re: Revised Update of Uncertainty Range and Distribution for Actinide Solubility to be used in CCA NUTS Calculations, May 23, 1996. ERMS #237791

Hobart, D.E., and Moore, R. 1996. Draft Analysis of Uranium (VI) Solubility Data for WIPP Performance Assessment, Sandia National Laboratories, March 28, 1996. ERMS #239856.

Hobart, D.E., and Moore, R. 1996. Analysis of Uranium (VI) Solubility Data for WIPP Performance Assessment: Implementation of Analysis Plan AP-028, Sandia National Laboratories, August 6, 1996. Contained in package ERMS #236488.

Pashalidis, I., Runde, W., Kim, J.I. 1993. "A Study of Solid-Liquid Phase Equilibria of Pu(VI) and U(VI) in Aqueous Carbonate Systems," Radiochim. Acta, 63, 141-146. ERMS #249861.

Reed, D.T., Wygmans, D.G., and Richmann, M.K. 1996. Stability of Pu(VI), Np(VI), and U(VI) in Simulated WIPP Brine, 3/13/96 Interim Report, Argonne National Laboratory Interim Report (personal communication). ERMS #235197.

Yamazaki, H., Lagerman, B., Symeopoulos, V., and Choppin, G. 1992. Solubility of Uranyl in Brine, Proceedings of the Third International High Level Radioactive Waste Management Conference, Las Vegas, NV, April 12-16, 1992, American Nuclear Society, La Grange Park, IL, and American Society of Engineers, New York. Located in: Vol. 2, p. 1607-1611. SAND92-7069C- ERMS #239678.

1 ***Parameter 42: Log of the Distribution of Solubility of U(VI) in Castile Brine***

Parameter Description:

This parameter represents the distribution (log_{10}) of the uncertainty about the modeled solubility value for uranium in the +VI oxidation state in Castile brine.

2

Material and Property Name(s):

SOLU6 SOLCIM (#3392)

3

Computational Code(s): PANEL

4

Value	***-2.0***	***-1.0***	***-0.50***	***-0.25***	***0***	***0.25***	***0.50***	***1.0***	***1.40***
Percentiles	***0***	***0.04***	***0.13***	***0.27***	***0.63***	***0.84***	***0.89***	***0.99***	***1.0***

5

Units: None (see PPR-04-2002, ERMS #524651)

6

Distribution Type: Cumulative

7

Data: Site-Specific Experimental Data and Thermodynamic Calculations

In the CCA, data on U(+VI) solubility in Castile brine was compiled by Hobart and Moore (1996), both from ongoing WIPP-directed research and from published literature. Project experimental data was from Reed et al. (1996) (see Appendix PA, Attachment SOTERM). Published data was from Yamazaki, et al (1992) and Pashalidas et al (1993). Based on these data, Hobart and Moore recommend a value for U(+VI) for use in PA. Bynum (1996) compared 150 modeled and experimentally determined solubilities and provided a distribution of the differences between them. The parameter records package associated with this parameter is located at: Solubility Parameters for Actinide Source Term Look-up Tables (ERMS #235835).

8

Discussion:

The solubility of U(+VI) in Castile brine is a function of pH, CO_2 fugacity, and other brine components. The uncertainty in solubilities was determined by Bynum (1996) by comparing modeled solubilities for all oxidation states with the experimentally determined solubilities.

Further information on this parameter is provided in Appendix PA, Attachment SOTERM.

9

WIPP Data Entry Form #464 ERMS: #237114

10

References:

Bynum, R.V. 1996. Memorandum to Martin Tierney and Christine Stockman, Re: Revised Update of Uncertainty Range and Distribution for Actinide Solubility to be used in CCA NUTS Calculations, May 23, 1996. ERMS #237791.

Hobart, D.E., and Moore, R. 1996. Draft Analysis of Uranium (VI) Solubility Data for WIPP Performance Assessment, Sandia National Laboratories, March 28, 1996. ERMS #233703.

Reed, D.T., Wygmans, D.G., and Richmann, M.K. 1996. Stability of Pu(VI), Np(VI), and U(VI) in Simulated WIPP Brine, Argonne National Laboratory Interim Report (personal communication). 3/13/96 Interim Report contained in ERMS #235197.

Yamazaki, H., Lagerman, B., Symeopoulos, V., and Choppin, G. 1992. Solubility of Uranyl in Brine, Proceedings of the Third International High Level Radioactive Waste Management Conference, Las Vegas, NV, April 12-26, 1992, American Nuclear Society, La Grange Park and American Society of Engineers, New York. SAND92-7069C – ERMS #239678.

Parameter 43: Log of the Distribution of Solubility of Th(IV) in Salado Brine

Parameter Description:

This parameter represents the distribution (log_{10}) of the uncertainty about the modeled solubility value for thorium in the +IV oxidation state in Salado brine.

Material and Property Name(s):

SOLTH4 SOLSIM (#3393)

Computational Code(s): PANEL

Value	*-2.0*	*-1.0*	*-0.50*	*-0.25*	*0*	*0.25*	*0.50*	*1.0*	*1.40*
Percentiles	*0*	*0.04*	*0.13*	*0.27*	*0.63*	*0.84*	*0.89*	*0.99*	*1.0*

Units: None (see PPR-04-2002, ERMS #524651)

Distribution Type: Cumulative

Data: Site-Specific Experimental Data and Thermodynamic Calculations

In the CCA, solubilities were calculated using the FMT code (Novak 1996). Bynum (1996) compared 150 modeled and experimentally determined solubilities and provided a distribution of the differences between them. The parameter records package associated with this parameter is located at: Solubility Parameters for Actinide Source Term Look-up Tables (ERMS #235835).

Discussion:

FMT calculates the solubility of Th(+IV) in Salado brine assuming equilibrium conditions The uncertainty in solubilities was determined by Bynum (1996) by comparing modeled solubilities for all oxidation states with the experimentally determined solubilities.

Further information on this parameter is provided in Appendix PA, Attachment SOTERM.

WIPP Data Entry Form #464 ERMS: 237115

References:

Bynum, R.V. 1996. Memorandum to Martin Tierney and Christine Stockman, Re: Revised Update of Uncertainty Range and Distribution for Actinide Solubility to be used in CCA NUTS Calculations, May 23, 1996. ERMS #237791.

Novak, C.F. 1996.Memorandum to J.T. Holmes Re: Release of FMT Data Base Files HMW_3456_960318.CHEMDAT and HMW_345_960325.CHEMDAT, March 27, 1996. ERMS #235923.

1 ***Parameter 44: Humic Proportionality Constant***

Parameter Description:

The humic proportionality constant is used to calculate concentrations of actinides associated with mobile humic substances for actinide elements with oxidation state of +III, in the Castile brine.

2

Material and Property Name(s):

PHUMOX3 PHUMCIM (#3429)

3

Computational Code(s): PANEL

4

Value	***0.07***	***1.37***	***1.60***
Percentiles	***0***	***0.50***	***1.0***

5

Units: None

6

Distribution Type: Cumulative

7

Data: Site-Specific Experimental Data

Experiments were conducted at Florida State University (Greg R. Choppin) and at SNL (Hans W. Papenguth and co-workers). These results, combined with WIPP-specific data on calcium and magnesium concentrations, formed the basis for this parameter distribution. The parameter records package associated with this parameter is located at: Mobile Colloidal Actinide Source Term 3, Humic Substances (ERMS #235855).

8

Discussion:

Humic substances encompass a broad variety of high-molecular-weight organic compounds that can mobilize actinides. To determine the concentration of actinides associated with humic substances, four pieces of information are required: (1) the concentration of reactive humic substance in the aqueous phase (that is, humic solubility); (2) the binding capacity of the humic substance; (3) actinide uptake (that is, actinide complexation constants); and (4) concentration of actinide ions in the aqueous phase (that is, actinide solubility). Quantification of actinide solubilities is described in Novak and Moore (1996). Collection of the other data, interpretation of that information, and development of parameter values for PA calculations is described in detail in Papenguth and Moore (1996). The humic proportionality constant is a combination of information from (1) and (3) above. This constant is multiplied by (4), the actinide concentration, to obtain the concentrations of actinides mobilized on humic colloids.

Further information on this parameter is found in Appendix PA, Attachment SOTERM.

9

WIPP Data Entry Form #464 ERMS: #237683

10

References:

Novak, C.F., and Moore, R.C. 1996. Technical Memorandum to Malcolm Siegel, Re: Estimates of Dissolved Concentrations for +III, +IV, +V, and +VI Actinides in a Salado and a Castile Brine under Anticipated Repository Conditions, March 28, 1996. ERMS #236207.

Papenguth, Hans W. 1996. Memo to Christine T. Stockman. RE: Colloidal Actinide Source Term Parameters, Revision 2, April 22, 1996. ERMS #237522.

Papenguth, Hans W., and Moore, R.C. 1996. Mobile - Colloidal- Actinide Source Term, 3. Humic Substances, Sandia National Laboratories (ERMS #235855 Attachment A).

Parameter 45: Oxidation State Distribution Parameter

Parameter Description:

This parameter determines whether the repository environment is more reducing or less reducing for a particular realization.

Material and Property Name(s):

GLOBAL OXSTAT (#3417)

Computational Code(s): PANEL

minimum	*maximum*
0	*1.0*

Units: None

Distribution Type: Uniform

Data: Site-Specific Experimental Data and Literature Research

Experimental results from Los Alamos National Laboratory, Pacific Northwest National Laboratory, and Argonne National Laboratories-East were used, as well as data from an extensive literature search. The parameter records package associated with this parameter is located at: Oxidation State Distribution (ERMS #235194).

Discussion:

The oxidation state distribution parameter is used to designate which oxidation states dominate the solubility. Actinides addressed are thorium, uranium, neptunium, plutonium, americium, and curium. Analysis of literature data demonstrated that certain actinides (that is, americium, thorium, curium) will exist only in one oxidation state given the expected WIPP repository conditions. Therefore, this distribution is not used with the PA for these actinides. Experimental evidence indicated that two oxidation states were possible for plutonium, uranium, and neptunium under the expected WIPP repository conditions. For these actinides, it is assumed that their solubilities and k_ds will be dominated by only one oxidation state, but it is uncertain which of two possible states will dominate. Therefore, in half of the realizations employing this parameter (if >0.5), the higher oxidation state solubilities and k_ds will be used, and in the other half of the realizations (if <0.5), the lower oxidation state solubilities and k_ds will be used (Weiner et al. 1996). Further information on this parameter is found in Appendix PA, Attachment SOTERM.

WIPP Data Entry Form #464 ERMS: #237663

References:

Novak, C.F., and Moore, R.C. 1996. Technical Memorandum to Malcolm Siegel, Re: Estimates of Dissolved Concentrations for +III, +IV, +V, and +VI Actinides in a Salado and a Castile Brine under Anticipated Repository Conditions, March 28, 1996. ERMS #236207.

Stockman, Christine. 1996. Memo to Martin Tierney. RE: Implementation of Chemistry Parameters in PA. April 16, 1996. ERMS #237536.

Weiner, Ruth F., Hobart, D.E., Tait, C.D., and Clark, D.L. 1996. Analysis of Actinide Oxidation States in the WIPP. Contained in package ERMS #235194.

1 ***Parameter 46: Mining Transmissivity Multiplier***

Parameter Description:

This parameter is a multiplier, which applies to the transmissivity in areas of the Culebra, which are located above areas of present and future potash mining.

2

Material and Property Name(s):

CULEBRA MINP_FAC (#3419)

3

Computational Code: Routine Calculation

4

minimum	*maximum*
1.0	*1000.0*

5

Units: None

6

Distribution Type: Uniform

7

Data: Regulatory Basis

Data for the Mining Transmissivity Multiplier comes directly from the Preamble published in 40 CFR Part 194 (61 FR 5229). Based on its review of the literature, the EPA determined that mining can increase the conductivity of overlying formations by a factor of much as 1,000. Since the EPA does not specify a distribution for the multiplier, the DOE has assigned it a uniform distribution from 1 to 1,000 with a median value of 500.5. A discussion of the data associated with this parameter may be found in the following parameter records package: Mining Transmissivity Multiplier (ERMS #236489).

8

Discussion:

EPA's 40 CFR Part 194 requires that the DOE evaluate the consequences of mining in the McNutt on the performance of the WIPP (Larson 1996). The impacts of mining are taken into account by using a multiplier, which varies from 1 to 1,000 with a uniform distribution. The multiplier applies only to the transmissivity in the Culebra and it applies to areas that qualify under a range of criteria, including both mined areas and areas to be mined (Howard 1996).

In the PA, two cases are considered: (1) the partial mining case which includes all mining outside of the controlled area and (2) the full mining case which includes mining outside and inside of the controlled area. Everywhere that the Culebra is underlain by economical quantities of potash (see Section 2.3.1.1), the transmissivity is multiplied by the multiplier. The multiplier is applied uniformly over the entire mined area for a particular Tfield; however, the value of the multiplier changes for different Tfields. The partial mining case applies to all transmissivity vectors in the PA analysis. Starting from that initial condition,

the full mining case has a 1 in 100 probability of occurring in any century over the 10,000 year regulatory time frame (for any given Tfield).

WIPP Data Entry Form #464 ERMS: #237666

References:

Howard, B. A. 1996. Memo from B. A. Howard to Mel Marietta, April 3, 1996, RE: Future Mining Events in the Performance Assessment. Attachment: Extent of Mining Position Paper, Revision 1. ERMS #238571.

Larson, Kurt. 1996. Memo to Mike Wallace, "Mining Transmissivity Multiplier—Area to be mined." April 25, 1996. ERMS #237455.

Wallace, M. 1996. Memo to M. Tierney, "Distribution for Non-Salado Parameter for SECOFL2D: Mining Transmissivity Multiplier," April 18, 1996. ERMS #239355.

1 ## *Parameter 47: Culebra Transmissivity Field Index*

Parameter Description:

This parameter is intended to incorporate uncertainty in the transmissivity field within the Culebra Dolomite Member of the Rustler Formation.

2

Material and Property Name(s):

GLOBAL TRANSIDX (#225)

3

Computational Code(s): SCMS Script

4

minimum	***maximum***
0.0	***1.0***

5

Units: None

6

Distribution Type: Uniform

7

Data: Professional Judgment - General Engineering Knowledge

No experimental data are associated with the transmissivity field index. The parameter is an index for selecting 1 of 100 transmissivity fields produced by PEST and MODFLOW. It varies uniformly from 0 to 1.

8

Discussion:

Using an approach known as conditioning, or making realizations of random fields coherent with measured information such as hydraulic head values, 100 equally likely Culebra transmissivity fields were generated (employing PEST and MODFLOW). After incorporating changes requested by EPA to account for future potash mining. Each realization was then converted to a flow field, using MODFLOW, assuming uniform Culebra thickness of 8 m and 16 percent effective porosity. TRANSDIX was used to sample on the interval (0,1). The result was mapped onto the integers 1-100 (the number of transmissivity fields) and the resulting integer was used to select a transmissivity field (Ruskauff 1996; Sandia WIPP Project 1992).

9

WIPP Data Entry Form #464 ERMS: #233055

10

References:

Ruskauff, Greg. 1996. Memorandum to Martin Tierney, Re: Culebra Transmissivity Field Index, March 13, 1996. ERMS #235193

Sandia WIPP Project. 1992. Preliminary Performance Assessment for the Waste Isolation Pilot Plant, December 1992, Vol.3: Model Parameters. SAND92-0700/3. Albuquerque, NM: Sandia National Laboratories. ERMS #223529.

1 ***Parameter 48: Climate Index***

Parameter Description:

A change in climate over the next 10,000 years could alter flow rates in the Culebra, thereby impacting radionuclide transport. The Climate Index is a multiplication factor to enhance the magnitude of flow in each realization of the Culebra flow field caused by changes in future climate.

2

Material and Property Name(s):

GLOBAL CLIMTIDX (#233)

3

Computational Code(s): PRESECOTP

4

Value	***1***	***1.25***	***1.50***	***2.25***
Percentiles	***0***	***0.75***	***0.75***	***1***

5

Units: None

6

Distribution Type: Cumulative

7

Data: General Literature and Professional Judgment

The parameter distribution was obtained by first surveying the available literature to obtain information that can be used to infer the annual precipitation rate since the end of the Pleistocene and for the next 10,000 years. Next, numerical simulations were performed to see how various assumed rates and temporal patterns of recharge would impact groundwater flow velocities in the Culebra within the WIPP site. The parameter records package associated with this parameter is located at: Climate Index (ERMS #236425).

8

Discussion:

The following main assumptions were used in the numerical simulations:

1. ***the groundwater basin conceptual model is applicable,***
2. ***the lateral boundaries are flow divides (that is, no-flow boundaries) during the period simulated,***
3. ***flow in the unsaturated zone can be neglected, and***
4. ***the flow system was equilibrated to a recharge rate sufficient to maintain the water table near the land surface at the start of the simulations.***

As described in the Climate Index Record Package (Corbet and Swift 1996), a step recharge function, which represents a radical disruption of the climate pattern of the Holocene, is unlikely and is assigned a 0.25 probability of occurrence and the Holocene recharge pattern is assigned a 0.75 probability of occurrence.

First, simulations were performed using a step recharge function for the pattern of future recharge. The results specify a uniform distribution between 1.5 and 2.25.

Next, six transient simulations using the Holocene pattern of future recharge were performed. The results specify a uniform distribution between 1.0 and 1.25.

WIPP Data Entry Form #464 ERMS: #233031

References:

Corbet, T. and Swift, P. 1996. Memo to M. Tierney. Re: Distribution for Non-Salado Parameter for SECOFL2D: Climate Index, April 12, 1996. ERMS #237465.

Parameter 49: Culebra Half Matrix Block Length

Parameter Description:

This parameter is used to describe the half matrix block length (defined as one-half the thickness of a matrix slab between two parallel plates of fractures) for the Culebra dolomite. It is one of the parameters required in the SECOTP2D code for the double-porosity conceptualization of the Culebra (see also Appendix PA, Section PA-4.9).

Material and Property Name(s):

CULEBRA HMBLKLT (#3485)

Computational Code(s): SECOTP2D

minimum	***maximum***
0.05	***0.5***

Units: Meters

Distribution Type: Uniform

Data: Professional Judgment - General Engineering Knowledge

The half matrix block length distribution is derived from numerical simulations of tracer test data. The data associated with this parameter are located in the following parameter records packages: Culebra Half Matrix Block Length (Culebra Transport Parameter) (ERMS #237225). Supporting data records packages for this parameter include: Tracer Test Interpretations, Simulations for Determination of Adective Porosity and Half Matrix Block Length parameters for CCA Calculations (ERMS #237450); Tracer Test Sample Analyses, H-19 Tracer Tests Conducted June 1995 through July 1995 (ERMS #237468); Tracer Test Sample Analyses, H-19 Tracer Tests Conducted December 1995 through April 1996 (ERMS #237452); and Tracer Test Sample Analyses, H-11 Tracer Tests Conducted February 1996 through March 1996 (ERMS #237467).

Discussion:

The half matrix block length is defined as one-half the thickness of a matrix slab between two parallel plates of fractures. Diffusive processes at the WIPP will cause some fraction of actinides, which are released from the repository, to diffuse from the advective porosity into the diffusive porosity (or matrix), thereby delaying and attenuating discharges at the site boundary. The larger the half matrix block length (smaller surface area for diffusion), the larger the release because there will be less diffusion and in turn less access to surface area for sorption (Meigs and McCord 1996; see CCA Appendix MASS).

The distribution of values for the half matrix block length is uniform, with values ranging from 0.05 to 0.5 m (that is, full matrix block length values from 0.1 to 1.0 m). This

distribution is based on numerical simulations of tracer test data from the H-3, H-11, and H-19 hydropads (Meigs and McCord 1996). Multiwell convergent flow tracer tests have been performed previously at H-3 and H-11 (Stensrud et al. 1989; Hydro Geo Chem, Inc. 1985). Additional tracer tests have been performed at H-11 and at H-19 (Beauheim et al. 1995). The 1995-96 tests at H-11 and H-19 consisted of single-well injection-withdrawal tests and multiwell convergent flow tests.

The matrix block length and the advective porosity are essentially fitting parameters inferred from comparing the results of numerical simulations of the tracer tests to the field data. Numerical simulations were performed with double-porosity models with both homogeneous and heterogeneous hydraulic conductivity fields. For the homogeneous approach, the field data was analyzed using the SWIFT-II transport code, and for the heterogeneous approach, the field data was analyzed using the THEMM code. Both modeling approaches yielded consistent results for each well-to-well path with regard to matrix block length (Meigs and McCord 1996).

WIPP Data Entry Form #464 ERMS: #238356

References:

Beauheim, R. L., Meigs, L.C., Saulnier, G.J., and Stensrud, W.A. 1995. Culebra Transport Program Test Plan: Tracer Testing of the Culebra Dolomite Member of the Rustler Formation at the H-19 and H-11 Hydropads on the WIPP Site. ERMS #230156.

Hydro Geo Chem, Inc. 1985. WIPP Hydrology Program Waste Isolation Pilot Plant, SENM Hydrologic Data Report #1. SAND85-7206. Albuquerque, NM: Sandia National Laboratories. ERMS #228430.

Meigs, Lucy, and McCord, Jim. 1996. Memo to file. RE: Physical Transport in the Culebra Dolomite, July 11, 1996. ERMS #239167.

Stensrud, W.A., Bame, M.A., Lantz, K.D., Palmer, J.B., and Saulnier, G.J., Jr. 1989. WIPP Hydrology Program Waste Isolation Pilot Plant Southeastern New Mexico Hydrologic Data Report #8. SAND89-7056. Albuquerque, NM: Sandia National Laboratories. ERMS #228582.

1 ***Parameter 50: Culebra Advective Porosity***

Parameter Description:

This parameter is used to describe the advective porosity (typically referred to as the fracture porosity) for the Culebra dolomite. It is one of the parameters required in the SECOTP2D code for the double-porosity conceptualization of the Culebra (see also Section 4.9).

2

Material and Property Name(s):

CULEBRA APOROS (#3487)

3

Computational Code(s): SECOTP2D

4

minimum	***maximum***
1.0×10^{-4}	***0.01***

5

Units: None

6

Distribution Type: Log uniform

7

Data: Professional Judgment - General Engineering Knowledge

This porosity distribution is derived from numerical simulations of tracer test data. The data associated with this parameter are located in the following parameter records packages: Culebra Advective Porosity (Culebra Transport parameter) (ERMS #237227). Supporting data records packages for this parameter include: Tracer Test Interpretations, Simulations for Determination of Adective Porosity and Half Matrix Block Length parameters for CCA Calculations (ERMS #237450); Tracer Test Sample Analyses, H-19 Tracer Tests Conducted December 1995 through April 1996 (ERMS #237452); and Tracer Test Sample Analyses, H-11 Tracer Tests Conducted February 1996 through March 1996 (ERMS #237467).

8

Discussion:

The Culebra is a fractured dolomite with nonuniform properties and multiple scales of porosity, including fractures ranging from microscale to large, vuggy zones, inter-particle and inter-crystalline porosity. When the permeability contrast is significant between different scales of connected porosity, the total porosity of the system can be modeled by dividing it into the advective porosity (for example, fractures, and to some extent vugs connected by fractures, and interparticle porosity) and the diffusive (or matrix) porosity. The advective porosity refers to porosity through which most of the flow occurs (for example, fractures), while the diffusive porosity includes features such as intercrystalline porosity, and to some extent microfractures, vugs, and interparticle porosity, accessible to solutes only through diffusion. The advective porosity used for the PA simulations has been determined from evaluation of tracer test data (Meigs and McCord 1996). The diffusive

porosity has been determined from laboratory measurements of core plugs, which do not contain large fractures (Meigs and McCord 1996).

The distribution for the advective porosity is based on numerical simulations of tracer test data from the H-3, H-11, and H-19 hydropads (Meigs and McCord 1996). Multiwell convergent flow tests have been performed previously at H-3 and H-11 (Stensrud et al. 1989; Hydro Geo Chem, Inc. 1985). Additional tracer tests have been performed at H-11 and at H-19 (Beauheim et al. 1995). The recent tests at H-11 and H-19 consisted of single-well injection-withdrawal tests and multiwell convergent flow tests.

The advective porosity and the matrix block length are essentially fitting parameters inferred from comparing the results of numerical simulations of the tracer tests to the field data. Numerical simulations were performed with double-porosity models with both homogeneous and heterogeneous hydraulic conductivity fields. For the homogeneous approach, the field data was analyzed using the SWIFT-II transport code, and for the heterogeneous approach, the field data was analyzed using the THEMM code. Both modeling approaches yielded consistent results for each well-to-well path with regard to advective porosity (Meigs and McCord 1996).

WIPP Data Entry Form #464 ERMS: #238358

References:

Beauheim, R. L., Meigs, L.C., Saulnier, G.J., and Stensrud, W.A. 1995. Culebra Transport Program Test Plan: Tracer Testing of the Culebra Dolomite Member of the Rustler Formation at the H-19 and H-11 Hydropads on the WIPP Site. ERMS #230156.

Hydro Geo Chem, Inc. 1985. WIPP Hydrology Program Waste Isolation Pilot Plant, SENM Hydrologic Data Report #1. SAND85-7206. Albuquerque, NM: Sandia National Laboratories. ERMS #228430.

Meigs, Lucy, and McCord, Jim. 1996. Memo to file. RE: Physical Transport in the Culebra Dolomite, July 11, 1996. ERMS #239167.

Stensrud, W.A., Bame, M.A., Lantz, K.D., Palmer, J.B., and Saulnier, G.J., Jr. 1989. WIPP Hydrology Program Waste Isolation Pilot Plant Southeastern New Mexico Hydrologic Data Report #8. SAND89-7056. Albuquerque, NM: Sandia National Laboratories. ERMS #28582.

1 ***Parameter 51: Culebra Diffusive Porosity***

Parameter Description:

This parameter is used to describe the diffusive porosity (typically referred to as the matrix porosity) for the Culebra dolomite. It is one of the parameters required in the SECOTP2D code for the double-porosity conceptualization of the Culebra (see also Section PA-4.9).

2

Material and Property Name(s):

CULEBRA DPOROS (#3486)

3

Computational Code(s): SECOTP2D

4

Value	***0.10***	***0.11***	***0.12***	***0.16***	***0.18***	***0.19***	***0.25***
Percentiles	***0***	***0.10***	***0.25***	***0.50***	***0.75***	***0.90***	***1***

5

Units: None

6

Distribution Type: Cumulative

7

Data: Site-Specific Experimental Data and Professional Judgment - General Engineering Knowledge

This porosity distribution is derived from laboratory measurements. The data associated with this parameter are located in the following parameter records packages: Culebra Diffusive Porosity (Culebra Transport Parameter) (ERMS #237228). Supporting data records packages for this parameter includes: Non-Salado Core Analyses Performed by Terra Tek (AA-2896) (ERMS #238234).

8

Discussion:

The Culebra is a fractured dolomite with nonuniform properties and multiple scales of porosity, including fractures ranging from microscale to large, vuggy zones and inter-particle and inter-crystalline porosity. When the permeability contrast is significant between different scales of connected porosity, the total porosity of the system can be modeled by dividing it into the advective (for example, fractures and, to some extent, vugs connected by fractures, and interparticle porosity) porosity and the diffusive (or matrix) porosity. The advective porosity refers to porosity through which most of the flow occurs, while the diffusive porosity includes features such as intercrystalline porosity and, to some extent, microfractures, vugs, and interparticle porosity accessible to solutes only through diffusion. The advective porosity to be used for the PA simulations has been determined from evaluation of tracer test data. The diffusive porosity has been determined from laboratory measurement of core plugs, which do not contain large fractures (Meigs and McCord 1996).

This diffusive porosity distribution is derived from laboratory measurements. Boyle's Law helium porosity measurements have been made from 103 Culebra core plugs from 17

locations as reported in Kelley and Saulnier (1990) as well as additional porosity measurements completed by Terra Tek (ERMS #238234). The methodology used for porosity measurements are described in Kelley and Saulnier (1990). To account for areal averaging, individual porosity measurements from a borehole and/or hydropad were averaged to yield a borehole/hydropad average porosity. The averaged values were used to construct the distribution (Meigs and McCord 1996).

WIPP Data Entry Form #464 ERMS: #238357

References:

Kelley, V. A., and Saulnier, G. 1990. Core Analyses for Selected Samples from the Culebra Dolomite at the Waste Isolation Pilot Plant Site. SAND90-7011. Albuquerque, NM: Sandia National Laboratories. ERMS #228629.

Meigs, Lucy, and McCord, Jim. 1996. Memo to file. RE: Physical Transport in the Culebra Dolomite, July 11, 1996. ERMS #239167.

1 ***Parameter 52: Matrix Distribution Coefficient for U(VI)***

Parameter Description:

This parameter describes the matrix distribution coefficient (K_d) for uranium in the +VI oxidation state. K_d is the equilibrium ratio of the mass of U adsorbed on the solid phase(s) per unit mass of solid divided by the concentration of that element in the aqueous phase.

2

Material and Property Name(s):

U+6 MKD_U (#3475)

3

Computational Code(s): SECOTP2D

4

minimum	*maximum*
3×10^{-5}	*0.02*

5

Units: Cubic meters/kilogram

6

Distribution Type: Log uniform

7

Data: Site-Specific Experimental Data

A discussion of the data associated with this parameter may be found in the following parameter records package: Analysis Reports Relating to Analysis Plan AP-086 (ERMS #520523), specifically Summary of parameter changes adopted from the Performance Assessment Verification Test for the Technical Baseline Migration (ERMS #522016).

8

Discussion:

In CCA Appendix PAR , Brush (1996) described the laboratory sorption studies used to determine matrix K_ds for dissolved uranium. The experimental data did not include K_ds for the clay-rich rock associated with fracture surfaces and dispersed in the matrix of the Culebra. Brush (1996) believed that this was a more conservative approach. Further, the fracture-surface K_d (actually, K_a) for uranium in the Culebra was set to zero, which was also conservative (DOE 1996). The laboratory sorption studies supporting the CCA values are summarized below.

I. Triay at LANL studied the sorption of Th(IV), U(VI), Np(V), Pu(V), and Am(III) by dolomite-rich Culebra rock. These experiments yielded sorption isotherms, plots of the quantity of radionuclide sorbed by the solid phase(s) versus the final dissolved radionuclide concentration, or plots of K_ds versus the final dissolved radionuclide concentration. The samples, which Triay used, contained a lower concentration of clay minerals than the Culebra as a whole and therefore, Triay's K_ds are conservative (Brush 1996).

P.V. Brady at SNL studied the sorption of Nd(III) (a nonradioactive analog of Pu(III) and Am(III)), Th(IV), U(VI), Np(V), Pu(V), and Am(III) from synthetic NaCl solutions by samples of pure dolomite from Norway. Although this study did not yield K_ds for actual

samples of Culebra rock and Culebra fluids, it did yield results useful for interpreting the results of Triay's study and for extending Triay's data to the pH conditions (about 9 to 10) expected from an MgO backfill in WIPP disposal rooms (Brush 1996).

D.A. Lucero at SNL studied actinide transport through intact core samples from the Culebra in the WIPP air intake shaft (AIS). This study did not yield K_ds directly. Instead, Lucero calculated retardation factors (Rs) and K_ds. For U(VI) and Np(V), which were eluted from the cores, Lucero was able to calculate discrete K_ds. For Th(IV), Pu(V), and Am(III), which were not eluted during the experiments, Lucero was only able to calculate minimum values of K_ds.

The range and probability distribution of matrix K_ds for deep (Castile and Salado) or Culebra brines that resulted in less retardation for each element or elemental oxidation state was used in the calculations. Since there are uncertainties as to the extent to which deep (Castile and Salado) and Culebra brines will mix, there are uncertainties as to the probability distributions of these factors (especially brine type, the partial pressure of CO_2, and the resulting pH) in the Culebra. Therefore, the matrix K_ds were specified as a uniform distribution rather than a Student's-t distribution.

Subsequent to the CCA PA calculations, two errors were found in the procedures used to calculate the matrix K_ds. First, a brine density of 1.00 g/ml was used rather than the measured brine density. Second, incorrect values for the mass of dolomite were incorporated (Brush and Storz 1996). The erroneous use of these values led to incorrectly calculated distribution coefficients. However, the influence of the changes in these values on the distribution coefficients was believed to be insignificant (Brush and Storz 1996). Brush and Storz (1996) provided the corrected values of these K_ds.

For some isotopes, Brush and Storz (1996) calculated K_ds for both deep (Castile or Salado) and Culebra brines. To remain conservative and consistent with the CCA, the range of K_d values for the brine that has the smaller mean value were used.

In 1997, the EPA's review of experimental K_d data indicated that K_d values appeared to be logarithmically distributed. In addition, since the actinide K_ds ranged over more than an order of magnitude, the EPA felt that a log uniform distribution was more appropriate (EPA 1998) than the uniform distribution specified by Brush and Storz (1996). The DOE has adopted the revised values and distribution for the K_ds (Hansen and Leigh 2003).

WIPP Data Entry Form #464 ERMS: #522016

References:

Brush, L. H. 1996. Memo to M. S. Tierney, RE: Ranges and Probability Distributions of K_ds for Dissolved Pu, Am, U, Th, and Np in the Culebra for the PA Calculations to Support the WIPP CCA, June 10, 1996. ERMS #238801.

Brush, L.H. and Storz, L. 1996. Memo to M. S. Tierney, RE: Revised Ranges and Probability Distributions of K_ds for Dissolved Pu, Am, U, Th, and Np in the Culebra for the PA calculations to Support the WIPP CCA, July 24, 1996. ERMS #241561.

Hansen, C., Leigh, C. 2003. A Reconciliation of the CCA and PAVT Parameter Baselines, Rev. 3. Carlsbad, NM. Sandia National Laboratories. ERMS #528582.

U.S. Department of Energy (DOE). 1996. Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant. DOE/CAO-1996-2184. Carlsbad, NM: United States Department of Energy, Waste Isolation Pilot Plant, Carlsbad Area Office.

U.S. Environmental Protection Agency (EPA). 1998. Technical Support Document for Section 194.23:Parameter Justification Report. Docket No. A-93-02, V-B-14. U.S. Environmental Protection Agency. Washington, D.C.

1 ***Parameter 53: Matrix Distribution Coefficient for U(IV)***

Parameter Description:

This parameter describes the matrix distribution coefficient (K_d) for uranium in the +IV oxidation state. K_d is the equilibrium ratio of the mass of uranium adsorbed on the solid phase(s) per unit mass of solid divided by the concentration of that element in the aqueous phase.

2

Material and Property Name(s):

U+4 MKD_U (#3479)

3

Computational Code(s): SECOTP2D

4

minimum	*maximum*
0.70	*10.0*

5

Units: Cubic meters/kilogram

6

Distribution Type: Log uniform

7

Data: Site-Specific Experimental Data

A discussion of the data associated with this parameter may be found in the following parameter records package: Analysis Reports Relating to Analysis Plan AP-086 (ERMS #520523), specifically Summary of parameter changes adopted from the Performance Assessment Verification Test for the Technical Baseline Migration (ERMS #522016).

8

Discussion:

In CCA Appendix PAR , Brush (1996) described the laboratory sorption studies used to determine matrix K_ds for dissolved uranium. The experimental data did not include K_ds for the clay-rich rock associated with fracture surfaces and dispersed in the matrix of the Culebra. Brush (1996) believed that this was a more conservative approach. Further, the fracture-surface K_d (actually, K_a) for uranium in the Culebra was set to zero, which was also conservative (DOE 1996). The laboratory sorption studies are summarized below.

I. Triay at LANL studied the sorption of Th(IV), U(VI), Np(V), Pu(V), and Am(III) by dolomite-rich Culebra rock. These experiments yielded sorption isotherms, plots of the quantity of radionuclide sorbed by the solid phase(s) versus the final dissolved radionuclide concentration, or plots of K_ds versus the final dissolved radionuclide concentration. The samples, which Triay used, contained a lower concentration of clay minerals than the Culebra as a whole and therefore, Triay's K_ds are conservative (Brush 1996).

P.V. Brady at SNL studied the sorption of Nd(III) (a nonradioactive analog of Pu(III) and Am(III)), Th(IV), U(VI), Np(V), Pu(V), and Am(III) from synthetic NaCl solutions by

samples of pure dolomite from Norway. Although this study did not yield K_ds for actual samples of Culebra rock and Culebra fluids, it did yield results useful for interpreting the results of Triay's study and for extending Triay's data to the pH conditions (about 9 to 10) expected from an MgO backfill in WIPP disposal rooms (Brush 1996).

D.A. Lucero at SNL studied actinide transport through intact core samples from the Culebra in the WIPP AIS. This study did not yield K_ds directly. Instead, Lucero calculated retardation factors (Rs) and K_ds. For U(VI) and Np(V), which were eluted from the cores, Lucero was able to calculate discrete K_ds. For Th(IV), Pu(V), and Am(III), which were not eluted during the experiments, Lucero was only able to calculate minimum values of K_ds.

The range and probability distribution of matrix K_ds for deep (Castile and Salado) or Culebra brines that resulted in less retardation for each element or elemental oxidation state was used in the calculations. Since there are uncertainties as to the extent to which deep (Castile and Salado) and Culebra brines will mix, there are uncertainties as to the probability distributions of these factors (especially brine type, the partial pressure of CO_2, and the resulting pH) in the Culebra. Therefore, the matrix K_ds were specified as a uniform distribution rather than a Student's-t distribution.

Subsequent to the CCA PA calculations, two errors were found in the procedures used to calculate the matrix K_ds. First, a brine density of 1.00 g/ml was used rather than the measured brine density. Second, incorrect values for the mass of dolomite were incorporated (Brush and Storz 1996). The erroneous use of these values led to incorrectly calculated distribution coefficients. However, the influence of the changes in these values on the distribution coefficients was believed to be insignificant (Brush and Storz 1996). Brush and Storz (1996) provided the corrected values of these K_ds.

For some isotopes, Brush and Storz (1996) calculated K_ds for both deep (Castile or Salado) and Culebra brines. To remain conservative and consistent with the CCA, the range of K_d values for the brine that has the smaller mean value were used.

In 1997, the EPA's review of experimental K_d data indicated that K_d values appeared to be logarithmically distributed. In addition, since the actinide K_ds ranged over more than an order of magnitude, the EPA felt that a log uniform distribution was more appropriate (EPA 1998) than the uniform distribution specified by Brush and Storz (1996). The DOE has adopted the revised values and distribution for the K_ds (Hansen and Leigh 2003).

WIPP Data Entry Form #464 ERMS: #522016

References:

Brush, L. H. 1996. Memo to M. S. Tierney, RE: Ranges and Probability Distributions of K_ds for Dissolved Pu, Am, U, Th, and Np in the Culebra for the PA Calculations to Support the WIPP CCA, June 10, 1996. ERMS #238801.

Brush, L.H. and Storz, L. 1996. Memo to M. S. Tierney, RE: Revised Ranges and Probability Distributions of K_ds for Dissolved Pu, Am, U, Th, and Np in the Culebra for the PA calculations to Support the WIPP CCA, July 24, 1996. ERMS #241561.

Hansen, C., Leigh, C. 2003. A Reconciliation of the CCA and PAVT Parameter Baselines, Rev. 3. Carlsbad, NM. Sandia National Laboratories. ERMS #528582

U.S. Department of Energy (DOE). 1996. Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant. DOE/CAO-1996-2184. Carlsbad, NM: United States Department of Energy, Waste Isolation Pilot Plant, Carlsbad Area Office.

U.S. Environmental Protection Agency (EPA). 1998. Technical Support Document for Section 194.23:Parameter Justification Report. Docket No. A-93-02, V-B-14. U.S. Environmental Protection Agency. Washington, D.C.

Parameter 54: Matrix Distribution Coefficient for Pu(III)

Parameter Description:

This parameter describes the matrix distribution coefficient (K_d) for plutonium in the +III oxidation state. K_d is the equilibrium ratio of the mass of plutonium adsorbed on the solid phase(s) per unit mass of solid divided by the concentration of that element in the aqueous phase.

Material and Property Name(s):

PU+3 MKD_PU (#3480)

Computational Code(s): SECOTP2D

minimum	*maximum*
0.02	*0.40*

Units: Cubic meters/kilogram

Distribution Type: Log uniform

Data: Site-Specific Experimental Data

A discussion of the data associated with this parameter may be found in the following parameter records package: Analysis Reports Relating to Analysis Plan AP-086 (ERMS #520523), specifically Summary of parameter changes adopted from the Performance Assessment Verification Test for the Technical Baseline Migration (ERMS #522016).

Discussion:

In CCA Appendix PAR , Brush (1996) described the laboratory sorption studies used to determine matrix K_ds for dissolved plutonium. The experimental data did not include K_ds for the clay-rich rock associated with fracture surfaces and dispersed in the matrix of the Culebra. Brush (1996) believed that this was a more conservative approach. Further, the fracture-surface K_d (actually, K_a) for plutonium in the Culebra was set to zero, which was also conservative. (DOE 1996) The laboratory sorption studies are summarized below.

I. Triay at LANL studied the sorption of Th(IV), U(VI), Np(V), Pu(V), and Am(III) by dolomite-rich Culebra rock. These experiments yielded sorption isotherms, plots of the quantity of radionuclide sorbed by the solid phase(s) versus the final dissolved radionuclide concentration, or plots of Kds versus the final dissolved radionuclide concentration. The samples, which Triay used, contained a lower concentration of clay minerals than the Culebra as a whole and therefore, Triay's Kds are conservative (Brush 1996).

P.V. Brady at SNL studied the sorption of Nd(III) (a nonradioactive analog of Pu(III) and Am(III)), Th(IV), U(VI), Np(V), Pu(V), and Am(III) from synthetic NaCl solutions by

samples of pure dolomite from Norway. Although this study did not yield K_ds for actual samples of Culebra rock and Culebra fluids, it did yield results useful for interpreting the results of Triay's study and for extending Triay's data to the pH conditions (about 9 to 10) expected from an MgO backfill in WIPP disposal rooms (Brush 1996).

D.A. Lucero at SNL studied actinide transport through intact core samples from the Culebra in the WIPP AIS. This study did not yield K_ds directly. Instead, Lucero calculated retardation factors (Rs) and K_ds. For U(VI) and Np(V), which were eluted from the cores, Lucero was able to calculate discrete K_ds. For Th(IV), Pu(V), and Am(III), which were not eluted during the experiments, Lucero was only able to calculate minimum values of K_ds.

The range and probability distribution of matrix K_ds for deep (Castile and Salado) or Culebra brines that resulted in less retardation for each element or elemental oxidation state was used in the calculations. Since there are uncertainties as to the extent to which deep (Castile and Salado) and Culebra brines will mix, there are uncertainties as to the probability distributions of these factors (especially brine type, the partial pressure of CO_2, and the resulting pH) in the Culebra. Therefore, the matrix K_ds were specified as a uniform distribution rather than a Student's-t distribution.

Subsequent to the CCA PA calculations, two errors were found in the procedures used to calculate the matrix K_ds. First, a brine density of 1.00 g/ml was used rather than the measured brine density. Second, incorrect values for the mass of dolomite were incorporated (Brush and Storz 1996). The erroneous use of these values led to incorrectly calculated distribution coefficients. However, the influence of the changes in these values on the distribution coefficients was believed to be insignificant (Brush and Storz 1996). Brush and Storz (1996) provided the corrected values of these K_ds.

For some isotopes, Brush and Storz (1996) calculated K_ds for both deep (Castile or Salado) and Culebra brines. To remain conservative and consistent with the CCA, the range of K_d values for the brine that has the smaller mean value were used.

In 1997, the EPA's review of experimental K_d data indicated that K_d values appeared to be logarithmically distributed. In addition, since the actinide K_ds ranged over more than an order of magnitude, the EPA felt that a log uniform distribution was more appropriate (EPA 1998) than the uniform distribution specified by Brush and Storz (1996). The DOE has adopted the revised values and distribution for the K_ds (Hansen and Leigh 2003)

WIPP Data Entry Form #464 ERMS: #527707

References:

Brush, L. H. 1996. Memo to M. S. Tierney, RE: Ranges and Probability Distributions of K_ds for Dissolved Pu, Am, U, Th, and Np in the Culebra for the PA Calculations to Support the WIPP CCA, June 10, 1996. ERMS #238801.

Brush, L.H. and Storz, L. 1996. Memo to M. S. Tierney, RE: Revised Ranges and Probability Distributions of K_ds for Dissolved Pu, Am, U, Th, and Np in the Culebra for the PA calculations to Support the WIPP CCA, July 24, 1996. ERMS #241561.

Hansen, C., Leigh, C. 2003. A Reconciliation of the CCA and PAVT Parameter Baselines, Rev. 3. Carlsbad, NM. Sandia National Laboratories. ERMS #528582.

U.S. Department of Energy (DOE). 1996. Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant. DOE/CAO-1996-2184. Carlsbad, NM: United States Department of Energy, Waste Isolation Pilot Plant, Carlsbad Area Office.

U.S. Environmental Protection Agency (EPA). 1998. Technical Support Document for Section 194.23:Parameter Justification Report. Docket No. A-93-02, V-B-14. U.S. Environmental Protection Agency. Washington, D.C.

Parameter 55: Matrix Distribution Coefficient for Pu(IV)

Parameter Description:

This parameter describes the matrix distribution coefficient (K_d) for plutonium in the +IV oxidation state. K_d is the equilibrium ratio of the mass of plutonium adsorbed on the solid phase(s) per unit mass of solid divided by the concentration of that element in the aqueous phase.

Material and Property Name(s):

PU+4 MKD_PU (#3481)

Computational Code(s): SECOTP2D

minimum	*maximum*
0.70	*10.0*

Units: Cubic meters/kilogram

Distribution Type: Log uniform

Data: Site-Specific Experimental Data

A discussion of the data associated with this parameter may be found in the following parameter records package: Analysis Reports Relating to Analysis Plan AP-086 (ERMS #520523), specifically Summary of parameter changes adopted from the Performance Assessment Verification Test for the Technical Baseline Migration (ERMS #522016).

Discussion:

In CCA Appendix PAR , Brush (1996) described the laboratory sorption studies used to determine matrix K_ds for dissolved plutonium. The experimental data did not include K_ds for the clay-rich rock associated with fracture surfaces and dispersed in the matrix of the Culebra. Brush (1996) believed that this was a more conservative approach. Further, the fracture-surface K_d (actually, K_a) for plutonium in the Culebra was set to zero, which was also conservative (DOE 1996). The laboratory sorption studies are summarized below.

I. Triay at LANL studied the sorption of Th(IV), U(VI), Np(V), Pu(V), and Am(III) by dolomite-rich Culebra rock. These experiments yielded sorption isotherms, plots of the quantity of radionuclide sorbed by the solid phase(s) versus the final dissolved radionuclide concentration, or plots of K_ds versus the final dissolved radionuclide concentration. The samples, which Triay used, contained a lower concentration of clay minerals than the Culebra as a whole and therefore, Triay's K_ds are conservative (Brush 1996).

P. V. Brady at SNL studied the sorption of Nd(III) (a nonradioactive analog of Pu(III) and Am(III)), Th(IV), U(VI), Np(V), Pu(V), and Am(III) from synthetic NaCl solutions by samples of pure dolomite from Norway. Although this study did not yield K_ds for actual

samples of Culebra rock and Culebra fluids, it did yield results useful for interpreting the results of Triay's study and for extending Triay's data to the pH conditions (about 9 to 10) expected from an MgO backfill in WIPP disposal rooms (Brush 1996).

D.A. Lucero at SNL studied actinide transport through intact core samples from the Culebra in the WIPP AIS. This study did not yield K_ds directly. Instead, Lucero calculated retardation factors (Rs) and K_ds. For U(VI) and Np(V), which were eluted from the cores, Lucero was able to calculate discrete K_ds. For Th(IV), Pu(V), and Am(III), which were not eluted during the experiments, Lucero was only able to calculate minimum values of K_ds.

The range and probability distribution of matrix K_ds for deep (Castile and Salado) or Culebra brines that resulted in less retardation for each element or elemental oxidation state was used in the calculations. Since there are uncertainties as to the extent to which deep (Castile and Salado) and Culebra brines will mix, there are uncertainties as to the probability distributions of these factors (especially brine type, the partial pressure of CO_2, and the resulting pH) in the Culebra. Therefore, the matrix K_ds were specified as a uniform distribution rather than a Student's-t distribution.

Subsequent to the CCA PA calculations, two errors were found in the procedures used to calculate the matrix K_ds. First, a brine density of 1.00 g/ml was used rather than the measured brine density. Second, incorrect values for the mass of dolomite were incorporated (Brush and Storz 1996). The erroneous use of these values led to incorrectly calculated distribution coefficients. However, the influence of the changes in these values on the distribution coefficients was believed to be insignificant (Brush and Storz 1996). Brush and Storz (1996) provided the corrected values of these K_ds.

For some isotopes, Brush and Storz (1996) calculated K_ds for both deep (Castile or Salado) and Culebra brines. To remain conservative and consistent with the CCA, the range of K_d values for the brine that has the smaller mean value were used.

In 1997, the EPA's review of experimental K_d data indicated that K_d values appeared to be logarithmically distributed. In addition, since the actinide K_ds ranged over more than an order of magnitude, the EPA felt that a log uniform distribution was more appropriate (EPA 1998) than the uniform distribution specified by Brush and Storz (1996). DOE has adopted the revised values and distribution for the K_ds (Hansen and Leigh 2003).

WIPP Data Entry Form #464 ERMS: #522016

References:

Brush, L. H. 1996. Memo to M. S. Tierney, RE: Ranges and Probability Distributions of K_ds for Dissolved Pu, Am, U, Th, and Np in the Culebra for the PA Calculations to Support the WIPP CCA, June 10, 1996. ERMS #238801.

Brush, L.H. and Storz, L. 1996. Memo to M. S. Tierney, RE: Revised Ranges and Probability Distributions of K_ds for Dissolved Pu, Am, U, Th, and Np in the Culebra for the PA calculations to Support the WIPP CCA, July 24, 1996. ERMS #241561.

Hansen, C., Leigh, C. 2003. A Reconciliation of the CCA and PAVT Parameter Baselines, Rev. 3. Carlsbad, NM. Sandia National Laboratories. ERMS #528582

U.S. Department of Energy (DOE). 1996. Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant. DOE/CAO-1996-2184. Carlsbad, NM: United States Department of Energy, Waste Isolation Pilot Plant, Carlsbad Area Office.

U.S. Environmental Protection Agency (EPA). 1998. Technical Support Document for Section 194.23: Parameter Justification Report. Docket No. A-93-02, V-B-14. U.S. Environmental Protection Agency. Washington, D.C.

1 ***Parameter 56: Matrix Distribution Coefficient for Th(IV)***

Parameter Description:

This parameter describes the matrix distribution coefficient (K_d) for thorium in the +IV oxidation state. K_d is the equilibrium ratio of the mass of thorium adsorbed on the solid phase(s) per unit mass of solid divided by the concentration of that element in the aqueous phase.

2

Material and Property Name(s):

TH+4 MKD_TH (#3478)

3

Computational Code(s): SECOTP2D

4

minimum	***maximum***
0.70	***10.0***

5

Units: Cubic meters/kilogram

6

Distribution Type: Log uniform

7

Data: Site-Specific Experimental Data

A discussion of the data associated with this parameter may be found in the following parameter records package: Analysis Reports Relating to Analysis Plan AP-086 (ERMS #520523), specifically Summary of parameter changes adopted from the Performance Assessment Verification Test for the Technical Baseline Migration (ERMS #522016).

8

Discussion:

In CCA Appendix PAR , Brush (1996) described the laboratory sorption studies used to determine matrix K_ds for dissolved thorium. The experimental data do not include K_ds for the clay-rich rock associated with fracture surfaces and dispersed in the matrix of the Culebra. Brush (1996) believed that this was a more conservative approach. Further, the fracture-surface K_d (actually, K_a) for thorium in the Culebra was set to zero, which was also conservative (DOE 1996). The laboratory sorption studies are summarized below.

I. Triay at LANL studied the sorption of Th(IV), U(VI), Np(V), Pu(V), and Am(III) by dolomite-rich Culebra rock. These experiments yielded sorption isotherms, plots of the quantity of radionuclide sorbed by the solid phase(s) versus the final dissolved radionuclide concentration, or plots of K_ds versus the final dissolved radionuclide concentration. The samples, which Triay used, contained a lower concentration of clay minerals than the Culebra as a whole and therefore, Triay's K_ds are conservative (Brush 1996).

P.V. Brady at SNL studied the sorption of Nd(III) (a nonradioactive analog of Pu(III) and Am(III)), Th(IV), U(VI), Np(V), Pu(V), and Am(III) from synthetic NaCl solutions by samples of pure dolomite from Norway. Although this study did not yield K_ds for actual

samples of Culebra rock and Culebra fluids, it did yield results useful for interpreting the results of Triay's study and for extending Triay's data to the pH conditions (about 9 to 10) expected from an MgO backfill in WIPP disposal rooms (Brush 1996).

D.A. Lucero at SNL studied actinide transport through intact core samples from the Culebra in the WIPP AIS. This study did not yield K_ds directly. Instead, Lucero calculated retardation factors (Rs) and K_ds. For U(VI) and Np(V), which were eluted from the cores, Lucero was able to calculate discrete K_ds. For Th(IV), Pu(V), and Am(III), which were not eluted during the experiments, Lucero was only able to calculate minimum values of K_ds.

The range and probability distribution of matrix K_ds for deep (Castile and Salado) or Culebra brines that resulted in less retardation for each element or elemental oxidation state was used in the calculations. Since there are uncertainties as to the extent to which deep (Castile and Salado) and Culebra brines will mix, there are uncertainties as to the probability distributions of these factors (especially brine type, the partial pressure of CO_2, and the resulting pH) in the Culebra. Therefore, the matrix K_ds were specified as a uniform distribution rather than a Student's-t distribution.

Subsequent to the CCA PA calculations, two errors were found in the procedures used to calculate the matrix K_ds. First, a brine density of 1.00 g/ml was used rather than the measured brine density, and, second, incorrect values for the mass of dolomite were incorporated (Brush and Storz 1996). The erroneous use of these values led to incorrectly calculated distribution coefficients. However, the influence of the changes in these values on the distribution coefficients was believed to be insignificant (Brush and Storz 1996). Brush and Storz (1996) provided the corrected values of these K_ds.

For some isotopes, Brush and Storz (1996) calculated K_ds for both deep (Castile or Salado) and Culebra brines. To remain conservative and consistent with the CCA, the range of K_d values for the brine that has the smaller mean value were used.

In 1997 the EPA's review of experimental K_d data indicated that K_d values appeared to be logarithmically distributed. In addition, since the actinide K_ds ranged over more than an order of magnitude, the EPA felt that a log uniform distribution was more appropriate (EPA, 1998) than the uniform distribution specified by Brush and Storz (1996). The DOE has adopted the revised values and distribution for the K_ds (Hansen and Leigh 2003).

WIPP Data Entry Form #464 ERMS: #522016

References:

Brush, L. H. 1996. Memo to M. S. Tierney, RE: Ranges and Probability Distributions of K_ds for Dissolved Pu, Am, U, Th, and Np in the Culebra for the PA Calculations to Support the WIPP CCA, June 10, 1996. ERMS #238801.

Brush, L.H. and Storz, L. 1996. Memo to M. S. Tierney, RE: Revised Ranges and Probability Distributions of K_ds for Dissolved Pu, Am, U, Th, and Np in the Culebra for the PA calculations to Support the WIPP CCA, July 24, 1996. ERMS #241561.

Hansen, C., Leigh, C. 2003. A Reconciliation of the CCA and PAVT Parameter Baselines, Rev. 3. Carlsbad, NM. Sandia National Laboratories. ERMS #528582.

U.S. Department of Energy (DOE). 1996. Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant. DOE/CAO-1996-2184. Carlsbad, NM: United States Department of Energy, Waste Isolation Pilot Plant, Carlsbad Area Office.

U.S. Environmental Protection Agency (EPA). 1998. Technical Support Document for Section 194.23:Parameter Justification Report. Docket No. A-93-02, V-B-14. U.S. Environmental Protection Agency. Washington, D.C.

1 ## *Parameter 57: Matrix Distribution Coefficient for Am(III)*

Parameter Description:

This parameter describes the matrix distribution coefficient (K_d) for americium in the +III oxidation state. K_d is the equilibrium ratio of the mass of americium adsorbed on the solid phase(s) per unit mass of solid divided by the concentration of that element in the aqueous phase.

2

Material and Property Name(s):

AM+3 MKD_AM (#3482)

3

Computational Code(s): SECOTP2D

4

minimum	*maximum*
0.02	*0.40*

5

Units: Cubic meters/kilogram

6

Distribution Type: Log uniform

7

Data: Site-Specific Experimental Data

A discussion of the data associated with this parameter may be found in the following parameter records package: Analysis Reports Relating to Analysis Plan AP-086 (ERMS #520523), specifically Summary of parameter changes adopted from the Performance Assessment Verification Test for the Technical Baseline Migration (ERMS #522016).

8

Discussion:

In CCA Appendix PAR , Brush (1996) described the laboratory sorption studies used to determine matrix K_ds for dissolved americium. The experimental data did not include K_ds for the clay-rich rock associated with fracture surfaces and dispersed in the matrix of the Culebra. Brush (1996) believed that this was a more conservative approach. Further, the fracture-surface K_d (actually, K_a) for americium in the Culebra was set to zero, which was also conservative (DOE 1996). The laboratory sorption studies are summarized below.

I. Triay at LANL studied the sorption of Th(IV), U(VI), Np(V), Pu(V), and Am(III) by dolomite-rich Culebra rock. These experiments yielded sorption isotherms, plots of the quantity of radionuclide sorbed by the solid phase(s) versus the final dissolved radionuclide concentration, or plots of K_ds versus the final dissolved radionuclide concentration. The samples, which Triay used, contained a lower concentration of clay minerals than the Culebra as a whole and therefore, Triay's K_ds are conservative (Brush 1996).

P.V. Brady at SNL studied the sorption of Nd(III) (a nonradioactive analog of Pu(III) and Am(III)), Th(IV), U(VI), Np(V), Pu(V), and Am(III) from synthetic NaCl solutions by samples of pure dolomite from Norway. Although this study did not yield K_ds for actual

samples of Culebra rock and Culebra fluids, it did yield results useful for interpreting the results of Triay's study and for extending Triay's data to the pH conditions (about 9 to 10) expected from an MgO backfill in WIPP disposal rooms (Brush 1996).

D.A. Lucero at SNL studied actinide transport through intact core samples from the Culebra in the WIPP AIS. This study did not yield K_ds directly. Instead, Lucero calculated retardation factors (Rs) and K_ds. For U(VI) and Np(V), which were eluted from the cores, Lucero was able to calculate discrete K_ds. For Th(IV), Pu(V), and Am(III), which were not eluted during the experiments, Lucero was only able to calculate minimum values of K_ds.

The range and probability distribution of matrix K_ds for deep (Castile and Salado) or Culebra brines that resulted in less retardation for each element or elemental oxidation state was used in the calculations. Since there are uncertainties as to the extent to which deep (Castile and Salado) and Culebra brines will mix, there are uncertainties as to the probability distributions of these factors (especially brine type, the partial pressure of CO_2, and the resulting pH) in the Culebra. Therefore, the matrix K_ds were specified as a uniform distribution rather than a Student's-t distribution.

Subsequent to the CCA PA calculations, two errors were found in the procedures used to calculate the matrix K_ds. First, a brine density of 1.00 g/ml was used rather than the measured brine density, and, second, incorrect values for the mass of dolomite were incorporated (Brush and Storz 1996). The erroneous use of these values led to incorrectly calculated distribution coefficients. However, the influence of the changes in these values on the distribution coefficients was believed to be insignificant (Brush and Storz 1996). Brush and Storz (1996) provided the corrected values of these K_ds.

For some isotopes, Brush and Storz (1996) calculated K_ds for both deep (Castile or Salado) and Culebra brines. To remain conservative and consistent with the CCA, the range of K_d values for the brine that has the smaller mean value were used.

In 1997, the EPA's review of experimental K_d data indicated that K_d values appeared to be logarithmically distributed. In addition, since the actinide K_ds ranged over more than an order of magnitude, the EPA felt that a log uniform distribution was more appropriate (EPA 1998) than the uniform distribution specified by Brush and Storz (1996). The ***DOE has adopted the revised values and distribution for the K_ds (Hansen and Leigh 2003).***

1

WIPP Data Entry Form #464 ERMS: #527706

2

References:

Brush, L. H. 1996. Memo to M. S. Tierney, RE: Ranges and Probability Distributions of K_ds for Dissolved Pu, Am, U, Th, and Np in the Culebra for the PA Calculations to Support the WIPP CCA, June 10, 1996. ERMS #238801.

Brush, L.H. and Storz, L. 1996. Memo to M. S. Tierney, RE: Revised Ranges and Probability Distributions of K_ds for Dissolved Pu, Am, U, Th, and Np in the Culebra for the PA calculations to Support the WIPP CCA, July 24, 1996. ERMS #241561.

Hansen, C., Leigh, C. 2003. A Reconciliation of the CCA and PAVT Parameter Baselines, Rev. 3. Carlsbad, NM. Sandia National Laboratories. ERMS #528582

U.S. Department of Energy (DOE). 1996. Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant. DOE/CAO-1996-2184. Carlsbad, NM: United States Department of Energy, Waste Isolation Pilot Plant, Carlsbad Area Office.

U.S. Environmental Protection Agency (EPA). 1998. Technical Support Document for Section 194.23:Parameter Justification Report. Docket No. A-93-02, V-B-14. U.S. Environmental Protection Agency. Washington, D.C.

1 ## *Parameter 58: Effective Shear Resistance to Erosion*

Parameter Description:

This parameter describes the intrusion borehole's effective shear strength for erosion.

2

Material and Property Name(s):

BOREHOLE TAUFAIL (#2254)

3

Computational Code: CUTTINGS_S

4

minimum	maximum
0.05	77.0

5

Units: Pascals

6

Distribution Type: Log uniform

7

Data: Professional Judgment

WIPP specific experimental data were not available for the effective shear resistance to erosion of the waste. Therefore, at the recommendation of the EPA, an estimation technique based on particle size distributions was used. A discussion of this parameter may be found in the following parameter records package: Analysis Reports Relating to Analysis Plan AP-086 (ERMS #520523), specifically Summary of parameter changes adopted from the Performance Assessment Verification Test for the Technical Baseline Migration (ERMS #522016).

8

Discussion:

The waste shear resistance was estimated based on particle size distributions as ***determined by an expert elicitation panel. The estimate used the Shield's parameter, which relies on a measure of the central point of a population of particles of various sizes, to determine the critical shear stress for an erodible, cohesionless sediment bed (Simon and Senturk 1992). With this approach, the calculated critical shear stresses ranged from 0.64 Pa to 77 Pa. For conservatism, the low value for waste shear resistance from the CCA PA was retained for the low value in the PAVT while the high value from the Shield's parameter method was used for the high value in the PAVT. The decision to use 0.05 Pa for the low value was supported by information that indicated that very fine-grained materials are not cohesionless as assumed in the Shield's parameter calculation. The information also showed that a lower bound of the critical shear stress for fine-grained cohesive sediments is on the order of the 0.05 Pa. (Parthenaides and Paaswell 1970) The high end of the range was considered appropriate for cohesionless particles and was retained based on the expert***

elicitation results. A log uniform distribution for the waste shear resistance was selected for the PAVT to provide equal weighting over the three orders of magnitude in the range, 0.05 to 77 Pa.

Until additional experimental data becomes available, the range of values selected for the PAVT is certainly inclusive of any reasonable values for the shear strength of the waste. Therefore, DOE has adopted the PAVT values for the shear strength of the waste (Hansen and Leigh 2003).

WIPP Data Entry Form #464 ERMS: #522016

References:

Simon, D.B. and Senturk, F. 1992. "Sediment Transport Technology Water and Sediment Dynamics." Water Resource Publication.

Hansen, C., Leigh, C. 2003. A Reconciliation of the CCA and PAVT Parameter Baselines, Rev. 3. Carlsbad, NM. Sandia National Laboratories. ERMS #528582.

1 ***Parameter 60: Probability of Hitting a Brine Reservoir***

Parameter Description:

The parameter represents the probability of hitting a brine reservoir during a drilling intrusion.

2

Material and Property Name(s):

GLOBAL PBRINE (#3493)

3

Computational Code: CCDFGF

4

minimum	***maximum***
0.01	***0.60***

5

Units: None

6

Distribution Type: Uniform

7

Data: Site-Specific Experimental Data

A discussion of the data associated with this parameter may be found in the following parameter records package: Analysis Reports Relating to Analysis Plan AP-086 (ERMS #520523), specifically Summary of parameter changes adopted from the Performance Assessment Verification Test for the Technical Baseline Migration (ERMS #522016).

8

Discussion:

In CCA Appendix PAR , geophysical methods, geological structure analysis, and geostatistical correlation were performed to determine the probability of intersection of a borehole with both the waste disposal region and a pressurized brine reservoir in the Castile formation. The DOE estimated that there is a 0.08 probability that any random borehole that penetrates waste at the WIPP also would penetrate an underlying brine reservoir (DOE 1996).

During preparation of the CCA, DOE reexamined their time-domain electromagnetic geophysical survey and found that between 10 and 55 percent of the waste panel area may be underlain by relatively conductive units, possibly due to one or more brine reservoirs (Alumbaugh 1996). The data did not support a means to distinguish boundaries between possible brine reservoirs and non-reservoir areas. As a consequence, DOE assumed that only one reservoir existed below the waste panels.

The DOE also mapped the geologic structure of selected units within the Castile and Salado Formations to examine the relationship between identified brine intercepts and evaporite deformation. Studies indicated that many of the observed brine encounters in the Delaware Basin were associated with structural deformation in the Castile Formation (e.g. ERDA-6).

The mapping exercise reaffirmed DOE's belief that much of the Castile Formation underlying the WIPP site is generally not deformed (and therefore, the likelihood of a brine reservoir beneath the waste panels was expected to be low). However, DOE did not consider the results of this geologic structural analysis in quantifying the probability of a drilling intrusion intersecting a brine reservoir.

The DOE then conducted a geostatistical analysis to estimate the probability of drilling into a fractured reservoir in areas overlain by the waste disposal panels. The analysis was based on 354 drill holes and 27 brine reservoir intercepts within the vicinity of the WIPP. Geostatistical techniques were used to estimate the probabilities that a randomly placed drilling intrusion would encounter pressurized brine in the Castile Formation. The overall probability for the waste panel area was determined to be 0.08 (a probability of 0.08 that a drilling intrusion would intersect a waste panel and penetrate into a underlying, pressurized brine reservoir). This value was selected for the parameter PBRINE in the PA calculation.

The EPA reviewed the CCA and supporting documentation and concluded that the parameter PBRINE should be changed from a constant having a value of 0.08 to a uniform distribution represented by a range of 0.01 to 0.60 (median value of 0.305). The EPA believes that this range better reflects the uncertainty in the parameter and is a more appropriate representation of the concept of reasonable expectation than the fixed value of 0.08 used by DOE in the CCA (EPA 1998a).

In reaching its conclusion, EPA considered the possibility that the WIPP-12 brine reservoir may underlie the entire WIPP site and thus the probability of a drilling intrusion encountering the pressurized reservoir could approach certainty (100 percent). This would require the assumption that this reservoir is cylindrical in shape, which EPA considered unlikely because brine resides in vertical or subvertical fractures, and because of the nature of the results from the time domain electromagnetic soundings.

For these reasons, EPA agreed with DOE that there exists a significant uncertainty concerning the magnitude and extent of brine reservoirs beneath the waste panels, but questioned DOE's basis for the probability of encountering such a brine reservoir to be only eight percent, since other DOE-generated information indicated that this probability could be as high as 60 percent (EPA 1998a and 1998b).

EPA found that the most direct information on the presence of brine reservoirs was provided by the time domain electromagnetic information, which could be interpreted to indicate that brine reservoirs underlie as much as 55 percent of the repository. The EPA also found that these same data could be interpreted to mean that brine reservoirs may underlie as little as 10 percent of the repository.

Using the time domain electromagnetic information, EPA developed probability distributions for four cases involving either random or block models to correlate adjacent measurements and assumed either the base of the Castile Formation or the base of the Anhydrite III layer in the Castile Formation was the cutoff point above which brine reservoirs may exist (EPA 1998a and 1998b). EPA found that it made little difference whether the random model or block model was used to characterize correlation between the time domain electromagnetic measurements. However, the simulated probability

distributions for encountering brine were highly sensitive to the geologic assumption of whether or not brine reservoirs exist below the bottom of the Anhydrite III layer. Using the base of the Castile Formation Anhydrite Layer III as the lowermost stratigraphic layer below which no brine reservoirs occur, the simulations showed that the area beneath the WIPP containing brine reservoirs varies from one to six percent. However, if the base of the Castile Formation is the lowermost stratigraphic layer below which no brine reservoirs occur, the area of the excavated repository underlain by reservoirs increases to about 35 to 58 percent.

For these reasons, EPA selected one percent as the lower limit and 60 percent as the upper limit for the fraction of the excavated area underlain by brine reservoirs. The upper limit was slightly larger than the largest estimated value for this parameter, but was less than 100percent because it was unreasonable to assume that brine reservoirs must exist. The lower limit was equal to the smallest estimated value and was greater than zero because it was also unreasonable to assume with absolute certainty that a reservoir does not exist. A uniform distribution was mandated because the range of this parameter spans slightly more than an order of magnitude and the use of a uniform distribution conservatively biased the sampling toward the high end. The DOE has adopted the value for the probability of a drilling intrusion intersecting a brine reservoir in the Castile Formation beneath the WIPP (Hansen and Leigh 2003).

WIPP Data Entry Form #464 ERMS: #248783

References:

Alumbaugh, D.L. 1996. "Re-analysis of the Time Domain Electromagnetic (TDEM) Data Collected at the WIPP Site." ERMS #245405. Sandia National Laboratories. Albuquerque, NM.

Hansen, C., Leigh, C. 2003. A Reconciliation of the CCA and PAVT Parameter Baselines, Rev. 3. Carlsbad, NM. Sandia National Laboratories. ERMS #528582

U.S. Department of Energy (DOE). 1996. Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant. DOE/CAO-1996-2184. Carlsbad, NM: United States Department of Energy, Waste Isolation Pilot Plant, Carlsbad Area Office.

U.S. Environmental Protection Agency (EPA). 1998a. Technical Support Document for Section 194.23:Parameter Justification Report. Docket No. A-93-02, V-B-14. U.S. Environmental Protection Agency. Washington, D.C.

U.S. Environmental Protection Agency (EPA). 1998b. Response to Comments, Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with 40 CFR 191 Disposal Regulations: Certification Decision. Docket No. A-93-02, V-C-1. U.S. Environmental Protection Agency. Washington D.C.

Parameter 61: Drill String Angular Velocity

Parameter Description:

This parameter describes the drill string angular velocity. This value is required to calculate the fluid-generated shear stress.

Material and Property Name(s):

BOREHOLE DOMEGA (#27)

Computational Code: CUTTINGS_S

Value	***4.2***	***6.3***	***8.4***	***10.5***	***12.6***	***14.7***	***16.8***	***18.8***	***20.9***	***23.0***
Percentiles	***0***	***0.15***	***0.65***	***0.80***	***0.90***	***0.95***	***0.97***	***0.98***	***0.99***	***1.0***

Units: Radians/second

Distribution Type: Cumulative

Data: Site-Specific Experimental Data

A discussion of the data associated with this parameter may be found in the following parameter records package: Analysis Reports Relating to Analysis Plan AP-086 (ERMS #520523), specifically Summary of parameter changes adopted from the Performance Assessment Verification Test for the Technical Baseline Migration (ERMS #522016).

Discussion:

The quantity of waste brought to the surface due to an inadvertent penetration of the repository by an exploratory drill bit depends upon three physical processes:

- ***Cuttings - waste contained in the cylindrical volume created by the cutting action of the drill bit passing through the waste.***
- ***Cavings - waste that erodes from the borehole in response to movement of drilling fluid within the annulus between the drill collars and the borehole wall***
- ***Spallings - waste forced into the drilling fluid due to pressurization of the repository by waste-generated gas. This requires a repository gas pressure that exceeds the hydrostatic pressure of the drilling mud.***

The cavings component of direct surface release, after a waste disposal room is penetrated, consists of that quantity of waste material that is eroded from the borehole wall by the action of the flowing drilling fluid. The erosion process model describes the shearing action on the waste by the drilling fluid as it moves up the borehole annulus. The amount of material eroded from the borehole wall is dependent upon the magnitude of the fluid-

generated shear stress acting on the wall and the effective shear resistance to erosion of the compacted, decomposed waste. The drill string angular velocity is required to calculate the fluid-generated shear stress.

For the CCA, the DOE had information about the rotational velocities used in current practice when drilling through salt. Using this information, the DOE derived a median value based on a constructed cumulative distribution of the known, applicable rotational velocities for drilling in salt. The derived median value was 7.8 radians/second. The CCA PA calculation assigned a constant value of 7.8 radians/second to the drill string angular velocity.

In its review, the EPA found that the data used to derive the median drill string angular velocity encompassed a rather large range of values, from 4.2 to 23 radians/second. Because of this large range, the EPA questioned whether the PA model showed sensitivity to variations in drill string angular velocity over this range. The EPA performed a sensitivity analysis over the range of drill string angular velocities and observed a 60 percent change in cavings releases. As a result, the EPA determined that a constant value for drill string angular velocity did not sufficiently reflect the uncertainty due to the wide range of possible values. The EPA also found that the potential impact on repository performance was sufficient to warrant use of a range of values and required the DOE to treat the drill string angular velocity as a sampled variable with a constructed cumulative distribution with a minimum of 4.2 radians/second, a maximum of 23 radians/second, and a median of 7.77 radians/second. The data were based on a study of current drilling practices in salt, documented in EPA (1998). DOE has adopted the distribution for the drill angular velocity (Hansen and Leigh 2003).

WIPP Data Entry Form #464 ERMS: #231512

References:

EPA (U.S. Environmental Protection Agency). 1998. Technical Support Document for Section 194.23:Parameter Justification Report.

Hansen, C., Leigh, C. 2003. A Reconciliation of the CCA and PAVT Parameter Baselines, Rev. 3. Carlsbad, NM. Sandia National Laboratories. ERMS #528582

1 ***Parameter 62: Residual Brine Saturation – Upper Portion of Simplified Shaft***

Parameter Description:

The residual brine saturation (S_{br}) is required in the two-phase flow model to define the relative permeability and capillary pressure curves (see CCA Appendix PA, Figure 4.2.1). Referred to also as S_{wr} (wetting phase) or S_{lr} (liquid phase), residual brine saturation is the point reached under high gas saturation conditions when brine is no longer continuous throughout the pore network and relative brine permeability becomes zero.

2

Material and Property Name(s):

SHFTU SAT_RBRN (# 3560)

3

Computational Code: BRAGFLO

4

Value	***0***	***0.20***	***0.60***
Percentiles	***0***	***.50***	***1***

5

Units: None

6

Distribution Type: Cumulative

7

Data: General Literature Data

A discussion of the data associated with this parameter may be found in the following parameter records packages: CRA Parameter Package (ERMS #526660) and Analysis Reports for AP-094 (ERMS #525186).

8

Discussion:

The values sampled for the material SHFTU are assigned to the other shaft seal materials (SHFTL_T1, SHFTL_T2, and CONC_MON). These distributions are the same as were used for the material SALT_T1 in DOE (1996) shaft seal model (James and Stein 2002, 2003).

A literature search was conducted to obtain residual liquid saturation values for consolidated geologic materials, concrete, and asphalt in support of the CCA. Residual liquid saturations for geologic materials were found in four references (Brooks and Corey 1964; Lappala et al. 1987; Parker et al. 1987; and Rawls et al. 1982). Brooks and Corey (1964) determined residual saturations for five unconsolidated samples based on measured values of liquid saturation as a function of capillary pressure. Lappala et al. (1987) determined residual moisture content for 11 soils by obtaining best fits to measured moisture content versus pressure head data using three models. The residual moisture contents determined for each soil using the three models were averaged and divided by the reported porosity to obtain a residual liquid saturation for each soil. Parker et al. (1987) fit

their saturation-pressure relationship to observed data to obtain residual saturations for a sandy and clayey porous media. Residual water contents reported by Rawls et al. (1982) for 11 soil texture classes were divided by the reported porosity to obtain residual saturations.

Mayer et al. (1992) reported a residual liquid saturation for normal concrete of 0.30. Data regarding residual liquid saturations in asphalt materials were not found in the literature.

The literature values of residual liquid saturation for geologic materials and concrete fall within the range of 0.0 to 0.6 with all but two values falling within the range of 0.0 to 0.4. It was recommended that a value of 0.2 be used for the residual liquid saturation of all seal components.

WIPP Data Entry Form #464 ERMS: #527670

References:

Brooks, R.H., and Corey, A.T. 1964. Hydraulic Properties of Porous Media. Hydrology Paper No. 3. Fort Collins, CO: Colorado State University.

James, S.J., and Stein, J. 2002. Analysis Plan for the Development of a Simplified Shaft Seal Model for the WIPP Performance Assessment. AP-094. Carlsbad, NM: Sandia National Laboratories. ERMS #524958.

James, S.J., Stein, J. 2003. Analysis Report for: Development of a Simplified Shaft Seal Model for the WIPP Performance Assessment, Rev. 1. January 23, 2003. Carlsbad, NM: Sandia National Laboratories. ERMS #525203.

Lappala, E.G., Healy, R.W., and Weeks, E.P. 1987. Documentation of Computer Program VS2D to Solve the Equations of Fluid Flow in Variably Saturated Porous Media. Water-Resources Investigations Report 83-4099. Denver, CO: U.S. Geological Survey. Tech Library books collection: PC173.4.P67L31987.

Mayer, G., Jacobs, F., and Wittmann, F.H. 1992. "Experimental Determination and Numerical Simulation of the Permeability of Cementitious Materials," Nuclear Engineering and Design. Vol. 138, no. 2, 171-177.

Parker, J.C., Lenhard, R.J., and Kuppusamy, T. 1987. "A Parametric Model for Constitutive Properties Governing Multiphase Flow in Porous Media," Water Resources Research. Vol. 23, no. 4, 618-624.

Rawls, W.J., Brakensiek, D.L., and Saxton, K.E. 1982. "Estimation of Soil Water Properties," Transactions of the ASAE. St. Joseph, MI: American Society of Agricultural Engineers. 1316-1328.

Parameter 63: Residual Gas Saturation – Upper Portion Simplified Shaft

Parameter Description:

The residual (critical) gas saturation (S_{gr}) is required in the two-phase flow model to define the relative permeability and capillary pressure curves (see CCA Appendix PA, Figure 4.2.1). S_{gr} corresponds to the degree of waste-generated gas saturation necessary to create an incipient interconnected pathway in porous material; a condition required for porous rock to be permeable to gas.

Material and Property Name(s):

SHFTU SAT_RGAS (# 3561)

Computational Code: BRAGFLO

minimum	***maximum***
0	***0.40***

Units: None

Distribution Type: Uniform

Data: General Literature Data

A discussion of the data associated with this parameter may be found in the following parameter records packages: CRA Parameter Package (ERMS #526660) and Analysis Reports for AP-094 (ERMS #525186).

Discussion:

The values sampled for the material SHFTU are assigned to the other shaft seal materials (SHFTL_T1, SHFTL_T2, and CONC_MON). These distributions are the same as were used for the material SALT_T1 in DOE (1996) shaft seal model (James and Stein 2002; 2003).

A literature search was conducted to obtain residual saturation values for consolidated geologic materials, concrete, and asphalt in support of the CCA.

A single value of 0.18 was found for normal concrete (Mayer et al. 1992). Based on this value, a distribution was assumed for the seal components. The recommended value was 0.2, and the recommended range was 0.0 to 0.4 with a uniform distribution for all shaft seal materials.

WIPP Data Entry Form #464 ERMS: #527671

References:

James, S.J., and Stein, J. 2002. Analysis Plan for the Development of a Simplified Shaft Seal Model for the WIPP Performance Assessment. AP-094. Carlsbad, NM: Sandia National Laboratories. ERMS #524958.

James, S.J., Stein, J. 2003. Analysis Report for: Development of a Simplified Shaft Seal Model for the WIPP Performance Assessment, Rev. 1. January 23, 2003. Carlsbad, NM: Sandia National Laboratories. ERMS #525203.

Mayer, G., Jacobs, F., and Wittmann, F.H. 1992. "Experimental Determination and Numerical Simulation of the Permeability of Cementitious Materials," Nuclear Engineering and Design. Vol. 138, no. 2, 171-177.

Parameter 64: Log of Intrinsic Permeability – Upper Portion of Simplified Shaft

Parameter Description:

This parameter describes the permeability distribution for the shaft in the non-Salado formations (see CCA Appendix PA, Figure 4.2.1). It is a sampled parameter for the x-direction and the values are then applied to the y- and z-directions.

Material and Property Name(s):

SHFTU PRMX_LOG (# 3557)

Computational Code: BRAGFLO

Value	*-20.5*	*-20.0*	*-19.5*	*-19.0*	*-18.5*	*-18.0*	*-17.5*	*-17.0*	*-16.5*
Percentiles	*0*	*0.03*	*0.11*	*0.24*	*0.43*	*0.65*	*0.89*	*0.99*	*1*

Units: Log (meters squared)

Distribution Type: Cumulative

Data:

A discussion of the data associated with this parameter may be found in the following parameter records packages: CRA Parameter Package (ERMS #526660) and Analysis Reports for AP-094 (ERMS #525186).

Discussion:

The simplified shaft seal model (James and Stein 2002; 2003) was developed by combining the effects of the many different materials used in the baseline shaft seal model and representing these effects with fewer materials.

The permeability of the non-Salado portion of the simplified shaft was obtained by calculating the effective permeability of the materials above the Salado in the baseline shaft seal model (EARTH and CLAY_RUS). A cumulative distribution was fit to the resulting equivalent permeability data (James and Stein 2003).

WIPP Data Entry Form #464 ERMS: #527656

References:

James, S.J., and Stein, J. 2002. Analysis Plan for the Development of a Simplified Shaft Seal Model for the WIPP Performance Assessment. AP-094. Carlsbad, NM: Sandia National Laboratories. ERMS #524958.

James, S.J., Stein, J. 2003. Analysis Report for: Development of a Simplified Shaft Seal Model for the WIPP Performance Assessment, Rev. 1. January 23, 2003. Carlsbad, NM: Sandia National Laboratories. ERMS #525203.

1 ***Parameter 65: Log of Intrinsic Permeability – Lower Portion of Simplified Shaft (0-200 yrs)***

Parameter Description:

This parameter describes the permeability distributions for the portion of the shaft in the Salado for the first 200 years of operation (see CCA Appendix PA, Figure 4.2.1). It is a sampled parameter for the x-direction and the values are then applied to the y- and z-directions.

2

Material and Property Name(s):

SHFTL_T1 PRMX_LOG (# 3569)

3

Computational Code: BRAGFLO

4

Value	***-20.0***	***-19.5***	***-19.0***	***-18.5***	***-18.0***	***-17.5***	***-17.0***	***-16.5***
Percentiles	***0***	***0.01***	***0.10***	***0.31***	***0.64***	***0.87***	***0.99***	***1***

5

Units: Log (meters squared)

6

Distribution Type: Cumulative

7

Data: Site- Specific Experimental Data

A discussion of the data associated with this parameter may be found in the following parameter records packages: CRA Parameter Package (ERMS #526660) and Analysis Reports for AP-094 (ERMS #525186).

8

Discussion:

The simplified shaft seal model (James and Stein 2002; 2003) was developed by combining the effects of the many different materials used in the baseline shaft seal model and representing these effects with fewer materials.

An analysis of the equivalent permeability data from the baseline shaft model used in the CCA indicates that the distributions for 0–10, 10–25, and 25–50 years are nearly identical (with mean equivalent permeabilities decreasing by 5 and 42 percent at 10 and 25 years, respectively). After 50 years, permeability progressively decreases between time intervals 25–50, 50–100, 100–200, and 200–400 years (with mean equivalent permeabilities decreasing by 133 percent, 604 percent, and 2507 percent at 50, 100, and 200 years, respectively). The final change occurs at 400 years and results in a very slight increase in effective permeability (mean equivalent permeability increases by 31 percent***) because of increases in concrete permeability assumed for the 400–10,000 year period.***

To capture the time-dependent behavior of the Salado composite material, there is a single permeability change at 200 years. A conservative choice for the distribution of the first 200

years is to average the distributions for the 0–10, 10–25, and 25–50 year intervals. Note that the 50–100 and 100–200 year intervals are not used. From 200 to 10,000 years, the distribution is defined as the average of the distributions from the baseline shaft seal model for the 200–400 and 400–10,000 year intervals. Because only the highest permeability data from the first 50 years is used to constrain the model for 200 years, this approach overestimates the permeability during the first 200 years and is thereby conservative. The permeability distributions can be implemented in PA by fitting a cumulative distribution to the data (James and Stein 2003).

WIPP Data Entry Form #464 ERMS: #527672

References:

James, S.J., and Stein, J. 2002. Analysis Plan for the Development of a Simplified Shaft Seal Model for the WIPP Performance Assessment. AP-094. Carlsbad, NM: Sandia National Laboratories. ERMS #524958.

James, S.J., Stein, J. 2003. Analysis Report for: Development of a Simplified Shaft Seal Model for the WIPP Performance Assessment, Rev. 1. January 23, 2003. Carlsbad, NM: Sandia National Laboratories. ERMS #525203.

Parameter 66: Log of Intrinsic Permeability – Lower Portion of Simplified Shaft (200-10,000 yrs)

Parameter Description:

This parameter describes the permeability distributions for the portion of the shaft in the Salado for the 200 to 10,000 years of operation (see CCA Appendix PA, Figure 4.2.1). It is a sampled parameter for the x-direction and the values are then applied to the y- and z-directions.

Material and Property Name(s):

SHFTL_T2 PRMX_LOG (# 3579)

Computational Code: BRAGFLO

Value	***-22.5***	***-22.0***	***-21.5***	***-21.0***	***-20.5***	***-20.0***	***-19.5***	***-19.0***	***-18.5***	***-18.0***
Percentiles	***0***	***0.02***	***0.08***	***0.17***	***0.31***	***0.53***	***0.70***	***0.87***	***0.97***	***1***

Units: Log (meters squared)

Distribution Type: Cumulative

Data: Site- Specific Experimental Data

A discussion of the data associated with this parameter may be found in the following parameter records packages: CRA Parameter Package (ERMS #526660) and Analysis Reports for AP-094 (ERMS #525186).

Discussion:

The simplified shaft seal model (James and Stein 2002; 2003) was developed by combining the effects of the many different materials used in the baseline shaft seal model and representing these effects with fewer materials.

An analysis of the equivalent permeability data from the baseline shaft model used in the CCA indicates that the distributions for 0–10, 10–25, and 25–50 years are nearly identical (with mean equivalent permeabilities decreasing by 5 and 42 percent at 10 and 25 years, respectively). After 50 years, permeability progressively decreases between time intervals 25–50, 50–100, 100–200, and 200–400 years (with mean equivalent permeabilities decreasing by 133, 604, and 2507 percent at 50, 100, and 200 years, respectively). The final change occurs at 400 years and results in a very slight increase in effective permeability (mean equivalent permeability increases by 31 percent) because of increases in concrete permeability assumed for the 400–10,000 year period.

To capture the time-dependent behavior of the Salado composite material from 200 to 10,000 years, the distribution is defined as the average of the distributions from the baseline shaft seal model for the 200–400 and 400–10,000 year intervals. Because only the highest

permeability data from the first 50 years is used to constrain the model for 200 years, this approach overestimates the permeability during the first 200 years and is thereby conservative. The permeability distributions are implemented in PA by fitting a cumulative distribution to the data. (James and Stein 2003)

WIPP Data Entry Form #464 ERMS: #527682

References:

James, S.J., and Stein, J. 2002. Analysis Plan for the Development of a Simplified Shaft Seal Model for the WIPP Performance Assessment. AP-094. Carlsbad, NM: Sandia National Laboratories. ERMS #524958.

James, S.J., Stein, J. 2003. Analysis Report for: Development of a Simplified Shaft Seal Model for the WIPP Performance Assessment, Rev. 1. January 23, 2003. Carlsbad, NM: Sandia National Laboratories. ERMS #525203.

Parameter 75: Index for Selecting Realizations for the SPALL Model

Parameter Description:

The index for selecting realizations in the SPALL model is used by CUTINGS_S to randomly match the 50 LHS elements (vectors) generated for DRSPALL to the 100 LHS elements (vectors) generated for BRAGFLO.

Material and Property Name(s):

SPALLMOD RNDSPALL ( )

Computational Code: CUTTINGS_S

minimum	*maximum*
0.0	*1.0*

Units: None.

Distribution Type: Uniform

Data: Professional Judgment

The parameter distribution is uniform because each of the 50 unique sets of property values generated for DRSPALL is deemed equally probable.

Discussion:

Uncertainty in waste property values for DRSPALL is addressed by using LHS to sample on selected input parameters to create 50 equally probable, unique sets of input data (vectors). DRSPALL is then executed 50 times (once per vector) to create an array of 50 equally probable spall volumes for a selected repository pressure. When exercised over several pressures, a "spallings response surface" is thus created.

CUTTINGS_S must use a technique to map BRAGFLO vectors to DRSPALL vectors, since the vectors are created by independent LHS runs. CUTTINGS_S thus reads the RNDSPALL( ) value for a given BRAGFLO vector, multiplies it by 50, and takes the resulting integer value as the "index" of the DRSPALL vector associated with this BRAGFLO vector. Since there are 50 DRSPALL vectors and 100 BRAGFLO vectors, two BRAGFLO vectors will be mapped to one DRSPALL vector.

WIPP Data Entry Form #464 ERMS: # NA

References:

NA

Table PAR-8. Parameters Sampled in LHS Code (and parameters to which sampled values were applied)

LHS#	Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Mean	Median	Low	High	Standard Deviation
1	2907	STEEL	Generic steel in waste	CORRMCO2	Inundated corrosion rate for steel without CO2 present	Uniform	m/s	1.59E-14	1.59E-14	0.00E+00	3.17E-14	9.15E-15
2	2823	WAS_AREA	Waste emplacement area and waste	PROBDEG	Probability of plastics and rubber biodegradation in event of microbial gas generation	Delta	NONE	2.00E+00	2.00E+00	0.00E+00	2.00E+00	0.00E+00
3	657	WAS_AREA	Waste emplacement area and waste	GRATMICI	Inundated biodegradation rate for cellulose	Uniform	moles/(kg*s)	4.92E-09	4.92E-09	3.17E-10	9.51E-09	2.65E-09
4	656	WAS_AREA	Waste emplacement area and waste	GRATMICH	Humid biodegredation rate for cellulose	Uniform	moles/(kg*s)	6.34E-10	6.34E-10	0.00E+00	1.27E-09	3.66E-10
5	2994	CELLULS	Cellulose	FBETA	Factor beta for microbial reaction rates	Uniform	NONE	5.00E-01	5.00E-01	0.00E+00	1.00E+00	2.89E-01
6	671	WAS_AREA	Waste emplacement area and waste	SAT_RGAS	Residual Gas Saturation	Uniform	NONE	7.50E-02	7.50E-02	0.00E+00	1.50E-01	4.33E-02
(6)		DRF_PCS	Drift/Explosion Wall Portion of PCS	SAT_RGAS	Residual Gas Saturation	Uniform	NONE	7.50E-02	7.50E-02	0.00E+00	1.50E-01	4.33E-02
(6)		REPOSIT	Repository regions outside of panel region	SAT_RGAS	Residual Gas Saturation	Uniform	NONE	7.50E-02	7.50E-02	0.00E+00	1.50E-02	4.33E-03
7	670	WAS_AREA	Waste emplacement area and waste	SAT_RBRN	Residual Brine Saturation	Uniform	NONE	2.76E-01	2.76E-01	0.00E+00	5.52E-01	1.59E-01
(7)		DRF_PCS		SAT_RBRN	Residual Brine Saturation	Uniform	NONE	2.76E-01	2.76E-01	0.00E+00	5.52E-01	1.59E-01
(7)		REPOSIT	Repository regions outside of panel region	SAT_RBRN	Residual Brine Saturation	Uniform	NONE	2.76E-01	2.76E-01	0.00E+00	5.52E-02	1.59E-02
8	2231	WAS_AREA	Waste emplacement area and waste	SAT_WICK	Index for computing wicking	Uniform	NONE	5.00E-01	5.00E-01	0.00E+00	1.00E+00	2.89E-01
9	3542	DRZ_PCS	DRZ directly above concrete portion of panel closure	PRMX_LOG	Log of intrinsic permeability, X-direction	Triangular	log(m^2)	-1.88E+01	-1.87E+01	-2.07E+01	-1.70E+01	7.55E-01
(9)		DRZ_PCS	DRZ directly above concrete portion of panel closure	PRMY_LOG	Log of intrinsic permeability, Y-direction	Triangular	log(m^2)	-1.88E+01	-1.87E+01	-2.07E+01	-1.70E+01	7.55E-01
(9)		DRZ_PCS	DRZ directly above concrete portion of panel closure	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Triangular	log(m^2)	-1.88E+01	-1.87E+01	-2.07E+01	-1.70E+01	7.55E-01

Table PAR-8. Parameters Sampled in LHS Code (and parameters to which sampled values were applied) — Continued

LHS#	Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Mean	Median	Low	High	Standard Deviation
10	3525	CONC_PCS	Concrete portion of PCS	PRMX_LOG	Log of intrinsic permeability, X-direction	Triangular	log(m^2)	-1.88E+01	-1.87E+01	-2.07E+01	-1.70E+01	7.55E-01
(10)		CONC_PCS	Concrete portion of PCS	PRMY_LOG	Log of intrinsic permeability, Y-direction	Triangular	$log(m^2)$	-1.88E+01	-1.87E+01	-2.07E+01	-1.70E+01	7.55E-01
(10)		CONC_PCS	Concrete portion of PCS	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Triangular	$log(m^2)$	-1.88E+01	-1.87E+01	-2.07E+01	-1.70E+01	7.55E-01
11	3626	SOLU4	Solubility Multiplier for U+4	SOLCIM	Solubility Mult. in Castile Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	NONE (see PPR-04-2002, ERMS #524651)	1.80E-01	-9.00E-02	-2.00E+00	1.40E+00	3.68E-01
12	3627	SOLTH4	Solubility Multiplier for Th+4	SOLCIM	Solubility Mult. in Castile Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	NONE (see PPR-04-2002, ERMS #524651)	1.80E-01	-9.00E-02	-2.00E+00	1.40E+00	3.68E-01
14	3532	CONC_PCS	Concrete portion of PCS	SAT_RGAS	Residual Gas Saturation	Uniform	NONE	2.00E-01	2.00E-01	0.00E+00	4.00E-01	1.16E-01
15	3531	CONC_PCS	Concrete portion of PCS	SAT_RBRN	Residual Brine Saturation	Cumulative	NONE	2.50E-01	2.00E-01	0.00E+00	6.00E-01	1.76E-01
16	3522	CONC_PCS	Concrete portion of PCS	PORE_DIS	Brooks-Corey pore distribution parameter	Cumulative	NONE	2.52E+00	9.40E-01	1.10E-01	8.10E+00	2.48E+00
17	544	S_HALITE	Salado halite, intact	POROSITY	Effective porosity	Cumulative	NONE	1.28E-02	1.00E-02	1.00E-03	3.00E-02	8.52E-03
18	547	S_HALITE	Salado halite, intact	PRMX_LOG	Log of intrinsic permeability, X-direction	Uniform	$log(m^2)$	-2.25E+01	-2.25E+01	-2.40E+01	-2.10E+01	8.66E-01
(18)		S_HALITE	Salado halite, intact	PRMY_LOG	Log of intrinsic permeability, Y-direction	Uniform	$log(m^2)$	-2.25E+01	-2.25E+01	-2.40E+01	-2.10E+01	8.66E-01
(18)		S_HALITE	Salado halite, intact	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Uniform	$log(m^2)$	-2.25E+01	-2.25E+01	-2.40E+01	-2.10E+01	8.66E-01
19	541	S_HALITE	Salado halite, intact	COMP_RCK	Bulk Compressibility	Uniform	Pa^{-1}	9.75E-11	9.75E-11	2.94E-12	1.92E-10	5.46E-11
20	591	S_MB139	Salado marker bed 139, intact and fractured	PRMX_LOG	Log of intrinsic permeability, X-direction	Student	$log(m^2)$	-1.89E+01	-1.89E+01	-2.10E+01	-1.71E+01	1.20E+00
(20)		S_MB139	Salado marker bed 139, intact and fractured	PRMY_LOG	Log of intrinsic permeability, Y-direction	Student	$log(m^2)$	-1.89E+01	-1.89E+01	-2.10E+01	-1.71E+01	1.20E+00
(20)		S_MB139	Salado marker bed 139, intact and fractured	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Student	$log(m^2)$	-1.89E+01	-1.89E+01	-2.10E+02	-1.71E+02	1.20E+01

Table PAR-8. Parameters Sampled in LHS Code (and parameters to which sampled values were applied) — Continued

LHS#	Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Mean	Median	Low	High	Standard Deviation
21	580	S_MB139	Salado marker bed 139, intact and fractured	COMP_RCK	Bulk Compressibility	Student	Pa^{-1}	8.26E-11	8.26E-11	1.09E-11	2.75E-10	1.12E-10
22	596	S_MB139	Salado marker bed 139, intact and fractured	RELP_MOD	Model number, relative permeability model	Delta	NONE	4.00E+00	4.00E+00	1.00E+00	4.00E+00	0.00E+00
23	598	S_MB139	Salado marker bed 139, intact and fractured	SAT_RBRN	Residual Brine Saturation	Student	NONE	8.36E-02	8.36E-02	7.78E-03	1.74E-01	5.01E-02
24	599	S_MB139	Salado marker bed 139, intact and fractured	SAT_RGAS	Residual Gas Saturation	Student	NONE	7.71E-02	7.71E-02	1.40E-02	1.97E-01	6.41E-02
25	587	S_MB139	Salado marker bed 139, intact and fractured	PORE_DIS	Brooks-Corey pore distribution parameter	Student	NONE	6.44E-01	6.44E-01	4.91E-01	8.42E-01	1.09E-01
26	546	S_HALITE	Salado halite, intact	PRESSURE	Brine far-field pore pressure	Uniform	Pa	1.25E+07	1.25E+07	1.10E+07	1.39E+07	8.23E+05
27	66	CASTILER	Castile Brine Reservoir	PRESSURE	Brine far-field pore pressure	Triangular	Pa	1.36E+07	1.27E+07	1.11E+07	1.70E+07	1.25E+06
28	67	CASTILER	Castile Brine Reservoir	PRMX_LOG	Log of intrinsic permeability, X-direction	Triangular	$log(m^2)$	-1.21E+01	-1.18E+01	-1.47E+01	-9.80E+00	1.01E+00
(28)		CASTILER	Castile Brine Reservoir	PRMY_LOG	Log of intrinsic permeability, Y-direction	Triangular	$log(m^2)$	-1.21E+01	-1.18E+01	-1.47E+01	-9.80E+00	1.01E+00
(28)		CASTILER	Castile Brine Reservoir	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Triangular	$log(m^2)$	-1.21E+02	-1.18E+02	-1.47E+02	-9.80E+01	1.01E+01
29	61	CASTILER	Castile Brine Reservoir	COMP_RCK	Bulk Compressibility	Triangular	Pa^{-1}	5.30E-11	4.00E-11	2.00E-11	1.00E-10	1.70E-11
30	3184	BH_SAND	Borehole filled with silty sand	PRMX_LOG	Log of intrinsic permeability, X-direction	Uniform	$log(m^2)$	-1.37E+01	-1.37E+01	-1.63E+01	-1.10E+01	1.53E+00
(30)		BH_SAND	Borehole filled with silty sand	PRMY_LOG	Log of intrinsic permeability, Y-direction	Uniform	$log(m^2)$	-1.37E+01	-1.37E+01	-1.63E+01	-1.10E+01	1.53E+00
(30)		BH_SAND	Borehole filled with silty sand	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Uniform	$log(m^2)$	-1.37E+01	-1.37E+01	-1.63E+02	-1.10E+02	1.53E+01
31	198	DRZ_1	Disturbed rock zone; time period 0 to 10,000 years	PRMX_LOG	Log of intrinsic permeability, X-direction	Uniform	$log(m^2)$	-1.60E+01	-1.60E+01	-1.94E+01	-1.25E+01	2.00E+00
(31)		DRZ_1	Disturbed rock zone; time period 0 to 10,000 years	PRMY_LOG	Log of intrinsic permeability, Y-direction	Uniform	$log(m^2)$	-1.60E+01	-1.60E+01	-1.94E+01	-1.25E+01	2.00E+00
(31)		DRZ_2	Disturbed rock zone; time period 0 to 10,000 years	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Uniform	$log(m^2)$	-1.60E+01	-1.60E+01	-1.94E+02	-1.25E+02	2.00E+01
32	3185	CONC_PLG	Concrete Plug, surface and Rustler	PRMX_LOG	Log of intrinsic permeability, X-direction	Uniform	$log(m^2)$	-1.80E+01	-1.80E+01	-1.90E+01	-1.70E+01	5.80E-01

Table PAR-8. Parameters Sampled in LHS Code (and parameters to which sampled values were applied) — Continued

LHS#	Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Mean	Median	Low	High	Standard Deviation
(32)		CONC_PLG	Concrete Plug, surface and Rustler	PRMY_LOG	Log of intrinsic permeability, Y-direction	Uniform	log(m^2)	-1.80E+01	-1.80E+01	-1.90E+01	-1.70E+01	5.80E-01
(32)		CONC_PLG	Concrete Plug, surface and Rustler	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Uniform	log(m^2)	-1.80E+01	-1.80E+01	-1.90E+01	-1.70E+01	5.80E-01
34	3262	SOLAM3	Solubility Multiplier for Am+3	SOLSIM	Solubility Mult. in Salado Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	NONE (see PPR-04-2002, ERMS #524651)	1.80E-01	-9.00E-02	-2.00E+00	1.40E+00	3.68E-01
35	3263	SOLAM3	Solubility Multiplier for Am+3	SOLCIM	Solubility Mult. in Castile Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	NONE (see PPR-04-2002, ERMS #524651)	1.80E-01	-9.00E-02	-2.00E+00	1.40E+00	3.68E-01
36	3265	SOLPU3	Solubility Multiplier for Pu+3	SOLSIM	Solubility Mult. in Salado Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	NONE (see PPR-04-2002, ERMS #524651)	1.80E-01	-9.00E-02	-2.00E+00	1.40E+00	3.68E-01
37	3264	SOLPU3	Solubility Multiplier for Pu+3	SOLCIM	Solubility Mult. in Castile Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	NONE (see PPR-04-2002, ERMS #524651)	1.80E-01	-9.00E-02	-2.00E+00	1.40E+00	3.68E-01
38	3266	SOLPU4	Solubility Multiplier for Pu+4	SOLSIM	Solubility Mult. in Salado Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	NONE (see PPR-04-2002, ERMS #524651)	1.80E-01	-9.00E-02	-2.00E+00	1.40E+00	3.68E-01
39	3389	SOLPU4	Solubility Multiplier for Pu+4	SOLCIM	Solubility Mult. in Castile Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	NONE (see PPR-04-2002, ERMS #524651)	1.80E-01	-9.00E-02	-2.00E+00	1.40E+00	3.68E-01
40	3390	SOLU4	Solubility Multiplier for U+4	SOLSIM	Solubility Mult. in Salado Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	NONE (see PPR-04-2002, ERMS #524651)	1.80E-01	-9.00E-02	-2.00E+00	1.40E+00	3.68E-01

Table PAR-8. Parameters Sampled in LHS Code (and parameters to which sampled values were applied) — Continued

LHS#	Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Mean	Median	Low	High	Standard Deviation
41	3391	SOLU6	Solubility Multiplier for U+6	SOLSIM	Solubility Mult. in Salado Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	NONE (see PPR-04-2002, ERMS #524651)	1.80E-01	-9.00E-02	-2.00E+00	1.40E+00	3.68E-01
42	3392	SOLU6	Solubility Multiplier for U+6	SOLCIM	Solubility Mult. in Castile Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	NONE (see PPR-04-2002, ERMS #524651)	1.80E-01	-9.00E-02	-2.00E+00	1.40E+00	3.68E-01
43	3393	SOLTH4	Solubility Multiplier for Th+4	SOLSIM	Solubility Mult. in Salado Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	NONE (see PPR-04-2002, ERMS #524651)	1.80E-01	-9.00E-02	-2.00E+00	1.40E+00	3.68E-01
44	3429	PHUMOX3	Proportionality Constant, +3 State, Humic Colloids	PHUMCIM	Proportionality Const., Humic Colloids, Castile Brine, MgO controls pH	Cumulative	NONE	1.10E+00	1.37E+00	6.50E-02	1.60E+00	4.69E-01
45	3417	GLOBAL	Information that applies globally	OXSTAT	Index for the Oxidation State	Uniform	NONE	5.00E-01	5.00E-01	0.00E+00	1.00E+00	2.89E-01
46	3419	CULEBRA	Culebra member of the Rustler formation	MINP_FAC	Mining Transmissivity Multiplier	Uniform	NONE	5.01E+02	5.01E+02	1.00E+00	1.00E+03	2.88E+02
47	225	GLOBAL	Information that applies globally	TRANSIDX	Index for selecting realizations of the Transmissivity Field	Uniform	NONE	5.00E-01	5.00E-01	0.00E+00	1.00E+00	2.89E-01
48	223	GLOBAL	Information that applies globally	CLIMTIDX	Climate Index	Cumulative	NONE	1.31E+00	1.17E+00	1.00E+00	2.25E+00	3.48E-01
49	3485	CULEBRA	Culebra member of the Rustler formation	HMBLKLT	Culebra Half Matrix-Block Length	Uniform	m	2.75E-01	2.75E-01	5.00E-02	5.00E-01	1.30E-01
50	3487	CULEBRA	Culebra member of the Rustler formation	APOROS	Culebra Advective Porosity	Log uniform	NONE	2.10E-03	1.00E-03	1.00E-04	1.00E-02	2.50E-03
51	3486	CULEBRA	Culebra member of the Rustler formation	DPOROS	Diffusive Porosity for Culebra Dolomite	Cumulative	NONE	1.60E-01	1.60E-01	1.00E-01	2.50E-01	3.50E-02
52	3475	U+6	Uranium VI	MKD_U	Matrix Partition Coefficient for Uranium	Log uniform	m^3/kg	3.10E-03	7.70E-04	3.00E-05	2.00E-02	4.60E-03
53	3479	U+4	Uranium IV	MKD_U	Matrix Partition Coefficient for Uranium	Log uniform	m^3/kg	3.50E+00	2.60E+00	7.00E-01	1.00E+01	2.50E+00

Table PAR-8. Parameters Sampled in LHS Code (and parameters to which sampled values were applied) — Continued

LHS#	Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Mean	Median	Low	High	Standard Deviation
54	3480	PU+3	Plutonium III	MKD_PU	Matrix Partition Coefficient for Plutonium	Log uniform	m^3/kg	1.30E-01	9.00E-02	2.00E-02	4.00E-01	1.00E-01
55	3481	PU+4	Plutonium IV	MKD_PU	Matrix Partition Coefficient for Plutonium	Log uniform	m^3/kg	3.50E+00	2.60E+00	7.00E-01	1.00E+01	2.50E+00
56	3478	TH+4	Thorium IV	MKD_TH	Matrix Partition Coefficient for Thorium	Log uniform	m^3/kg	3.50E+00	2.60E+00	7.00E-01	1.00E+01	2.50E+00
58	2254	BOREHOLE	Borehole and Fill	TAUFAIL	Effective shear strength for erosion (rfail)	Log uniform	Pa	1.05E+01	1.96E+00	5.00E-02	7.70E+01	1.71E+01
60	3493	GLOBAL	Information that applies globally	PBRINE	Prob. that Drilling Intrusion In Excavated Area Encounters Pressurized Brine	Uniform	NONE	3.05E-01	3.05E-01	1.00E-02	6.00E-01	1.70E-01
61	27	BOREHOLE	Borehole and Fill	DOMEGA	Drill string angular velocity (0)	Cumulative	rad/s	8.63E+00	7.80E+00	4.20E+00	2.30E+01	3.16E+00
62	3560	SHFTU	Upper portion of simplified shaft	SAT_RBRN	Residual Brine Saturation	Cumulative	NONE	2.50E-01	2.00E-01	0.00E+00	6.00E-01	1.76E-01
(62)		CONC_MON	Concrete Monolith	SAT_RBRN	Residual Brine Saturation	Cumulative	NONE	2.50E-01	2.00E-01	0.00E+00	6.00E-01	1.76E-01
(62)		SHFTL_T1	Lower portion of simplified shaft from 0 - 200 years	SAT_RBRN	Residual Brine Saturation	Cumulative	NONE	2.50E-01	2.00E-01	0.00E+00	6.00E-01	1.76E-01
(62)		SHFTL_T2	Lower portion of simplified shaft from 200 - 10,000 years	SAT_RBRN	Residual Brine Saturation	Cumulative	NONE	2.50E-01	2.00E-01	0.00E+00	6.00E-01	1.76E-01
63	3561	SHFTU	Upper portion of simplified shaft	SAT_RGAS	Residual Gas Saturation	Uniform	NONE	2.00E-01	2.00E-01	0.00E+00	4.00E-01	1.16E-01
(63)		CONC_MON	Concrete Monolith	SAT_RGAS	Residual Gas Saturation	Uniform	NONE	2.00E-01	2.00E-01	0.00E+00	4.00E-01	1.16E-01
(63)		SHFTL_T1	Lower portion of simplified shaft from 0 - 200 years	SAT_RGAS	Residual Gas Saturation	Uniform	NONE	2.00E-01	2.00E-01	0.00E+00	4.00E-01	1.16E-01
(63)		SHFTL_T2	Lower portion of simplified shaft from 200 - 10,000 years	SAT_RGAS	Residual Gas Saturation	Uniform	NONE	2.00E-01	2.00E-01	0.00E+00	4.00E-01	1.16E-01
64	3557	SHFTU	Upper portion of simplified shaft	PRMX_LOG	Log of intrinsic permeability, X-direction	Cumulative	$\log(m^2)$	-1.82E+01	-1.83E+01	-2.05E+01	-1.65E+01	7.94E-01
(64)		SHFTU	Upper portion of simplified shaft	PRMY_LOG	Log of intrinsic permeability, Y direction	Cumulative	$\log(m^2)$	-1.82E+01	-1.83E+01	-2.05E+01	-1.65E+01	7.94E-01

Table PAR-8. Parameters Sampled in LHS Code (and parameters to which sampled values were applied) — Continued

LHS#	Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Mean	Median	Low	High	Standard Deviation
(64)		SHFTU	Upper portion of simplified shaft	PRMZ_LOG	Log of intrinsic permeability, Z direction	Cumulative	$\log(m^2)$	-1.82E+01	-1.83E+01	-2.05E+01	-1.65E+01	7.94E-01
65	3569	SHFTL_T1	Lower portion of simplified shaft from 0 - 200 years	PRMX_LOG	Log of intrinsic permeability, X-direction	Cumulative	$\log(m^2)$	-1.80E+01	-1.82E+01	-2.00E+01	-1.65E+01	5.97E-01
(65)		SHFTL_T1	Lower portion of simplified shaft from 0 - 200 years	PRMY_LOG	Log of intrinsic permeability, Y-direction	Cumulative	$\log(m^2)$	-1.80E+01	-1.82E+01	-2.00E+01	-1.65E+01	5.97E-01
(65)		SHFTL_T1	Lower portion of simplified shaft from 0 - 200 years	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Cumulative	$\log(m^2)$	-1.80E+01	-1.82E+01	-2.00E+01	-1.65E+01	5.97E-01
66	3579	SHFTL_T2	Lower portion of simplified shaft from 200 - 10,000 years	PRMX_LOG	Log of intrinsic permeability, X-direction	Cumulative	$\log(m^2)$	-1.98E+01	-2.01E+01	-2.25E+01	-1.80E+01	9.37E-01
(66)		SHFTL_T2	Lower portion of simplified shaft from 200 - 10,000 years	PRMY_LOG	Log of intrinsic permeability, Y-direction	Cumulative	$\log(m^2)$	-1.98E+01	-2.01E+01	-2.25E+01	-1.80E+01	9.37E-01
(66)		SHFTL_T2	Lower portion of simplified shaft from 200 - 10,000 years	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Cumulative	$\log(m^2)$	-1.98E+01	-2.01E+01	-2.25E+01	-1.80E+01	9.37E-01
75	NA	SPALLMOD	Material developed for DRSPALL	RNDSPALL	Index for selecting realizations of the SPALL model.	Uniform	NONE	0.50E+00	0.50E+00	0.00E+00	1.00E+00	2.89E-01

1 [1]For parameters with a triangular distribution, the value provided for the median is actually the mode

Table PAR-9. LHS Sampled Values (100 vectors) Replicate 1

Parameter	1	2	3	4	5	6	7	8	9	10	11	12	14	15	16	17	18	19	20	21	22	23	24	25
Vector	STEEL	WAS_AREA	WAS_AREA	WAS_AREA	CELLULS	WAS_AREA	WAS_AREA	WAS_AREA	DRZ_PCS	CONC_PCS	SOLU4	SOLTH4	CONC_PCS	CONC_PCS	CONC_PCS	S_HALITE	S_HALITE	S_HALITE	S_MB139	S_MB139	S_MB139	S_MB139	S_MB139	S_MB139
Num.	CORRMCO2	PROBDEG	GRATMICI	GRATMICH	FBETA	SAT_RGAS	SAT_RBRN	SAT_WICK	PRMX_LOG	PRMX_LOG	SOLCIM	SOLCIM	SAT_RGAS	SAT_RBRN	PORE_DIS	POROSITY	PRMX_LOG	COMP_RCK	PRMX_LOG	COMP_RCK	RELP_MOD	SAT_RBRN	SAT_RGAS	PORE_DIS
1	1.09E-14	0.00E+00	8.17E-09	1.11E-10	5.59E-01	1.70E-02	9.33E-02	8.69E-01	-1.95E+01	-1.89E+01	-1.51E+00	5.78E-01	2.80E-01	3.06E-01	9.27E-01	2.33E-02	-2.23E+01	8.37E-11	-1.90E+01	9.76E-11	4.00E+00	1.08E-01	9.60E-02	5.73E-01
2	1.49E-14	2.00E+00	3.54E-09	6.47E-10	6.83E-02	1.48E-01	9.96E-02	7.30E-01	-1.75E+01	-1.73E+01	2.26E-01	-4.71E-01	1.44E-01	1.34E-01	7.95E-01	1.07E-02	-2.35E+01	1.57E-10	-1.86E+01	3.53E-11	1.00E+00	1.09E-01	5.56E-02	6.65E-01
3	1.20E-15	0.00E+00	2.31E-09	1.16E-09	3.07E-01	1.39E-01	1.86E-01	9.48E-01	-2.01E+01	-1.86E+01	-2.60E-01	8.41E-02	1.40E-01	3.83E-01	3.40E+00	5.58E-03	-2.26E+01	1.19E-10	-1.94E+01	1.41E-10	4.00E+00	1.15E-01	1.05E-01	6.62E-01
4	1.97E-14	2.00E+00	7.38E-09	1.15E-09	7.86E-02	6.79E-02	2.44E-01	8.75E-01	-1.93E+01	-1.89E+01	-4.15E-01	-2.73E-01	2.81E-02	7.63E-03	5.57E-01	4.73E-03	-2.35E+01	1.60E-10	-1.89E+01	8.13E-11	1.00E+00	1.23E-02	6.04E-02	7.43E-01
5	2.87E-14	1.00E+00	5.20E-09	9.97E-10	6.91E-01	3.89E-03	2.21E-01	5.80E-01	-1.83E+01	-2.02E+01	-6.54E-02	2.63E-04	4.01E-02	1.45E-03	7.79E+00	8.67E-03	-2.14E+01	4.39E-11	-1.87E+01	5.83E-11	4.00E+00	1.39E-01	7.07E-02	8.26E-01
6	1.89E-14	1.00E+00	1.98E-09	2.08E-10	9.77E-01	1.41E-01	1.16E-01	7.79E-01	-1.87E+01	-1.75E+01	-2.05E-02	2.69E-01	1.17E-01	4.16E-01	4.86E+00	2.54E-02	-2.33E+01	1.45E-10	-2.00E+01	2.33E-10	1.00E+00	9.22E-02	7.15E-02	7.31E-01
7	1.06E-14	0.00E+00	4.58E-09	6.89E-10	5.09E-01	8.61E-02	1.09E-01	4.52E-02	-1.82E+01	-1.92E+01	1.30E-01	-2.00E-01	1.72E-01	5.05E-02	4.65E+00	2.84E-02	-2.16E+01	4.62E-11	-1.83E+01	1.30E-11	4.00E+00	7.24E-02	8.48E-02	6.30E-01
8	2.51E-14	0.00E+00	3.13E-09	6.15E-10	1.39E-01	5.49E-03	3.35E-01	6.12E-01	-1.85E+01	-1.92E+01	1.55E-01	-1.32E-01	3.06E-01	1.85E-01	8.36E-01	1.54E-02	-2.12E+01	1.92E-11	-1.96E+01	1.96E-10	1.00E+00	7.25E-02	4.13E-02	6.83E-01
9	1.57E-14	1.00E+00	9.32E-09	2.58E-10	8.39E-01	1.28E-01	4.42E-01	6.82E-01	-1.99E+01	-2.01E+01	1.04E-01	-7.16E-02	3.91E-01	5.11E-01	5.64E+00	2.79E-02	-2.12E+01	1.66E-11	-1.84E+01	2.12E-11	1.00E+00	3.78E-02	1.29E-01	6.48E-01
10	2.41E-15	2.00E+00	2.78E-09	7.11E-10	4.32E-01	1.13E-01	3.22E-01	5.36E-01	-2.00E+01	-1.91E+01	2.45E-01	-4.41E-01	1.14E-01	1.65E-01	7.55E+00	5.91E-03	-2.34E+01	1.55E-10	-1.92E+01	1.21E-10	1.00E+00	9.86E-02	6.38E-02	5.82E-01
11	2.48E-14	0.00E+00	2.64E-09	8.21E-12	5.00E-01	7.27E-02	5.43E-01	5.85E-01	-1.85E+01	-1.88E+01	-3.44E-01	-2.34E-02	7.47E-02	1.98E-01	5.02E-01	4.49E-03	-2.38E+01	1.81E-10	-1.87E+01	3.63E-11	4.00E+00	8.44E-02	8.39E-02	6.26E-01
12	1.72E-14	1.00E+00	5.56E-09	1.26E-09	1.06E-01	8.71E-02	2.73E-01	3.35E-01	-1.88E+01	-1.84E+01	-6.84E-01	-4.63E-01	1.29E-01	5.62E-01	2.58E+00	2.00E-02	-2.28E+01	1.16E-10	-1.90E+01	8.81E-11	4.00E+00	5.25E-02	1.14E-01	6.60E-01
13	3.02E-14	0.00E+00	8.73E-09	2.03E-10	5.95E-01	8.05E-02	7.81E-02	9.05E-01	-1.89E+01	-1.86E+01	2.80E-01	-1.41E+00	2.12E-01	3.18E-01	3.66E+00	7.96E-03	-2.34E+01	1.49E-10	-1.86E+01	6.64E-11	4.00E+00	7.62E-02	9.41E-02	6.05E-01
14	3.64E-15	2.00E+00	4.90E-09	8.19E-10	3.17E-01	1.06E-01	2.08E-01	3.17E-02	-1.97E+01	-1.83E+01	-1.14E+00	-9.53E-01	2.58E-01	2.65E-01	4.43E+00	6.45E-03	-2.36E+01	1.73E-10	-1.87E+01	6.88E-11	4.00E+00	6.39E-02	1.08E-01	7.38E-01
15	3.16E-14	2.00E+00	6.82E-09	7.72E-10	2.69E-01	6.11E-02	5.19E-01	2.90E-01	-1.87E+01	-1.88E+01	-9.96E-01	2.45E-01	3.22E-01	6.69E-02	6.95E+00	1.43E-02	-2.37E+01	1.71E-10	-1.92E+01	1.23E-10	4.00E+00	7.96E-02	6.85E-02	5.25E-01
16	1.71E-14	1.00E+00	3.04E-09	1.66E-10	8.10E-02	7.56E-02	2.09E-02	9.34E-01	-1.88E+01	-1.87E+01	-1.31E-01	-9.54E-02	3.38E-01	1.06E-02	4.89E-01	9.05E-03	-2.11E+01	1.26E-11	-2.06E+01	2.75E-10	4.00E+00	8.36E-02	1.16E-01	6.16E-01
17	2.83E-14	1.00E+00	4.41E-09	2.67E-10	1.59E-01	1.01E-01	3.80E-01	7.45E-01	-1.87E+01	-1.89E+01	-3.87E-01	-4.89E-02	2.96E-01	2.57E-01	8.89E-01	3.30E-03	-2.25E+01	1.25E-10	-1.77E+01	1.09E-11	1.00E+00	7.83E-02	9.02E-02	5.96E-01
18	6.12E-15	2.00E+00	4.52E-09	1.20E-10	4.30E-02	9.56E-02	4.41E-01	3.54E-01	-1.89E+01	-1.79E+01	3.11E-02	-6.74E-02	2.52E-01	5.53E-01	3.35E+00	2.74E-03	-2.15E+01	2.44E-11	-2.10E+01	2.75E-10	1.00E+00	9.44E-02	1.13E-01	6.65E-01
19	1.37E-14	0.00E+00	5.15E-09	8.26E-10	8.23E-01	6.64E-02	3.60E-01	9.81E-01	-1.94E+01	-1.96E+01	5.41E-01	-3.04E-01	2.21E-01	1.77E-01	1.97E-01	1.23E-02	-2.13E+01	1.54E-11	-1.91E+01	1.29E-10	1.00E+00	1.11E-01	1.01E-01	6.38E-01
20	2.09E-14	0.00E+00	3.70E-09	4.86E-10	7.16E-01	3.15E-02	3.42E-01	9.98E-01	-1.89E+01	-1.83E+01	-1.85E+00	-7.91E-02	3.76E-01	5.72E-01	2.14E+00	2.20E-02	-2.19E+01	5.48E-11	-1.84E+01	1.09E-11	1.00E+00	8.57E-02	2.30E-02	6.55E-01
21	4.71E-16	0.00E+00	7.27E-09	1.08E-09	2.74E-01	1.44E-02	2.39E-01	8.22E-02	-1.84E+01	-1.81E+01	-9.06E-02	-4.91E-01	3.31E-01	3.91E-01	6.91E-01	1.46E-02	-2.15E+01	4.16E-11	-1.88E+01	7.41E-11	1.00E+00	1.01E-01	8.00E-02	5.67E-01
22	2.95E-14	2.00E+00	7.82E-09	1.28E-10	9.37E-01	1.11E-02	6.78E-03	8.23E-01	-1.85E+01	-1.80E+01	9.83E-01	-1.23E-02	2.75E-01	2.90E-01	2.71E+00	2.94E-02	-2.27E+01	1.22E-10	-1.88E+01	8.03E-11	4.00E+00	5.41E-02	8.70E-02	6.40E-01
23	7.20E-15	1.00E+00	3.91E-09	9.41E-11	4.76E-01	4.32E-02	2.54E-01	7.89E-01	-1.81E+01	-1.87E+01	-3.07E-02	3.72E-02	1.89E-01	1.55E-01	2.24E-01	9.37E-03	-2.13E+01	2.99E-11	-1.96E+01	1.90E-10	4.00E+00	8.82E-02	9.13E-02	6.78E-01
24	2.55E-14	0.00E+00	3.24E-09	3.05E-10	7.09E-01	2.49E-02	4.76E-01	4.42E-01	-1.86E+01	-1.95E+01	-5.29E-02	-7.85E-01	2.87E-01	1.00E-01	6.02E+00	3.77E-03	-2.38E+01	1.79E-10	-1.88E+01	9.32E-11	1.00E+00	8.41E-02	3.99E-02	6.18E-01
25	9.22E-16	0.00E+00	2.18E-09	5.57E-10	8.04E-01	6.99E-02	9.40E-02	3.78E-01	-1.87E+01	-1.76E+01	-5.87E-01	-3.98E-01	3.40E-01	7.19E-02	3.39E-01	1.19E-02	-2.32E+01	1.39E-10	-1.84E+01	2.80E-11	1.00E+00	1.33E-01	5.05E-02	6.08E-01
26	1.40E-14	2.00E+00	6.22E-09	6.14E-11	7.50E-01	6.98E-03	2.35E-01	2.93E-01	-1.93E+01	-1.84E+01	-9.76E-02	-2.32E-01	3.19E-01	2.76E-02	3.84E-01	1.09E-02	-2.37E+01	1.78E-10	-1.85E+01	3.33E-11	1.00E+00	8.77E-02	8.15E-02	6.55E-01
27	1.54E-14	2.00E+00	1.41E-09	5.69E-10	2.60E-02	7.13E-02	4.82E-01	4.81E-01	-1.91E+01	-1.84E+01	-7.98E-02	-1.69E-01	3.34E-01	2.96E-01	3.74E+00	1.66E-02	-2.36E+01	1.59E-10	-1.91E+01	9.89E-11	4.00E+00	6.13E-02	1.09E-01	6.96E-01
28	3.66E-17	1.00E+00	7.54E-09	7.40E-10	1.25E-01	1.26E-01	5.56E-02	2.56E-01	-1.83E+01	-1.98E+01	-1.35E-01	-2.27E-01	1.50E-01	4.87E-01	5.65E-01	2.51E-02	-2.24E+01	9.37E-11	-1.85E+01	2.45E-11	4.00E+00	9.83E-02	3.77E-02	5.90E-01
29	2.60E-14	2.00E+00	7.17E-09	8.58E-10	6.89E-01	1.22E-01	5.08E-02	4.56E-01	-1.95E+01	-1.90E+01	6.72E-01	-3.38E-01	4.94E-02	1.07E-01	1.05E+00	2.45E-02	-2.18E+01	4.79E-11	-1.90E+01	8.49E-11	1.00E+00	1.05E-01	1.40E-02	6.43E-01
30	1.44E-14	2.00E+00	9.12E-09	1.11E-09	4.50E-01	5.10E-02	2.78E-01	7.93E-01	-1.79E+01	-1.88E+01	6.05E-01	5.74E-02	6.39E-02	5.86E-02	3.14E+00	1.97E-02	-2.29E+01	1.18E-10	-1.91E+01	9.54E-11	1.00E+00	9.07E-02	1.07E-01	6.04E-01
31	4.92E-15	0.00E+00	8.45E-09	1.00E-09	4.44E-01	6.17E-02	4.64E-01	3.44E-01	-1.79E+01	-1.78E+01	7.47E-01	9.69E-01	3.50E-01	1.84E-02	4.76E+00	1.74E-02	-2.30E+01	1.11E-10	-1.81E+01	1.09E-11	1.00E+00	9.66E-02	5.20E-02	7.01E-01
32	1.03E-14	0.00E+00	7.69E-09	1.17E-09	3.85E-01	3.27E-02	3.92E-01	1.94E-01	-1.90E+01	-1.91E+01	-2.71E-02	-1.66E+00	2.32E-01	1.25E-01	7.04E+00	6.78E-03	-2.17E+01	3.64E-11	-1.97E+01	1.81E-10	4.00E+00	8.98E-02	5.41E-02	6.46E-01
33	1.47E-14	0.00E+00	6.98E-09	1.04E-09	8.48E-01	8.25E-02	4.31E-02	7.07E-01	-1.94E+01	-1.80E+01	-4.33E-01	-1.51E-01	3.88E-02	1.14E-01	7.95E+00	8.34E-03	-2.33E+01	1.53E-10	-1.83E+01	1.09E-11	4.00E+00	3.43E-02	6.73E-02	6.35E-01
34	1.17E-14	1.00E+00	7.58E-10	5.16E-10	3.60E-01	1.03E-01	3.72E-01	7.67E-01	-1.84E+01	-1.90E+01	-5.61E-02	6.53E-01	2.25E-01	4.92E-01	1.70E+00	2.80E-02	-2.26E+01	9.63E-11	-1.88E+01	8.27E-11	4.00E+00	8.29E-02	3.41E-02	6.10E-01
35	2.91E-14	0.00E+00	4.71E-09	1.02E-09	5.76E-01	9.04E-02	3.53E-01	6.42E-01	-1.81E+01	-1.74E+01	7.24E-02	-7.48E-01	1.80E-02	5.84E-01	6.40E+00	2.42E-03	-2.20E+01	7.01E-11	-1.86E+01	6.74E-11	4.00E+00	7.15E-02	6.13E-02	6.52E-01
36	1.75E-14	0.00E+00	6.53E-09	1.25E-09	6.56E-01	1.20E-01	4.75E-01	5.50E-01	-1.83E+01	-1.91E+01	1.10E+00	9.06E-01	1.58E-01	3.54E-01	3.05E+00	1.38E-02	-2.14E+01	2.83E-11	-1.82E+01	1.09E-11	4.00E+00	7.75E-02	1.06E-01	6.44E-01
37	2.06E-14	0.00E+00	4.92E-09	1.48E-10	1.46E-01	4.14E-02	5.35E-01	1.75E-01	-1.75E+01	-2.02E+01	-1.29E-02	-4.06E-03	2.07E-01	1.50E-01	3.24E-01	1.89E-02	-2.31E+01	1.30E-10	-1.91E+01	1.15E-10	1.00E+00	6.78E-02	7.63E-02	6.17E-01

Table PAR-9. LHS Sampled Values (100 vectors) Replicate 1 — Continued

Parameter	1	2	3	4	5	6	7	8	9	10	11	12	14	15	16	17	18	19	20	21	22	23	24	25
Vector Num.	STEEL CORRMCO2	WAS_AREA PROBDEG	WAS_AREA GRATMICI	WAS_AREA GRATMICH	CELLULS FBETA	WAS_AREA SAT_RGAS	WAS_AREA SAT_RBRN	WAS_AREA SAT_WICK	DRZ_PCS PRMX_LOG	CONC_PCS PRMX_LOG	SOLU4 SOLCIM	SOLTH4 SOLCIM	CONC_PCS SAT_RGAS	CONC_PCS SAT_RBRN	CONC_PCS PORE_DIS	S_HALITE POROSITY	S_HALITE PRMX_LOG	S_HALITE COMP_RCK	S_MB139 PRMX_LOG	S_MB139 COMP_RCK	S_MB139 RELP_MOD	S_MB139 SAT_RBRN	S_MB139 SAT_RGAS	S_MB139 PORE_DIS
38	2.60E-14	0.00E+00	1.31E-09	9.67E-10	9.42E-01	1.44E-01	4.31E-01	4.27E-01	-1.88E+01	-1.94E+01	-2.13E-01	1.30E-01	1.88E-01	6.03E-02	4.10E+00	5.17E-03	-2.27E+01	9.82E-11	-1.94E+01	1.48E-10	4.00E+00	8.61E-02	8.44E-02	6.21E-01
39	2.17E-15	1.00E+00	3.26E-09	1.49E-11	5.87E-01	2.86E-02	1.12E-01	6.25E-01	-1.93E+01	-1.86E+01	1.44E-01	7.25E-01	2.68E-01	5.40E-02	4.02E+00	2.06E-03	-2.34E+01	1.64E-10	-1.86E+01	4.88E-11	4.00E+00	7.93E-02	9.59E-02	5.82E-01
40	4.45E-15	2.00E+00	8.32E-09	3.93E-10	8.12E-01	1.43E-01	5.20E-01	8.58E-01	-1.98E+01	-1.94E+01	-3.62E-02	-6.44E-01	2.16E-01	2.31E-01	7.25E-01	1.51E-02	-2.15E+01	2.75E-11	-1.80E+01	1.09E-11	1.00E+00	5.53E-02	4.27E-02	6.32E-01
41	1.25E-14	2.00E+00	6.07E-09	3.40E-10	9.03E-01	1.31E-01	5.39E-01	2.28E-01	-1.91E+01	-1.89E+01	4.42E-02	3.96E-01	2.94E-01	1.30E-01	5.29E+00	2.56E-02	-2.25E+01	1.06E-10	-2.01E+01	2.52E-10	4.00E+00	6.05E-02	1.70E-02	6.69E-01
42	1.22E-14	1.00E+00	5.21E-10	4.10E-10	7.83E-01	2.63E-02	4.45E-02	4.67E-01	-1.84E+01	-1.82E+01	-2.16E-01	-8.34E-02	4.74E-03	4.04E-02	4.26E-01	5.40E-03	-2.18E+01	4.02E-11	-1.95E+01	1.64E-10	4.00E+00	5.99E-02	6.27E-02	6.74E-01
43	1.40E-15	1.00E+00	8.60E-09	3.99E-10	4.26E-01	3.86E-02	4.19E-01	6.07E-01	-2.01E+01	-1.79E+01	-1.67E-01	-1.47E-02	2.88E-01	8.12E-02	4.68E-01	2.69E-02	-2.39E+01	1.90E-10	-1.95E+01	1.59E-10	4.00E+00	1.17E-01	9.15E-02	6.98E-01
44	2.77E-14	0.00E+00	8.93E-09	1.12E-09	6.31E-01	3.60E-02	1.95E-01	8.87E-01	-1.86E+01	-1.98E+01	-7.94E-01	7.29E-02	1.71E-01	4.55E-01	5.98E-01	1.64E-03	-2.17E+01	4.85E-11	-1.93E+01	1.43E-10	1.00E+00	1.02E-01	8.22E-02	7.70E-01
45	3.11E-14	2.00E+00	2.15E-09	7.09E-10	5.45E-01	5.43E-02	3.56E-01	1.17E-01	-1.87E+01	-1.83E+01	-3.08E-01	-6.91E-01	2.79E-01	4.08E-01	2.43E-01	2.40E-02	-2.24E+01	1.00E-10	-1.88E+01	5.46E-11	4.00E+00	9.10E-02	1.03E-01	5.93E-01
46	7.84E-15	1.00E+00	5.73E-09	4.58E-10	8.86E-01	4.45E-02	3.19E-01	4.15E-01	-1.85E+01	-1.93E+01	-7.37E-02	-1.26E-01	3.13E-01	3.68E-01	1.29E+00	1.04E-03	-2.27E+01	8.47E-11	-1.89E+01	8.79E-11	4.00E+00	5.01E-02	6.32E-02	7.18E-01
47	2.97E-15	1.00E+00	9.75E-10	1.10E-09	8.97E-01	1.32E-01	5.10E-01	8.44E-01	-1.79E+01	-1.88E+01	-1.78E-01	-1.89E-01	3.09E-01	1.35E-02	8.17E-01	1.84E-02	-2.22E+01	6.87E-11	-1.90E+01	1.09E-10	4.00E+00	4.19E-02	1.74E-01	7.25E-01
48	8.52E-15	0.00E+00	1.08E-09	3.24E-10	9.22E-02	1.15E-01	6.21E-02	7.54E-01	-1.96E+01	-1.87E+01	-4.72E-01	1.17E-01	6.91E-02	4.43E-02	6.27E-01	1.94E-02	-2.25E+01	7.72E-11	-1.71E+01	1.09E-11	4.00E+00	6.50E-02	6.69E-02	6.86E-01
49	8.98E-15	0.00E+00	5.55E-09	1.64E-10	2.23E-01	4.54E-02	3.10E-01	4.73E-01	-1.93E+01	-1.87E+01	-2.35E-01	-5.41E-01	2.38E-03	2.50E-01	6.63E+00	2.08E-02	-2.12E+01	2.30E-11	-1.91E+01	9.03E-11	1.00E+00	1.11E-01	9.35E-02	6.90E-01
50	2.31E-14	0.00E+00	8.04E-09	5.90E-10	1.66E-01	1.07E-01	2.27E-01	1.23E-01	-2.03E+01	-1.91E+01	3.69E-01	-4.22E-02	8.23E-02	3.37E-02	5.89E+00	2.88E-02	-2.21E+01	7.66E-11	-1.94E+01	1.39E-10	4.00E+00	4.49E-02	7.31E-02	6.82E-01
51	1.87E-14	2.00E+00	8.79E-09	2.96E-10	2.18E-01	1.10E-01	1.61E-01	1.34E-01	-1.83E+01	-1.89E+01	-1.87E-01	1.90E-01	2.15E-01	2.07E-01	1.79E-01	1.33E-03	-2.11E+01	7.04E-12	-1.81E+01	1.09E-11	4.00E+00	7.80E-02	8.83E-02	5.70E-01
52	9.60E-15	1.00E+00	6.89E-09	9.47E-10	3.44E-01	8.90E-02	4.06E-01	3.91E-01	-1.85E+01	-1.95E+01	7.75E-01	-2.03E-01	1.66E-01	4.11E-01	2.34E+00	8.39E-03	-2.32E+01	1.48E-10	-1.88E+01	7.33E-11	4.00E+00	8.01E-02	1.63E-01	6.80E-01
53	1.65E-14	1.00E+00	6.15E-09	5.01E-10	7.79E-01	3.55E-02	4.88E-01	9.28E-01	-1.92E+01	-1.80E+01	8.00E-01	1.14E+00	1.32E-01	5.24E-01	4.33E+00	3.45E-03	-2.37E+01	1.83E-10	-1.86E+01	4.34E-11	1.00E+00	7.05E-02	1.40E-02	6.39E-01
54	1.29E-14	0.00E+00	1.21E-09	7.82E-10	7.45E-01	1.00E-01	2.87E-01	3.68E-01	-1.91E+01	-1.88E+01	8.60E-01	-5.71E-01	1.99E-01	4.76E-01	1.92E+00	1.02E-02	-2.39E+01	1.88E-10	-1.84E+01	3.00E-11	4.00E+00	1.68E-01	2.62E-02	6.71E-01
55	2.34E-14	0.00E+00	1.71E-09	7.54E-10	1.90E-02	5.95E-02	4.30E-01	7.12E-01	-1.97E+01	-1.93E+01	-1.40E-01	-3.51E-01	3.56E-01	7.61E-02	7.19E+00	8.16E-03	-2.14E+01	1.14E-11	-1.96E+01	1.76E-10	1.00E+00	5.83E-02	4.86E-02	6.03E-01
56	1.20E-14	0.00E+00	2.81E-09	2.84E-10	7.63E-01	4.83E-02	2.97E-01	5.16E-01	-2.03E+01	-1.97E+01	5.89E-01	-1.07E+00	2.35E-01	1.41E-01	2.92E-01	3.10E-03	-2.35E+01	1.63E-10	-1.89E+01	6.31E-11	1.00E+00	7.38E-02	7.49E-02	6.33E-01
57	6.89E-15	0.00E+00	5.04E-09	9.63E-10	7.39E-01	5.05E-02	3.76E-02	2.08E-01	-1.76E+01	-1.99E+01	9.51E-02	-1.22E-01	2.03E-01	2.09E-01	1.55E+00	1.35E-02	-2.37E+01	1.68E-10	-1.87E+01	4.17E-11	1.00E+00	7.78E-03	7.64E-02	6.29E-01
58	2.46E-14	0.00E+00	4.79E-09	1.07E-09	2.09E-01	1.24E-01	4.62E-01	1.47E-01	-1.96E+01	-1.92E+01	1.48E-02	8.42E-01	1.55E-01	4.62E-01	3.07E-01	4.33E-03	-2.26E+01	1.03E-10	-1.98E+01	1.84E-10	4.00E+00	1.07E-01	6.01E-02	6.23E-01
59	1.92E-14	0.00E+00	4.05E-09	1.18E-09	5.22E-01	2.05E-02	3.98E-01	6.96E-01	-1.74E+01	-1.77E+01	-2.02E-01	4.44E-01	3.61E-01	1.11E-01	5.32E-01	2.65E-02	-2.18E+01	6.33E-11	-1.91E+01	1.11E-10	1.00E+00	4.84E-02	1.21E-01	6.22E-01
60	5.20E-15	0.00E+00	5.36E-09	6.80E-10	3.91E-01	2.18E-03	1.99E-01	6.58E-01	-1.90E+01	-1.85E+01	4.85E-01	2.56E-02	3.88E-01	3.46E-01	5.77E+00	9.59E-03	-2.23E+01	9.06E-11	-1.95E+01	1.69E-10	4.00E+00	1.22E-01	5.44E-02	6.76E-01
61	2.75E-14	0.00E+00	4.19E-09	2.74E-11	9.26E-01	5.75E-02	1.41E-01	2.65E-01	-1.72E+01	-2.00E+01	-1.97E-01	1.62E-02	9.74E-02	4.33E-01	3.92E+00	1.30E-02	-2.31E+01	1.34E-10	-1.93E+01	1.18E-10	1.00E+00	8.94E-02	1.53E-01	7.20E-01
62	1.59E-14	0.00E+00	8.06E-09	1.23E-09	2.51E-01	4.05E-02	2.77E-02	4.40E-01	-1.84E+01	-1.92E+01	6.55E-02	-3.61E-01	3.26E-01	5.52E-01	5.86E-01	6.28E-03	-2.17E+01	5.18E-11	-1.92E+01	1.32E-10	4.00E+00	6.64E-02	2.81E-02	5.99E-01
63	2.16E-14	0.00E+00	4.71E-10	9.88E-10	9.61E-01	7.36E-02	4.95E-01	5.22E-02	-1.78E+01	-1.85E+01	-1.10E-01	-8.60E-01	2.50E-01	8.53E-02	7.72E-01	2.75E-02	-2.29E+01	1.29E-10	-1.98E+01	2.21E-10	1.00E+00	9.51E-02	4.40E-02	6.51E-01
64	1.34E-14	2.00E+00	1.95E-09	5.43E-10	8.76E-01	9.33E-03	5.04E-01	4.04E-01	-1.91E+01	-1.75E+01	1.89E-01	-2.16E-01	5.98E-02	5.35E-01	6.59E-01	7.61E-03	-2.11E+01	6.57E-12	-1.87E+01	5.30E-11	4.00E+00	9.94E-02	7.79E-02	6.62E-01
65	1.63E-14	0.00E+00	2.55E-09	7.29E-10	6.25E-01	8.49E-02	2.68E-01	1.64E-01	-1.95E+01	-1.93E+01	-1.25E-01	-4.16E-02	3.97E-01	5.15E-01	2.44E+00	4.23E-03	-2.14E+01	3.77E-11	-1.93E+01	1.12E-10	1.00E+00	1.05E-01	7.48E-02	7.14E-01
66	2.27E-14	0.00E+00	4.17E-09	8.89E-10	5.20E-01	2.34E-02	4.50E-01	7.39E-01	-1.99E+01	-1.79E+01	9.40E-01	-1.80E-01	3.36E-02	3.73E-01	2.44E-01	2.04E-02	-2.39E+01	1.86E-10	-1.78E+01	1.09E-11	4.00E+00	6.90E-02	1.36E-01	6.57E-01
67	3.25E-15	2.00E+00	6.41E-10	1.06E-09	6.41E-01	1.38E-03	6.99E-02	8.04E-01	-1.81E+01	-2.05E+01	-1.92E-01	-1.13E-01	3.47E-01	1.40E-01	8.41E-01	7.10E-03	-2.33E+01	1.40E-10	-1.85E+01	1.76E-11	4.00E+00	9.61E-02	7.38E-02	6.25E-01
68	5.70E-15	2.00E+00	6.33E-09	4.35E-10	1.16E-01	1.08E-01	2.62E-01	5.07E-01	-1.81E+01	-1.97E+01	1.99E-01	-2.43E-01	2.67E-01	3.25E-01	6.88E-01	8.74E-03	-2.30E+01	1.32E-10	-1.87E+01	7.08E-11	4.00E+00	9.28E-02	6.94E-02	6.94E-01
69	2.63E-14	0.00E+00	6.44E-09	8.43E-10	6.07E-01	1.32E-02	1.28E-01	3.09E-01	-1.89E+01	-1.80E+01	-6.27E-01	-1.79E+00	3.82E-01	4.69E-01	2.88E+00	2.39E-02	-2.22E+01	7.94E-11	-1.85E+01	6.03E-11	1.00E+00	6.40E-02	8.06E-02	7.54E-01
70	2.72E-14	0.00E+00	2.39E-09	8.68E-10	9.31E-03	2.75E-02	1.91E-01	6.76E-01	-1.86E+01	-1.84E+01	-3.12E-03	1.49E-01	1.83E-01	9.69E-02	7.40E+00	2.30E-02	-2.21E+01	7.20E-11	-1.89E+01	1.01E-10	1.00E+00	7.67E-02	3.07E-02	5.53E-01
71	8.72E-15	0.00E+00	9.47E-09	1.80E-10	4.06E-01	1.20E-01	1.71E-01	3.21E-01	-1.73E+01	-1.93E+01	-8.82E-01	-2.38E-01	4.64E-02	5.01E-01	5.09E+00	9.70E-03	-2.23E+01	8.21E-11	-1.89E+01	7.61E-11	4.00E+00	1.04E-01	9.72E-02	6.49E-01
72	1.96E-14	2.00E+00	7.10E-09	1.21E-09	9.53E-01	7.52E-03	1.23E-01	6.04E-02	-1.91E+01	-1.82E+01	-2.24E-01	1.69E-01	1.04E-01	3.43E-01	1.36E-01	4.91E-03	-2.31E+01	1.09E-10	-1.92E+01	1.07E-10	1.00E+00	7.51E-02	8.91E-02	5.02E-01
73	2.00E-14	1.00E+00	8.55E-09	3.52E-10	4.68E-01	2.20E-02	3.65E-01	2.62E-02	-1.98E+01	-1.78E+01	-1.15E-01	4.65E-01	2.61E-01	2.38E-01	7.99E+00	4.00E-03	-2.13E+01	2.07E-11	-1.84E+01	4.02E-11	1.00E+00	1.29E-01	1.32E-01	6.42E-01
74	2.35E-14	0.00E+00	6.00E-09	3.72E-10	2.89E-01	1.18E-01	2.11E-01	5.48E-01	-1.94E+01	-2.01E+01	-4.50E-01	-1.06E-01	2.42E-01	2.06E-02	1.43E+00	9.99E-03	-2.24E+01	8.83E-11	-1.82E+01	1.09E-11	4.00E+00	1.20E-01	8.80E-02	6.68E-01

Table PAR-9. LHS Sampled Values (100 vectors) Replicate 1 — Continued

Parameter	1	2	3	4	5	6	7	8	9	10	11	12	14	15	16	17	18	19	20	21	22	23	24	25
Vector	STEEL	WAS_AREA	WAS_AREA	WAS_AREA	CELLULS	WAS_AREA	WAS_AREA	WAS_AREA	DRZ_PCS	CONC_PCS	SOLU4	SOLTH4	CONC_PCS	CONC_PCS	CONC_PCS	S_HALITE	S_HALITE	S_HALITE	S_MB139	S_MB139	S_MB139	S_MB139	S_MB139	S_MB139
Num.	CORRMCO2	PROBDEG	GRATMICI	GRATMICH	FBETA	SAT_RGAS	SAT_RBRN	SAT_WICK	PRMX_LOG	PRMX_LOG	SOLCIM	SOLCIM	SAT_RGAS	SAT_RBRN	PORE_DIS	POROSITY	PRMX_LOG	COMP_RCK	PRMX_LOG	COMP_RCK	RELP_MOD	SAT_RBRN	SAT_RGAS	PORE_DIS
38	**2.60E-14**	**0.00E+00**	**1.31E-09**	**9.67E-10**	**9.42E-01**	**1.44E-01**	**4.31E-01**	**4.27E-01**	**-1.88E+01**	**-1.94E+01**	**-2.13E-01**	**1.30E-01**	**1.88E-01**	**6.03E-02**	**4.10E+00**	**5.17E-03**	**-2.27E+01**	**9.82E-11**	**-1.94E+01**	**1.48E-10**	**4.00E+00**	**8.61E-02**	**8.44E-02**	**6.21E-01**
39	**2.17E-15**	**1.00E+00**	**3.26E-09**	**1.49E-11**	**5.87E-01**	**2.86E-02**	**1.12E-01**	**6.25E-01**	**-1.93E+01**	**-1.86E+01**	**1.44E-01**	**7.25E-01**	**2.68E-01**	**5.40E-02**	**4.02E+00**	**2.06E-03**	**-2.34E+01**	**1.64E-10**	**-1.86E+01**	**4.88E-11**	**4.00E+00**	**7.93E-02**	**9.59E-02**	**5.82E-01**
40	**4.45E-15**	**2.00E+00**	**8.32E-09**	**3.93E-10**	**8.12E-01**	**1.43E-01**	**5.20E-01**	**8.58E-01**	**-1.98E+01**	**-1.94E+01**	**-3.62E-02**	**-6.44E-01**	**2.16E-01**	**2.31E-01**	**7.25E-01**	**1.51E-02**	**-2.15E+01**	**2.75E-11**	**-1.80E+01**	**1.09E-11**	**1.00E+00**	**5.53E-02**	**4.27E-02**	**6.32E-01**
41	**1.25E-14**	**2.00E+00**	**6.07E-09**	**3.40E-10**	**9.03E-01**	**1.31E-01**	**5.39E-01**	**2.28E-01**	**-1.91E+01**	**-1.89E+01**	**4.42E-02**	**3.96E-01**	**2.94E-01**	**1.30E-01**	**5.29E+00**	**2.56E-02**	**-2.25E+01**	**1.06E-10**	**-2.01E+01**	**2.52E-10**	**4.00E+00**	**6.05E-02**	**1.70E-02**	**6.69E-01**
42	**1.22E-14**	**1.00E+00**	**5.21E-10**	**4.10E-10**	**7.83E-01**	**2.63E-02**	**4.45E-02**	**4.67E-01**	**-1.84E+01**	**-1.82E+01**	**-2.16E-01**	**-8.34E-02**	**4.74E-03**	**4.04E-02**	**4.26E-01**	**5.40E-03**	**-2.18E+01**	**4.02E-11**	**-1.95E+01**	**1.64E-10**	**4.00E+00**	**5.99E-02**	**6.27E-02**	**6.74E-01**
43	**1.40E-15**	**1.00E+00**	**8.60E-09**	**3.99E-10**	**4.26E-01**	**3.86E-02**	**4.19E-01**	**6.07E-01**	**-2.01E+01**	**-1.79E+01**	**-1.67E-01**	**-1.47E-02**	**2.88E-01**	**8.12E-02**	**4.68E-01**	**2.69E-02**	**-2.39E+01**	**1.90E-10**	**-1.95E+01**	**1.59E-10**	**4.00E+00**	**1.17E-01**	**9.15E-02**	**6.98E-01**
44	**2.77E-14**	**0.00E+00**	**8.93E-09**	**1.12E-09**	**6.31E-01**	**3.60E-02**	**1.95E-01**	**8.87E-01**	**-1.86E+01**	**-1.98E+01**	**-7.94E-01**	**7.29E-02**	**1.71E-01**	**4.55E-01**	**5.98E-01**	**1.64E-03**	**-2.17E+01**	**4.85E-11**	**-1.93E+01**	**1.43E-10**	**1.00E+00**	**1.02E-01**	**8.22E-02**	**7.70E-01**
45	**3.11E-14**	**2.00E+00**	**2.15E-09**	**7.09E-10**	**5.45E-01**	**5.43E-02**	**3.56E-01**	**1.17E-01**	**-1.87E+01**	**-1.83E+01**	**-3.08E-01**	**-6.91E-01**	**2.79E-01**	**4.08E-01**	**2.43E-01**	**2.40E-02**	**-2.24E+01**	**1.00E-10**	**-1.88E+01**	**5.46E-11**	**4.00E+00**	**9.10E-02**	**1.03E-01**	**5.93E-01**
75	1.30E-14	0.00E+00	9.00E-09	8.00E-10	4.13E-01	4.66E-02	4.99E-01	5.21E-01	-1.80E+01	-1.90E+01	-3.24E-01	-1.57E-01	8.94E-03	1.81E-01	1.74E-01	2.61E-02	-2.34E+01	1.51E-10	-1.93E+01	1.35E-10	4.00E+00	8.21E-02	6.48E-02	5.36E-01
76	2.98E-14	2.00E+00	7.87E-09	6.27E-10	1.91E-01	1.26E-01	1.52E-02	9.19E-01	-1.92E+01	-1.83E+01	1.08E-01	-1.85E-01	3.01E-01	7.34E-02	4.54E-01	2.15E-03	-2.20E+01	5.72E-11	-1.90E+01	1.04E-10	4.00E+00	9.75E-02	1.01E-01	5.88E-01
77	2.19E-14	1.00E+00	1.67E-09	4.78E-10	3.28E-01	1.42E-01	3.48E-01	9.68E-01	-1.82E+01	-1.87E+01	-8.34E-02	-9.39E-01	1.08E-01	1.57E-01	5.15E-01	2.80E-03	-2.25E+01	1.03E-10	-1.94E+01	1.49E-10	1.00E+00	6.29E-02	7.02E-02	5.43E-01
78	1.82E-14	1.00E+00	8.30E-09	4.10E-11	8.68E-01	1.16E-01	8.60E-02	2.42E-01	-1.82E+01	-1.92E+01	-5.54E-01	-2.95E-01	1.43E-02	1.22E-01	6.76E+00	1.81E-02	-2.20E+01	7.43E-11	-1.92E+01	1.32E-10	1.00E+00	1.15E-01	4.60E-02	5.86E-01
79	2.25E-14	2.00E+00	7.41E-09	9.03E-10	9.88E-01	6.49E-02	3.88E-01	5.68E-01	-1.99E+01	-1.94E+01	-2.47E-01	-1.41E-01	8.97E-02	1.64E-01	4.17E-01	1.27E-02	-2.31E+01	1.27E-10	-1.86E+01	5.56E-11	1.00E+00	1.25E-01	8.28E-02	6.87E-01
80	2.41E-14	0.00E+00	6.58E-09	5.82E-10	5.76E-02	9.63E-02	3.85E-01	1.09E-01	-1.88E+01	-1.71E+01	4.78E-02	-1.63E-01	1.23E-01	3.01E-02	2.64E-01	1.70E-02	-2.28E+01	1.08E-10	-1.90E+01	1.20E-10	1.00E+00	1.03E-01	7.72E-02	6.32E-01
81	4.08E-15	0.00E+00	1.80E-09	2.46E-10	5.62E-01	8.27E-02	1.76E-01	3.81E-01	-1.77E+01	-1.77E+01	1.75E-01	1.97E-01	6.46E-02	1.93E-01	4.02E-01	5.79E-03	-2.11E+01	8.70E-12	-1.83E+01	1.46E-11	4.00E+00	6.86E-02	7.89E-02	7.03E-01
82	9.33E-15	2.00E+00	1.45E-09	1.20E-09	7.27E-01	3.35E-02	3.06E-01	8.20E-01	-1.86E+01	-1.97E+01	-4.91E-01	7.72E-01	2.55E-02	3.94E-01	7.53E-01	2.17E-02	-2.19E+01	6.42E-11	-1.85E+01	4.67E-11	4.00E+00	1.27E-01	5.70E-02	6.07E-01
83	2.68E-14	0.00E+00	9.34E-09	4.30E-10	7.99E-01	1.35E-01	1.52E-01	5.97E-01	-1.76E+01	-1.77E+01	-4.03E-01	3.24E-01	3.92E-01	9.47E-02	9.07E-01	5.13E-03	-2.22E+01	6.60E-11	-1.82E+01	1.09E-11	1.00E+00	6.99E-02	3.64E-02	8.05E-01
84	1.78E-14	0.00E+00	3.82E-09	3.67E-10	3.75E-02	7.66E-02	5.25E-01	7.95E-03	-1.80E+01	-1.99E+01	2.34E-01	-5.64E-02	1.10E-01	1.20E-01	6.17E-01	2.53E-03	-2.32E+01	1.46E-10	-1.78E+01	1.09E-11	1.00E+00	1.12E-01	8.59E-02	6.75E-01
85	3.08E-14	1.00E+00	5.84E-09	9.26E-10	1.83E-01	1.34E-01	1.44E-01	2.79E-01	-1.88E+01	-1.86E+01	-7.46E-01	8.54E-01	1.95E-01	5.79E-01	7.17E-01	1.77E-02	-2.40E+01	1.92E-10	-1.99E+01	2.08E-10	1.00E+00	1.00E-01	5.74E-02	7.07E-01
86	1.80E-15	1.00E+00	9.18E-09	1.14E-09	3.63E-01	6.34E-02	2.50E-01	4.94E-01	-1.90E+01	-1.83E+01	-1.58E-01	2.12E-01	9.44E-02	1.74E-01	3.44E-01	1.46E-03	-2.29E+01	1.42E-10	-1.89E+01	7.85E-11	1.00E+00	5.74E-02	1.40E-02	7.09E-01
87	6.49E-15	1.00E+00	5.75E-09	8.80E-10	2.44E-01	9.22E-02	3.01E-01	8.96E-01	-1.96E+01	-1.96E+01	-2.42E-01	2.37E-01	1.41E-01	3.33E-01	1.98E+00	2.97E-02	-2.19E+01	5.89E-11	-1.80E+01	1.09E-11	1.00E+00	8.49E-02	9.31E-02	5.61E-01
88	4.38E-15	0.00E+00	7.65E-09	6.60E-10	9.10E-01	1.49E-01	1.58E-01	6.65E-01	-1.78E+01	-1.90E+01	1.39E-01	-4.12E-01	3.69E-01	9.17E-02	3.68E-01	7.35E-03	-2.21E+01	9.30E-11	-2.03E+01	2.75E-10	4.00E+00	9.19E-02	7.23E-02	5.77E-01
89	1.12E-14	2.00E+00	1.59E-09	7.92E-10	5.39E-01	7.81E-02	5.48E-01	8.36E-01	-1.86E+01	-1.82E+01	-1.33E+00	-2.53E-01	1.76E-01	1.44E-01	6.12E+00	7.77E-03	-2.16E+01	5.33E-11	-1.76E+01	1.09E-11	4.00E+00	8.89E-02	5.90E-02	6.00E-01
90	9.95E-15	2.00E+00	4.28E-09	1.04E-09	2.92E-01	9.43E-02	1.81E-01	9.53E-01	-1.80E+01	-2.04E+01	-1.73E-01	1.63E-01	1.26E-01	2.79E-01	5.40E+00	3.66E-03	-2.39E+01	1.76E-10	-1.93E+01	1.55E-10	1.00E+00	8.10E-02	1.41E-01	6.45E-01
91	2.11E-14	1.00E+00	8.43E-10	9.21E-10	6.63E-01	1.37E-01	2.84E-01	9.18E-02	-1.90E+01	-1.86E+01	-2.93E-01	-3.45E-02	8.46E-02	2.41E-01	7.88E-01	1.14E-02	-2.10E+01	4.70E-12	-1.81E+01	1.09E-11	1.00E+00	8.67E-02	9.98E-02	6.69E-01
92	3.05E-14	0.00E+00	2.46E-09	1.23E-09	8.52E-01	1.04E-01	7.38E-02	1.66E-02	-2.04E+01	-1.88E+01	-3.63E-01	5.03E-01	3.56E-01	3.86E-02	1.46E-01	7.26E-03	-2.30E+01	1.36E-10	-1.88E+01	9.40E-11	1.00E+00	9.37E-02	1.23E-01	6.28E-01
93	5.74E-15	2.00E+00	3.45E-09	2.37E-10	6.14E-01	1.30E-01	3.26E-01	8.00E-02	-1.90E+01	-1.96E+01	-9.14E-01	1.36E-01	2.46E-01	4.30E-01	6.55E-01	2.13E-02	-2.28E+01	1.13E-10	-1.92E+01	1.25E-10	1.00E+00	5.18E-02	4.78E-02	6.36E-01
94	8.23E-15	0.00E+00	5.38E-09	6.07E-10	9.91E-01	5.39E-02	4.11E-01	3.14E-01	-1.93E+01	-1.85E+01	-1.51E-01	-9.80E-02	5.56E-02	2.21E-01	7.30E+00	1.85E-03	-2.22E+01	8.67E-11	-1.95E+01	1.57E-10	1.00E+00	4.08E-02	9.90E-02	4.91E-01
95	2.81E-14	0.00E+00	3.36E-09	5.27E-10	3.31E-01	1.11E-01	4.55E-01	9.78E-01	-1.89E+01	-1.81E+01	2.06E-01	-3.88E-01	2.40E-01	2.85E-01	8.61E-01	1.58E-02	-2.29E+01	1.23E-10	-1.89E+01	6.14E-11	4.00E+00	1.49E-01	1.12E-01	6.14E-01
96	2.66E-15	0.00E+00	3.72E-09	2.19E-10	4.83E-01	9.84E-02	2.23E-01	2.37E-01	-1.78E+01	-1.82E+01	-4.64E-02	1.00E-01	3.77E-01	4.47E-01	6.38E+00	9.12E-03	-2.36E+01	1.67E-10	-1.82E+01	1.09E-11	1.00E+00	7.41E-02	1.25E-01	5.55E-01
97	2.94E-14	0.00E+00	8.88E-10	4.45E-10	6.74E-01	1.46E-01	2.48E-02	1.88E-01	-1.92E+01	-1.95E+01	4.26E-01	2.26E-01	3.65E-01	1.90E-01	1.11E+00	6.19E-03	-2.16E+01	3.20E-11	-1.74E+01	1.09E-11	4.00E+00	7.54E-02	1.40E-02	6.12E-01
98	7.47E-15	0.00E+00	2.98E-09	7.67E-11	1.80E-01	1.64E-02	1.38E-01	2.14E-01	-2.02E+01	-1.85E+01	-2.85E-01	6.08E-01	2.37E-02	1.68E-01	9.19E-01	6.59E-03	-2.16E+01	3.45E-11	-1.99E+01	2.48E-10	1.00E+00	2.69E-02	6.61E-02	6.59E-01
99	2.43E-14	1.00E+00	6.70E-09	7.50E-11	3.74E-01	1.84E-02	4.23E-01	6.35E-01	-1.97E+01	-2.00E+01	1.19E-03	-2.15E-01	1.60E-01	5.42E-01	1.22E-01	2.25E-02	-2.18E+01	6.00E-11	-1.87E+01	4.94E-11	4.00E+00	6.68E-02	5.16E-02	6.92E-01
100	2.13E-14	1.00E+00	4.08E-10	6.39E-10	2.38E-01	5.70E-02	4.29E-03	1.54E-01	-1.95E+01	-1.94E+01	3.01E-01	6.43E-02	7.67E-02	6.00E-01	5.12E+00	1.62E-02	-2.38E+01	1.72E-10	-1.90E+01	1.05E-10	1.00E+00	8.14E-02	1.17E-01	6.53E-01

Table PAR-9. LHS Sampled Values (100 vectors) Replicate 1 — Continued

Parameter	26	27	28	29	30	31	32	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
Vector Num.	S_HALITE PRESSURE	CASTILER PRESSURE	CASTILER PRMX_LOG	CASTILER COMP_RCK	BH_SAND PRMX_LOG	DRZ_1 PRMX_LOG	CONC_PLG PRMX_LOG	SOLAM3 SOLSIM	SOLAM3 SOLCIM	SOLPU3 SOLSIM	SOLPU3 SOLCIM	SOLPU4 SOLSIM	SOLPU4 SOLCIM	SOLU4 SOLSIM	SOLU6 SOLSIM	SOLU6 SOLCIM	SOLTH4 SOLSIM	PHUMOX3 PHUMCIM	GLOBAL OXSTAT	CULEBRA MINP_FAC	GLOBAL TRANSIDX	GLOBAL CLIMTIDX	CULEBRA HMBLKLT
1	1.27E+07	1.61E+07	-1.21E+01	6.60E-11	-1.56E+01	-1.53E+01	-1.83E+01	-2.01E-01	-6.30E-01	8.10E-02	-2.59E-01	1.37E-01	-1.94E+00	-4.22E-01	2.02E-01	-3.34E-02	-3.65E-01	1.44E+00	5.60E-01	2.98E+02	1.67E-01	1.23E+00	2.86E-01
2	1.22E+07	1.33E+07	-1.16E+01	5.79E-11	-1.22E+01	-1.80E+01	-1.83E+01	-9.92E-01	1.00E-02	-6.62E-01	4.83E-01	-3.87E-02	8.40E-01	-5.96E-02	-6.76E-02	-1.21E-01	-3.14E-01	1.41E+00	1.86E-01	2.09E+02	3.23E-01	1.75E+00	4.38E-01
3	1.27E+07	1.23E+07	-1.18E+01	5.32E-11	-1.35E+01	-1.42E+01	-1.84E+01	-1.38E-01	-5.31E-01	-1.22E-02	-4.38E-02	-1.46E-01	-4.45E-02	9.30E-01	-2.99E-01	-4.32E-01	-9.85E-02	2.22E-01	7.35E-01	5.39E+02	3.36E-01	1.13E+00	2.51E-01
4	1.32E+07	1.28E+07	-1.42E+01	8.88E-11	-1.24E+01	-1.45E+01	-1.83E+01	-3.15E-01	-4.96E-01	-1.90E-01	1.20E-01	-5.63E-02	-7.06E-01	-5.11E-02	-3.38E-02	6.11E-01	-1.98E+00	1.56E+00	9.76E-01	5.30E+01	1.91E-01	1.12E+00	4.27E-01
5	1.20E+07	1.45E+07	-1.23E+01	6.99E-11	-1.59E+01	-1.44E+01	-1.86E+01	2.38E-01	7.50E-01	-3.97E-02	6.16E-02	-1.65E+00	-1.56E-01	-3.26E-02	1.36E-01	4.60E-02	8.39E-01	1.38E+00	1.25E-01	5.70E+02	7.28E-01	1.65E+00	3.17E-01
6	1.18E+07	1.41E+07	-1.28E+01	6.49E-11	-1.18E+01	-1.50E+01	-1.87E+01	2.97E-01	4.80E-01	-1.28E-04	-7.09E-01	-2.95E-02	1.33E-01	-2.25E-01	-1.29E-01	-6.44E-02	7.86E-01	1.54E+00	4.65E-01	6.91E+02	1.26E-01	1.07E+00	5.75E-02
7	1.19E+07	1.33E+07	-1.18E+01	6.94E-11	-1.12E+01	-1.73E+01	-1.76E+01	-7.43E-02	9.08E-01	5.78E-01	1.73E-01	-1.20E-01	1.49E-01	-1.08E-01	-1.90E+00	1.13E-01	-5.54E-01	1.42E+00	6.22E-02	8.42E+01	6.73E-01	1.23E+00	3.13E-01
8	1.17E+07	1.21E+07	-1.02E+01	2.15E-11	-1.25E+01	-1.75E+01	-1.72E+01	-1.12E-01	-4.14E-01	-1.53E-01	9.37E-01	-3.22E-01	6.37E-02	1.24E+00	5.65E-01	2.05E-01	-1.42E-01	1.53E+00	5.34E-01	2.59E+02	5.56E-01	1.12E+00	1.82E-01
9	1.17E+07	1.51E+07	-1.20E+01	5.93E-11	-1.14E+01	-1.62E+01	-1.90E+01	-1.77E-01	-1.58E-01	-4.65E-01	-1.60E-01	-3.04E-01	-2.91E-01	-1.51E-01	-7.52E-01	-4.00E-03	-9.54E-01	1.53E-01	5.20E-01	1.00E+01	4.78E-01	1.24E+00	5.25E-02
10	1.38E+07	1.26E+07	-1.01E+01	2.46E-11	-1.19E+01	-1.27E+01	-1.76E+01	6.45E-01	-2.26E-01	9.98E-01	-9.46E-01	-1.32E-01	3.28E-01	2.52E-02	-3.89E-02	3.45E-01	-2.86E-01	1.52E+00	7.41E-01	6.43E+02	8.68E-01	1.16E+00	4.77E-01
11	1.14E+07	1.34E+07	-1.12E+01	4.30E-11	-1.37E+01	-1.47E+01	-1.80E+01	2.25E-01	-8.14E-02	-4.05E-01	-2.32E-01	-6.94E-01	-1.29E-01	-7.09E-01	-9.58E-01	9.06E-01	1.70E-01	1.58E+00	9.65E-01	6.61E+01	5.85E-01	1.13E+00	1.39E-01
12	1.28E+07	1.35E+07	-1.12E+01	5.04E-11	-1.36E+01	-1.41E+01	-1.75E+01	-3.69E-02	3.15E-02	-9.71E-02	1.59E-01	6.72E-03	-8.56E-02	-2.13E-01	2.84E-01	-1.36E-01	-4.75E-01	1.51E+00	1.94E-01	1.95E+02	9.56E-01	1.02E+00	1.63E-01
13	1.11E+07	1.29E+07	-1.33E+01	6.77E-11	-1.43E+01	-1.31E+01	-1.88E+01	-2.78E-01	-1.87E+00	-5.73E-02	7.76E-01	6.56E-02	-1.23E-01	-1.80E-01	1.71E-01	-2.44E-01	5.89E-01	9.61E-01	1.75E-01	8.21E+02	9.13E-01	1.17E+00	2.16E-01
14	1.25E+07	1.18E+07	-1.19E+01	4.03E-11	-1.56E+01	-1.32E+01	-1.79E+01	6.99E-02	2.76E-01	-7.76E-01	-3.30E-01	-1.30E+00	7.74E-03	1.68E-01	-1.16E-01	-9.50E-01	1.28E-01	1.58E+00	3.96E-01	9.41E+01	2.91E-01	1.17E+00	9.10E-02
15	1.12E+07	1.16E+07	-1.21E+01	4.56E-11	-1.38E+01	-1.34E+01	-1.81E+01	-4.08E-01	-1.93E-01	7.51E-01	-5.56E-02	1.69E-01	4.21E-01	1.18E-01	1.03E-01	7.04E-01	5.38E-02	1.00E+00	4.86E-02	2.29E+02	9.26E-02	1.05E+00	2.99E-01
16	1.29E+07	1.44E+07	-1.16E+01	4.53E-11	-1.46E+01	-1.39E+01	-1.77E+01	-1.71E-01	6.20E-01	1.40E-01	1.09E-01	3.20E-01	-1.79E-01	-1.34E-02	-2.00E-01	1.12E-02	-6.86E-02	5.73E-01	8.16E-01	4.74E+02	4.37E-01	1.09E+00	4.48E-01
17	1.18E+07	1.43E+07	-1.30E+01	7.60E-11	-1.13E+01	-1.53E+01	-1.89E+01	4.28E-01	-2.29E-01	-5.99E-01	5.38E-01	-9.78E-01	-2.27E-01	-2.41E-01	-6.41E-01	-7.84E-02	2.35E-01	1.57E+00	4.80E-01	9.05E+02	3.16E-01	1.05E+00	3.58E-01
18	1.16E+07	1.41E+07	-1.15E+01	6.18E-11	-1.36E+01	-1.76E+01	-1.71E+01	1.74E-01	-9.58E-02	2.44E-01	-1.09E-01	-3.98E-01	-1.66E+00	4.07E-02	2.03E-01	-5.92E-02	-2.09E-01	1.10E+00	2.18E-01	7.05E+02	2.07E-01	2.03E+00	4.90E-01
19	1.30E+07	1.25E+07	-1.23E+01	6.06E-11	-1.51E+01	-1.66E+01	-1.71E+01	9.65E-01	-3.89E-01	2.99E-01	2.41E-01	-2.67E-01	-3.29E-01	1.24E-01	-8.10E-01	-3.45E-01	-8.19E-01	1.57E+00	2.59E-01	1.19E+02	4.59E-01	1.10E+00	8.04E-02
20	1.37E+07	1.23E+07	-1.11E+01	3.37E-11	-1.13E+01	-1.54E+01	-1.77E+01	-2.93E-01	1.59E-01	-1.35E-01	-3.37E-02	-4.89E-01	2.10E-01	3.49E-01	9.36E-01	-3.86E-01	2.45E-01	1.39E+00	1.60E-02	4.50E+02	7.35E-02	1.96E+00	1.56E-01
21	1.21E+07	1.64E+07	-1.33E+01	7.39E-11	-1.22E+01	-1.65E+01	-1.82E+01	-5.45E-01	1.24E-01	2.18E-01	-5.19E-02	-1.75E+00	8.05E-02	6.12E-02	-3.54E-01	7.44E-02	9.19E-01	1.39E+00	6.29E-01	8.87E+02	1.85E-01	1.01E+00	2.36E-01
22	1.20E+07	1.54E+07	-1.22E+01	4.46E-11	-1.44E+01	-1.47E+01	-1.76E+01	9.19E-01	2.39E-01	1.77E-01	-2.40E-01	-4.66E-02	7.80E-01	7.53E-01	-1.48E-01	-2.86E-01	-3.90E-01	1.46E+00	8.22E-01	5.58E+02	6.44E-03	1.11E+00	4.93E-01
23	1.29E+07	1.32E+07	-1.16E+01	3.59E-11	-1.10E+01	-1.77E+01	-1.79E+01	-1.22E-01	-8.32E-01	-2.05E-01	-4.08E-01	-1.59E-01	-5.70E-02	-1.25E-01	7.91E-02	1.03E-01	-6.01E-01	1.42E+00	5.16E-02	5.08E+02	4.16E-01	1.02E+00	3.36E-01
24	1.30E+07	1.53E+07	-1.17E+01	4.17E-11	-1.52E+01	-1.92E+01	-1.75E+01	-9.12E-02	1.46E-02	-9.47E-01	-3.91E-01	9.48E-02	1.83E-01	8.13E-01	-1.92E-01	-2.00E-01	-4.18E-01	1.50E+00	9.97E-01	2.60E+01	4.66E-01	1.19E+00	6.06E-02
25	1.25E+07	1.28E+07	-1.07E+01	3.48E-11	-1.63E+01	-1.81E+01	-1.80E+01	-1.73E+00	-5.68E-02	4.69E-01	6.43E-01	2.01E-01	1.81E-02	-1.27E+00	-1.82E-01	2.17E-01	-2.34E-01	3.82E-01	6.69E-01	2.50E+02	1.51E-01	1.19E+00	6.48E-02
26	1.32E+07	1.45E+07	-1.13E+01	4.98E-11	-1.57E+01	-1.25E+01	-1.82E+01	-1.09E-01	-3.29E-01	1.07E-01	8.88E-01	2.49E-01	-7.26E-02	1.93E-01	1.86E-02	-7.84E-01	-7.57E-02	1.50E+00	5.00E-01	8.70E+02	7.53E-01	1.90E+00	1.31E-01
27	1.23E+07	1.49E+07	-1.12E+01	3.06E-11	-1.47E+01	-1.42E+01	-1.80E+01	-1.61E-01	-2.25E-02	-8.74E-01	-1.44E-01	9.38E-01	-3.77E-01	-1.65E-01	-1.15E+00	-5.65E-01	-5.61E-02	7.23E-01	5.91E-01	7.41E+02	5.00E-01	1.24E+00	1.52E-01
28	1.36E+07	1.28E+07	-1.34E+01	4.41E-11	-1.40E+01	-1.61E+01	-1.77E+01	7.78E-01	-1.46E-01	1.87E-02	3.42E-02	-1.49E-01	-4.59E-01	1.33E-01	-4.65E-01	2.64E-01	2.76E-01	1.16E+00	3.54E-01	5.14E+02	7.86E-01	1.08E+00	7.46E-02
29	1.37E+07	1.63E+07	-1.23E+01	6.73E-11	-1.59E+01	-1.36E+01	-1.88E+01	-8.92E-01	-6.75E-01	-1.82E-01	-2.25E-01	-9.08E-01	-1.00E-01	2.18E-01	-1.44E-01	-7.14E-02	-2.17E-02	1.53E+00	2.67E-01	7.90E+02	2.71E-01	1.93E+00	9.64E-02
30	1.27E+07	1.24E+07	-1.39E+01	8.52E-11	-1.20E+01	-1.51E+01	-1.78E+01	-1.27E-01	-1.85E-01	1.13E-01	-3.55E-01	2.55E-01	5.74E-01	-3.69E-01	-2.72E-01	-1.88E+00	-4.36E-02	7.77E-01	8.36E-01	4.69E+01	2.47E-01	1.04E+00	1.16E-01
31	1.30E+07	1.36E+07	-1.23E+01	6.37E-11	-1.12E+01	-1.54E+01	-1.78E+01	-3.17E-02	-1.39E+00	1.57E-01	-1.70E-01	1.79E-01	-1.46E-01	-7.62E-02	-2.46E-01	-4.90E-01	-1.92E-01	1.49E+00	9.24E-01	9.61E+02	9.33E-01	1.11E+00	3.81E-01
32	1.32E+07	1.60E+07	-1.28E+01	4.75E-11	-1.29E+01	-1.80E+01	-1.71E+01	-8.80E-02	-3.17E-01	-1.53E-01	4.34E-01	3.66E-01	-1.73E-01	8.60E-02	-2.31E-01	-1.56E-01	-1.59E+00	1.44E+00	2.93E-01	9.98E+02	6.95E-02	1.21E+00	1.89E-01
33	1.28E+07	1.24E+07	-1.05E+01	3.84E-11	-1.17E+01	-1.33E+01	-1.73E+01	1.79E-01	-2.40E-01	8.56E-01	-1.12E-01	5.78E-02	-8.23E-01	-1.14E-01	1.26E-01	-4.58E-02	2.15E-01	8.12E-01	3.85E-01	2.37E+02	8.28E-01	1.20E+00	3.39E-01
34	1.29E+07	1.66E+07	-1.17E+01	4.60E-11	-1.62E+01	-1.28E+01	-1.75E+01	3.33E-01	-2.04E-01	-7.01E-02	-1.75E-01	5.59E-01	9.89E-01	-4.49E-01	-3.24E-01	-5.44E-02	-2.97E-02	1.56E+00	5.03E-01	6.15E+02	7.74E-01	1.24E+00	2.02E-01
35	1.26E+07	1.52E+07	-1.24E+01	5.47E-11	-1.61E+01	-1.89E+01	-1.84E+01	1.33E+00	-1.44E-01	6.13E-01	-1.93E-01	1.15E-01	-4.45E-01	-1.42E-01	2.31E-01	-4.02E-02	-7.06E-01	9.40E-02	2.83E-01	1.45E+02	5.92E-01	1.11E+00	1.72E-01
36	1.33E+07	1.34E+07	-1.06E+01	2.93E-11	-1.61E+01	-1.67E+01	-1.84E+01	-6.61E-02	-3.46E-01	-1.96E+00	-8.79E-02	1.49E-01	8.66E-02	-3.19E-01	6.10E-01	2.02E-02	6.13E-01	1.38E+00	7.82E-01	3.46E+02	5.17E-01	1.15E+00	4.08E-01
37	1.37E+07	1.48E+07	-1.04E+01	5.09E-11	-1.54E+01	-1.44E+01	-1.84E+01	-2.13E-02	-1.31E-01	-5.17E-02	-6.39E-02	-2.47E-01	-5.87E-01	-3.95E-01	8.26E-01	-1.20E+00	3.43E-01	1.49E+00	3.13E-01	3.76E+02	3.92E-01	1.02E+00	4.43E-01
38	1.16E+07	1.48E+07	-1.08E+01	4.81E-11	-1.46E+01	-1.71E+01	-1.85E+01	-1.30E+00	-3.96E-01	6.69E-03	8.39E-02	-5.55E-01	-6.34E-01	2.05E-01	-1.55E+00	-2.19E-01	-1.30E-01	1.06E+00	9.20E-02	4.83E+02	1.01E-02	1.06E+00	4.69E-01
39	1.35E+07	1.17E+07	-1.14E+01	7.31E-11	-1.29E+01	-1.93E+01	-1.73E+01	6.80E-01	-6.11E-01	-3.22E-01	1.91E-01	-4.58E-01	-1.08E-01	-3.45E-01	-2.25E-01	7.99E-01	-7.68E-03	9.09E-01	4.36E-01	7.14E+02	6.61E-01	2.01E+00	2.26E-01
40	1.15E+07	1.39E+07	-1.19E+01	4.22E-11	-1.59E+01	-1.56E+01	-1.70E+01	-1.52E-01	-4.72E-01	2.13E-01	-8.92E-01	-6.11E-01	-3.63E-01	-7.73E-02	6.65E-02	2.01E-01	-1.66E-01	1.48E+00	7.60E-01	7.30E+02	6.26E-01	1.15E+00	3.56E-01
41	1.24E+07	1.14E+07	-1.19E+01	3.73E-11	-1.28E+01	-1.57E+01	-1.79E+01	-8.85E-01	-6.04E-03	-1.72E-01	6.61E-01	2.04E-01	-2.79E-01	-6.10E-01	7.68E-01	-2.31E-01	-4.29E-01	3.18E-01	6.55E-01	8.49E+02	5.60E-01	1.07E+00	1.69E-01
42	1.14E+07	1.22E+07	-1.26E+01	5.70E-11	-1.30E+01	-1.57E+01	-1.83E+01	3.82E-02	-1.75E+00	-1.07E-01	-5.29E-01	7.58E-02	-2.57E-03	-2.07E-01	-9.41E-01	-2.56E-01	-8.53E-02	1.47E+00	1.35E-01	8.39E+02	7.00E-01	1.16E+00	1.05E-01
43	1.19E+07	1.37E+07	-1.22E+01	4.28E-11	-1.25E+01	-1.73E+01	-1.87E+01	2.45E-01	-1.37E-01	-3.51E-01	-2.07E-01	6.57E-01	-2.31E-01	-2.13E-02	-4.09E-01	4.84E-01	5.15E-01	3.68E-01	2.31E-01	1.33E+02	4.23E-01	1.19E+00	4.67E-01
44	1.26E+07	1.44E+07	-1.20E+01	6.09E-11	-1.29E+01	-1.27E+01	-1.72E+01	-2.07E-01	3.83E-01	-3.62E-01	-8.02E-01	8.65E-01	-4.75E-01	-9.95E-01	-5.28E-01	-1.95E-02	-9.27E-02	1.48E+00	2.40E-01	9.72E+02	9.41E-01	2.14E+00	1.42E-01
45	1.36E+07	1.39E+07	-1.10E+01	2.98E-11	-1.16E+01	-1.63E+01	-1.74E+01	-3.67E-01	-9.37E-01	1.88E-01	-6.35E-01	-2.23E-01	-2.14E-01	6.85E-01	-3.08E-01	-1.12E-01	7.14E-01	9.29E-01	8.43E-01	5.75E+02	9.10E-01	1.63E+00	3.94E-01
46	1.24E+07	1.56E+07	-1.36E+01	8.39E-11	-1.11E+01	-1.69E+01	-1.83E+01	-4.14E-01	3.39E-01	1.15E+00	1.40E-01	-3.46E-01	5.22E-01	-2.96E-01	3.69E-01	-1.67E-01	-3.54E-02	1.11E+00	6.05E-01	4.91E+02	8.06E-01	1.12E+00	1.97E-01
47	1.19E+07	1.40E+07	-1.25E+01	6.26E-11	-1.57E+01	-1.31E+01	-1.74E+01	-3.54E-01	4.35E-01	-3.19E-01	9.90E-02	-6.28E-01	-9.57E-02	8.50E-01	5.58E-02	1.86E-01	-1.12E-01	1.43E+00	4.45E-01	3.94E+02	7.45E-01	1.13E+00	2.75E-01
48	1.18E+07	1.52E+07	-1.17E+01	5.16E-11	-1.50E+01	-1.37E+01	-1.71E+01	6.62E-03	-1.67E-02	-5.53E-01	-3.08E-01	1.64E-01	5.48E-02	7.16E-01	-8.53E-02	-4.09E-01	-2.22E-01	1.90E-01	4.18E-01	9.27E+02	1.43E-01	1.01E+00	3.44E-01
49	1.23E+07	1.47E+07	-1.13E+01	2.81E-11	-1.51E+01	-1.71E+01	-1.81E+01	-3.33E-01	-2.69E-01	3.80E-02	-1.58E-01	-4.74E-01	-1.89E-02	-1.92E+00	-5.87E-02	5.96E-01	-3.32E-01	5.50E-01	7.15E-01	4.26E+02	7.16E-01	1.25E+00	3.04E-01
50	1.34E+07	1.25E+07	-1.20E+01	5.88E-11	-1.43E+01	-1.90E+01	-1.77E+01	-5.72E-01	1.72E-01	-1.25E-01	7.99E-03	2.15E-02	-9.43E-01	-3.78E-01	8.86E-01	6.57E-02	9.88E-01	1.53E+00	6.46E-01	7.69E+02	3.77E-01	1.14E+00	1.33E-01

Table PAR-9. LHS Sampled Values (100 vectors) Replicate 1 — Continued

Parameter	26	27	28	29	30	31	32	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
Vector Num.	S_HALITE PRESSURE	CASTILER PRESSURE	CASTILER PRMX_LOG	CASTILER COMP_RCK	BH_SAND PRMX_LOG	DRZ_1 PRMX_LOG	CONC_PLG PRMX_LOG	SOLAM3 SOLSIM	SOLAM3 SOLCIM	SOLPU3 SOLSIM	SOLPU3 SOLCIM	SOLPU4 SOLSIM	SOLPU4 SOLCIM	SOLU4 SOLSIM	SOLU6 SOLSIM	SOLU6 SOLCIM	SOLTH4 SOLSIM	PHUMOX3 PHUMCIM	GLOBAL OXSTAT	CULEBRA MINP_FAC	GLOBAL TRANSIDX	GLOBAL CLIMTIDX	CULEBRA HMBLKLT
51	1.16E+07	1.40E+07	-1.03E+01	2.66E-11	-1.43E+01	-1.87E+01	-1.86E+01	-4.57E-02	9.91E-02	5.35E-01	-4.25E-01	-2.56E-02	-2.17E-01	9.65E-01	-1.81E-01	-5.42E-01	-5.34E-02	1.37E+00	9.60E-01	9.13E+02	6.49E-01	1.03E+00	7.23E-02
52	1.20E+07	1.38E+07	-1.17E+01	4.72E-11	-1.53E+01	-1.84E+01	-1.75E+01	1.06E-01	-1.18E+00	6.69E-01	-1.52E-01	5.38E-01	3.60E-01	-2.46E-01	-4.23E-01	-2.43E-01	1.01E+00	1.46E+00	2.79E-02	1.60E+02	8.13E-02	1.56E+00	2.83E-01
53	1.35E+07	1.42E+07	-1.15E+01	4.07E-11	-1.51E+01	-1.60E+01	-1.78E+01	-1.94E+00	-8.42E-02	-4.84E-02	-4.62E-01	-3.81E-01	-1.13E-01	5.82E-01	-5.89E-01	-4.54E-01	-1.39E-01	5.28E-01	3.34E-01	3.52E+02	3.48E-01	1.22E+00	2.70E-01
54	1.31E+07	1.27E+07	-1.31E+01	7.75E-11	-1.26E+01	-1.46E+01	-1.72E+01	3.09E-02	-1.07E-01	-2.11E-01	-2.12E-01	-2.71E-01	-9.54E-01	-4.29E-01	-9.54E-02	-9.82E-02	4.69E-02	1.40E+00	8.55E-01	4.20E+02	4.97E-02	1.00E+00	3.89E-01
55	1.11E+07	1.37E+07	-1.16E+01	3.80E-11	-1.32E+01	-1.58E+01	-1.86E+01	3.73E-01	-7.73E-01	-2.41E-01	-1.85E-01	-1.23E+00	8.93E-01	-9.21E-01	-7.75E-02	-7.40E-01	2.05E-01	4.91E-01	5.77E-01	2.64E+02	8.87E-01	1.22E+00	3.29E-01
56	1.17E+07	1.43E+07	-1.29E+01	3.92E-11	-1.26E+01	-1.78E+01	-1.88E+01	8.51E-01	9.90E-01	-2.42E-02	1.84E-01	1.40E+00	-1.11E+00	8.22E-02	-2.28E-02	-1.29E-01	8.52E-01	1.01E+00	2.74E-01	8.13E+02	4.10E-01	1.18E+00	3.27E-01
57	1.14E+07	1.35E+07	-1.14E+01	4.14E-11	-1.35E+01	-1.91E+01	-1.89E+01	-2.12E-01	-2.87E-01	-1.18E-01	-1.90E+00	-1.19E-02	-3.08E-01	1.62E-01	3.04E-01	8.46E-01	-2.28E-01	1.41E+00	1.41E-01	5.21E+02	1.71E-01	2.16E+00	4.78E-01
58	1.25E+07	1.38E+07	-1.40E+01	7.16E-11	-1.27E+01	-1.34E+01	-1.76E+01	-1.85E-01	8.75E-01	3.43E-01	-2.91E-01	-8.33E-01	-2.46E-01	-1.68E-01	-2.08E-01	-4.27E-01	1.04E-01	1.55E+00	7.68E-01	3.26E+01	4.81E-01	2.25E+00	4.52E-01
59	1.33E+07	1.32E+07	-1.34E+01	4.66E-11	-1.56E+01	-1.84E+01	-1.74E+01	7.24E-01	8.84E-02	-4.35E-01	-2.84E-01	-2.32E-01	-4.01E-02	-1.56E+00	-1.01E-01	8.68E-01	-5.00E-01	1.47E+00	3.24E-01	9.32E+02	1.35E-01	1.60E+00	2.23E-01
60	1.15E+07	1.29E+07	-1.30E+01	4.86E-11	-1.23E+01	-1.68E+01	-1.81E+01	-7.91E-01	1.36E-01	-6.70E-02	-7.77E-01	-1.85E-01	2.28E-01	-8.16E-01	-3.58E-01	-1.16E-02	-1.72E-01	1.44E+00	8.75E-02	1.30E+02	9.81E-01	1.06E+00	2.05E-01
61	1.33E+07	1.25E+07	-1.19E+01	3.50E-11	-1.58E+01	-1.59E+01	-1.73E+01	-7.09E-01	7.89E-02	9.04E-01	-3.49E-02	1.02E-01	-2.38E-01	-1.02E-01	-4.96E-01	-1.48E-01	-1.49E-01	2.46E-01	9.09E-01	3.84E+02	9.29E-01	1.02E+00	3.24E-01
62	1.13E+07	1.20E+07	-1.07E+01	5.40E-11	-1.41E+01	-1.48E+01	-1.84E+01	-4.57E-01	5.85E-02	-2.17E-01	7.36E-02	9.92E-01	-9.55E-03	-1.68E-02	-4.58E-01	3.94E-01	9.17E-02	1.55E+00	5.88E-01	2.83E+02	2.63E-01	1.17E+00	2.65E-01
63	1.23E+07	1.27E+07	-1.09E+01	5.53E-11	-1.17E+01	-1.50E+01	-1.89E+01	8.37E-01	1.84E-01	-2.25E-01	-1.60E+00	-1.74E-01	-1.83E-01	4.60E-01	-7.82E-03	-3.61E-01	-2.37E-01	7.26E-02	4.81E-01	8.98E+02	8.51E-01	1.24E+00	2.58E-01
64	1.24E+07	1.12E+07	-1.30E+01	5.29E-11	-1.62E+01	-1.40E+01	-1.90E+01	-3.79E-01	-3.84E-02	-7.90E-02	2.02E-01	-1.94E-01	-5.05E-02	1.81E-01	-6.89E-01	1.65E-01	-1.96E-01	1.54E+00	7.96E-01	8.07E+02	3.62E-01	1.83E+00	4.57E-01
65	1.13E+07	1.23E+07	-1.13E+01	6.86E-11	-1.50E+01	-1.78E+01	-1.79E+01	2.13E-01	2.31E-01	-1.18E-01	-5.93E-01	6.16E-01	-2.43E-02	-2.17E-01	5.25E-01	-2.06E-01	-8.11E-02	1.57E+00	8.84E-01	4.33E+02	2.76E-02	1.07E+00	3.08E-01
66	1.23E+07	1.31E+07	-1.09E+01	3.62E-11	-1.15E+01	-1.77E+01	-1.82E+01	-8.03E-02	8.43E-01	2.36E-01	1.09E+00	-7.48E-01	1.29E-01	-7.32E-01	2.50E-01	-3.09E-01	-8.46E-01	8.72E-01	9.39E-01	9.40E+02	1.17E-01	2.05E+00	2.76E-01
67	1.31E+07	1.29E+07	-1.35E+01	7.87E-11	-1.34E+01	-1.38E+01	-1.76E+01	-2.41E-01	-1.19E-01	-2.61E-01	-7.77E-02	-2.06E-01	-5.09E-01	-1.33E-01	1.21E+00	-2.28E-01	1.53E-01	2.75E-01	8.94E-01	1.82E+02	3.53E-01	1.18E+00	2.93E-01
68	1.39E+07	1.37E+07	-1.10E+01	3.78E-11	-1.45E+01	-1.70E+01	-1.90E+01	-8.37E-03	1.07E-01	-1.78E-01	-1.35E-01	-8.41E-01	-2.65E-01	-6.65E-01	6.79E-03	-6.87E-01	-1.45E+00	6.97E-01	6.76E-03	7.38E+02	5.27E-01	1.14E+00	1.92E-01
69	1.35E+07	1.35E+07	-1.20E+01	4.94E-11	-1.32E+01	-1.65E+01	-1.87E+01	-2.16E-01	-8.43E-01	-2.48E-01	-2.47E-01	-5.19E-02	-6.82E-02	-1.11E+00	-8.37E-01	-1.61E-01	1.89E-01	1.27E+00	9.87E-01	5.81E+02	6.06E-01	1.09E+00	4.97E-01
70	1.36E+07	1.31E+07	-1.27E+01	7.09E-11	-1.49E+01	-1.70E+01	-1.84E+01	1.95E-01	7.79E-01	-2.07E-02	3.29E-01	-6.47E-03	-8.47E-01	2.93E-01	-1.48E+00	1.36E-01	1.41E-01	1.04E+00	6.75E-01	3.40E+02	5.46E-01	1.20E+00	1.01E-01
71	1.34E+07	1.19E+07	-1.27E+01	7.70E-11	-1.45E+01	-1.91E+01	-1.71E+01	-5.39E-02	6.68E-02	-1.59E+00	-7.47E-02	-8.12E-02	9.39E-01	1.45E-01	-2.21E-01	-8.42E-01	4.11E-01	7.55E-01	4.29E-01	7.74E+02	6.98E-01	1.86E+00	4.85E-01
72	1.34E+07	1.47E+07	-1.08E+01	5.22E-11	-1.37E+01	-1.30E+01	-1.81E+01	1.25E-01	-4.42E-02	-7.97E-01	4.21E-02	-2.17E-01	-1.91E-01	-3.33E-01	-4.62E-02	1.28E-01	-2.56E-01	6.60E-01	1.60E-01	1.04E+02	7.91E-01	1.04E+00	3.97E-01
73	1.21E+07	1.50E+07	-1.32E+01	8.18E-11	-1.27E+01	-1.29E+01	-1.72E+01	1.99E-02	-1.79E-01	-2.97E-01	-5.89E-03	-1.18E-01	1.91E-01	4.13E-01	1.11E-01	2.43E-01	-1.23E-01	1.28E-01	8.70E-01	6.10E+02	2.60E-01	1.54E+00	2.45E-01
74	1.21E+07	1.22E+07	-1.29E+01	6.43E-11	-1.60E+01	-1.82E+01	-1.89E+01	1.44E-01	-1.17E-02	8.35E-01	-8.42E-01	-9.38E-02	1.20E+00	-2.34E-01	4.32E-01	4.29E-01	-6.65E-01	1.20E+00	4.09E-01	7.55E+02	3.10E-01	1.03E+00	3.64E-01
75	1.12E+07	1.19E+07	-1.15E+01	5.15E-11	-1.33E+01	-1.41E+01	-1.78E+01	1.40E-01	4.23E-02	3.56E-01	-1.29E-01	-2.98E-01	1.06E-01	-1.26E-01	8.34E-02	-8.55E-02	-1.94E-02	4.45E-01	9.11E-01	6.30E+02	3.86E-01	2.19E+00	8.62E-02
76	1.37E+07	1.27E+07	-1.14E+01	3.90E-11	-1.21E+01	-1.44E+01	-1.88E+01	5.04E-02	6.93E-01	-4.47E-01	-1.18E+00	-7.01E-02	2.20E-01	-8.71E-02	2.21E-01	-1.79E-01	-3.40E-01	6.91E-01	6.81E-01	4.60E+02	4.92E-01	1.23E+00	8.43E-02
77	1.28E+07	1.59E+07	-1.36E+01	5.41E-11	-1.33E+01	-1.38E+01	-1.71E+01	-4.90E-01	5.15E-01	9.49E-02	-1.18E-01	-1.06E-01	1.56E-01	-8.62E-01	-5.49E-02	-1.45E-01	3.58E-01	2.71E-01	3.47E-01	4.03E+02	2.24E-01	1.15E+00	4.16E-01
78	1.12E+07	1.41E+07	-1.11E+01	3.15E-11	-1.15E+01	-1.51E+01	-1.75E+01	-2.34E-01	1.51E-01	-1.03E+00	5.23E-02	3.66E-02	-4.05E-01	-4.77E-01	1.62E-01	-1.52E+00	-8.95E-01	1.60E+00	5.64E-01	4.64E+02	1.04E-01	1.22E+00	3.74E-01
79	1.22E+07	1.57E+07	-1.08E+01	2.79E-11	-1.23E+01	-1.84E+01	-1.73E+01	-1.61E-02	5.58E-01	-9.17E-01	8.18E-01	-1.76E-02	4.66E-01	3.54E-01	-1.66E-02	1.12E+00	1.60E-01	1.31E+00	7.44E-02	3.08E+02	9.61E-01	1.05E+00	3.69E-01
80	1.15E+07	1.30E+07	-1.38E+01	8.14E-11	-1.40E+01	-1.88E+01	-1.74E+01	-7.59E-01	-1.70E-01	-4.17E-01	-1.32E+00	-1.99E-01	-7.23E-01	-4.20E-02	7.06E-01	5.93E-02	6.82E-02	8.23E-01	3.64E-01	5.43E+02	8.45E-01	1.09E+00	1.26E-01
81	1.16E+07	1.54E+07	-1.19E+01	5.67E-11	-1.21E+01	-1.61E+01	-1.80E+01	-4.30E-01	-1.97E-01	-1.96E-01	-3.61E-01	4.37E-01	-2.02E-01	6.04E-01	9.76E-01	1.72E-01	6.58E-01	1.41E+00	6.32E-01	1.87E+01	6.36E-01	1.71E+00	1.19E-01
82	1.11E+07	1.46E+07	-1.28E+01	3.97E-11	-1.18E+01	-1.88E+01	-1.87E+01	4.79E-01	-9.84E-01	-6.69E-01	2.31E-01	1.24E-01	-4.27E-01	4.81E-03	1.80E-01	-9.36E-01	-2.76E-01	1.26E+00	7.26E-01	2.15E+02	5.79E-01	1.11E+00	3.72E-01
83	1.31E+07	1.21E+07	-1.22E+01	3.31E-11	-1.49E+01	-1.74E+01	-1.78E+01	5.73E-01	-7.04E-02	-8.63E-02	1.50E-01	-2.42E-01	-1.31E+00	-1.58E-01	-4.43E-01	-2.72E-01	1.34E-02	4.11E-01	1.12E-01	7.36E+01	2.84E-01	1.21E+00	3.87E-01
84	1.25E+07	1.27E+07	-1.25E+01	3.66E-11	-1.19E+01	-1.26E+01	-1.82E+01	-9.74E-02	-2.11E-01	-1.65E-01	-1.47E-02	8.09E-01	1.74E-01	-5.53E-04	-1.60E-01	5.40E-01	-1.08E+00	3.47E-01	3.11E-02	3.17E+02	5.08E-02	1.20E+00	2.41E-01
85	1.27E+07	1.37E+07	-1.25E+01	6.29E-11	-1.38E+01	-1.83E+01	-1.82E+01	1.64E-01	-4.34E-01	1.55E-01	7.25E-01	-3.69E-01	-7.98E-02	2.44E-01	-1.19E-01	9.92E-01	-1.07E-01	1.35E+00	7.71E-01	9.59E+02	5.32E-01	1.04E+00	1.10E-01
86	1.11E+07	1.49E+07	-1.05E+01	3.41E-11	-1.53E+01	-1.55E+01	-1.79E+01	7.28E-02	2.21E-01	-1.04E-01	-2.57E-02	-2.09E-01	6.16E-01	-2.61E-01	-2.41E-01	-1.88E-01	-1.53E-01	1.17E+00	6.95E-01	6.86E+02	7.61E-01	1.04E+00	4.04E-01
87	1.13E+07	1.21E+07	-1.24E+01	4.89E-11	-1.39E+01	-1.62E+01	-1.85E+01	-6.37E-01	1.08E+00	6.00E-02	-4.98E-01	2.92E-02	-4.93E-01	-6.63E-02	-3.91E-01	-1.82E-01	2.84E-02	1.32E+00	6.13E-01	8.61E+02	8.19E-01	1.09E+00	4.60E-01
88	1.21E+07	1.30E+07	-1.31E+01	6.66E-11	-1.48E+01	-1.37E+01	-1.86E+01	5.34E-01	-3.75E-02	-2.84E-01	9.82E-01	-1.73E-01	2.65E-02	-1.83E-01	4.12E-02	-9.53E-02	1.09E-01	6.29E-01	9.47E-01	3.64E+02	7.40E-01	1.82E+00	3.47E-01
89	1.22E+07	1.32E+07	-1.31E+01	8.65E-11	-1.30E+01	-1.94E+01	-1.78E+01	-2.94E-03	-5.28E-02	4.45E-01	2.23E-01	7.81E-01	-1.37E-01	-2.01E-01	-7.15E-02	-4.81E-01	1.05E-02	1.40E+00	3.02E-01	6.60E+02	6.86E-01	1.72E+00	2.90E-01
90	1.31E+07	1.33E+07	-1.13E+01	3.21E-11	-1.16E+01	-1.85E+01	-1.85E+01	-1.09E+00	-2.20E-01	-3.39E-02	-4.32E-01	-1.64E-01	1.18E-01	5.70E-02	-2.61E-01	6.82E-01	1.98E-01	1.51E+00	8.68E-01	9.83E+02	2.14E-01	1.78E+00	1.45E-01
91	1.38E+07	1.31E+07	-1.18E+01	4.11E-11	-1.11E+01	-1.35E+01	-1.86E+01	1.10E-01	-2.48E-01	1.99E-01	5.75E-01	4.78E-01	-3.03E-02	-5.53E-01	1.48E-01	1.44E-01	4.71E-01	1.45E+00	7.06E-01	1.73E+02	3.49E-02	1.15E+00	1.61E-01
92	1.26E+07	1.42E+07	-1.25E+01	4.37E-11	-1.54E+01	-1.91E+01	-1.75E+01	-1.57E-01	-4.48E-01	7.19E-01	-2.16E-01	-1.32E-01	2.60E-01	-2.72E-01	-1.09E-01	-1.45E+00	-2.06E-01	1.51E+00	2.08E-01	5.91E+02	6.17E-01	2.09E+00	2.31E-01
93	1.35E+07	1.55E+07	-1.45E+01	9.02E-11	-1.39E+01	-1.72E+01	-1.89E+01	9.06E-02	-1.66E-01	5.41E-02	2.02E-02	2.31E-01	7.45E-01	5.44E-01	-4.34E-04	3.39E-02	-4.02E-01	1.21E+00	8.04E-01	3.23E+02	8.70E-01	2.12E+00	4.23E-01
94	1.37E+07	1.26E+07	-1.37E+01	7.94E-11	-1.42E+01	-1.64E+01	-1.81E+01	-2.65E-01	2.10E-01	-1.36E+00	-1.95E-01	2.14E-01	4.41E-02	-9.48E-02	-1.35E-01	8.73E-02	7.49E-02	1.43E+00	2.29E-01	8.56E+02	4.49E-01	1.01E+00	2.10E-01
95	1.32E+07	1.45E+07	-1.22E+01	7.43E-11	-1.31E+01	-1.86E+01	-1.88E+01	-4.74E-01	2.02E-01	2.56E-02	-9.36E-02	7.06E-01	-1.63E-01	2.29E-01	4.75E-01	-1.08E-01	-4.49E-01	1.59E+00	4.55E-01	2.72E+02	9.94E-01	1.06E+00	4.29E-01
96	1.15E+07	1.30E+07	-1.36E+01	5.78E-11	-1.55E+01	-1.30E+01	-1.85E+01	-5.58E-02	-2.84E-02	1.28E-01	-1.03E-01	-4.14E-01	-3.49E-01	1.02E-01	6.90E-01	-2.11E-01	-7.23E-01	1.59E+00	1.64E-01	6.52E+02	8.98E-01	1.20E+00	2.21E-01
97	1.19E+07	1.26E+07	-1.26E+01	5.60E-11	-1.23E+01	-1.58E+01	-1.70E+01	-1.88E-01	-1.14E-01	-4.87E-01	-7.75E-03	-9.75E-02	-1.43E-01	-4.88E-01	-2.05E-01	2.27E-01	-1.78E-01	8.99E-01	5.28E-01	7.90E+02	9.74E-01	1.52E+00	4.12E-01
98	1.38E+07	1.36E+07	-1.21E+01	4.46E-11	-1.42E+01	-1.79E+01	-1.87E+01	-1.43E-01	-6.32E-02	-1.44E-01	2.81E-01	-6.30E-02	2.41E-01	-4.15E-02	-1.65E-01	-6.48E-01	-2.19E-03	1.45E+00	3.77E-01	1.63E+02	8.38E-01	1.10E+00	4.33E-01
99	1.28E+07	1.18E+07	-1.41E+01	9.53E-11	-1.33E+01	-1.49E+01	-1.72E+01	-2.44E-01	-2.63E-01	-2.33E-01	-4.82E-01	-8.77E-02	6.82E-01	1.35E-02	-1.73E-01	-2.64E-02	-1.86E-01	4.76E-01	1.08E-01	6.73E+02	2.31E-01	1.08E+00	2.55E-01
100	1.12E+07	1.32E+07	-1.27E+01	6.01E-11	-1.47E+01	-1.67E+01	-1.74E+01	-2.26E-01	-1.01E-01	-3.86E-01	3.99E-01	-4.39E-01	-1.97E-01	-1.89E-01	2.74E-02	-3.24E-01	-2.49E-01	6.02E-01	5.41E-01	6.27E+02	6.54E-01	1.16E+00	1.78E-01

Table PAR-9. LHS Sampled Values (100 vectors) Replicate 1 — Continued

Parameter	50	51	52	53	54	55	56	57	58	60	61	62	63	64	65	66	75
Vector Num.	CULEBRA APOROS	CULEBRA DPOROS	U+6 MKD_U	U+4 MKD_U	PU+3 MKD_PU	PU+4 MKD_PU	TH+4 MKD_TH	AM+3 MKD_AM	BOREHOLE TAUFAIL	GLOBAL PBRINE	BOREHOLE DOMEGA	SHFTU SAT_RBRN	SHFTU SAT_RGAS	SHFTU PRMX_LOG	SHFTL_T1 PRMX_LOG	SHFTL_T2 PRMX_LOG	SPALLMOD RNDSPALL
1	1.14E-03	1.20E-01	3.25E-03	2.06E+00	2.66E-02	1.53E+00	5.20E+00	3.89E-02	1.03E+00	4.85E-01	7.01E+00	3.86E-01	2.05E-01	-1.79E+01	-1.79E+01	-2.08E+01	1.66E-01
2	2.01E-04	1.72E-01	1.31E-02	4.61E+00	5.43E-02	5.02E+00	2.22E+00	2.04E-02	1.09E+01	2.00E-01	1.15E+01	5.10E-01	1.46E-01	-1.87E+01	-1.85E+01	-2.01E+01	3.58E-01
3	1.66E-03	1.41E-01	4.46E-04	2.23E+00	3.93E-02	8.22E+00	6.69E+00	2.64E-02	3.65E+01	3.73E-01	6.30E+00	1.90E-01	3.48E-01	-1.80E+01	-1.70E+01	-2.04E+01	1.71E-01
4	1.03E-04	1.46E-01	1.45E-02	1.88E+00	1.01E-01	2.28E+00	1.26E+00	6.96E-02	5.40E+00	3.24E-01	9.11E+00	3.69E-02	3.30E-01	-1.82E+01	-1.70E+01	-2.02E+01	3.26E-01
5	3.82E-04	1.80E-01	1.84E-03	4.78E+00	6.50E-02	1.50E+00	2.58E+00	1.81E-01	2.42E-01	1.73E-01	7.05E+00	2.54E-01	1.90E-01	-1.77E+01	-1.87E+01	-2.04E+01	5.72E-01
6	2.87E-04	1.45E-01	2.83E-04	6.97E+00	1.16E-01	4.20E+00	1.29E+00	6.56E-02	6.25E-02	3.30E-01	1.25E+01	5.28E-01	1.04E-01	-1.80E+01	-1.72E+01	-2.17E+01	8.18E-01
7	1.87E-04	1.10E-01	1.95E-03	3.77E+00	5.01E-02	2.72E+00	5.87E+00	1.20E-01	8.56E+00	1.26E-02	6.49E+00	2.36E-01	2.14E-01	-1.82E+01	-1.82E+01	-2.01E+01	6.89E-01
8	1.10E-04	1.11E-01	1.07E-04	8.51E-01	5.81E-02	8.05E+00	2.74E+00	2.20E-01	1.30E-01	5.88E-02	7.47E+00	2.75E-01	2.34E-02	-1.89E+01	-1.91E+01	-1.96E+01	3.26E-02
9	2.69E-03	1.85E-01	4.01E-03	2.64E+00	1.85E-01	3.77E+00	1.59E+00	2.36E-01	1.35E+00	1.80E-01	1.84E+01	5.47E-01	2.76E-01	-1.79E+01	-1.83E+01	-1.94E+01	7.45E-01
10	1.19E-03	1.65E-01	3.91E-03	2.57E+00	3.17E-02	8.66E-01	2.34E+00	7.87E-02	5.43E-02	2.09E-01	1.30E+01	2.22E-01	1.31E-01	-1.83E+01	-1.80E+01	-2.05E+01	9.88E-01
11	7.85E-04	1.24E-01	5.59E-05	7.83E+00	2.32E-02	5.39E+00	8.75E+00	5.81E-02	7.41E-02	4.18E-01	5.32E+00	2.84E-02	2.94E-01	-1.87E+01	-1.83E+01	-1.85E+01	8.25E-01
12	3.38E-03	1.90E-01	4.10E-04	8.59E+00	2.27E-01	6.40E+00	6.84E+00	1.02E-01	1.04E-01	4.75E-01	4.65E+00	1.71E-01	2.77E-01	-1.87E+01	-1.94E+01	-1.97E+01	1.57E-01
13	5.83E-03	1.80E-01	1.51E-03	1.47E+00	1.63E-01	1.20E+00	5.45E+00	1.58E-01	3.02E-01	9.01E-02	7.13E+00	8.40E-02	3.98E-01	-2.03E+01	-1.85E+01	-1.99E+01	9.18E-01
14	1.94E-03	1.76E-01	3.03E-04	2.98E+00	4.02E-02	6.56E+00	1.13E+00	8.38E-02	5.11E+01	4.69E-01	7.18E+00	5.97E-01	8.03E-02	-2.00E+01	-1.74E+01	-2.03E+01	5.63E-01
15	6.16E-03	1.81E-01	9.41E-04	4.29E+00	3.39E-01	9.10E-01	2.08E+00	2.50E-02	5.00E-01	3.90E-01	8.22E+00	5.86E-01	5.15E-02	-1.89E+01	-1.75E+01	-1.97E+01	3.82E-01
16	2.79E-03	1.74E-01	1.16E-03	9.95E+00	2.88E-01	1.44E+00	7.25E+00	9.41E-02	4.77E+01	1.09E-01	8.24E+00	3.66E-01	3.53E-01	-1.77E+01	-1.86E+01	-1.95E+01	2.28E-01
17	8.32E-04	1.15E-01	1.45E-04	7.95E-01	2.85E-02	4.98E+00	7.86E-01	2.13E-01	1.82E+00	5.75E-01	8.38E+00	0	1.32E-01	-1.81E+01	-1.92E+01	-1.99E+01	1.95E-01
18	6.56E-04	1.59E-01	8.99E-05	8.92E-01	1.78E-01	2.87E+00	1.36E+00	4.57E-02	5.62E-01	5.70E-01	8.14E+00	3.35E-01	3.05E-01	-1.98E+01	-1.74E+01	-1.99E+01	6.72E-01
19	4.02E-03	1.75E-01	7.07E-04	8.45E+00	1.47E-01	7.04E-01	7.31E-01	2.79E-02	6.90E+00	5.08E-01	6.02E+00	1.27E-01	1.41E-01	-1.83E+01	-1.84E+01	-2.00E+01	4.17E-01
20	1.65E-04	1.67E-01	5.77E-04	3.34E+00	3.33E-02	1.95E+00	7.43E+00	9.03E-02	1.51E+00	5.36E-01	8.19E+00	8.50E-03	3.24E-01	-1.88E+01	-1.81E+01	-1.90E+01	8.82E-01
21	5.78E-04	1.12E-01	2.08E-04	7.35E+00	3.73E-01	4.65E+00	1.37E+00	1.13E-01	3.43E+00	2.64E-01	1.56E+01	8.99E-02	2.53E-02	-2.03E+01	-1.73E+01	-2.07E+01	3.97E-01
22	3.21E-04	1.51E-01	1.10E-03	4.44E+00	3.02E-02	4.81E+00	1.63E+00	8.01E-02	4.80E-01	4.95E-01	7.93E+00	4.04E-01	3.95E-01	-1.84E+01	-1.85E+01	-1.93E+01	7.73E-02
23	4.06E-04	1.66E-01	4.29E-03	8.00E-01	1.95E-01	5.14E+00	1.53E+00	2.53E-01	2.46E+00	9.27E-02	5.57E+00	5.83E-01	1.55E-01	-1.90E+01	-1.84E+01	-2.14E+01	9.26E-01
24	2.22E-03	1.96E-01	1.02E-03	1.15E+00	3.99E-01	2.50E+00	3.56E+00	2.28E-02	6.11E-01	2.34E-01	9.71E+00	1.37E-01	3.59E-01	-1.92E+01	-1.80E+01	-2.07E+01	2.35E-01
25	1.39E-04	1.82E-01	5.15E-05	2.70E+00	2.78E-02	3.18E+00	1.04E+00	3.54E-01	8.20E-01	1.57E-01	6.78E+00	4.65E-01	3.92E-01	-1.91E+01	-1.89E+01	-2.11E+01	5.84E-01
26	4.53E-03	1.65E-01	7.55E-03	4.13E+00	1.69E-01	8.97E+00	9.99E-01	2.74E-02	3.20E-01	3.04E-02	7.37E+00	1.41E-01	4.70E-02	-1.74E+01	-1.75E+01	-2.18E+01	9.08E-01
27	1.06E-03	1.35E-01	2.13E-03	1.96E+00	1.38E-01	2.06E+00	8.21E-01	1.09E-01	1.94E+00	3.17E-01	7.06E+00	4.96E-03	1.02E-01	-1.75E+01	-1.84E+01	-1.98E+01	8.60E-01
28	3.07E-03	2.36E-01	1.48E-03	1.39E+00	9.94E-02	1.66E+00	2.93E+00	6.16E-02	2.03E-01	2.47E-01	1.13E+01	4.77E-01	1.68E-01	-1.78E+01	-1.76E+01	-1.82E+01	6.70E-02
29	3.65E-04	2.28E-01	2.37E-04	7.61E-01	5.90E-02	1.15E+00	3.85E+00	1.00E-01	1.56E+01	4.30E-01	4.98E+00	3.11E-01	5.72E-02	-1.84E+01	-1.88E+01	-1.86E+01	1.04E-01
30	1.16E-04	1.08E-01	3.37E-05	1.21E+00	2.53E-02	2.34E+00	3.39E+00	4.94E-02	6.22E+00	4.14E-01	7.28E+00	1.47E-01	2.19E-01	-1.92E+01	-1.80E+01	-2.05E+01	5.01E-01
31	7.69E-03	2.48E-01	9.54E-04	6.82E+00	4.76E-02	6.81E+00	4.51E+00	3.82E-01	2.95E+01	4.01E-01	1.20E+01	4.63E-01	2.52E-01	-1.88E+01	-1.77E+01	-1.97E+01	9.86E-02
32	3.25E-03	1.07E-01	1.66E-04	2.19E+00	2.92E-02	6.15E+00	1.84E+00	2.54E-02	7.59E-01	4.42E-01	7.53E+00	1.15E-01	3.65E-02	-1.76E+01	-1.83E+01	-2.07E+01	7.87E-01
33	1.95E-04	1.77E-01	9.51E-05	8.70E-01	3.12E-01	3.05E+00	3.16E+00	1.32E-01	4.45E-01	2.85E-01	2.23E+01	3.09E-03	1.86E-01	-1.84E+01	-1.82E+01	-2.13E+01	3.06E-01
34	4.73E-04	1.00E-01	4.04E-05	1.24E+00	2.35E-01	1.98E+00	6.21E+00	3.21E-02	5.59E+01	3.37E-01	1.05E+01	2.96E-01	2.25E-01	-1.85E+01	-1.78E+01	-2.05E+01	4.77E-02
35	1.77E-04	1.70E-01	8.71E-04	9.11E+00	3.44E-02	9.87E+00	4.28E+00	2.43E-01	3.05E+01	6.90E-02	8.01E+00	4.51E-01	4.14E-02	-1.79E+01	-1.81E+01	-1.96E+01	6.34E-01
36	2.13E-03	1.18E-01	8.57E-03	1.82E+00	4.32E-02	7.81E+00	1.90E+00	1.23E-01	8.98E-02	5.51E-01	4.40E+00	4.26E-01	2.66E-01	-1.80E+01	-1.71E+01	-2.12E+01	4.66E-01
37	1.30E-04	2.07E-01	3.23E-03	4.26E+00	1.44E-01	8.48E+00	1.75E+00	1.07E-01	6.62E+01	2.60E-01	1.40E+01	9.45E-02	2.82E-01	-1.94E+01	-1.80E+01	-2.00E+01	4.48E-01
38	1.76E-03	1.63E-01	5.29E-04	9.54E-01	6.17E-02	1.76E+00	7.50E+00	2.83E-01	1.90E-01	3.48E-01	1.03E+01	1.76E-01	6.78E-02	-1.76E+01	-1.83E+01	-2.19E+01	3.77E-01
39	1.46E-03	1.19E-01	2.81E-03	2.92E+00	1.99E-01	4.51E+00	5.05E+00	8.73E-02	2.23E+01	1.82E-01	7.79E+00	3.98E-01	8.59E-02	-1.91E+01	-1.73E+01	-1.90E+01	3.61E-01
40	4.25E-04	1.06E-01	1.63E-03	2.38E+00	9.28E-02	3.68E+00	8.19E+00	2.02E-01	4.57E+01	2.97E-01	8.09E+00	5.66E-01	2.85E-01	-1.86E+01	-1.94E+01	-2.15E+01	7.03E-01
41	2.60E-03	1.13E-01	1.42E-04	2.39E+00	4.13E-02	1.23E+00	1.41E+00	7.54E-02	1.37E+01	2.27E-02	6.52E+00	1.67E-02	7.65E-02	-1.92E+01	-1.81E+01	-1.87E+01	8.88E-02
42	3.88E-03	1.64E-01	6.34E-04	5.19E+00	2.70E-01	6.01E+00	2.29E+00	1.28E-01	2.10E+01	5.97E-01	1.37E+01	1.32E-01	2.03E-01	-1.82E+01	-1.99E+01	-1.98E+01	4.04E-01
43	3.11E-04	1.76E-01	1.84E-02	2.00E+00	3.63E-02	6.97E+00	9.22E+00	3.56E-02	9.52E-02	3.55E-01	7.25E+00	7.55E-02	3.22E-02	-1.93E+01	-1.95E+01	-2.01E+01	2.99E-02
44	3.38E-04	1.12E-01	5.64E-03	1.27E+00	6.37E-02	2.60E+00	1.66E+00	3.50E-02	1.84E-01	7.80E-02	1.10E+01	5.68E-01	2.42E-01	-1.99E+01	-1.76E+01	-1.93E+01	1.38E-01
45	8.17E-04	1.16E-01	2.62E-03	5.03E+00	2.50E-01	1.01E+00	1.19E+00	3.02E-01	1.89E+01	5.25E-01	6.04E+00	2.10E-01	3.45E-01	-1.70E+01	-1.76E+01	-2.24E+01	2.17E-01
46	1.32E-03	1.40E-01	1.35E-02	2.28E+00	2.12E-01	3.58E+00	9.50E-01	2.95E-02	4.17E-01	5.57E-01	4.21E+00	4.11E-01	3.41E-01	-1.74E+01	-1.81E+01	-1.92E+01	2.04E-01
47	6.48E-03	1.69E-01	7.41E-05	7.22E-01	3.76E-02	1.26E+00	7.72E+00	9.71E-02	1.24E+00	1.51E-01	1.01E+01	1.84E-01	3.12E-01	-1.86E+01	-1.77E+01	-1.91E+01	5.32E-01
48	1.58E-04	1.68E-01	1.26E-03	5.90E+00	2.99E-01	9.45E-01	7.04E-01	3.62E-01	6.16E-02	1.44E-01	5.30E+00	2.25E-01	2.60E-01	-1.96E+01	-1.78E+01	-1.89E+01	8.79E-01
49	3.66E-03	1.61E-01	1.29E-04	3.60E+00	1.67E-01	3.40E+00	9.35E-01	7.35E-02	3.90E-01	3.81E-01	7.83E+00	1.23E-01	3.75E-01	-1.97E+01	-1.81E+01	-2.06E+01	1.65E-02
50	5.25E-04	1.31E-01	4.87E-04	6.57E+00	5.32E-02	4.01E+00	1.93E+00	6.65E-02	7.77E+00	5.30E-01	9.95E+00	4.45E-01	3.65E-01	-1.81E+01	-1.90E+01	-2.10E+01	9.94E-01

Table PAR-9. LHS Sampled Values (100 vectors) Replicate 1 — Continued

Parameter	50	51	52	53	54	55	56	57	58	60	61	62	63	64	65	66	75
Vector Num.	CULEBRA APOROS	CULEBRA DPOROS	U+6 MKD_U	U+4 MKD_U	PU+3 MKD_PU	PU+4 MKD_PU	TH+4 MKD_TH	AM+3 MKD_AM	BOREHOLE TAUFAIL	GLOBAL PBRINE	BOREHOLE DOMEGA	SHFTU SAT_RBRN	SHFTU SAT_RGAS	SHFTU PRMX_LOG	SHFTL_T1 PRMX_LOG	SHFTL_T2 PRMX_LOG	SPALLMOD RNDSPALL
51	2.33E-04	1.57E-01	4.99E-03	1.36E+00	2.18E-02	1.82E+00	8.76E+00	2.40E-02	6.84E-02	1.13E-01	1.22E+01	4.18E-02	3.39E-01	-1.85E+01	-1.76E+01	-1.93E+01	6.19E-01
52	2.69E-04	1.88E-01	2.73E-04	1.79E+00	2.42E-01	1.31E+00	3.77E+00	3.07E-01	1.65E-01	8.36E-02	6.21E+00	4.54E-02	9.37E-02	-1.77E+01	-1.79E+01	-1.88E+01	2.58E-01
53	4.46E-04	1.21E-01	4.67E-03	3.53E+00	1.27E-01	3.02E+00	8.77E-01	1.40E-01	5.62E+00	2.54E-01	1.62E+01	3.48E-01	2.45E-01	-1.82E+01	-1.93E+01	-1.81E+01	7.58E-01
54	8.44E-03	1.14E-01	1.58E-02	1.12E+00	4.82E-02	1.12E+00	1.12E+00	5.14E-02	3.14E+00	3.86E-02	4.49E+00	1.12E-01	2.88E-01	-1.95E+01	-1.87E+01	-1.92E+01	5.56E-01
55	1.44E-03	1.50E-01	1.68E-02	5.54E+00	3.24E-02	1.06E+00	1.71E+00	5.68E-02	4.21E+01	1.66E-01	6.83E+00	2.80E-01	2.23E-01	-1.88E+01	-1.77E+01	-2.09E+01	2.45E-01
56	1.32E-04	1.58E-01	5.77E-05	9.37E-01	7.58E-02	1.69E+00	7.07E+00	2.18E-01	7.10E+01	2.93E-01	6.88E+00	5.58E-01	3.19E-01	-1.88E+01	-1.79E+01	-2.02E+01	5.50E-01
57	9.99E-03	1.48E-01	3.06E-05	6.16E+00	4.38E-02	2.17E+00	7.73E-01	2.21E-02	1.02E+01	1.61E-01	7.66E+00	1.17E-01	2.98E-01	-1.95E+01	-1.80E+01	-1.94E+01	4.57E-01
58	9.72E-04	1.72E-01	1.78E-04	8.21E+00	7.74E-02	1.60E+00	2.00E+00	2.70E-01	2.03E+00	1.60E-02	9.47E+00	1.05E-01	2.60E-01	-1.95E+01	-1.90E+01	-2.05E+01	2.88E-01
59	7.06E-04	2.12E-01	1.13E-02	1.71E+00	7.41E-02	9.14E-01	3.72E+00	1.99E-01	1.31E+01	2.39E-01	8.45E+00	6.43E-02	2.71E-01	-1.90E+01	-1.83E+01	-2.00E+01	9.57E-01
60	6.14E-04	1.83E-01	6.59E-04	7.10E-01	1.06E-01	3.54E+00	3.22E+00	1.39E-01	9.78E+00	4.28E-01	7.86E+00	1.47E-02	3.70E-01	-1.72E+01	-1.77E+01	-2.03E+01	9.38E-01
61	1.65E-03	1.86E-01	9.73E-03	1.58E+00	2.62E-02	2.25E+00	1.23E+00	4.14E-02	4.55E+00	5.87E-01	8.29E+00	2.58E-01	9.70E-03	-2.01E+01	-1.89E+01	-2.06E+01	6.58E-01
62	3.54E-03	1.55E-01	1.98E-02	7.26E+00	2.21E-02	9.79E-01	2.94E+00	3.21E-01	1.41E+00	5.91E-01	7.48E+00	1.58E-01	1.12E-01	-1.93E+01	-1.78E+01	-2.03E+01	7.66E-01
63	4.89E-04	1.28E-01	2.24E-03	2.47E+00	4.55E-02	4.41E+00	3.96E+00	5.43E-02	7.24E-01	4.39E-01	6.38E+00	1.64E-01	3.79E-01	-1.89E+01	-1.82E+01	-1.94E+01	2.94E-01
64	1.26E-03	1.83E-01	5.28E-03	3.44E+00	2.73E-01	5.59E+00	4.95E+00	1.53E-01	4.96E+00	2.18E-01	8.65E+00	2.02E-01	2.38E-01	-1.83E+01	-1.71E+01	-1.97E+01	4.83E-01
65	1.53E-03	2.24E-01	3.76E-04	1.05E+00	3.19E-01	3.35E+00	1.07E+00	1.76E-01	2.85E-01	2.28E-01	1.18E+01	1.96E-01	2.09E-01	-1.70E+01	-1.90E+01	-2.04E+01	1.46E-01
66	5.00E-03	1.78E-01	7.47E-04	1.18E+00	1.57E-01	8.03E-01	8.39E+00	4.63E-02	1.14E-01	5.01E-01	8.35E+00	3.77E-01	6.38E-02	-1.86E+01	-1.84E+01	-2.17E+01	1.19E-01
67	5.44E-03	1.11E-01	2.18E-04	5.33E+00	8.01E-02	2.80E+00	9.84E+00	2.32E-01	7.00E-01	5.19E-01	9.10E+00	5.34E-01	8.90E-02	-1.76E+01	-1.87E+01	-1.92E+01	5.21E-01
68	2.40E-04	1.30E-01	5.11E-04	8.77E+00	2.24E-01	7.36E-01	9.48E+00	3.24E-02	1.32E-01	5.45E-01	8.94E+00	1.03E-01	1.77E-01	-1.78E+01	-1.82E+01	-2.02E+01	5.10E-01
69	1.67E-04	1.60E-01	3.61E-05	3.12E+00	5.68E-02	8.49E-01	4.75E+00	3.04E-02	3.81E+00	4.25E-02	9.26E+00	4.91E-01	1.57E-02	-1.73E+01	-1.84E+01	-1.86E+01	7.31E-01
70	9.37E-03	1.17E-01	7.84E-04	1.03E+00	1.35E-01	9.63E+00	4.23E+00	6.40E-02	1.60E-01	2.42E-01	6.97E+00	3.38E-01	3.27E-01	-1.89E+01	-1.86E+01	-2.09E+01	8.49E-01
71	2.39E-03	1.15E-01	3.60E-03	8.35E-01	2.15E-01	1.58E+00	2.63E+00	5.36E-02	1.64E+00	1.33E-01	8.76E+00	4.21E-01	3.82E-01	-1.75E+01	-1.92E+01	-2.10E+01	6.26E-01
72	5.58E-04	1.71E-01	1.15E-04	7.42E-01	1.08E-01	6.36E+00	9.02E-01	4.32E-02	8.35E+00	1.39E-01	6.72E+00	1.77E-01	3.12E-01	-1.75E+01	-1.82E+01	-2.02E+01	8.61E-01
73	3.58E-04	1.84E-01	7.79E-05	5.65E+00	8.28E-02	1.43E+00	5.30E+00	6.03E-02	2.41E+01	4.54E-01	5.74E+00	9.62E-02	1.16E-01	-1.84E+01	-1.88E+01	-1.91E+01	9.78E-01
74	2.41E-03	1.03E-01	6.55E-03	1.07E+00	1.12E-01	5.79E+00	2.41E+00	1.60E-01	2.02E+01	2.11E-01	9.87E+00	2.01E-02	3.17E-02	-1.79E+01	-1.82E+01	-1.95E+01	6.61E-01
75	2.91E-04	1.29E-01	5.92E-03	9.82E-01	1.23E-01	1.36E+00	1.09E+00	2.72E-01	1.23E+01	3.61E-01	7.32E+00	5.18E-01	1.77E-02	-1.72E+01	-1.80E+01	-1.89E+01	6.93E-01
76	6.75E-03	1.82E-01	4.51E-05	1.43E+00	5.16E-02	1.83E+00	1.17E+00	3.76E-01	3.33E+01	1.88E-01	7.60E+00	5.74E-02	3.46E-03	-1.94E+01	-1.89E+01	-2.19E+01	5.08E-02
77	8.04E-03	2.20E-01	1.21E-02	1.31E+00	3.07E-02	9.44E+00	4.06E+00	4.85E-02	1.11E+00	2.71E-01	7.95E+00	2.98E-01	6.86E-02	-1.73E+01	-1.81E+01	-1.98E+01	8.37E-01
78	4.36E-03	1.87E-01	1.32E-03	3.99E+00	2.56E-01	7.18E+00	9.70E+00	3.26E-01	1.71E+01	4.11E-01	6.47E+00	7.01E-02	1.38E-01	-1.75E+01	-1.71E+01	-1.89E+01	6.00E-01
79	4.70E-03	1.43E-01	1.70E-03	9.34E+00	2.35E-02	3.24E+00	8.22E-01	1.91E-01	3.77E+01	3.99E-01	1.93E+01	2.43E-02	3.01E-01	-1.81E+01	-1.74E+01	-1.99E+01	2.72E-01
80	2.96E-03	1.16E-01	3.40E-04	3.90E+00	7.13E-02	1.91E+00	2.65E+00	1.73E-01	5.25E-02	2.78E-01	1.29E+01	2.66E-01	2.36E-01	-1.71E+01	-1.77E+01	-1.94E+01	1.21E-01
81	1.02E-03	1.53E-01	1.10E-02	2.13E+00	9.58E-02	7.49E-01	4.79E+00	2.15E-02	6.18E+01	3.02E-01	6.57E+00	3.46E-02	7.50E-03	-1.83E+01	-1.86E+01	-2.14E+01	7.75E-01
82	8.84E-04	1.89E-01	2.52E-04	6.35E+00	1.78E-01	1.18E+00	2.50E+00	3.43E-02	3.49E-01	5.18E-02	1.04E+01	4.97E-01	1.50E-01	-1.90E+01	-1.87E+01	-2.15E+01	9.67E-01
83	5.22E-03	1.02E-01	1.88E-04	4.63E+00	3.55E-01	2.74E+00	2.12E+00	1.65E-01	3.02E+00	3.69E-01	5.80E+00	1.33E-01	1.25E-01	-1.84E+01	-1.72E+01	-2.11E+01	3.45E-01
84	2.20E-04	1.39E-01	9.71E-05	3.71E+00	8.95E-02	1.39E+00	3.45E+00	1.16E-01	1.47E+01	5.81E-01	9.52E+00	4.38E-01	3.85E-01	-1.81E+01	-1.85E+01	-2.03E+01	4.91E-01
85	1.83E-03	1.95E-01	3.86E-04	1.66E+00	6.72E-02	8.38E-01	5.66E+00	3.84E-02	7.41E+01	1.28E-01	6.68E+00	1.85E-01	3.64E-01	-1.78E+01	-1.84E+01	-2.06E+01	7.29E-01
86	8.72E-03	1.22E-01	1.25E-04	3.05E+00	3.33E-01	1.07E+00	7.98E+00	1.46E-01	2.40E+00	3.86E-01	6.64E+00	3.24E-01	1.73E-01	-1.78E+01	-1.88E+01	-2.00E+01	8.06E-01
87	2.53E-04	1.86E-01	3.19E-04	1.48E+00	3.82E-01	7.65E+00	9.66E-01	2.10E-02	2.72E+01	5.16E-01	5.06E+00	6.09E-02	9.80E-02	-1.79E+01	-1.86E+01	-1.96E+01	4.80E-01
88	1.47E-04	1.36E-01	6.58E-05	6.41E+00	1.20E-01	4.33E+00	7.41E-01	4.06E-02	1.47E-01	5.59E-01	1.08E+01	7.99E-02	1.94E-01	-1.77E+01	-1.89E+01	-1.91E+01	9.00E-01
89	2.08E-03	1.89E-01	1.61E-04	2.78E+00	2.09E-02	1.03E+00	8.46E-01	1.88E-01	4.10E+00	3.10E-01	8.02E+00	1.52E-01	1.82E-01	-1.82E+01	-1.82E+01	-2.02E+01	2.66E-01
90	2.09E-04	1.73E-01	8.02E-05	9.56E+00	8.75E-02	9.06E+00	1.78E+00	2.59E-01	2.73E+00	6.89E-02	4.89E+00	1.56E-01	2.28E-01	-1.78E+01	-1.83E+01	-2.01E+01	6.41E-01
91	7.30E-03	1.07E-01	2.87E-03	1.54E+00	2.02E-01	5.47E+00	2.18E+00	4.43E-02	3.55E+00	1.20E-01	1.16E+01	1.64E-01	3.35E-01	-1.85E+01	-1.89E+01	-1.87E+01	4.22E-01
92	6.71E-04	1.18E-01	9.79E-03	2.85E+00	1.31E-01	7.29E+00	6.51E+00	3.09E-02	5.81E-01	4.79E-01	7.69E+00	3.16E-01	1.99E-01	-1.97E+01	-1.85E+01	-1.83E+01	7.96E-01
93	7.58E-04	1.62E-01	2.47E-03	9.93E-01	1.50E-01	4.10E+00	4.45E+00	3.97E-01	8.05E-02	4.92E-01	6.41E+00	4.83E-02	1.16E-01	-1.99E+01	-1.84E+01	-2.10E+01	7.16E-01
94	1.22E-04	1.33E-01	8.81E-03	7.91E+00	2.82E-01	7.99E-01	5.95E+00	8.58E-02	8.92E-01	1.96E-01	6.92E+00	2.45E-01	1.68E-01	-1.85E+01	-1.86E+01	-2.04E+01	3.30E-03
95	1.31E-03	1.05E-01	4.76E-05	3.26E+00	3.55E-01	2.13E+00	3.06E+00	2.96E-01	9.43E-01	4.48E-01	7.42E+00	4.86E-01	7.49E-02	-1.91E+01	-1.78E+01	-1.87E+01	9.42E-01
96	5.14E-04	1.26E-01	7.06E-03	5.83E+00	2.43E-02	2.54E+00	1.44E+00	7.11E-02	2.18E+00	4.98E-02	7.62E+00	1.96E-01	2.55E-01	-1.71E+01	-1.91E+01	-2.12E+01	1.89E-01
97	1.06E-04	2.40E-01	6.54E-05	4.88E+00	6.87E-02	3.93E+00	3.33E+00	2.34E-02	1.09E-01	4.60E-01	6.61E+00	3.68E-01	5.31E-02	-1.87E+01	-1.78E+01	-2.08E+01	3.13E-01
98	5.63E-03	1.79E-01	4.19E-05	1.61E+00	2.03E-02	7.63E-01	1.48E+00	1.26E-01	2.32E-01	3.20E-01	7.19E+00	5.40E-01	1.63E-01	-1.76E+01	-1.79E+01	-1.93E+01	4.31E-01
99	7.24E-03	1.68E-01	3.67E-05	7.52E+00	3.71E-02	8.64E+00	6.15E+00	3.73E-02	2.69E-01	1.00E-01	7.75E+00	5.55E-02	1.59E-01	-1.80E+01	-1.76E+01	-2.21E+01	5.92E-01
100	9.43E-04	1.03E-01	7.27E-03	1.75E+00	8.50E-02	2.39E+00	2.82E+00	3.35E-01	6.52E+00	3.46E-01	1.45E+01	8.22E-02	1.21E-01	-1.77E+01	-1.75E+01	-1.95E+01	3.38E-01

Table PAR-10. LHS Sampled Values (100 vectors) Replicate 2

Parameter	1	2	3	4	5	6	7	8	9	10	11	12	14	15	16	17	18	19	20	21	22	23	24	25
Vector Num.	STEEL CORRMCO2	WAS_AREA PROBDEG	WAS_AREA GRATMICI	WAS_AREA GRATMICH	CELLULS FBETA	WAS_AREA SAT_RGAS	WAS_AREA SAT_RBRN	WAS_AREA SAT_WICK	DRZ_PCS PRMX_LOG	CONC_PCS PRMX_LOG	SOLU4 SOLCIM	SOLTH4 SOLCIM	CONC_PCS SAT_RGAS	CONC_PCS SAT_RBRN	CONC_PCS PORE_DIS	S_HALITE POROSITY	S_HALITE PRMX_LOG	S_HALITE COMP_RCK	S_MB139 PRMX_LOG	S_MB139 COMP_RCK	S_MB139 RELP_MOD	S_MB139 SAT_RBRN	S_MB139 SAT_RGAS	S_MB139 PORE_DIS
1	7.81E-15	1.00E+00	7.04E-09	1.26E-09	3.94E-01	1.46E-02	3.19E-01	2.99E-01	-1.99E+01	-1.86E+01	-4.10E-01	6.99E-02	3.37E-01	8.32E-02	4.08E-01	2.84E-02	-2.31E+01	1.34E-10	-1.75E+01	1.09E-11	4.00E+00	4.16E-02	9.74E-02	5.88E-01
2	1.80E-14	2.00E+00	5.94E-09	8.62E-10	5.39E-01	1.27E-01	2.10E-01	7.62E-01	-1.84E+01	-2.00E+01	-2.93E-01	7.66E-01	1.48E-01	3.12E-01	1.58E+00	2.25E-03	-2.39E+01	1.81E-10	-1.93E+01	1.65E-10	4.00E+00	7.49E-02	1.08E-01	5.43E-01
3	1.84E-14	2.00E+00	7.66E-10	1.63E-10	5.98E-01	8.24E-02	1.13E-01	8.09E-01	-2.02E+01	-2.02E+01	-4.88E-01	-2.83E-01	1.37E-01	7.97E-02	4.28E+00	8.30E-03	-2.39E+01	1.84E-10	-1.85E+01	2.21E-11	4.00E+00	9.27E-02	8.77E-02	6.78E-01
4	1.11E-15	0.00E+00	7.18E-09	8.09E-10	2.35E-02	6.58E-02	5.24E-01	6.13E-01	-1.87E+01	-1.94E+01	-1.16E-01	1.02E+00	3.14E-01	1.29E-01	3.91E+00	2.27E-03	-2.37E+01	1.66E-10	-1.93E+01	1.38E-10	4.00E+00	1.26E-01	8.05E-02	6.45E-01
5	1.61E-14	2.00E+00	9.47E-09	5.32E-10	4.07E-01	9.18E-02	1.51E-01	8.41E-01	-1.90E+01	-1.91E+01	-3.64E-01	1.86E-01	2.72E-02	6.46E-02	7.78E+00	2.23E-02	-2.20E+01	5.29E-11	-1.86E+01	5.60E-11	4.00E+00	8.35E-02	1.13E-01	6.22E-01
6	1.75E-14	0.00E+00	1.46E-09	2.73E-10	4.31E-01	1.23E-01	5.11E-01	9.68E-01	-1.89E+01	-1.88E+01	2.54E-02	-9.70E-02	3.99E-01	3.76E-01	4.00E+00	2.02E-02	-2.29E+01	1.23E-10	-1.99E+01	2.10E-10	4.00E+00	8.15E-02	2.78E-02	6.31E-01
7	2.39E-14	1.00E+00	8.21E-09	2.10E-10	6.64E-01	1.74E-02	1.93E-01	1.65E-01	-1.80E+01	-1.93E+01	-1.65E-02	-1.09E-01	3.32E-01	1.64E-04	5.06E-01	1.50E-02	-2.12E+01	1.80E-11	-1.96E+01	1.62E-10	1.00E+00	6.12E-02	1.14E-01	6.37E-01
8	1.48E-14	0.00E+00	3.25E-09	8.26E-10	3.08E-01	6.42E-02	2.04E-01	7.69E-02	-1.93E+01	-1.90E+01	1.27E-01	-7.69E-01	5.14E-02	5.45E-01	2.79E+00	6.07E-03	-2.30E+01	1.37E-10	-1.97E+01	1.92E-10	4.00E+00	5.72E-02	9.50E-02	5.69E-01
9	2.50E-15	1.00E+00	8.73E-09	6.36E-10	5.13E-01	1.12E-01	3.05E-01	1.34E-01	-1.94E+01	-1.81E+01	-3.38E-01	8.83E-01	2.88E-01	1.60E-01	5.05E+00	4.89E-03	-2.17E+01	4.51E-11	-2.01E+01	2.69E-10	4.00E+00	8.62E-02	9.97E-02	7.05E-01
10	1.50E-15	0.00E+00	5.77E-09	9.66E-10	7.27E-01	3.11E-02	4.38E-01	4.49E-01	-1.79E+01	-1.91E+01	3.69E-01	-2.45E-01	2.58E-01	2.19E-01	7.31E-01	1.01E-02	-2.28E+01	1.18E-10	-1.87E+01	5.92E-11	1.00E+00	1.10E-01	1.40E-02	5.54E-01
11	2.77E-14	1.00E+00	2.11E-09	1.00E-09	8.49E-01	1.97E-03	2.61E-01	4.91E-01	-2.03E+01	-1.94E+01	-6.66E-02	6.43E-01	1.34E-01	5.69E-01	7.49E+00	1.47E-02	-2.14E+01	2.61E-11	-1.91E+01	9.93E-11	4.00E+00	9.43E-02	3.40E-02	6.72E-01
12	1.57E-14	1.00E+00	2.91E-09	1.20E-09	7.43E-01	1.02E-01	3.48E-01	2.04E-01	-1.89E+01	-1.80E+01	-1.38E+00	1.56E-01	3.75E-01	5.11E-01	1.11E+00	1.61E-02	-2.24E+01	1.05E-10	-1.84E+01	2.91E-11	4.00E+00	9.36E-02	5.99E-02	6.95E-01
13	6.99E-15	2.00E+00	5.85E-09	7.10E-10	4.95E-01	6.78E-02	2.30E-01	3.62E-01	-1.85E+01	-1.77E+01	-5.86E-02	5.80E-03	1.26E-01	3.07E-01	1.73E+00	1.10E-02	-2.32E+01	1.41E-10	-1.94E+01	1.35E-10	1.00E+00	5.52E-02	1.01E-01	6.58E-01
14	1.50E-14	0.00E+00	3.78E-09	1.18E-09	7.51E-01	1.94E-02	3.43E-02	4.21E-01	-1.75E+01	-1.96E+01	-1.16E+00	1.16E-01	2.08E-01	4.58E-01	5.58E-01	1.40E-03	-2.23E+01	7.24E-11	-1.83E+01	1.09E-11	1.00E+00	7.78E-03	9.09E-02	6.05E-01
15	1.66E-14	0.00E+00	5.70E-09	5.97E-10	9.73E-01	3.74E-02	4.60E-01	7.19E-01	-1.97E+01	-1.94E+01	-1.96E-01	-9.35E-03	2.09E-01	2.10E-01	3.44E-01	2.54E-02	-2.24E+01	8.22E-11	-1.81E+01	1.09E-11	1.00E+00	9.18E-02	1.31E-01	6.19E-01
16	1.75E-15	2.00E+00	6.59E-09	1.47E-10	7.91E-01	1.02E-01	1.29E-01	6.95E-01	-2.03E+01	-1.77E+01	-2.14E-01	-1.17E+00	4.49E-02	2.42E-01	2.50E+00	7.89E-03	-2.14E+01	2.83E-11	-1.93E+01	1.32E-10	4.00E+00	6.88E-02	3.83E-02	6.88E-01
17	9.22E-15	2.00E+00	9.01E-09	1.16E-10	4.50E-01	5.04E-02	1.97E-01	1.04E-01	-1.86E+01	-1.77E+01	-1.62E-01	-1.89E-01	1.50E-02	4.93E-01	3.84E-01	2.79E-02	-2.23E+01	9.34E-11	-1.90E+01	1.04E-10	4.00E+00	1.04E-01	7.78E-02	6.70E-01
18	2.74E-14	0.00E+00	4.05E-09	8.72E-10	1.94E-01	2.61E-02	1.00E-01	1.74E-01	-1.82E+01	-1.85E+01	5.34E-01	3.89E-01	1.68E-01	5.52E-02	4.27E-01	6.93E-03	-2.38E+01	1.79E-10	-1.90E+01	1.07E-10	1.00E+00	1.42E-01	6.30E-02	6.90E-01
19	3.03E-15	0.00E+00	5.31E-09	1.09E-10	2.26E-01	3.76E-02	7.91E-02	9.41E-01	-1.83E+01	-1.88E+01	3.03E-01	1.21E-01	7.83E-02	3.59E-01	6.66E+00	7.35E-03	-2.17E+01	6.99E-11	-1.88E+01	6.96E-11	1.00E+00	9.71E-02	1.21E-01	5.26E-01
20	2.43E-14	2.00E+00	7.60E-09	4.74E-10	4.61E-01	8.67E-02	3.67E-01	2.35E-01	-1.83E+01	-1.90E+01	-1.91E-01	-4.00E-01	3.43E-01	3.41E-01	4.12E+00	9.58E-03	-2.36E+01	1.75E-10	-2.00E+01	2.50E-10	1.00E+00	5.46E-02	9.80E-02	5.92E-01
21	5.43E-16	0.00E+00	6.42E-09	4.63E-10	5.51E-01	1.33E-01	4.04E-01	6.24E-01	-1.92E+01	-1.85E+01	-7.03E-03	-6.82E-01	2.18E-01	1.41E-01	7.22E-01	2.47E-03	-2.15E+01	3.36E-11	-1.89E+01	1.05E-10	1.00E+00	8.07E-02	7.16E-02	6.28E-01
22	6.63E-15	0.00E+00	3.62E-09	9.40E-10	5.72E-01	1.06E-01	4.24E-01	5.97E-01	-1.96E+01	-1.93E+01	-1.02E-01	-1.84E-01	2.56E-01	1.65E-01	2.37E-01	5.67E-03	-2.38E+01	1.77E-10	-1.87E+01	3.72E-11	4.00E+00	2.78E-02	1.04E-01	6.01E-01
23	1.98E-14	2.00E+00	4.18E-09	3.12E-10	3.57E-01	9.06E-02	5.36E-01	3.72E-02	-1.82E+01	-2.05E+01	-3.85E-01	7.08E-01	2.64E-01	4.55E-01	5.49E+00	9.92E-03	-2.15E+01	4.20E-11	-1.91E+01	1.16E-10	1.00E+00	7.39E-02	1.03E-01	7.08E-01
24	1.71E-14	0.00E+00	4.29E-09	5.58E-10	4.77E-01	5.14E-02	4.98E-01	5.20E-01	-1.91E+01	-1.95E+01	-1.50E-01	-2.19E-01	3.82E-01	1.37E-01	9.04E-01	4.99E-03	-2.31E+01	1.25E-10	-1.88E+01	9.61E-11	4.00E+00	7.75E-02	7.18E-02	7.10E-01
25	2.61E-14	0.00E+00	6.38E-09	5.95E-10	1.33E-01	8.70E-02	2.54E-01	3.14E-01	-1.93E+01	-1.83E+01	8.22E-02	-5.18E-03	6.96E-02	5.29E-01	1.78E-01	1.83E-02	-2.38E+01	1.87E-10	-1.84E+01	1.79E-11	4.00E+00	1.23E-01	1.01E-01	5.95E-01
26	3.17E-14	1.00E+00	5.61E-09	3.69E-10	8.82E-01	1.43E-01	4.30E-01	3.03E-01	-1.88E+01	-1.74E+01	-3.45E-01	-1.24E-01	2.66E-01	1.53E-01	1.38E+00	2.92E-03	-2.18E+01	4.04E-11	-1.83E+01	1.09E-11	1.00E+00	1.19E-01	8.22E-02	6.38E-01
27	9.53E-15	1.00E+00	7.34E-09	1.25E-09	6.57E-01	4.22E-02	1.47E-01	9.16E-01	-1.79E+01	-1.74E+01	1.74E-01	9.85E-01	2.97E-01	9.99E-02	4.45E-01	3.27E-03	-2.26E+01	1.02E-10	-1.96E+01	1.83E-10	4.00E+00	9.95E-02	7.45E-02	6.57E-01
28	1.38E-14	2.00E+00	8.33E-09	3.54E-10	8.92E-01	1.28E-01	3.95E-01	9.37E-01	-2.02E+01	-1.79E+01	1.17E+00	-7.99E-01	3.58E-01	4.08E-01	3.72E-01	9.00E-03	-2.18E+01	4.27E-11	-1.97E+01	1.96E-10	1.00E+00	7.84E-02	1.06E-01	6.43E-01
29	2.66E-14	1.00E+00	3.52E-09	9.96E-10	7.88E-01	1.17E-01	9.87E-02	7.36E-01	-1.86E+01	-1.85E+01	1.54E-01	2.43E-01	2.90E-01	2.24E-01	8.73E-01	1.65E-02	-2.33E+01	1.55E-10	-1.89E+01	7.43E-11	1.00E+00	1.32E-01	5.88E-02	6.29E-01
30	2.47E-14	0.00E+00	3.99E-09	9.38E-11	3.49E-02	6.00E-02	5.32E-01	2.89E-01	-1.92E+01	-2.01E+01	-9.28E-01	5.76E-02	2.95E-01	5.16E-01	3.50E+00	2.17E-02	-2.35E+01	1.56E-10	-1.78E+01	1.09E-11	1.00E+00	7.66E-02	1.45E-02	6.55E-01
31	2.36E-14	1.00E+00	6.07E-09	5.64E-10	9.30E-01	1.43E-03	3.41E-01	4.89E-01	-1.90E+01	-1.98E+01	-3.06E-01	-3.18E-01	2.29E-01	1.01E-01	8.31E-01	1.38E-02	-2.39E+01	1.89E-10	-1.95E+01	1.75E-10	4.00E+00	6.37E-02	9.24E-02	6.82E-01
32	2.27E-14	0.00E+00	2.22E-09	1.24E-09	9.25E-02	8.93E-02	2.89E-01	4.61E-01	-1.98E+01	-1.88E+01	2.13E-01	-6.88E-02	1.32E-01	3.27E-02	3.57E+00	9.80E-03	-2.32E+01	1.39E-10	-1.81E+01	1.09E-11	4.00E+00	8.01E-02	1.07E-01	6.42E-01
33	2.20E-14	0.00E+00	2.53E-09	6.76E-10	6.38E-01	1.04E-01	1.69E-01	5.41E-02	-2.00E+01	-1.96E+01	4.45E-01	-2.55E-01	1.91E-01	4.43E-01	6.80E-01	2.34E-02	-2.19E+01	6.71E-11	-1.95E+01	1.71E-10	1.00E+00	7.90E-02	5.72E-02	6.24E-01
34	2.02E-14	0.00E+00	2.39E-09	4.30E-10	3.32E-01	7.42E-03	2.99E-01	8.63E-02	-1.79E+01	-1.80E+01	-8.72E-02	-3.91E-01	3.07E-01	4.17E-01	2.84E+00	1.06E-03	-2.11E+01	1.23E-11	-1.80E+01	1.09E-11	4.00E+00	6.60E-02	4.80E-02	6.86E-01
35	8.32E-15	0.00E+00	1.40E-09	2.98E-11	4.21E-01	1.08E-01	1.21E-01	5.83E-01	-1.94E+01	-1.76E+01	-2.17E-01	3.03E-02	2.46E-01	1.88E-01	6.24E-01	2.61E-02	-2.18E+01	7.48E-11	-1.88E+01	6.67E-11	1.00E+00	7.61E-02	8.52E-02	6.67E-01
36	1.22E-14	0.00E+00	9.20E-09	1.22E-09	3.29E-01	7.86E-02	2.96E-01	3.49E-01	-1.95E+01	-1.91E+01	-4.58E-01	-2.10E-01	2.32E-01	5.01E-01	7.44E-01	1.72E-02	-2.12E+01	1.25E-11	-1.72E+01	1.09E-11	1.00E+00	8.85E-02	8.35E-02	6.32E-01
37	1.88E-14	0.00E+00	7.57E-09	9.81E-10	2.51E-01	4.03E-02	1.36E-01	6.68E-01	-1.88E+01	-1.93E+01	8.09E-01	-1.62E-01	8.96E-02	5.22E-01	6.50E+00	8.04E-03	-2.19E+01	5.81E-11	-1.87E+01	4.52E-11	4.00E+00	5.19E-02	7.89E-02	7.36E-01
38	2.86E-14	0.00E+00	2.48E-09	2.28E-10	9.82E-01	2.91E-02	3.84E-01	6.05E-01	-1.81E+01	-1.76E+01	4.88E-01	3.03E-01	2.20E-01	3.71E-01	2.14E-01	8.79E-03	-2.24E+01	8.42E-11	-1.86E+01	2.63E-11	1.00E+00	7.18E-02	8.66E-02	6.14E-01
39	1.15E-16	0.00E+00	4.75E-09	6.89E-10	2.88E-01	8.44E-03	3.23E-01	8.68E-01	-2.04E+01	-1.84E+01	-6.65E-01	1.72E-01	1.23E-01	1.48E-01	6.64E-01	7.18E-03	-2.34E+01	1.59E-10	-1.87E+01	4.38E-11	1.00E+00	8.94E-02	5.75E-02	5.73E-01
40	2.95E-14	1.00E+00	1.71E-09	5.11E-10	5.44E-01	9.63E-02	4.88E-01	1.59E-01	-1.92E+01	-1.92E+01	2.94E-01	-1.95E-02	1.59E-01	1.69E-01	8.51E-01	1.98E-02	-2.13E+01	2.11E-11	-2.07E+01	2.75E-10	4.00E+00	7.12E-02	7.64E-02	4.91E-01
41	9.14E-16	0.00E+00	8.25E-09	1.18E-09	3.18E-01	4.62E-02	4.84E-01	7.90E-01	-1.85E+01	-1.81E+01	2.38E-01	1.37E-01	1.07E-01	1.10E-01	3.35E+00	2.50E-02	-2.28E+01	1.26E-10	-1.90E+01	8.46E-11	1.00E+00	9.09E-02	5.57E-02	6.06E-01
42	3.00E-14	1.00E+00	3.32E-09	1.11E-09	3.46E-01	1.23E-01	6.82E-02	2.12E-01	-1.92E+01	-1.82E+01	-7.57E-01	-1.80E+00	4.07E-02	3.45E-01	5.21E+00	1.93E-02	-2.23E+01	9.98E-11	-1.90E+01	9.31E-11	1.00E+00	1.74E-01	6.13E-02	6.18E-01
43	1.42E-14	1.00E+00	9.68E-10	5.77E-10	5.30E-01	8.54E-02	1.14E-02	3.23E-01	-1.88E+01	-1.89E+01	-4.44E-01	5.75E-01	2.00E-02	2.64E-02	3.74E+00	5.30E-03	-2.33E+01	1.51E-10	-1.85E+01	6.18E-11	1.00E+00	8.07E-02	4.59E-02	6.13E-01
44	2.17E-15	0.00E+00	5.13E-09	5.54E-11	5.81E-01	2.01E-02	1.73E-01	1.46E-02	-1.95E+01	-1.81E+01	-1.85E-01	2.82E-01	1.70E-01	2.90E-01	7.08E+00	2.87E-02	-2.29E+01	1.14E-10	-1.88E+01	7.60E-11	1.00E+00	9.78E-02	1.36E-01	7.94E-01
45	2.24E-14	0.00E+00	8.41E-09	5.00E-10	3.75E-01	1.21E-01	1.40E-01	2.64E-01	-1.72E+01	-1.83E+01	-2.34E-02	5.49E-01	6.07E-02	3.33E-01	8.85E-01	1.89E-02	-2.13E+01	1.81E-11	-1.92E+01	1.27E-10	4.00E+00	4.74E-02	6.88E-02	5.78E-01

Table PAR-10. LHS Sampled Values (100 vectors) Replicate 2 — Continued

Parameter	1	2	3	4	5	6	7	8	9	10	11	12	14	15	16	17	18	19	20	21	22	23	24	25
Vector	STEEL	WAS_AREA	WAS_AREA	WAS_AREA	CELLULS	WAS_AREA	WAS_AREA	WAS_AREA	DRZ_PCS	CONC_PCS	SOLU4	SOLTH4	CONC_PCS	CONC_PCS	CONC_PCS	S_HALITE	S_HALITE	S_HALITE	S_MB139	S_MB139	S_MB139	S_MB139	S_MB139	S_MB139
Num.	CORRMCO2	PROBDEG	GRATMICI	GRATMICH	FBETA	SAT_RGAS	SAT_RBRN	SAT_WICK	PRMX_LOG	PRMX_LOG	SOLCIM	SOLCIM	SAT_RGAS	SAT_RBRN	PORE_DIS	POROSITY	PRMX_LOG	COMP_RCK	PRMX_LOG	COMP_RCK	RELP_MOD	SAT_RBRN	SAT_RGAS	PORE_DIS
46	2.57E-14	1.00E+00	1.20E-09	6.34E-10	6.14E-01	9.51E-02	4.67E-01	8.23E-01	-1.91E+01	-1.82E+01	1.32E-01	1.82E-02	2.40E-01	2.98E-01	8.19E-01	2.10E-02	-2.20E+01	8.47E-11	-1.86E+01	6.10E-11	1.00E+00	6.21E-02	5.34E-02	6.99E-01
47	6.85E-15	0.00E+00	4.62E-09	7.39E-10	1.16E-01	3.57E-02	4.89E-02	1.73E-03	-1.87E+01	-1.78E+01	-1.34E-01	-2.31E-01	2.49E-01	1.97E-01	4.79E+00	7.67E-03	-2.35E+01	1.65E-10	-1.92E+01	1.24E-10	1.00E+00	1.73E-02	7.37E-02	6.49E-01
48	1.64E-14	2.00E+00	8.08E-09	1.55E-13	7.13E-01	4.91E-02	4.09E-01	1.22E-01	-1.91E+01	-1.93E+01	5.46E-02	-1.73E-01	8.15E-02	1.76E-01	3.17E-01	5.94E-03	-2.24E+01	7.93E-11	-1.91E+01	1.14E-10	1.00E+00	8.29E-02	8.93E-02	7.21E-01
49	1.43E-14	1.00E+00	2.63E-09	1.10E-09	1.84E-01	7.58E-02	1.82E-01	4.57E-01	-1.87E+01	-1.78E+01	2.00E-01	-3.37E-02	3.25E-01	1.89E-01	2.64E-01	2.92E-02	-2.32E+01	1.45E-10	-1.86E+01	6.63E-11	4.00E+00	1.09E-01	9.16E-02	6.63E-01
50	7.31E-15	0.00E+00	4.49E-09	3.64E-10	8.86E-02	1.15E-01	5.51E-01	2.40E-02	-1.77E+01	-1.79E+01	-5.52E-01	-9.15E-01	9.65E-03	3.23E-01	8.03E-01	3.61E-03	-2.38E+01	1.76E-10	-1.85E+01	4.07E-11	1.00E+00	1.18E-01	7.50E-02	5.82E-01
51	1.19E-14	0.00E+00	6.73E-09	6.63E-10	9.17E-01	1.17E-01	5.25E-01	7.53E-01	-1.86E+01	-1.89E+01	6.76E-01	-1.53E-01	2.80E-01	5.87E-01	5.71E-01	1.05E-02	-2.35E+01	1.60E-10	-1.89E+01	8.78E-11	4.00E+00	1.15E-01	6.28E-02	6.69E-01
52	9.14E-15	2.00E+00	2.27E-09	3.37E-10	7.71E-01	5.70E-02	4.76E-01	1.92E-01	-1.82E+01	-1.83E+01	7.48E-01	9.00E-01	1.74E-01	1.34E-01	4.87E+00	5.70E-03	-2.36E+01	1.70E-10	-1.79E+01	1.09E-11	1.00E+00	4.58E-02	5.44E-02	7.27E-01
53	2.47E-14	0.00E+00	9.35E-09	2.38E-11	7.20E-02	1.13E-01	3.12E-01	8.82E-01	-1.96E+01	-1.86E+01	-2.78E-01	-1.41E-01	8.54E-02	4.70E-03	1.85E+00	2.14E-02	-2.30E+01	1.40E-10	-1.83E+01	1.09E-11	4.00E+00	6.69E-02	6.47E-02	7.34E-01
54	1.00E-14	0.00E+00	7.71E-09	9.11E-10	5.65E-01	1.46E-01	2.11E-02	3.76E-01	-1.85E+01	-2.00E+01	-2.26E-01	-4.78E-01	3.18E-01	2.02E-01	5.31E+00	1.22E-02	-2.22E+01	8.92E-11	-1.81E+01	1.09E-11	4.00E+00	1.02E-01	7.81E-02	5.97E-01
55	1.72E-14	1.00E+00	3.37E-09	3.85E-10	2.67E-01	1.30E-01	2.82E-01	2.42E-01	-1.95E+01	-1.95E+01	-2.34E-01	-4.18E-02	3.79E-01	4.76E-01	2.06E+00	1.71E-03	-2.11E+01	3.78E-12	-1.94E+01	1.25E-10	4.00E+00	1.06E-01	8.43E-02	6.83E-01
56	2.78E-15	2.00E+00	1.91E-09	1.16E-09	8.14E-01	1.09E-01	8.83E-02	5.51E-01	-1.88E+01	-1.97E+01	-1.80E-01	-5.89E-01	3.97E-02	1.50E-01	2.50E-01	8.52E-03	-2.20E+01	6.31E-11	-2.02E+01	2.75E-10	1.00E+00	8.42E-02	4.97E-02	6.80E-01
57	3.01E-14	0.00E+00	5.49E-09	1.09E-09	7.65E-01	1.37E-01	2.42E-01	9.65E-02	-1.93E+01	-1.94E+01	2.43E-01	-5.33E-02	3.72E-01	2.63E-01	6.93E+00	2.64E-02	-2.27E+01	9.37E-11	-1.88E+01	7.35E-11	1.00E+00	8.42E-02	1.09E-01	5.48E-01
58	5.96E-15	1.00E+00	5.04E-10	1.13E-09	4.74E-02	4.08E-02	3.63E-01	5.08E-01	-1.84E+01	-1.90E+01	1.29E-02	-8.72E-01	9.94E-02	4.87E-02	4.80E-01	4.03E-03	-2.33E+01	1.44E-10	-1.91E+01	9.73E-11	4.00E+00	1.13E-01	1.44E-01	7.70E-01
59	8.15E-15	0.00E+00	6.48E-10	9.60E-10	1.23E-01	5.71E-02	4.57E-01	7.47E-01	-1.78E+01	-1.87E+01	1.82E-01	-5.53E-01	3.03E-02	2.71E-01	1.65E-01	8.59E-03	-2.10E+01	5.69E-12	-1.86E+01	3.93E-11	4.00E+00	7.01E-02	1.97E-01	6.75E-01
60	1.95E-14	2.00E+00	5.05E-09	1.14E-09	6.07E-01	1.19E-01	5.07E-01	8.30E-01	-1.81E+01	-1.89E+01	8.34E-02	-1.27E-01	1.77E-01	6.01E-02	7.53E+00	2.47E-02	-2.16E+01	7.50E-11	-1.88E+01	5.31E-11	1.00E+00	6.96E-02	3.57E-02	6.73E-01
61	1.07E-14	0.00E+00	7.81E-09	1.15E-09	3.61E-01	1.31E-01	3.33E-01	7.23E-01	-1.86E+01	-1.81E+01	-4.12E-01	-2.01E-01	2.71E-01	1.25E-01	4.63E+00	1.13E-02	-2.25E+01	1.07E-10	-1.93E+01	1.44E-10	1.00E+00	6.00E-02	9.37E-02	7.16E-01
62	5.28E-15	0.00E+00	2.72E-09	9.32E-10	2.19E-01	1.47E-01	3.09E-02	4.71E-02	-1.88E+01	-1.98E+01	5.99E-01	-7.77E-02	3.61E-01	4.25E-01	5.71E+00	1.88E-02	-2.35E+01	1.48E-10	-1.95E+01	1.47E-10	4.00E+00	8.20E-02	4.95E-02	8.12E-01
63	1.28E-14	1.00E+00	1.14E-09	4.86E-10	7.36E-01	1.41E-01	5.44E-01	3.56E-01	-1.84E+01	-1.89E+01	-2.40E-01	1.92E-01	1.48E-01	9.56E-03	7.94E+00	5.49E-03	-2.19E+01	5.04E-11	-1.82E+01	1.09E-11	1.00E+00	4.33E-02	1.11E-01	6.39E-01
64	2.82E-14	0.00E+00	4.70E-09	7.19E-10	9.56E-01	2.55E-02	5.63E-02	6.38E-01	-1.89E+01	-2.02E+01	1.57E-01	-6.08E-02	6.57E-03	1.74E-01	3.23E+00	2.30E-02	-2.21E+01	9.05E-11	-1.98E+01	2.23E-10	1.00E+00	1.06E-01	1.18E-01	6.65E-01
65	1.81E-14	1.00E+00	6.94E-09	4.52E-10	4.46E-01	5.30E-02	1.55E-01	9.09E-01	-1.94E+01	-1.97E+01	9.95E-01	-2.91E-01	9.41E-02	2.84E-01	9.09E-01	3.79E-03	-2.13E+01	2.54E-11	-1.84E+01	3.40E-11	4.00E+00	9.88E-02	4.23E-02	6.55E-01
66	2.66E-14	2.00E+00	7.98E-10	7.90E-10	9.21E-01	9.52E-03	4.97E-01	1.88E-01	-1.85E+01	-1.84E+01	-2.46E-01	-2.27E-01	6.77E-02	2.80E-01	2.98E+00	3.02E-03	-2.26E+01	7.72E-11	-1.92E+01	9.42E-11	4.00E+00	9.02E-02	8.14E-02	5.36E-01
67	1.08E-14	0.00E+00	3.66E-10	1.70E-10	7.02E-01	2.75E-02	2.11E-01	9.97E-01	-1.84E+01	-1.80E+01	-7.12E-01	-3.52E-01	3.48E-01	5.38E-01	6.18E+00	1.43E-02	-2.34E+01	1.53E-10	-1.92E+01	1.54E-10	4.00E+00	3.74E-02	8.58E-02	6.34E-01
68	4.66E-15	2.00E+00	6.26E-09	1.06E-09	9.90E-01	4.69E-02	7.66E-02	4.40E-01	-1.95E+01	-1.84E+01	-4.55E-02	-1.36E-01	3.52E-01	3.93E-01	1.30E+00	1.30E-02	-2.37E+01	1.72E-10	-1.82E+01	1.29E-11	1.00E+00	7.56E-02	2.05E-02	6.53E-01
69	2.52E-14	0.00E+00	5.43E-09	1.03E-09	9.01E-01	6.63E-02	3.26E-01	6.60E-02	-2.01E+01	-1.91E+01	-3.94E-02	-3.58E-01	2.43E-01	4.55E-02	2.53E+00	6.67E-03	-2.25E+01	1.03E-10	-1.85E+01	4.77E-11	4.00E+00	9.65E-02	1.26E-01	6.60E-01
70	2.54E-14	2.00E+00	4.88E-09	1.08E-09	6.24E-02	7.05E-02	3.89E-01	8.10E-01	-1.88E+01	-1.71E+01	-1.74E+00	-4.90E-01	3.03E-01	5.60E-01	4.41E+00	2.06E-02	-2.22E+01	5.42E-11	-1.94E+01	1.40E-10	1.00E+00	5.95E-02	7.94E-02	6.51E-01
71	2.81E-14	0.00E+00	2.86E-09	1.83E-10	2.92E-01	3.22E-02	1.07E-01	1.11E-01	-1.90E+01	-1.88E+01	-8.72E-01	1.44E-01	3.85E-01	2.18E-02	1.37E-01	1.56E-02	-2.25E+01	9.76E-11	-2.10E+01	2.75E-10	1.00E+00	1.24E-01	4.36E-02	6.23E-01
72	3.61E-15	2.00E+00	7.49E-09	1.03E-09	1.46E-01	8.04E-02	5.18E-01	6.86E-01	-1.97E+01	-2.03E+01	-9.79E-01	-2.38E-01	2.14E-01	1.84E-01	4.20E-01	1.17E-02	-2.10E+01	8.27E-12	-1.93E+01	1.57E-10	1.00E+00	1.02E-01	6.58E-02	6.47E-01
73	3.05E-14	0.00E+00	6.87E-09	7.59E-10	5.42E-02	1.25E-01	3.47E-01	5.65E-01	-1.97E+01	-1.79E+01	3.95E-02	6.73E-01	7.27E-02	5.98E-02	6.52E-01	9.32E-03	-2.31E+01	1.19E-10	-1.96E+01	1.78E-10	1.00E+00	7.38E-02	1.40E-02	6.87E-01
74	2.14E-14	1.00E+00	8.86E-09	2.49E-10	8.09E-01	7.72E-02	4.70E-01	8.74E-01	-1.74E+01	-1.96E+01	-1.06E-01	-1.76E-01	2.82E-01	1.23E-01	2.76E-01	1.60E-02	-2.40E+01	1.86E-10	-1.84E+01	1.09E-11	4.00E+00	8.79E-02	4.41E-02	7.45E-01
75	2.92E-14	0.00E+00	8.53E-09	8.20E-10	9.44E-01	8.26E-02	4.44E-01	9.83E-01	-1.83E+01	-1.87E+01	-1.78E+00	-6.25E-01	1.87E-01	1.05E-01	7.83E-01	3.36E-03	-2.36E+01	1.62E-10	-1.98E+01	2.21E-10	4.00E+00	1.00E-01	8.87E-02	6.52E-01
76	2.18E-14	2.00E+00	4.37E-09	7.13E-11	1.54E-01	2.31E-02	4.33E-01	5.39E-01	-1.82E+01	-1.89E+01	-1.42E-01	-2.07E-01	1.17E-01	2.54E-01	6.75E+00	2.94E-02	-2.33E+01	1.49E-10	-1.90E+01	1.02E-10	4.00E+00	1.01E-01	3.93E-02	5.85E-01
77	3.08E-14	2.00E+00	8.90E-09	8.42E-10	2.74E-01	7.48E-02	4.17E-01	3.33E-01	-1.98E+01	-1.85E+01	7.59E-01	-1.50E-01	5.94E-02	4.35E-01	5.37E-01	1.70E-02	-2.30E+01	1.15E-10	-1.78E+01	1.09E-11	4.00E+00	5.24E-02	1.32E-01	6.49E-01
78	1.92E-14	2.00E+00	3.06E-09	6.54E-10	8.44E-04	1.13E-02	6.57E-02	9.26E-01	-1.73E+01	-1.85E+01	-9.05E-02	-9.95E-01	3.55E-01	6.95E-02	7.31E+00	2.26E-02	-2.17E+01	3.77E-11	-1.85E+01	3.19E-11	4.00E+00	1.35E-01	1.16E-01	6.11E-01
79	2.04E-14	0.00E+00	6.81E-09	4.96E-11	2.41E-01	1.10E-01	4.11E-02	7.03E-01	-1.81E+01	-1.98E+01	-1.21E-01	-4.50E-01	3.95E-01	5.59E-01	6.26E-01	2.72E-03	-2.16E+01	4.87E-11	-1.71E+01	1.09E-11	1.00E+00	7.27E-02	5.17E-02	6.61E-01
80	3.13E-14	0.00E+00	9.28E-09	2.57E-10	1.67E-01	9.40E-02	1.85E-01	4.75E-01	-1.89E+01	-1.82E+01	-2.54E-01	7.91E-02	3.30E-01	7.40E-02	4.73E-01	4.18E-03	-2.17E+01	6.88E-11	-1.89E+01	8.23E-11	1.00E+00	6.73E-02	6.95E-02	5.94E-01
81	1.11E-14	2.00E+00	8.04E-09	5.36E-10	6.20E-01	1.25E-02	4.01E-01	8.52E-01	-1.77E+01	-1.96E+01	-2.47E-03	2.17E-01	2.25E-01	9.11E-02	7.13E+00	4.42E-03	-2.11E+01	9.74E-12	-1.89E+01	8.43E-11	1.00E+00	9.49E-02	7.65E-02	6.29E-01
82	8.62E-15	1.00E+00	4.09E-09	6.10E-10	8.30E-01	1.34E-01	2.34E-01	6.51E-01	-1.77E+01	-1.86E+01	9.15E-01	-1.50E+00	1.98E-01	1.60E-01	8.05E+00	1.36E-02	-2.40E+01	1.91E-10	-1.89E+01	9.07E-11	4.00E+00	8.71E-02	9.62E-02	6.26E-01
83	4.32E-15	2.00E+00	2.03E-09	7.33E-10	6.42E-01	1.39E-01	1.26E-01	7.86E-01	-1.80E+01	-1.86E+01	-5.23E-02	9.20E-02	3.23E-01	9.59E-02	1.94E-01	2.69E-02	-2.15E+01	3.68E-11	-1.90E+01	8.82E-11	4.00E+00	8.77E-02	9.46E-02	6.76E-01
84	2.94E-14	1.00E+00	8.63E-09	1.21E-09	4.12E-01	7.16E-02	2.20E-01	9.00E-01	-1.89E+01	-1.87E+01	-6.95E-02	4.35E-02	2.12E-02	5.82E-01	9.25E-01	1.34E-03	-2.26E+01	1.09E-10	-1.86E+01	5.42E-11	4.00E+00	1.08E-01	6.71E-02	7.53E-01
85	2.09E-14	0.00E+00	1.83E-09	7.73E-10	8.52E-01	7.25E-02	3.54E-01	6.70E-01	-1.76E+01	-1.87E+01	-4.81E-01	-2.74E-02	3.49E-02	1.16E-01	2.19E+00	2.98E-02	-2.16E+01	3.17E-11	-1.91E+01	1.22E-10	4.00E+00	4.91E-02	7.29E-02	7.02E-01
86	2.33E-14	2.00E+00	1.66E-09	1.05E-09	4.85E-01	2.13E-02	2.79E-01	2.59E-01	-1.80E+01	-1.88E+01	6.76E-02	-1.66E+00	2.03E-01	1.63E-02	5.96E-01	4.45E-03	-2.22E+01	8.79E-11	-1.91E+01	1.20E-10	4.00E+00	8.55E-02	5.30E-02	6.97E-01
87	3.98E-15	0.00E+00	6.56E-09	4.12E-10	8.73E-01	9.81E-02	4.50E-01	2.77E-01	-1.83E+01	-1.91E+01	-1.58E-01	-8.98E-02	1.50E-03	3.65E-01	6.36E+00	9.23E-03	-2.21E+01	5.73E-11	-1.88E+01	7.88E-11	1.00E+00	1.12E-01	3.13E-02	5.86E-01
88	2.29E-14	0.00E+00	1.53E-09	4.41E-10	2.34E-01	1.44E-01	2.26E-03	9.58E-01	-1.90E+01	-1.89E+01	2.90E-03	1.03E-01	1.92E-01	3.85E-01	1.06E+00	6.28E-03	-2.28E+01	1.29E-10	-1.90E+01	7.95E-11	1.00E+00	6.43E-02	1.24E-01	6.44E-01
89	6.22E-15	1.00E+00	6.14E-09	9.16E-10	2.01E-01	1.42E-01	3.77E-01	2.21E-01	-1.81E+01	-2.04E+01	2.25E-01	-1.14E-01	1.08E-01	1.17E-01	1.44E-01	2.43E-02	-2.19E+01	6.49E-11	-1.94E+01	1.32E-10	4.00E+00	2.98E-02	1.40E-02	5.60E-01
90	3.46E-15	0.00E+00	8.81E-10	7.76E-10	9.66E-01	1.00E-01	1.61E-01	4.04E-01	-1.78E+01	-1.92E+01	-8.31E-01	8.44E-01	1.42E-01	4.67E-01	7.69E-01	2.38E-02	-2.13E+01	2.21E-11	-1.84E+01	2.27E-11	4.00E+00	1.54E-01	9.02E-02	6.41E-01
91	1.24E-14	0.00E+00	5.21E-09	4.04E-10	6.94E-01	4.64E-03	2.74E-01	3.96E-01	-1.92E+01	-1.75E+01	6.40E-01	-4.19E-01	3.09E-01	1.34E-02	5.99E+00	4.65E-03	-2.14E+01	2.94E-11	-1.87E+01	6.42E-11	4.00E+00	9.05E-02	2.35E-02	5.67E-01

Table PAR-10. LHS Sampled Values (100 vectors) Replicate 2 — Continued

Parameter	1	2	3	4	5	6	7	8	9	10	11	12	14	15	16	17	18	19	20	21	22	23	24	25
Vector	STEEL	WAS_AREA	WAS_AREA	WAS_AREA	CELLULS	WAS_AREA	WAS_AREA	WAS_AREA	DRZ_PCS	CONC_PCS	SOLU4	SOLTH4	CONC_PCS	CONC_PCS	CONC_PCS	S_HALITE	S_HALITE	S_HALITE	S_MB139	S_MB139	S_MB139	S_MB139	S_MB139	S_MB139
Num.	CORRMCO2	PROBDEG	GRATMICI	GRATMICH	FBETA	SAT_RGAS	SAT_RBRN	SAT_WICK	PRMX_LOG	PRMX_LOG	SOLCIM	SOLCIM	SAT_RGAS	SAT_RBRN	PORE_DIS	POROSITY	PRMX_LOG	COMP_RCK	PRMX_LOG	COMP_RCK	RELP_MOD	SAT_RBRN	SAT_RGAS	PORE_DIS
92	2.72E-14	1.00E+00	3.10E-09	8.79E-10	1.79E-01	6.19E-02	8.99E-02	7.75E-01	-1.99E+01	-1.87E+01	-3.45E-02	4.80E-01	5.39E-02	4.20E-02	5.55E+00	2.06E-03	-2.27E+01	1.11E-10	-1.92E+01	1.11E-10	1.00E+00	5.81E-02	1.40E-02	6.36E-01
93	1.31E-14	2.00E+00	7.24E-09	8.94E-10	6.82E-01	5.50E-02	2.61E-02	3.89E-01	-1.91E+01	-1.92E+01	-1.32E-01	-3.29E-01	3.67E-01	3.91E-02	2.32E+00	2.73E-02	-2.21E+01	4.71E-11	-1.80E+01	1.09E-11	1.00E+00	7.07E-02	6.44E-02	6.09E-01
94	1.52E-14	1.00E+00	3.87E-09	2.40E-10	8.37E-01	5.98E-02	2.68E-01	5.73E-01	-1.93E+01	-1.90E+01	1.03E-01	-9.91E-02	1.62E-01	8.66E-02	3.29E-01	1.77E-02	-2.12E+01	1.52E-11	-1.83E+01	1.45E-11	4.00E+00	9.33E-02	8.25E-02	7.14E-01
95	5.51E-15	2.00E+00	3.72E-09	1.98E-10	6.75E-01	1.35E-01	2.51E-01	4.14E-01	-1.87E+01	-1.84E+01	-2.05E-01	2.14E-01	1.52E-01	2.34E-01	5.79E-01	1.80E-03	-2.27E+01	1.20E-10	-1.87E+01	7.19E-11	1.00E+00	1.05E-01	1.61E-01	6.20E-01
96	1.02E-14	0.00E+00	7.92E-09	2.95E-10	5.00E-01	3.30E-02	5.10E-02	5.43E-01	-1.75E+01	-1.99E+01	-5.96E-01	-4.34E-01	1.04E-01	1.94E-01	3.00E-01	1.27E-02	-2.36E+01	1.68E-10	-1.88E+01	5.05E-11	1.00E+00	7.82E-02	6.10E-02	6.65E-01
97	4.84E-15	0.00E+00	9.07E-09	1.33E-10	8.68E-01	4.44E-02	9.54E-03	1.47E-01	-1.86E+01	-1.83E+01	-1.71E-01	2.28E-01	2.72E-01	4.83E-01	6.98E-01	7.11E-03	-2.32E+01	1.32E-10	-1.90E+01	1.09E-10	4.00E+00	8.52E-02	6.66E-02	6.00E-01
98	2.11E-14	1.00E+00	1.30E-09	3.27E-10	1.51E-02	1.51E-02	2.22E-01	9.70E-01	-1.87E+01	-1.92E+01	-7.83E-02	4.09E-01	1.16E-01	5.99E-01	1.24E-01	2.57E-02	-2.27E+01	9.72E-11	-1.91E+01	1.12E-10	1.00E+00	6.48E-02	7.06E-02	6.16E-01
99	1.33E-14	0.00E+00	4.94E-09	2.92E-10	1.05E-01	3.19E-03	3.74E-01	5.24E-01	-1.97E+01	-1.99E+01	8.93E-01	-7.59E-02	3.91E-01	4.03E-01	5.92E+00	7.57E-03	-2.29E+01	1.31E-10	-1.95E+01	1.50E-10	1.00E+00	1.16E-01	1.56E-01	6.07E-01
100	1.17E-14	0.00E+00	4.43E-10	8.42E-11	3.88E-01	1.49E-01	2.43E-01	6.43E-01	-1.99E+01	-1.86E+01	1.13E-01	-3.99E-02	1.81E-01	2.99E-02	5.18E-01	6.44E-03	-2.21E+01	6.08E-11	-1.77E+01	1.09E-11	4.00E+00	9.55E-02	6.86E-02	5.01E-01

Table PAR-10. LHS Sampled Values (100 vectors) Replicate 2 — Continued

Parameter	26	27	28	29	30	31	32	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
Vector Num.	S_HALITE PRESSURE	CASTILER PRESSURE	CASTILER PRMX_LOG	CASTILER COMP_RCK	BH_SAND PRMX_LOG	DRZ_1 PRMX_LOG	CONC_PLG PRMX_LOG	SOLAM3 SOLSIM	SOLAM3 SOLCIM	SOLPU3 SOLSIM	SOLPU3 SOLCIM	SOLPU4 SOLSIM	SOLPU4 SOLCIM	SOLU4 SOLSIM	SOLU6 SOLSIM	SOLU6 SOLCIM	SOLTH4 SOLSIM	PHUMOX3 PHUMCIM	GLOBAL OXSTAT	CULEBRA MINP_FAC	GLOBAL TRANSIDX	GLOBAL CLIMTIDX	CULEBRA HMBLKLT
1	1.20E+07	1.29E+07	-1.15E+01	6.02E-11	-1.33E+01	-1.74E+01	-1.71E+01	-1.01E-01	-4.84E-01	3.55E-01	2.39E-01	1.88E-01	2.12E-01	-4.98E-01	2.49E-01	-1.48E-01	-7.50E-01	1.46E+00	8.42E-01	7.97E+02	5.39E-01	1.01E+00	4.79E-01
2	1.28E+07	1.21E+07	-1.43E+01	6.75E-11	-1.37E+01	-1.62E+01	-1.78E+01	8.79E-01	-1.21E+00	8.65E-01	1.47E-01	-2.34E-03	3.53E-01	-1.95E-01	2.82E-03	1.23E-01	-4.53E-01	1.41E+00	6.50E-01	4.76E+02	8.09E-02	1.06E+00	1.93E-01
3	1.12E+07	1.32E+07	-1.12E+01	3.64E-11	-1.49E+01	-1.48E+01	-1.71E+01	3.64E-01	-4.19E-01	-7.16E-02	-4.14E-01	9.07E-01	-7.40E-01	-2.06E-01	-3.58E-01	-1.24E+00	-1.90E-01	1.41E+00	1.44E-01	9.89E+01	7.78E-01	2.10E+00	3.45E-01
4	1.29E+07	1.52E+07	-1.27E+01	7.45E-11	-1.53E+01	-1.57E+01	-1.73E+01	-2.81E-01	-1.35E-01	-1.23E+00	-1.32E+00	-2.57E-01	-2.34E-01	-9.56E-03	-1.03E-01	-1.73E-01	1.26E-01	1.07E-01	3.58E-01	9.38E+02	4.94E-01	1.06E+00	1.14E-01
5	1.29E+07	1.26E+07	-1.10E+01	2.35E-11	-1.22E+01	-1.83E+01	-1.84E+01	4.07E-01	8.67E-02	-1.80E-01	-1.01E-01	8.78E-02	-1.17E-01	6.41E-01	-4.03E-01	-3.88E-03	-1.67E-01	3.73E-01	1.95E-01	9.89E+02	5.94E-01	1.07E+00	4.30E-01
6	1.19E+07	1.23E+07	-1.24E+01	6.88E-11	-1.36E+01	-1.42E+01	-1.85E+01	-9.67E-01	4.85E-01	-7.99E-01	-2.12E-01	7.49E-01	4.59E-02	-7.74E-01	-2.49E-01	1.53E-01	-9.49E-01	9.88E-01	5.89E-02	8.65E+02	5.85E-01	1.04E+00	3.90E-01
7	1.38E+07	1.57E+07	-1.13E+01	3.17E-11	-1.32E+01	-1.45E+01	-1.77E+01	5.62E-02	-2.35E-01	5.03E-02	8.40E-01	-1.04E-01	1.18E-01	5.24E-02	-1.68E-01	-7.84E-01	-2.70E-01	1.40E+00	6.17E-01	8.19E+02	2.36E-01	1.17E+00	3.09E-01
8	1.34E+07	1.30E+07	-1.07E+01	4.03E-11	-1.52E+01	-1.65E+01	-1.90E+01	1.91E-01	-2.24E-02	-7.75E-01	1.07E+00	-3.54E-02	-2.20E-02	-3.86E-01	9.23E-01	-1.75E-01	-1.56E-02	1.42E+00	3.32E-01	6.53E+02	9.06E-01	1.87E+00	6.32E-02
9	1.28E+07	1.62E+07	-1.16E+01	2.97E-11	-1.11E+01	-1.63E+01	-1.71E+01	-2.54E-01	8.63E-01	7.05E-01	-3.29E-01	-4.19E-02	1.92E-01	-3.20E-03	1.91E-02	9.26E-01	-6.01E-02	1.29E+00	5.40E-01	2.83E+02	5.72E-01	1.15E+00	7.35E-02
10	1.20E+07	1.19E+07	-1.17E+01	3.96E-11	-1.10E+01	-1.81E+01	-1.89E+01	9.39E-01	3.65E-01	-1.01E-01	-4.57E-01	2.43E-01	2.33E-03	-1.06E-01	9.85E-02	4.64E-02	2.49E-01	9.60E-01	8.64E-01	7.29E+02	6.57E-01	1.20E+00	3.73E-01
11	1.33E+07	1.31E+07	-1.18E+01	3.84E-11	-1.29E+01	-1.35E+01	-1.74E+01	-5.40E-02	8.44E-01	1.07E-01	-1.71E-01	-1.86E-01	3.44E-01	1.31E-01	2.63E-02	-2.37E-01	-5.12E-01	1.43E+00	5.62E-01	3.40E+02	5.09E-01	1.17E+00	2.55E-01
12	1.37E+07	1.27E+07	-1.10E+01	2.77E-11	-1.61E+01	-1.77E+01	-1.75E+01	7.76E-01	4.48E-02	1.22E-02	-1.58E-01	-2.74E-01	1.70E-01	-1.91E+00	-3.24E-01	-3.49E-01	-1.84E-01	7.59E-01	5.96E-01	4.88E+02	9.33E-01	1.14E+00	2.45E-01
13	1.23E+07	1.49E+07	-1.33E+01	5.62E-11	-1.57E+01	-1.26E+01	-1.88E+01	-1.51E+00	6.92E-01	1.36E+00	3.28E-02	-1.51E-01	-1.84E-02	-6.64E-01	-7.33E-04	-5.26E-01	4.32E-01	1.44E+00	7.62E-02	6.08E+02	7.42E-01	1.23E+00	3.31E-01
14	1.13E+07	1.23E+07	-1.02E+01	2.65E-11	-1.39E+01	-1.51E+01	-1.72E+01	-2.32E-01	9.41E-01	-2.43E-01	-3.54E-01	-2.43E-01	-1.94E-01	9.97E-01	-4.12E-01	-2.15E-02	-1.20E-01	1.52E+00	4.46E-01	5.15E+02	4.05E-02	1.12E+00	1.23E-01
15	1.28E+07	1.40E+07	-1.40E+01	6.48E-11	-1.44E+01	-1.90E+01	-1.87E+01	-4.06E-01	9.99E-01	-1.54E-02	1.36E-01	-1.98E-02	-4.49E-01	-8.56E-01	-1.32E-01	-2.06E-01	7.88E-01	1.34E+00	9.10E-01	2.41E+02	5.29E-01	1.18E+00	2.20E-01
16	1.39E+07	1.51E+07	-1.10E+01	4.33E-11	-1.48E+01	-1.83E+01	-1.81E+01	-3.41E-01	-6.98E-02	-4.96E-01	-2.64E-01	1.63E-01	-2.05E-01	-7.01E-01	-9.39E-01	-5.92E-02	-8.56E-01	8.60E-01	5.84E-01	3.84E+02	3.16E-01	1.59E+00	3.21E-01
17	1.16E+07	1.14E+07	-1.09E+01	3.43E-11	-1.17E+01	-1.87E+01	-1.90E+01	-2.93E-01	-2.51E-01	-2.51E-01	-1.92E-01	-1.81E+00	5.08E-02	2.17E-01	-9.64E-02	-7.80E-02	-1.90E-05	1.47E+00	8.03E-01	3.29E+01	1.85E-01	1.08E+00	1.55E-01
18	1.19E+07	1.39E+07	-1.05E+01	3.21E-11	-1.28E+01	-1.72E+01	-1.85E+01	-1.44E-01	7.26E-01	-1.54E-03	2.54E-03	-8.20E-02	2.42E-01	-8.56E-02	-2.31E-02	-4.88E-01	1.41E-01	1.54E-01	2.07E-01	3.65E+02	7.95E-01	1.15E+00	2.70E-01
19	1.16E+07	1.20E+07	-1.19E+01	5.49E-11	-1.25E+01	-1.85E+01	-1.76E+01	-2.19E-01	-1.09E-01	1.79E-01	7.12E-01	9.81E-02	-6.93E-01	-9.17E-02	-4.48E-01	-2.01E-01	5.72E-01	5.57E-01	8.87E-01	5.59E+02	9.96E-01	1.53E+00	4.94E-01
20	1.17E+07	1.46E+07	-1.30E+01	4.96E-11	-1.37E+01	-1.60E+01	-1.89E+01	5.12E-03	-2.47E-01	1.17E-02	-8.66E-01	8.03E-01	2.27E-01	2.33E-01	-1.98E-01	1.75E-01	3.13E-01	1.09E+00	6.48E-01	5.92E+02	8.90E-01	1.96E+00	3.16E-01
21	1.14E+07	1.15E+07	-1.25E+01	4.56E-11	-1.32E+01	-1.37E+01	-1.84E+01	-7.16E-02	3.39E-02	8.72E-02	-3.37E-02	9.51E-01	-2.45E-01	-1.59E-01	-1.74E-01	-1.89E+00	-6.40E-01	5.83E-01	4.80E-01	9.52E+02	1.10E-01	1.04E+00	2.36E-01
22	1.25E+07	1.33E+07	-1.21E+01	6.18E-11	-1.16E+01	-1.49E+01	-1.89E+01	-6.73E-02	-3.64E-03	-3.98E-01	-4.07E-01	-4.44E-01	-2.25E-01	4.38E-01	-2.90E-01	1.97E-01	-1.38E-01	1.57E+00	6.72E-01	9.42E+02	8.75E-01	1.21E+00	4.33E-01
23	1.12E+07	1.59E+07	-1.12E+01	3.70E-11	-1.18E+01	-1.88E+01	-1.87E+01	-3.80E-02	-3.43E-01	-3.73E-01	-5.54E-02	-2.12E-01	-1.06E+00	-4.05E-01	2.27E-01	-3.02E-01	-2.92E-01	1.56E+00	6.30E-01	3.45E+02	6.46E-02	1.09E+00	3.56E-01
24	1.38E+07	1.16E+07	-1.20E+01	8.05E-11	-1.13E+01	-1.50E+01	-1.83E+01	-3.76E-01	-1.87E-01	5.59E-01	-2.14E-02	-2.07E-01	-2.19E-01	-1.34E-01	-2.72E-01	-3.77E-01	-1.70E+00	1.25E-01	9.87E-01	2.35E+02	4.74E-01	2.06E+00	1.71E-01
25	1.31E+07	1.53E+07	-1.33E+01	7.59E-11	-1.25E+01	-1.30E+01	-1.88E+01	-2.00E-01	1.84E-01	4.63E-01	-7.25E-01	-6.48E-02	-3.96E-01	-9.38E-01	1.37E-01	-2.85E-01	-1.53E-01	1.40E+00	4.88E-01	1.60E+02	2.97E-01	1.07E+00	2.77E-01
26	1.25E+07	1.19E+07	-1.03E+01	3.81E-11	-1.14E+01	-1.32E+01	-1.80E+01	-1.67E-01	-4.42E-01	-1.07E-01	6.74E-01	-8.64E-01	2.23E-01	-3.10E-01	-8.69E-02	-4.02E-02	3.99E-02	1.05E+00	1.17E-02	7.08E+02	6.00E-01	1.03E+00	4.72E-01
27	1.27E+07	1.34E+07	-1.27E+01	6.56E-11	-1.54E+01	-1.92E+01	-1.78E+01	-5.56E-02	-9.70E-01	-6.35E-01	7.77E-01	-5.56E-02	-6.45E-03	9.60E-02	-8.45E-01	-7.37E-02	-1.75E-01	3.21E-01	4.49E-02	1.30E+02	3.99E-01	1.24E+00	3.75E-01
28	1.30E+07	1.41E+07	-1.06E+01	3.31E-11	-1.60E+01	-1.39E+01	-1.83E+01	7.27E-01	-8.75E-02	2.18E-01	-3.08E-01	1.54E-01	-1.65E+00	3.25E-01	8.86E-01	1.40E-01	-4.88E-01	4.86E-01	2.51E-01	2.22E+02	5.53E-01	1.07E+00	4.25E-01
29	1.36E+07	1.21E+07	-1.32E+01	6.27E-11	-1.35E+01	-1.36E+01	-1.83E+01	-7.59E-01	-1.18E-01	6.72E-01	-6.79E-01	-4.80E-01	-1.38E-01	1.01E+00	-2.95E-02	-6.64E-02	-1.96E+00	1.31E+00	8.10E-01	6.79E+02	6.60E-01	1.19E+00	1.89E-01
30	1.31E+07	1.40E+07	-1.22E+01	4.77E-11	-1.54E+01	-1.87E+01	-1.83E+01	-5.51E-01	1.66E-01	1.70E-01	-1.67E-02	-3.37E-01	1.86E-01	2.02E-02	-1.91E-01	2.28E-02	1.14E-01	1.24E+00	3.15E-03	3.11E+02	1.91E-01	1.20E+00	1.73E-01
31	1.11E+07	1.36E+07	-1.22E+01	6.40E-11	-1.57E+01	-1.41E+01	-1.86E+01	-7.02E-01	4.09E-01	2.60E-02	-3.63E-01	-2.89E-01	-4.41E-01	6.80E-02	-1.20E-01	-3.18E-01	-2.57E-02	2.37E-01	7.32E-01	4.64E+02	7.82E-01	1.03E+00	4.99E-01
32	1.25E+07	1.18E+07	-1.29E+01	5.29E-11	-1.59E+01	-1.71E+01	-1.82E+01	9.12E-02	-9.85E-02	5.37E-01	-2.06E-01	-1.53E-01	-5.20E-01	1.99E-01	-7.55E-02	9.60E-01	1.77E-01	1.49E+00	2.61E-02	5.36E+02	7.54E-01	1.22E+00	3.84E-01
33	1.12E+07	1.28E+07	-1.28E+01	5.14E-11	-1.47E+01	-1.59E+01	-1.70E+01	-1.24E-02	7.95E-02	-2.16E-01	-1.98E-01	-1.30E+00	4.49E-01	1.59E-01	-1.85E-01	7.04E-01	-4.33E-01	6.04E-01	6.39E-01	9.18E+02	8.85E-01	1.22E+00	1.60E-01
34	1.17E+07	1.65E+07	-1.22E+01	4.59E-11	-1.29E+01	-1.89E+01	-1.80E+01	2.31E-01	-4.08E-01	9.51E-01	-2.46E-01	2.31E-01	-8.01E-01	-2.99E-01	-1.08E-01	-1.61E-01	-1.16E-01	4.56E-01	3.00E-01	8.28E+02	3.42E-01	1.03E+00	3.41E-01
35	1.26E+07	1.33E+07	-1.43E+01	9.49E-11	-1.34E+01	-1.66E+01	-1.84E+01	1.65E-01	-8.11E-01	-1.24E-01	-6.40E-01	-5.36E-01	-1.46E-01	8.94E-01	-5.79E-02	-7.06E-01	1.39E+00	1.52E+00	4.07E-01	5.48E+02	3.28E-02	1.10E+00	2.25E-01
36	1.23E+07	1.25E+07	-1.25E+01	5.56E-11	-1.46E+01	-1.54E+01	-1.75E+01	-1.51E-02	-2.95E-02	-1.89E-01	-2.21E-01	1.28E+00	9.51E-01	8.04E-01	-4.20E-02	-1.33E+00	-7.62E-02	8.00E-01	5.51E-01	8.68E+00	2.73E-01	1.81E+00	4.68E-01
37	1.15E+07	1.30E+07	-1.36E+01	7.82E-11	-1.27E+01	-1.58E+01	-1.88E+01	1.51E-01	-2.12E-01	-2.00E+00	-1.24E-01	2.12E-01	6.82E-02	1.85E-01	2.89E-01	-1.67E+00	-5.84E-01	1.06E+00	3.68E-02	8.06E+02	3.33E-01	1.01E+00	1.13E-01
38	1.12E+07	1.42E+07	-1.39E+01	5.82E-11	-1.32E+01	-1.82E+01	-1.78E+01	2.18E-01	9.60E-02	-3.39E-01	-1.30E-01	-1.01E-01	-5.20E-02	-3.39E-01	-5.71E-01	1.57E-01	-9.18E-01	1.17E+00	6.81E-01	1.97E+02	6.94E-01	1.18E+00	3.15E-01
39	1.34E+07	1.60E+07	-1.15E+01	5.91E-11	-1.31E+01	-1.79E+01	-1.81E+01	-1.28E-01	-1.42E-01	-3.47E-02	3.63E-01	3.17E-01	-6.18E-02	1.50E-01	-1.48E-01	3.02E-02	5.34E-01	1.56E+00	2.27E-01	3.80E+02	1.24E-01	1.11E+00	1.33E-01
40	1.14E+07	1.20E+07	-1.01E+01	5.23E-11	-1.63E+01	-1.90E+01	-1.78E+01	-1.98E-03	-1.98E-01	7.97E-01	-2.70E-01	1.58E-02	5.91E-01	-1.83E-01	-2.28E-01	-1.83E-01	2.35E-01	1.20E+00	5.37E-01	4.97E+02	8.37E-01	1.05E+00	7.86E-02
41	1.26E+07	1.31E+07	-1.04E+01	2.89E-11	-1.55E+01	-1.48E+01	-1.77E+01	1.08E+00	-1.49E-01	-7.68E-02	-4.77E-01	-1.58E+00	-2.82E-01	3.87E-02	5.81E-01	-2.13E-01	-2.33E-01	1.55E+00	2.72E-01	4.08E+02	4.42E-01	2.22E+00	4.55E-01
42	1.22E+07	1.44E+07	-1.23E+01	5.31E-11	-1.24E+01	-1.84E+01	-1.77E+01	-1.07E+00	-1.78E-01	6.06E-02	5.22E-01	5.90E-02	-1.89E+00	7.52E-01	-2.50E-01	-2.16E-01	-2.16E-01	1.54E+00	7.45E-01	3.07E+02	9.79E-01	1.02E+00	1.98E-01
43	1.21E+07	1.26E+07	-1.20E+01	5.72E-11	-1.21E+01	-1.43E+01	-1.84E+01	2.44E-01	-1.24E-02	-2.78E-01	-2.40E-01	4.47E-01	1.51E-01	-7.80E-01	1.51E-01	3.09E-01	-3.31E-02	1.54E+00	7.19E-01	7.61E+02	8.46E-01	1.19E+00	4.15E-01
44	1.37E+07	1.22E+07	-1.24E+01	7.76E-11	-1.40E+01	-1.64E+01	-1.81E+01	3.16E-01	1.97E-02	-4.27E-01	-7.93E-01	1.20E-01	-3.76E-02	-2.38E-01	-6.79E-02	7.88E-01	-2.57E-01	1.37E+00	7.67E-01	8.81E+02	6.47E-01	1.70E+00	2.95E-01
45	1.31E+07	1.47E+07	-1.28E+01	7.92E-11	-1.38E+01	-1.43E+01	-1.72E+01	-4.40E-02	5.57E-01	2.08E-01	-2.00E+00	7.63E-02	-6.36E-01	8.55E-02	-2.38E-01	-5.99E-01	-1.27E-01	1.50E+00	4.51E-01	5.79E+02	8.57E-01	1.75E+00	9.82E-02
46	1.32E+07	1.23E+07	-1.18E+01	3.76E-11	-1.24E+01	-1.29E+01	-1.85E+01	1.26E-01	2.25E-01	-2.46E-01	4.74E-01	5.34E-01	-2.99E-01	-1.77E-02	6.70E-02	-1.41E-01	-1.66E-01	1.45E+00	3.25E-01	7.83E+01	1.43E-01	1.79E+00	9.44E-02
47	1.19E+07	1.17E+07	-1.13E+01	3.57E-11	-1.30E+01	-1.55E+01	-1.75E+01	-1.81E+00	-9.25E-01	3.94E-02	-2.87E-01	-1.34E-01	1.23E-01	-4.23E-01	-5.52E-02	-1.21E-01	-2.09E-01	1.46E+00	4.38E-01	1.08E+02	2.22E-01	1.89E+00	3.81E-01
48	1.33E+07	1.28E+07	-1.22E+01	7.18E-11	-1.43E+01	-1.94E+01	-1.71E+01	-2.39E-01	8.00E-01	8.22E-01	8.76E-01	-2.17E-01	-1.40E-01	2.45E-01	6.37E-01	-2.48E-01	-3.49E-01	1.50E+00	1.09E-01	6.94E+02	4.17E-01	1.25E+00	4.63E-01
49	1.27E+07	1.64E+07	-1.16E+01	4.90E-11	-1.51E+01	-1.53E+01	-1.79E+01	-4.22E-01	-1.47E+00	-2.36E-01	7.69E-02	2.67E-01	8.94E-02	9.00E-01	-3.56E-01	-1.10E-01	-1.23E+00	1.53E+00	7.04E-01	8.60E+02	8.16E-01	1.16E+00	4.47E-01
50	1.35E+07	1.29E+07	-1.25E+01	7.29E-11	-1.23E+01	-1.33E+01	-1.72E+01	5.39E-01	6.15E-02	-8.57E-02	1.04E-01	-3.47E-02	-8.95E-02	-7.09E-02	-3.91E-01	-4.36E-01	-4.05E-01	1.44E+00	6.61E-01	7.50E+02	7.17E-01	1.10E+00	2.16E-01
51	1.22E+07	1.35E+07	-1.14E+01	3.03E-11	-1.49E+01	-1.69E+01	-1.70E+01	3.89E-02	-1.57E-01	-5.07E-01	-2.29E-01	-2.27E-01	1.31E-02	-5.82E-01	8.31E-01	-4.64E-01	8.18E-01	1.59E+00	9.44E-01	1.88E+02	5.16E-01	1.09E+00	2.62E-01

Table PAR-10. LHS Sampled Values (100 vectors) Replicate 2 — Continued

Parameter	26	27	28	29	30	31	32	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
Vector Num.	S_HALITE PRESSURE	CASTILER PRESSURE	CASTILER PRMX_LOG	CASTILER COMP_RCK	BH_SAND PRMX_LOG	DRZ_1 PRMX_LOG	CONC_PLG PRMX_LOG	SOLAM3 SOLSIM	SOLAM3 SOLCIM	SOLPU3 SOLSIM	SOLPU3 SOLCIM	SOLPU4 SOLSIM	SOLPU4 SOLCIM	SOLU4 SOLSIM	SOLU6 SOLSIM	SOLU6 SOLCIM	SOLTH4 SOLSIM	PHUMOX3 PHUMCIM	GLOBAL OXSTAT	CULEBRA MINP_FAC	GLOBAL TRANSIDX	GLOBAL CLIMTIDX	CULEBRA HMBLKLT
52	1.36E+07	1.24E+07	-1.20E+01	4.39E-11	-1.62E+01	-1.38E+01	-1.78E+01	-7.98E-02	-7.68E-02	-3.89E-01	2.11E-01	-1.80E-01	-2.38E-01	2.63E-01	-1.09E+00	-4.68E-02	7.36E-01	1.44E+00	3.93E-01	8.34E+02	3.78E-01	1.14E+00	4.23E-01
53	1.10E+07	1.37E+07	-1.37E+01	4.64E-11	-1.58E+01	-1.38E+01	-1.80E+01	1.04E-01	2.41E-01	-5.48E-02	4.47E-01	-3.64E-01	5.08E-01	-2.14E-01	4.26E-02	6.50E-01	-8.06E-01	1.02E+00	6.98E-01	4.53E+02	6.77E-01	1.08E+00	1.64E-01
54	1.18E+07	1.56E+07	-1.31E+01	8.38E-11	-1.55E+01	-1.75E+01	-1.82E+01	-1.22E-01	1.36E-01	-9.19E-02	-6.75E-02	-1.18E+00	1.42E-01	-1.43E+00	1.20E-01	2.67E-01	-6.75E-01	7.73E-01	1.14E-01	4.32E+01	7.63E-02	1.17E+00	4.44E-01
55	1.11E+07	1.28E+07	-1.34E+01	6.66E-11	-1.52E+01	-1.62E+01	-1.80E+01	-4.33E-01	1.08E-01	-1.58E+00	-6.59E-03	-8.79E-02	-4.45E-02	3.57E-01	-2.21E-01	1.10E-01	-1.02E-01	1.58E+00	1.70E-01	5.84E+02	9.87E-01	1.65E+00	4.03E-01
56	1.30E+07	1.47E+07	-1.26E+01	5.40E-11	-1.39E+01	-1.86E+01	-1.81E+01	4.88E-01	1.45E-01	1.43E-01	3.59E-02	-6.02E-01	9.40E-01	-1.11E-01	-1.73E+00	-2.56E-01	8.92E-02	9.24E-01	9.94E-02	1.41E+02	4.05E-01	1.24E+00	2.52E-01
57	1.38E+07	1.34E+07	-1.23E+01	4.52E-11	-1.42E+01	-1.78E+01	-1.85E+01	-1.67E-01	-3.04E-01	-2.07E-01	1.51E-02	6.87E-01	-8.67E-01	8.72E-03	5.47E-01	2.40E-01	4.64E-01	8.23E-01	8.21E-01	9.07E+02	1.61E-02	1.73E+00	1.78E-01
58	1.30E+07	1.38E+07	-1.30E+01	4.21E-11	-1.35E+01	-1.76E+01	-1.86E+01	3.01E-02	-4.55E-01	2.26E-01	-4.29E-01	-1.63E-01	-6.85E-02	-2.35E-01	6.72E-01	-2.81E-02	-3.08E-01	1.42E+00	4.30E-01	2.57E+02	9.30E-01	1.05E+00	6.39E-02
59	1.34E+07	1.22E+07	-1.18E+01	3.47E-11	-1.59E+01	-1.85E+01	-1.77E+01	-1.45E+00	1.23E-01	-2.96E-01	-1.08E-02	-9.56E-02	-9.37E-02	-1.62E-01	5.27E-02	6.80E-01	-2.43E-01	8.95E-01	5.71E-01	7.34E+02	2.42E-01	1.13E+00	2.84E-01
60	1.21E+07	1.42E+07	-1.19E+01	6.32E-11	-1.34E+01	-1.74E+01	-1.85E+01	-3.33E-01	-2.39E-01	7.87E-02	1.17E-01	6.10E-01	1.61E-01	-6.71E-02	1.87E-01	-3.95E-01	1.73E-03	2.70E-01	3.78E-01	6.30E+02	7.02E-01	2.18E+00	7.24E-02
61	1.14E+07	1.48E+07	-1.14E+01	4.85E-11	-1.36E+01	-1.41E+01	-1.77E+01	-3.27E-02	-9.63E-02	-9.12E-01	-1.79E-01	-1.73E-01	-1.95E-01	-2.80E-01	1.99E-01	1.89E-01	2.75E-01	1.39E+00	5.25E-01	1.71E+02	7.34E-01	1.01E+00	3.53E-01
62	1.24E+07	1.38E+07	-1.21E+01	6.97E-11	-1.51E+01	-1.46E+01	-1.83E+01	5.64E-01	-1.27E-01	9.15E-01	1.71E-01	-2.47E-01	-4.15E-01	5.70E-01	-1.53E-01	-1.32E-01	8.50E-01	3.38E-01	8.53E-01	7.01E+01	2.84E-01	1.08E+00	4.52E-01
63	1.28E+07	1.43E+07	-1.11E+01	3.88E-11	-1.12E+01	-1.63E+01	-1.82E+01	-2.28E-01	-8.73E-01	2.02E-01	-2.34E-01	-4.53E-01	-1.77E-01	-4.59E-02	3.83E-01	-8.69E-02	-1.97E-01	1.36E+00	2.65E-01	5.11E+01	9.48E-01	1.59E+00	2.80E-01
64	1.34E+07	1.45E+07	-1.26E+01	5.41E-11	-1.15E+01	-1.67E+01	-1.79E+01	-2.14E-02	-1.64E+00	-1.70E-01	-4.87E-01	4.35E-02	8.46E-01	-4.51E-01	-4.88E-01	-4.76E-01	-4.41E-02	1.48E+00	1.84E-01	9.24E+02	6.34E-01	1.02E+00	3.06E-01
65	1.27E+07	1.44E+07	-1.09E+01	4.16E-11	-1.20E+01	-1.27E+01	-1.72E+01	-9.38E-01	-2.04E-01	6.14E-01	-3.84E-01	1.12E-01	-3.06E-02	-2.50E-01	1.56E-01	2.05E-01	5.09E-02	1.53E+00	8.43E-02	9.63E+02	1.10E-01	1.85E+00	4.84E-01
66	1.32E+07	1.36E+07	-1.41E+01	9.26E-11	-1.57E+01	-1.34E+01	-1.80E+01	6.21E-01	-4.62E-02	-1.65E-01	-8.90E-02	-2.01E-01	-3.40E-01	-2.29E-01	-3.14E-01	2.37E-01	-1.50E-01	7.15E-01	1.21E-01	1.19E+02	1.34E-01	1.08E+00	3.97E-01
67	1.30E+07	1.39E+07	-1.25E+01	4.93E-11	-1.15E+01	-1.72E+01	-1.72E+01	5.97E-02	-3.63E-01	-1.33E-01	2.35E-01	-4.96E-01	6.04E-01	7.40E-01	9.56E-01	-7.75E-01	1.95E-01	4.64E-01	4.16E-01	2.75E+02	8.61E-01	1.11E+00	3.51E-01
68	1.13E+07	1.53E+07	-1.24E+01	8.26E-11	-1.17E+01	-1.70E+01	-1.81E+01	1.12E-01	5.08E-02	-2.12E-01	6.34E-01	-1.90E-01	-4.93E-01	-1.45E-01	-1.15E-01	5.06E-01	-1.48E+00	1.47E+00	3.83E-01	7.75E+02	8.29E-01	1.12E+00	5.01E-02
69	1.27E+07	1.47E+07	-1.17E+01	5.10E-11	-1.19E+01	-1.78E+01	-1.89E+01	1.80E-02	6.17E-01	-4.57E-01	-4.66E-02	-1.12E-01	3.18E-02	4.53E-01	-1.00E-02	-1.59E-01	2.24E-01	1.38E+00	2.46E-01	6.61E+02	6.11E-01	2.08E+00	4.41E-01
70	1.16E+07	1.37E+07	-1.34E+01	7.12E-11	-1.18E+01	-1.77E+01	-1.79E+01	-1.77E-01	1.92E-01	4.25E-01	1.20E-01	-2.35E-02	7.63E-02	-1.32E-01	-2.10E-01	2.26E-01	6.17E-01	6.80E-01	8.76E-01	9.97E+02	9.38E-02	1.23E+00	3.26E-01
71	1.24E+07	1.25E+07	-1.13E+01	3.50E-11	-1.22E+01	-1.66E+01	-1.79E+01	2.85E-01	-3.60E-02	-3.26E-01	-8.98E-01	4.61E-01	-1.04E-01	-1.02E-01	3.28E-01	-3.25E-01	6.28E-02	1.43E+00	2.12E-01	8.49E+02	2.45E-02	1.16E+00	4.11E-01
72	1.18E+07	1.24E+07	-1.29E+01	6.82E-11	-1.44E+01	-1.26E+01	-1.88E+01	2.13E-01	-2.83E-01	2.97E-01	6.73E-02	-4.13E-01	-1.24E-01	-5.46E-02	-6.55E-01	-9.28E-02	-6.69E-02	1.57E+00	6.03E-01	7.86E+02	3.28E-01	1.09E+00	1.81E-01
73	1.21E+07	1.38E+07	-1.20E+01	4.44E-11	-1.49E+01	-1.55E+01	-1.75E+01	-2.46E-01	-5.47E-02	-2.29E-01	5.66E-01	3.57E-01	-1.71E-01	-9.58E-01	-4.77E-01	-9.78E-01	7.63E-02	1.58E+00	9.01E-01	4.47E+02	6.22E-01	1.13E+00	2.98E-01
74	1.24E+07	1.30E+07	-1.07E+01	4.47E-11	-1.41E+01	-1.81E+01	-1.86E+01	-1.89E-01	-2.24E-01	3.22E-01	2.82E-01	1.78E-01	7.46E-01	3.32E-02	-3.90E-02	5.54E-02	3.46E-02	1.58E+00	7.78E-01	7.54E+02	6.81E-01	1.52E+00	1.43E-01
75	1.33E+07	1.32E+07	-1.21E+01	5.01E-11	-1.53E+01	-1.69E+01	-1.76E+01	-4.52E-01	-5.44E-01	-1.59E-01	-5.78E-01	-7.05E-01	-3.04E-01	-1.24E-01	-8.13E-02	-1.02E-01	1.54E-01	1.47E+00	3.16E-01	5.67E+02	2.63E-01	2.00E+00	1.39E-01
76	1.35E+07	1.29E+07	-1.23E+01	5.59E-11	-1.20E+01	-1.50E+01	-1.74E+01	-1.50E-01	-1.70E-01	-8.39E-01	1.62E-01	7.07E-02	-1.06E-01	1.24E-01	-1.64E-01	8.19E-01	1.57E-01	6.14E-01	1.54E-01	2.44E+01	4.56E-01	1.04E+00	4.76E-01
77	1.20E+07	1.41E+07	-1.38E+01	8.79E-11	-1.19E+01	-1.60E+01	-1.73E+01	-1.06E-01	-4.64E-01	-6.99E-01	-1.67E+00	-1.40E-01	7.60E-01	-2.50E-01	-5.19E-01	-3.69E-01	1.50E-02	5.35E-01	3.67E-01	4.15E+02	4.30E-01	2.15E+00	1.20E-01
78	1.15E+07	1.44E+07	-1.19E+01	6.00E-11	-1.56E+01	-1.58E+01	-1.79E+01	9.72E-01	1.32E+00	-1.83E-01	-5.94E-02	-7.29E-01	-7.06E-02	-4.69E-01	-1.41E-01	-4.18E-01	-2.27E-01	1.51E+00	5.03E-01	6.50E+02	3.06E-01	2.23E+00	2.40E-01
79	1.39E+07	1.45E+07	-1.17E+01	4.25E-11	-1.60E+01	-1.80E+01	-1.87E+01	1.42E-01	-6.94E-01	-1.29E-01	-5.01E-01	-7.04E-02	9.77E-02	-1.76E-01	-7.52E-01	-1.28E-01	-8.74E-02	1.55E+00	9.30E-01	8.95E+02	9.51E-01	1.19E+00	3.62E-01
80	1.33E+07	1.32E+07	-1.18E+01	4.80E-11	-1.29E+01	-1.73E+01	-1.75E+01	8.23E-01	1.75E-01	-3.13E-01	-3.59E-02	-4.94E-02	-9.09E-01	-2.75E-02	1.69E-01	3.83E-01	-3.86E-01	1.38E+00	5.20E-01	8.68E+01	7.23E-01	1.11E+00	1.50E-01
81	1.35E+07	1.33E+07	-1.31E+01	8.48E-11	-1.40E+01	-1.52E+01	-1.87E+01	-3.15E-01	2.36E-01	1.27E-01	-1.86E-01	2.15E-01	2.82E-01	1.76E-01	-2.01E-02	1.01E-01	-7.76E-02	1.59E+00	7.27E-01	1.69E+01	9.61E-01	1.00E+00	2.30E-01
82	1.23E+07	1.36E+07	-1.16E+01	3.99E-11	-1.27E+01	-1.92E+01	-1.73E+01	-1.58E-01	5.22E-01	-6.53E-02	-7.62E-02	-1.27E-01	-1.26E-01	7.63E-02	-8.16E-01	-2.24E-01	-3.64E-01	1.60E+00	2.33E-01	6.18E+02	2.63E-04	1.03E+00	1.45E-01
83	1.18E+07	1.17E+07	-1.28E+01	7.40E-11	-1.13E+01	-1.91E+01	-1.74E+01	-6.63E-01	-6.04E-02	-2.77E-02	-1.24E+00	5.60E-01	-5.97E-01	-1.62E+00	-4.35E-01	9.07E-02	2.09E-01	1.49E+00	1.37E-01	1.69E+02	5.68E-01	1.22E+00	2.71E-01
84	1.22E+07	1.34E+07	-1.12E+01	4.07E-11	-1.14E+01	-1.46E+01	-1.82E+01	8.23E-02	-2.21E-01	-4.07E-02	-9.57E-02	-3.43E-01	-3.80E-01	-1.68E-01	-9.80E-01	5.51E-01	9.32E-01	7.39E-01	7.80E-01	6.83E+02	4.29E-01	1.21E+00	4.06E-01
85	1.15E+07	1.50E+07	-1.08E+01	4.18E-11	-1.42E+01	-1.28E+01	-1.89E+01	1.83E-01	-1.62E-01	-5.86E-02	-8.04E-02	2.45E-02	-3.34E-01	-6.03E-02	-1.35E+00	-9.31E-03	-4.21E-01	1.12E+00	9.39E-01	2.05E+02	1.51E-01	1.17E+00	1.99E-01
86	1.29E+07	1.42E+07	-1.27E+01	6.98E-11	-1.30E+01	-1.28E+01	-1.72E+01	-1.84E-01	-1.15E-01	-9.48E-01	2.16E-01	7.51E-01	-1.39E-02	2.09E-01	7.82E-01	1.18E+00	6.62E-01	1.52E+00	8.94E-01	3.22E+02	2.14E-01	1.25E+00	2.10E-01
87	1.11E+07	1.55E+07	-1.17E+01	4.08E-11	-1.62E+01	-1.68E+01	-1.73E+01	-2.04E-01	-1.81E+00	-1.17E-01	-1.40E-01	7.79E-03	-8.05E-02	-3.84E-02	7.07E-01	4.92E-01	-9.28E-02	2.86E-01	9.52E-01	6.37E+02	2.50E-01	1.15E+00	3.68E-01
88	1.37E+07	1.31E+07	-1.13E+01	6.39E-11	-1.38E+01	-1.40E+01	-1.76E+01	1.74E-01	2.55E-01	-4.34E-02	9.44E-02	-1.24E-01	1.11E+00	-1.21E+00	2.11E-01	4.32E-01	-1.01E-02	1.40E+00	9.62E-01	3.59E+02	5.66E-02	1.06E+00	3.37E-01
89	1.36E+07	1.52E+07	-1.36E+01	6.14E-11	-1.11E+01	-1.51E+01	-1.76E+01	-1.11E-01	1.16E-02	-4.78E-01	3.33E-01	-8.02E-01	-1.60E-01	-1.46E-01	-2.06E-01	-2.35E-01	-1.41E-01	6.48E-01	1.73E-01	4.35E+02	7.67E-01	1.22E+00	4.88E-01
90	1.25E+07	1.35E+07	-1.19E+01	4.72E-11	-1.45E+01	-1.37E+01	-1.82E+01	-8.01E-01	-2.93E-01	-1.40E-01	1.96E-01	-1.36E-02	-1.56E-01	-4.39E-01	4.84E-01	-1.90E-01	-3.36E-01	1.39E+00	3.01E-01	9.71E+02	3.65E-01	1.94E+00	2.33E-01
91	1.23E+07	1.39E+07	-1.30E+01	5.77E-11	-1.47E+01	-1.44E+01	-1.89E+01	-5.85E-01	-6.09E-01	1.16E-01	-9.60E-01	-9.26E-01	8.68E-01	-3.65E-01	-2.32E-01	-1.11E-01	1.05E-01	1.48E+00	7.91E-01	3.96E+02	1.64E-01	1.12E+00	2.07E-01
92	1.26E+07	1.26E+07	-1.35E+01	7.65E-11	-1.50E+01	-1.93E+01	-1.85E+01	-8.50E-01	-6.51E-02	-4.42E-01	-1.09E-01	-6.38E-01	-9.66E-01	-2.21E-01	1.13E+00	-6.55E-01	-4.72E-01	1.14E+00	9.98E-01	4.22E+02	2.03E-01	1.63E+00	2.90E-01
93	1.36E+07	1.26E+07	-1.14E+01	3.08E-11	-1.45E+01	-1.31E+01	-1.74E+01	-4.89E-01	-1.50E-02	-6.05E-01	-1.14E-01	-9.71E-01	-1.42E+00	-5.01E-01	-1.29E-01	-9.38E-01	9.66E-01	4.19E-01	4.99E-01	7.16E+02	9.12E-01	1.01E+00	5.72E-02
94	1.13E+07	1.25E+07	-1.38E+01	8.84E-11	-1.24E+01	-1.47E+01	-1.71E+01	6.79E-01	-3.35E-01	2.49E-01	1.89E-01	-3.83E-01	-2.55E-01	1.17E-01	4.15E-01	-4.96E-02	3.58E-01	3.83E-01	4.70E-01	8.71E+02	4.62E-01	1.20E+00	8.37E-02
95	1.18E+07	1.50E+07	-1.16E+01	5.19E-11	-1.48E+01	-1.31E+01	-1.82E+01	-4.80E-01	3.39E-01	-1.50E+00	4.89E-02	-2.32E-01	6.64E-01	5.20E-01	1.12E-01	-8.82E-01	-1.06E-01	1.73E-01	9.78E-01	5.01E+02	3.55E-01	1.19E+00	3.95E-01
96	1.32E+07	1.27E+07	-1.15E+01	4.31E-11	-1.59E+01	-1.54E+01	-1.75E+01	-3.60E-01	-1.88E-01	-1.52E-01	-1.34E-01	8.87E-01	-1.82E-01	-8.03E-02	7.29E-02	8.70E-01	-5.51E-02	6.88E-02	3.41E-01	2.97E+02	4.86E-01	1.13E+00	1.27E-01
97	1.14E+07	1.30E+07	-1.32E+01	5.87E-11	-1.43E+01	-1.30E+01	-1.87E+01	-8.88E-02	-6.61E-01	-9.81E-03	9.95E-01	1.94E-01	-2.10E-01	-1.91E-01	8.93E-02	5.99E-02	-3.80E-02	1.50E+00	6.94E-02	2.13E+02	8.10E-01	2.03E+00	1.05E-01
98	1.20E+07	1.55E+07	-1.04E+01	3.33E-11	-1.21E+01	-1.56E+01	-1.87E+01	-9.27E-02	-3.87E-01	1.36E-01	-1.49E-01	-4.00E-01	-4.67E-01	-3.04E-02	2.24E-01	2.15E-04	-2.42E-01	9.31E-01	2.82E-01	5.27E+02	5.46E-01	1.16E+00	2.60E-01
99	1.17E+07	1.28E+07	-1.11E+01	3.69E-11	-1.16E+01	-1.35E+01	-1.73E+01	-2.12E-01	-7.67E-01	-1.96E-01	9.02E-01	-3.17E-01	-3.65E-01	-3.39E-01	-1.84E+00	8.00E-02	-2.07E-01	1.21E+00	8.33E-01	1.45E+02	1.77E-01	1.24E+00	1.02E-01
100	1.17E+07	1.58E+07	-1.08E+01	2.50E-11	-1.26E+01	-1.67E+01	-1.86E+01	-1.36E-01	2.12E-01	1.58E-01	-1.66E-01	1.38E-01	4.67E-01	6.85E-01	-6.92E-01	-1.72E-02	1.89E-01	2.19E-01	7.54E-01	2.64E+02	3.86E-01	1.11E+00	8.70E-02

Table PAR-10. LHS Sampled Values (100 vectors) Replicate 2 — Continued

Parameter	50	51	52	53	54	55	56	57	58	60	61	62	63	64	65	66	75
Vector Num.	CULEBRA APOROS	CULEBRA DPOROS	U+6 MKD_U	U+4 MKD_U	PU+3 MKD_PU	PU+4 MKD_PU	TH+4 MKD_TH	AM+3 MKD_AM	BOREHOLE TAUFAIL	GLOBAL PBRINE	BOREHOLE DOMEGA	SHFTU SAT_RBRN	SHFTU SAT_RGAS	SHFTU PRMX_LOG	SHFTL_T1 PRMX_LOG	SHFTL_T2 PRMX_LOG	SPALLMOD RNDSPALL
1	1.45E-03	1.89E-01	2.64E-03	2.30E+00	2.61E-02	8.04E-01	2.47E+00	1.12E-01	4.20E+00	3.31E-01	1.20E+01	2.99E-01	2.15E-01	-1.89E+01	-1.83E+01	-1.96E+01	3.99E-01
2	1.31E-03	1.12E-01	1.96E-03	9.56E-01	2.48E-01	1.08E+00	4.44E+00	5.16E-02	2.30E+01	5.23E-02	5.70E+00	9.75E-02	5.30E-02	-1.82E+01	-1.79E+01	-1.91E+01	1.75E-01
3	1.44E-04	1.57E-01	1.28E-03	9.36E-01	1.38E-01	1.74E+00	1.14E+00	3.80E-01	3.59E-01	5.66E-01	6.91E+00	3.20E-01	2.27E-01	-1.77E+01	-1.89E+01	-2.04E+01	3.87E-01
4	2.72E-03	1.61E-01	1.01E-02	1.48E+00	6.93E-02	1.63E+00	1.62E+00	8.31E-02	5.43E-02	5.39E-01	9.59E+00	1.20E-01	1.32E-01	-1.79E+01	-1.89E+01	-1.95E+01	1.61E-02
5	6.07E-03	1.80E-01	1.72E-03	5.24E+00	9.60E-02	7.07E+00	8.54E+00	1.58E-01	1.77E+00	5.85E-01	8.73E+00	3.97E-01	3.24E-01	-2.02E+01	-1.73E+01	-2.02E+01	1.64E-01
6	3.49E-03	1.53E-01	1.14E-04	7.25E-01	1.88E-01	8.39E-01	8.46E+00	2.13E-01	5.53E+01	2.61E-01	8.09E+00	2.73E-01	3.69E-01	-1.86E+01	-1.75E+01	-2.17E+01	1.00E+00
7	2.56E-04	1.84E-01	2.48E-04	1.14E+00	3.77E-01	9.87E-01	1.16E+00	2.80E-02	3.26E-01	5.06E-01	6.15E+00	1.37E-03	2.37E-01	-1.98E+01	-1.91E+01	-2.11E+01	4.53E-01
8	3.32E-04	1.42E-01	2.18E-04	6.46E+00	4.46E-02	1.02E+00	6.52E+00	3.58E-01	3.56E+01	5.49E-01	7.13E+00	2.90E-01	3.86E-01	-1.93E+01	-1.88E+01	-2.01E+01	8.99E-01
9	4.07E-04	1.19E-01	1.89E-03	6.72E+00	4.70E-02	9.58E-01	1.49E+00	7.89E-02	5.71E+00	2.66E-01	4.64E+00	5.56E-01	2.19E-01	-1.96E+01	-1.75E+01	-2.10E+01	8.30E-01
10	1.60E-04	1.87E-01	7.98E-05	8.00E-01	2.01E-01	7.09E+00	8.92E-01	1.29E-01	8.79E-01	3.13E-01	1.26E+01	1.79E-02	1.83E-01	-1.91E+01	-1.86E+01	-1.93E+01	4.69E-01
11	1.48E-04	1.90E-01	4.77E-03	7.65E+00	5.12E-02	8.88E-01	2.28E+00	5.32E-02	2.02E+01	2.42E-02	1.31E+01	1.64E-01	1.95E-01	-1.74E+01	-1.92E+01	-1.91E+01	8.18E-01
12	7.89E-03	1.04E-01	4.09E-03	7.54E-01	3.52E-01	3.97E+00	9.63E-01	3.34E-02	2.75E+01	5.57E-01	2.06E+01	1.66E-01	4.22E-02	-1.76E+01	-1.77E+01	-2.03E+01	4.07E-01
13	4.68E-03	1.82E-01	5.02E-04	7.11E-01	1.23E-01	9.20E+00	2.42E+00	2.98E-02	1.21E-01	4.67E-01	7.50E+00	2.68E-01	2.84E-01	-1.87E+01	-1.83E+01	-1.91E+01	9.45E-01
14	2.41E-03	1.88E-01	2.11E-03	9.09E-01	4.19E-02	8.01E+00	1.59E+00	1.21E-01	2.35E+00	5.08E-02	7.99E+00	6.50E-02	3.73E-01	-1.84E+01	-1.77E+01	-1.99E+01	2.70E-01
15	5.92E-03	1.68E-01	3.09E-05	1.30E+00	2.02E-02	4.49E+00	8.61E-01	2.58E-01	8.43E+00	1.94E-01	7.38E+00	5.96E-01	2.43E-02	-1.83E+01	-1.87E+01	-2.12E+01	5.40E-02
16	9.08E-04	1.70E-01	3.91E-04	1.91E+00	8.99E-02	3.83E+00	1.78E+00	1.46E-01	2.91E+00	8.06E-02	9.08E+00	8.64E-03	1.46E-01	-1.81E+01	-1.85E+01	-2.00E+01	1.43E-01
17	8.68E-04	1.08E-01	5.90E-04	8.27E-01	1.25E-01	1.31E+00	7.82E-01	8.67E-02	4.81E-01	2.78E-01	6.65E+00	1.29E-01	9.74E-02	-1.78E+01	-1.87E+01	-1.97E+01	9.76E-01
18	2.09E-04	2.08E-01	2.32E-04	6.15E+00	3.12E-01	1.97E+00	4.37E+00	6.47E-02	1.86E+01	4.62E-01	5.43E+00	5.42E-02	1.99E-02	-1.81E+01	-1.73E+01	-1.94E+01	7.11E-01
19	2.77E-03	1.13E-01	2.76E-03	3.92E+00	2.46E-01	5.44E+00	6.07E+00	2.77E-01	3.01E+01	1.33E-01	1.30E+01	4.94E-02	3.52E-01	-2.00E+01	-1.87E+01	-1.96E+01	5.48E-01
20	7.97E-03	2.03E-01	3.22E-04	2.85E+00	2.30E-02	1.49E+00	7.15E-01	1.52E-01	6.94E+00	4.30E-01	7.21E+00	2.50E-02	3.63E-01	-1.70E+01	-1.74E+01	-1.92E+01	8.80E-02
21	4.72E-04	1.23E-01	1.45E-02	4.27E+00	3.81E-02	1.23E+00	1.38E+00	5.01E-02	1.19E-01	7.00E-02	6.39E+00	2.18E-01	2.09E-01	-1.87E+01	-1.94E+01	-1.99E+01	6.48E-01
22	1.08E-03	1.38E-01	7.12E-04	1.36E+00	1.60E-01	1.20E+00	5.02E+00	2.15E-02	4.02E+01	5.82E-01	4.84E+00	4.99E-01	8.93E-03	-1.93E+01	-1.81E+01	-1.98E+01	1.31E-01
23	7.75E-04	1.70E-01	9.31E-05	4.39E+00	1.92E-01	3.41E+00	4.65E+00	1.58E-01	1.43E+01	2.78E-02	7.74E+00	3.52E-01	3.14E-01	-1.94E+01	-1.89E+01	-1.94E+01	5.83E-01
24	4.37E-04	1.19E-01	1.63E-03	1.52E+00	2.12E-02	2.78E+00	6.30E+00	3.09E-01	4.08E-01	3.98E-01	7.32E+00	1.03E-01	2.08E-01	-1.90E+01	-1.77E+01	-1.93E+01	6.70E-01
25	2.30E-04	1.68E-01	1.55E-02	1.11E+00	1.49E-01	1.19E+00	4.56E+00	2.20E-01	1.06E-01	3.70E-02	8.63E+00	8.34E-02	2.76E-01	-1.99E+01	-1.70E+01	-1.93E+01	7.16E-02
26	3.70E-03	1.80E-01	5.99E-05	6.31E+00	4.62E-02	8.50E-01	1.77E+00	1.01E-01	7.57E-01	3.63E-01	9.22E+00	1.38E-01	1.12E-01	-1.77E+01	-1.77E+01	-1.90E+01	1.82E-01
27	6.44E-04	1.58E-01	1.69E-04	1.45E+00	2.45E-02	3.09E+00	2.20E+00	1.39E-01	1.29E+01	1.38E-01	4.56E+00	8.95E-02	2.54E-01	-1.81E+01	-1.93E+01	-1.95E+01	7.85E-01
28	1.13E-03	1.83E-01	8.97E-04	2.58E+00	1.35E-01	7.51E+00	5.26E+00	2.23E-02	9.96E-01	1.92E-02	9.91E+00	4.67E-01	9.41E-02	-1.83E+01	-1.88E+01	-1.96E+01	3.63E-01
29	1.58E-03	1.77E-01	4.04E-05	3.81E+00	2.87E-01	2.16E+00	8.85E-01	1.66E-01	1.56E+00	3.77E-01	7.90E+00	5.77E-01	3.99E-01	-1.88E+01	-1.94E+01	-2.02E+01	3.09E-01
30	1.01E-03	1.84E-01	1.13E-02	9.20E+00	3.31E-01	2.28E+00	3.31E+00	6.96E-02	6.70E+00	3.88E-01	9.24E+00	1.25E-02	3.07E-01	-1.84E+01	-1.91E+01	-2.05E+01	1.02E-01
31	1.32E-03	1.10E-01	8.75E-04	9.86E+00	1.42E-01	6.20E+00	1.30E+00	2.27E-01	2.10E+00	1.15E-01	8.52E+00	3.07E-02	3.12E-02	-1.78E+01	-1.79E+01	-2.06E+01	8.53E-01
32	6.04E-04	1.00E-01	3.50E-03	1.65E+00	3.96E-02	9.18E-01	7.26E-01	3.90E-02	8.42E-01	2.03E-01	8.12E+00	1.15E-01	3.17E-01	-1.91E+01	-1.82E+01	-2.03E+01	7.72E-01
33	4.29E-04	1.78E-01	3.53E-04	9.70E-01	3.28E-02	3.86E+00	5.37E+00	3.46E-01	3.66E+00	4.46E-02	4.98E+00	2.39E-02	2.36E-02	-1.97E+01	-1.89E+01	-1.92E+01	2.27E-01
34	8.45E-03	1.34E-01	2.85E-04	1.25E+00	1.44E-01	1.26E+00	1.27E+00	2.69E-01	1.21E+00	1.53E-01	6.96E+00	1.74E-01	2.43E-01	-1.89E+01	-1.81E+01	-1.89E+01	7.07E-01
35	5.60E-03	1.77E-01	8.58E-03	1.09E+00	5.81E-02	1.69E+00	5.52E+00	3.94E-01	7.67E+01	4.55E-01	9.51E+00	1.25E-01	2.48E-01	-1.79E+01	-1.85E+01	-1.88E+01	6.17E-01
36	2.03E-04	1.61E-01	4.25E-04	4.76E+00	3.89E-01	4.57E+00	5.62E+00	1.26E-01	1.05E+01	3.73E-01	6.51E+00	5.09E-01	1.14E-01	-1.79E+01	-1.70E+01	-1.92E+01	9.27E-01
37	2.54E-03	1.42E-01	4.85E-05	2.90E+00	3.70E-02	2.47E+00	1.10E+00	8.89E-02	2.70E-01	2.57E-01	7.42E+00	4.57E-01	1.03E-01	-1.76E+01	-1.78E+01	-1.97E+01	9.71E-02
38	7.31E-03	1.72E-01	6.06E-04	5.66E+00	2.60E-01	1.01E+00	7.84E+00	4.06E-02	6.91E-02	4.01E-01	7.71E+00	1.06E-01	2.70E-01	-1.81E+01	-1.77E+01	-2.08E+01	8.82E-01
39	7.00E-04	1.72E-01	3.65E-05	3.60E+00	2.00E-01	2.84E+00	3.37E+00	5.93E-02	1.81E-01	2.47E-01	6.59E+00	1.35E-01	6.28E-02	-1.82E+01	-1.78E+01	-1.99E+01	8.00E-01
40	1.41E-03	1.90E-01	1.02E-03	2.21E+00	2.64E-01	5.71E+00	2.86E+00	1.18E-01	5.36E-02	2.29E-01	5.55E+00	5.37E-01	8.23E-02	-1.87E+01	-1.81E+01	-2.05E+01	1.99E-01
41	8.16E-04	1.81E-01	1.22E-03	5.14E+00	1.02E-01	1.35E+00	2.05E+00	3.27E-01	1.98E-01	2.40E-01	6.74E+00	2.00E-01	3.58E-01	-1.76E+01	-1.76E+01	-2.20E+01	5.29E-01
42	3.15E-03	1.65E-01	1.66E-02	1.79E+00	3.12E-02	1.39E+00	8.20E+00	2.59E-02	6.08E-01	3.52E-01	4.33E+00	1.18E-01	7.00E-02	-1.75E+01	-1.80E+01	-2.02E+01	4.84E-01
43	1.81E-03	1.55E-01	1.10E-02	8.52E+00	6.24E-02	8.67E+00	4.77E+00	2.93E-02	9.15E-02	2.94E-01	7.05E+00	1.11E-01	1.37E-01	-1.77E+01	-1.97E+01	-1.94E+01	9.58E-01
44	4.40E-03	1.46E-01	7.58E-03	7.81E+00	7.91E-02	2.53E+00	1.08E+00	3.21E-02	7.51E-01	1.77E-01	5.06E+00	1.72E-01	2.97E-01	-1.86E+01	-1.71E+01	-1.87E+01	6.28E-01
45	7.45E-04	1.41E-01	1.43E-03	2.12E+00	6.29E-02	9.13E-01	8.88E+00	2.17E-01	1.09E+00	4.10E-01	1.47E+01	2.55E-01	4.41E-03	-1.77E+01	-1.87E+01	-1.98E+01	8.31E-01
46	7.12E-03	1.73E-01	9.70E-03	3.96E+00	4.00E-02	1.46E+00	1.69E+00	2.93E-01	3.41E+00	5.34E-01	6.44E+00	3.43E-02	2.09E-03	-2.04E+01	-1.83E+01	-2.15E+01	1.15E-01

Table PAR-10. LHS Sampled Values (100 vectors) Replicate 2 — Continued

Parameter	50	51	52	53	54	55	56	57	58	60	61	62	63	64	65	66	75
Vector Num.	CULEBRA APOROS	CULEBRA DPOROS	U+6 MKD_U	U+4 MKD_U	PU+3 MKD_PU	PU+4 MKD_PU	TH+4 MKD_TH	AM+3 MKD_AM	BOREHOLE TAUFAIL	GLOBAL PBRINE	BOREHOLE DOMEGA	SHFTU SAT_RBRN	SHFTU SAT_RGAS	SHFTU PRMX_LOG	SHFTL_T1 PRMX_LOG	SHFTL_T2 PRMX_LOG	SPALLMOD RNDSPALL
47	2.16E-03	1.18E-01	3.56E-05	7.92E+00	2.64E-02	3.35E+00	7.28E+00	4.34E-02	1.55E-01	4.26E-01	1.35E+01	1.89E-01	8.86E-02	-1.85E+01	-1.81E+01	-2.08E+01	2.60E-01
48	2.66E-04	1.79E-01	4.39E-03	7.88E-01	2.74E-02	3.55E+00	3.21E+00	7.18E-02	2.61E+00	5.41E-01	8.27E+00	1.47E-01	3.77E-01	-1.76E+01	-1.79E+01	-2.00E+01	5.13E-01
49	4.05E-03	1.66E-01	6.78E-04	4.36E+00	5.49E-02	8.49E+00	2.19E+00	2.49E-01	2.17E+00	3.89E-01	1.74E+01	2.47E-01	1.23E-01	-1.92E+01	-1.85E+01	-1.90E+01	9.16E-01
50	9.96E-04	1.75E-01	3.35E-05	5.37E+00	2.92E-01	6.71E+00	1.05E+00	3.32E-02	6.71E+01	1.40E-01	6.78E+00	5.24E-01	2.34E-01	-1.86E+01	-1.88E+01	-1.96E+01	4.26E-01
51	5.47E-03	1.15E-01	2.22E-03	6.69E+00	3.13E-02	3.46E+00	7.22E+00	5.87E-02	2.24E-01	5.92E-01	5.99E+00	6.22E-02	3.93E-01	-1.82E+01	-1.83E+01	-1.84E+01	4.98E-01
52	1.17E-04	1.21E-01	7.34E-05	1.40E+00	4.92E-02	1.87E+00	9.65E+00	1.79E-01	3.64E-01	6.77E-02	5.29E+00	4.83E-01	1.69E-01	-1.77E+01	-1.75E+01	-2.00E+01	5.78E-01
53	3.27E-04	2.31E-01	8.97E-05	1.36E+00	5.70E-02	8.23E+00	7.02E+00	9.49E-02	3.98E+00	5.01E-01	7.94E+00	3.89E-01	1.06E-01	-1.80E+01	-1.86E+01	-1.80E+01	5.62E-01
54	3.76E-04	1.15E-01	5.58E-03	1.01E+00	7.42E-02	4.26E+00	2.96E+00	1.92E-01	6.26E-02	3.22E-01	6.36E+00	4.77E-01	3.02E-01	-2.01E+01	-1.84E+01	-2.00E+01	7.35E-01
55	1.70E-04	1.14E-01	5.27E-05	7.18E+00	2.36E-01	4.14E+00	8.24E-01	6.10E-02	1.63E-01	2.88E-01	9.73E+00	1.50E-01	1.27E-01	-1.98E+01	-1.74E+01	-1.90E+01	2.65E-01
56	8.87E-03	1.50E-01	5.35E-03	5.77E+00	2.19E-01	2.66E+00	4.04E+00	3.19E-01	1.95E+00	2.75E-01	1.57E+01	5.73E-01	1.77E-01	-1.95E+01	-1.80E+01	-1.82E+01	3.47E-01
57	3.58E-04	1.86E-01	7.46E-05	2.55E+00	2.31E-01	2.92E+00	2.59E+00	3.05E-01	9.75E-02	5.19E-01	8.30E+00	3.92E-02	1.31E-02	-1.78E+01	-1.80E+01	-1.88E+01	9.87E-01
58	9.19E-04	1.89E-01	4.17E-05	3.73E+00	8.09E-02	5.33E+00	9.48E+00	3.66E-01	2.80E-01	1.48E-01	1.09E+01	1.86E-01	2.62E-01	-1.73E+01	-1.84E+01	-2.15E+01	4.48E-01
59	2.26E-04	1.74E-01	1.80E-02	2.07E+00	3.24E-01	5.87E+00	1.53E+00	5.55E-02	4.80E+01	4.78E-01	8.17E+00	2.00E-01	1.41E-01	-1.71E+01	-1.82E+01	-2.03E+01	2.15E-01
60	1.83E-04	1.13E-01	3.73E-03	2.16E+00	2.49E-02	7.82E+00	3.62E+00	2.02E-02	7.44E+00	2.17E-01	1.16E+01	2.36E-01	3.40E-01	-1.80E+01	-1.76E+01	-1.85E+01	2.34E-01
61	2.41E-04	2.25E-01	1.41E-02	3.02E+00	4.25E-02	2.63E+00	7.57E-01	2.39E-01	4.56E+01	3.37E-01	7.08E+00	1.82E-01	1.73E-01	-1.88E+01	-1.90E+01	-2.04E+01	7.66E-01
62	5.96E-04	1.63E-01	1.03E-04	2.42E+00	1.16E-01	6.12E+00	3.69E+00	2.07E-02	6.29E+01	3.07E-01	7.30E+00	4.10E-02	2.04E-01	-1.85E+01	-1.84E+01	-2.22E+01	2.09E-01
63	6.91E-04	1.71E-01	4.79E-03	8.81E-01	1.65E-01	6.63E+00	2.08E+00	2.05E-01	6.25E+00	1.83E-01	7.88E+00	4.27E-01	1.51E-01	-1.78E+01	-1.81E+01	-2.01E+01	8.78E-01
64	1.09E-04	1.47E-01	2.95E-03	1.03E+00	8.92E-02	1.88E+00	1.03E+00	9.81E-02	2.79E+01	2.45E-01	7.82E+00	2.80E-01	2.94E-01	-1.82E+01	-1.71E+01	-2.14E+01	5.40E-01
65	9.81E-03	1.16E-01	1.06E-04	5.57E+00	1.19E-01	3.11E+00	1.47E+00	2.86E-01	6.05E+01	5.29E-01	4.44E+00	2.32E-01	1.66E-01	-1.75E+01	-1.83E+01	-1.98E+01	2.47E-01
66	1.52E-04	1.85E-01	7.27E-03	9.51E+00	2.19E-02	5.88E+00	1.01E+00	3.69E-02	3.22E+01	5.98E-01	7.78E+00	3.47E-01	3.33E-01	-1.94E+01	-1.85E+01	-1.99E+01	7.59E-01
67	1.63E-03	1.82E-01	8.06E-04	3.12E+00	9.47E-02	2.40E+00	4.91E+00	2.48E-02	5.89E-02	1.75E-01	6.63E+00	2.09E-01	2.44E-01	-1.96E+01	-1.76E+01	-2.10E+01	3.27E-01
68	1.76E-04	1.17E-01	4.67E-04	1.19E+00	3.38E-01	7.44E+00	2.87E+00	1.35E-01	9.51E+00	5.64E-01	6.84E+00	9.54E-02	2.68E-01	-1.73E+01	-1.80E+01	-2.12E+01	3.54E-01
69	5.01E-03	1.05E-01	3.12E-03	1.22E+00	2.25E-01	7.03E-01	9.80E+00	2.73E-02	5.22E-01	1.17E-01	1.19E+01	4.16E-01	2.82E-01	-1.74E+01	-1.95E+01	-2.01E+01	3.46E-02
70	1.25E-04	1.11E-01	5.90E-03	5.91E+00	3.75E-01	4.73E+00	4.12E+00	3.37E-01	2.08E-01	3.44E-01	6.30E+00	4.92E-01	3.08E-01	-1.72E+01	-1.90E+01	-2.11E+01	3.79E-01
71	2.19E-03	1.08E-01	6.77E-03	1.26E+00	2.22E-02	9.51E+00	7.97E+00	4.67E-02	1.18E+01	4.50E-01	7.47E+00	5.88E-01	1.56E-01	-1.83E+01	-1.85E+01	-2.14E+01	6.61E-01
72	4.25E-03	1.86E-01	1.23E-04	2.51E+00	3.50E-02	1.16E+00	9.13E+00	3.05E-02	6.69E-01	3.03E-01	1.24E+01	4.78E-03	3.31E-01	-1.79E+01	-1.72E+01	-2.19E+01	9.03E-01
73	3.09E-04	1.06E-01	1.95E-04	1.86E+00	1.04E-01	1.56E+00	7.77E-01	1.76E-01	1.06E+00	2.08E-01	1.05E+01	1.53E-01	3.55E-01	-1.94E+01	-1.84E+01	-2.04E+01	1.56E-01
74	3.47E-03	1.28E-01	1.96E-02	8.25E+00	9.91E-02	1.67E+00	1.99E+00	1.87E-01	1.40E+01	1.24E-02	7.60E+00	4.49E-01	4.97E-02	-1.89E+01	-1.83E+01	-2.04E+01	6.37E-01
75	3.00E-04	1.26E-01	4.51E-05	3.24E+00	1.79E-01	3.69E+00	2.56E+00	4.18E-02	5.23E+00	1.66E-01	8.36E+00	7.40E-02	6.00E-02	-1.86E+01	-1.82E+01	-1.87E+01	9.68E-01
76	2.33E-03	1.75E-01	1.58E-04	7.72E-01	7.68E-02	3.25E+00	1.40E+00	7.51E-02	8.44E-02	9.60E-02	1.11E+01	4.46E-01	1.58E-01	-1.80E+01	-1.86E+01	-2.08E+01	2.94E-01
77	6.33E-03	1.57E-01	4.52E-04	1.73E+00	1.12E-01	9.41E+00	3.87E+00	2.32E-02	2.09E+01	1.27E-01	7.23E+00	4.79E-02	3.24E-01	-1.95E+01	-1.92E+01	-2.25E+01	7.95E-01
78	1.70E-03	1.67E-01	6.91E-05	1.95E+00	2.97E-02	7.61E-01	1.90E+00	3.50E-02	1.62E+01	6.03E-02	6.52E+00	1.79E-01	3.95E-02	-1.83E+01	-1.81E+01	-2.02E+01	4.11E-01
79	1.33E-04	1.97E-01	1.11E-03	2.69E+00	3.56E-02	2.06E+00	1.25E+00	4.46E-02	1.31E-01	3.25E-01	6.98E+00	5.31E-01	1.60E-01	-1.85E+01	-1.82E+01	-2.07E+01	8.65E-01
80	2.82E-04	1.03E-01	3.77E-04	7.45E+00	7.05E-02	8.83E+00	5.89E+00	2.46E-01	2.53E+01	1.04E-01	8.95E+00	5.75E-02	3.41E-01	-1.75E+01	-1.72E+01	-2.07E+01	4.88E-02
81	3.26E-03	1.04E-01	2.57E-04	2.01E+00	8.54E-02	5.00E+00	3.83E+00	9.53E-02	1.27E+00	5.71E-01	7.17E+00	7.91E-02	4.51E-02	-1.81E+01	-1.90E+01	-2.05E+01	3.31E-01
82	5.01E-04	1.50E-01	9.95E-04	6.96E+00	4.81E-02	6.49E+00	1.96E+00	4.90E-02	3.01E-01	4.87E-01	2.17E+01	1.93E-01	6.77E-02	-1.90E+01	-1.79E+01	-2.06E+01	7.25E-01
83	1.31E-04	2.49E-01	5.70E-05	8.99E+00	1.69E-01	7.80E-01	5.86E+00	2.69E-02	8.64E+00	3.54E-01	7.67E+00	1.57E-01	2.72E-01	-1.84E+01	-1.84E+01	-1.95E+01	6.28E-02
84	3.90E-04	2.16E-01	1.48E-03	1.07E+00	2.86E-02	4.31E+00	6.66E+00	1.06E-01	1.49E-01	4.45E-01	1.02E+01	4.35E-01	1.36E-01	-1.91E+01	-1.85E+01	-2.16E+01	5.93E-01
85	1.23E-03	1.28E-01	1.34E-04	2.74E+00	1.30E-01	1.11E+00	3.11E+00	5.53E-02	2.39E-01	4.88E-01	6.17E+00	3.72E-01	3.91E-01	-1.78E+01	-1.84E+01	-1.86E+01	2.24E-02
86	1.91E-03	1.65E-01	3.41E-03	8.44E-01	2.09E-01	2.24E+00	2.74E+00	8.14E-02	4.30E-01	1.06E-01	1.13E+01	4.11E-01	3.47E-01	-1.93E+01	-1.74E+01	-1.91E+01	4.31E-01
87	5.05E-04	1.30E-01	1.47E-04	1.63E+00	3.34E-02	7.28E-01	7.52E+00	3.78E-02	5.23E+01	2.85E-01	1.01E+01	3.06E-01	3.40E-02	-1.84E+01	-1.83E+01	-2.13E+01	4.74E-01
88	2.97E-03	1.37E-01	6.37E-05	4.96E+00	6.66E-02	2.95E+00	2.72E+00	1.41E-01	1.39E+00	1.89E-01	1.02E+01	1.41E-01	1.91E-01	-1.72E+01	-1.86E+01	-1.98E+01	6.57E-01
89	1.89E-03	1.33E-01	6.52E-03	9.38E+00	5.24E-02	5.02E+00	1.21E+00	1.15E-01	7.49E-02	2.23E-01	6.69E+00	3.79E-01	1.17E-01	-1.69E+01	-1.78E+01	-2.03E+01	6.82E-01
90	3.83E-03	1.62E-01	3.02E-04	3.43E+00	6.51E-02	9.81E+00	3.03E+00	1.10E-01	5.47E-01	8.52E-02	5.81E+00	6.87E-02	7.73E-02	-1.88E+01	-1.80E+01	-2.10E+01	1.26E-01
91	1.10E-04	1.18E-01	8.63E-03	4.71E+00	1.58E-01	4.81E+00	6.87E+00	1.99E-01	1.70E+01	4.16E-01	8.20E+00	3.23E-01	1.87E-01	-1.90E+01	-1.78E+01	-2.01E+01	6.66E-03
92	9.53E-03	2.36E-01	2.44E-03	3.08E+00	3.61E-01	1.55E+00	9.21E-01	2.45E-02	3.06E+00	4.17E-01	7.59E+00	5.14E-01	2.56E-01	-1.85E+01	-1.73E+01	-2.02E+01	6.02E-01

Table PAR-10. LHS Sampled Values (100 vectors) Replicate 2 — Continued

Parameter	50	51	52	53	54	55	56	57	58	60	61	62	63	64	65	66	75
Vector Num.	CULEBRA APOROS	CULEBRA DPOROS	U+6 MKD_U	U+4 MKD_U	PU+3 MKD_PU	PU+4 MKD_PU	TH+4 MKD_TH	AM+3 MKD_AM	BOREHOLE TAUFAIL	GLOBAL PBRINE	BOREHOLE DOMEGA	SHFTU SAT_RBRN	SHFTU SAT_RGAS	SHFTU PRMX_LOG	SHFTL_T1 PRMX_LOG	SHFTL_T2 PRMX_LOG	SPALLMOD RNDSPALL
93	1.18E-03	1.44E-01	7.46E-04	3.46E+00	1.07E-01	2.34E+00	4.18E+00	6.68E-02	3.80E+01	9.03E-02	6.85E+00	3.44E-01	3.67E-01	-1.87E+01	-1.82E+01	-1.87E+01	6.94E-01
94	5.30E-04	1.10E-01	2.03E-04	8.68E+00	2.75E-01	2.00E+00	8.08E-01	9.16E-02	7.83E-02	5.16E-01	1.40E+01	4.05E-01	8.43E-02	-1.84E+01	-1.79E+01	-2.09E+01	9.36E-01
95	1.93E-04	1.32E-01	1.32E-03	1.59E+00	8.33E-02	1.06E+00	1.67E+00	1.69E-01	1.69E+00	4.40E-01	1.14E+01	2.57E-01	2.24E-01	-1.80E+01	-1.78E+01	-2.18E+01	2.85E-01
96	5.11E-03	1.15E-01	1.26E-04	4.16E+00	1.77E-01	7.46E-01	3.54E+00	6.43E-02	5.72E-01	4.94E-01	7.52E+00	3.68E-01	2.90E-01	-1.92E+01	-1.88E+01	-2.07E+01	5.54E-01
97	5.70E-04	2.40E-01	1.27E-02	3.33E+00	6.05E-02	1.40E+00	1.33E+00	7.37E-02	1.07E+01	1.60E-01	1.59E+01	5.47E-01	2.31E-01	-1.76E+01	-1.82E+01	-2.09E+01	3.19E-01
98	1.04E-04	1.01E-01	1.85E-04	1.75E+00	2.90E-02	2.11E+00	1.85E+00	2.39E-02	4.78E+00	4.75E-01	1.05E+01	3.35E-01	7.58E-02	-1.89E+01	-1.81E+01	-1.85E+01	5.01E-01
99	6.86E-03	1.62E-01	1.24E-02	2.32E+00	2.98E-01	5.22E+00	2.33E+00	3.63E-02	2.76E+00	3.65E-01	8.04E+00	5.66E-01	1.99E-01	-1.71E+01	-1.82E+01	-1.95E+01	7.44E-01
100	2.08E-03	1.24E-01	5.50E-04	4.55E+00	2.39E-02	1.79E+00	9.67E-01	4.57E-02	4.59E+00	2.12E-01	8.35E+00	8.74E-02	3.81E-01	-1.80E+01	-1.76E+01	-2.04E+01	8.41E-01

Table PAR-11. LHS Sampled Values (100 vectors) Replicate 3

Parameter	1	2	3	4	5	6	7	8	9	10	11	12	14	15	16	17	18	19	20	21	22	23	24	25
Vector	STEEL	WAS_AREA	WAS_AREA	WAS_AREA	CELLULS	WAS_AREA	WAS_AREA	WAS_AREA	DRZ_PCS	CONC_PCS	SOLU4	SOLTH4	CONC_PCS	CONC_PCS	CONC_PCS	S_HALITE	S_HALITE	S_HALITE	S_MB139	S_MB139	S_MB139	S_MB139	S_MB139	S_MB139
Num.	CORRMCO2	PROBDEG	GRATMICI	GRATMICH	FBETA	SAT_RGAS	SAT_RBRN	SAT_WICK	PRMX_LOG	PRMX_LOG	SOLCIM	SOLCIM	SAT_RGAS	SAT_RBRN	PORE_DIS	POROSITY	PRMX_LOG	COMP_RCK	PRMX_LOG	COMP_RCK	RELP_MOD	SAT_RBRN	SAT_RGAS	PORE_DIS
1	1.50E-15	0.00E+00	3.32E-09	4.55E-10	8.57E-01	9.81E-02	2.56E-01	6.81E-01	-1.75E+01	-1.85E+01	-1.38E-01	2.26E-02	7.95E-02	1.28E-01	1.48E-01	9.34E-03	-2.15E+01	3.76E-11	-1.88E+01	7.45E-11	4.00E+00	7.44E-02	1.40E-02	6.93E-01
2	1.76E-14	0.00E+00	2.90E-09	3.12E-10	7.11E-01	8.22E-02	4.02E-01	4.09E-01	-2.02E+01	-1.93E+01	1.31E-01	-3.43E-01	6.38E-02	1.17E-01	6.59E+00	2.24E-02	-2.27E+01	1.08E-10	-1.94E+01	1.31E-10	4.00E+00	9.81E-02	8.59E-02	6.95E-01
3	2.13E-14	2.00E+00	9.41E-09	1.12E-09	1.33E-01	5.13E-02	9.78E-02	6.32E-01	-1.84E+01	-1.87E+01	-4.24E-02	6.71E-02	1.96E-01	5.93E-01	5.11E-01	4.04E-03	-2.30E+01	1.17E-10	-1.89E+01	7.27E-11	1.00E+00	5.62E-02	8.65E-02	6.75E-01
4	2.54E-14	2.00E+00	5.78E-09	1.25E-09	3.16E-01	1.11E-01	1.90E-01	7.96E-01	-1.88E+01	-1.77E+01	1.17E+00	-1.57E-01	1.31E-01	3.93E-01	7.30E+00	1.14E-02	-2.35E+01	1.68E-10	-1.84E+01	1.09E-11	1.00E+00	9.59E-02	6.68E-02	6.23E-01
5	2.45E-14	0.00E+00	7.65E-09	1.05E-09	3.13E-02	1.29E-01	1.20E-01	5.55E-01	-1.80E+01	-1.77E+01	6.66E-02	-2.71E-01	2.20E-01	1.41E-01	2.74E+00	1.81E-02	-2.22E+01	7.83E-11	-1.81E+01	1.09E-11	4.00E+00	1.17E-01	5.03E-02	6.18E-01
6	4.30E-15	0.00E+00	9.18E-09	3.44E-10	4.73E-01	6.58E-02	1.45E-01	3.80E-01	-1.85E+01	-1.93E+01	9.84E-01	8.37E-01	9.38E-02	6.59E-02	5.56E-01	8.31E-03	-2.17E+01	3.55E-11	-1.95E+01	1.62E-10	4.00E+00	1.03E-01	4.41E-02	6.61E-01
7	1.13E-14	1.00E+00	7.43E-09	4.25E-10	3.22E-01	7.76E-03	3.12E-01	5.68E-02	-1.87E+01	-1.79E+01	7.24E-01	7.85E-01	3.60E-01	1.38E-01	3.38E-01	1.99E-02	-2.26E+01	1.03E-10	-1.87E+01	4.86E-11	4.00E+00	8.64E-02	1.11E-01	6.84E-01
8	7.27E-15	2.00E+00	6.29E-09	1.21E-10	1.80E-01	9.21E-02	4.67E-01	5.81E-01	-1.93E+01	-1.91E+01	-2.44E-01	-2.03E-01	3.30E-01	1.71E-01	6.93E+00	1.28E-02	-2.14E+01	1.80E-11	-1.92E+01	1.08E-10	4.00E+00	1.29E-01	9.64E-02	6.67E-01
9	2.94E-14	1.00E+00	8.46E-09	4.67E-10	2.58E-01	1.35E-01	5.34E-01	1.26E-01	-1.91E+01	-1.86E+01	-1.28E-01	-1.27E-01	3.56E-01	7.09E-02	4.04E-01	1.13E-03	-2.34E+01	1.40E-10	-1.84E+01	3.47E-11	4.00E+00	6.27E-02	6.51E-02	5.82E-01
10	1.29E-14	0.00E+00	3.37E-09	2.06E-10	7.92E-01	3.17E-02	1.73E-01	5.49E-01	-1.85E+01	-1.88E+01	-5.62E-01	-1.06E-01	7.50E-03	3.55E-01	7.68E+00	6.96E-03	-2.34E+01	1.56E-10	-1.96E+01	1.65E-10	1.00E+00	1.06E-01	1.40E-02	6.46E-01
11	2.25E-14	2.00E+00	5.91E-09	2.27E-10	4.84E-01	6.24E-02	4.15E-01	9.14E-02	-1.88E+01	-2.03E+01	-6.04E-02	-3.93E-01	2.69E-01	3.49E-01	3.52E+00	4.43E-03	-2.18E+01	6.23E-11	-1.88E+01	6.72E-11	4.00E+00	8.52E-02	1.18E-01	6.76E-01
12	3.13E-14	2.00E+00	1.17E-09	1.17E-09	6.41E-01	7.06E-02	1.02E-01	7.53E-01	-1.86E+01	-1.93E+01	-9.18E-03	-2.43E-01	1.99E-01	3.02E-01	2.72E-01	3.56E-03	-2.24E+01	7.08E-11	-1.85E+01	3.11E-11	1.00E+00	9.40E-02	6.17E-02	6.39E-01
13	6.29E-16	0.00E+00	5.43E-09	1.09E-09	4.97E-01	1.83E-02	4.86E-01	4.65E-01	-1.98E+01	-2.02E+01	4.41E-01	-3.80E-01	2.12E-01	9.81E-02	1.23E+00	7.95E-03	-2.29E+01	1.30E-10	-1.95E+01	1.68E-10	4.00E+00	4.20E-02	7.41E-02	6.48E-01
14	5.73E-15	0.00E+00	6.56E-09	1.21E-09	9.11E-01	1.07E-01	3.28E-01	4.92E-01	-1.81E+01	-1.96E+01	-2.15E-01	-1.77E-01	3.20E-01	1.16E-01	7.77E-01	1.72E-02	-2.38E+01	1.78E-10	-1.94E+01	1.12E-10	1.00E+00	8.20E-02	1.20E-01	5.46E-01
15	3.16E-14	0.00E+00	7.23E-10	1.12E-09	4.52E-01	4.22E-02	5.21E-01	2.51E-02	-1.81E+01	-1.82E+01	-2.65E-02	-1.13E-01	2.43E-01	2.06E-01	7.58E+00	6.90E-03	-2.27E+01	1.06E-10	-1.89E+01	8.42E-11	4.00E+00	5.80E-02	1.22E-01	5.90E-01
16	2.89E-14	0.00E+00	4.61E-09	3.61E-10	8.39E-01	5.75E-02	2.76E-01	3.01E-01	-1.74E+01	-1.80E+01	-5.43E-01	7.66E-02	2.01E-01	4.95E-02	5.93E+00	1.44E-02	-2.37E+01	1.73E-10	-1.90E+01	8.17E-11	4.00E+00	4.63E-02	4.27E-02	6.59E-01
17	3.09E-14	1.00E+00	5.54E-09	7.81E-10	6.97E-01	1.41E-02	2.26E-01	8.89E-01	-1.88E+01	-1.95E+01	-6.13E-01	5.08E-01	3.87E-01	2.24E-01	7.11E-01	2.01E-02	-2.14E+01	3.42E-11	-1.92E+01	1.56E-10	1.00E+00	1.43E-01	9.51E-02	5.94E-01
18	1.51E-14	0.00E+00	2.85E-09	5.63E-10	4.47E-01	1.06E-01	3.40E-01	1.39E-01	-1.91E+01	-1.86E+01	-1.09E-01	-6.01E-01	3.00E-01	4.89E-01	5.85E-01	7.14E-03	-2.39E+01	1.86E-10	-1.96E+01	1.84E-10	4.00E+00	1.19E-01	5.45E-02	7.06E-01
19	1.62E-14	1.00E+00	2.29E-09	1.19E-09	2.78E-01	1.42E-01	2.97E-02	1.01E-01	-1.88E+01	-1.89E+01	-3.62E-01	-3.81E-02	2.61E-02	8.52E-02	5.26E-01	2.74E-02	-2.23E+01	9.07E-11	-2.01E+01	2.75E-10	1.00E+00	8.91E-02	5.74E-02	6.74E-01
20	2.08E-14	1.00E+00	7.58E-09	8.59E-10	8.60E-01	1.23E-01	1.27E-01	2.09E-01	-1.97E+01	-1.74E+01	-1.66E-01	-1.48E+00	1.55E-01	4.29E-02	8.35E-01	2.28E-03	-2.32E+01	1.39E-10	-1.93E+01	1.36E-10	1.00E+00	7.06E-02	8.77E-02	6.55E-01
21	1.41E-14	0.00E+00	8.72E-09	8.75E-10	5.12E-01	7.93E-02	4.09E-01	3.35E-01	-2.00E+01	-1.94E+01	-1.82E+00	-1.37E-01	1.72E-01	2.10E-01	5.63E-01	2.24E-02	-2.28E+01	1.13E-10	-1.88E+01	7.69E-11	4.00E+00	1.07E-01	4.77E-02	6.72E-01
22	1.44E-14	1.00E+00	5.21E-09	1.16E-09	8.26E-01	2.51E-02	8.22E-02	5.16E-01	-2.03E+01	-1.77E+01	-4.99E-02	-2.54E-01	2.11E-01	4.26E-01	5.58E+00	1.78E-02	-2.13E+01	1.32E-11	-1.78E+01	1.09E-11	4.00E+00	8.42E-02	3.97E-02	6.60E-01
23	4.46E-15	1.00E+00	7.04E-09	5.12E-10	9.31E-01	7.29E-02	4.80E-01	8.31E-01	-1.84E+01	-1.98E+01	-8.07E-02	-2.24E-01	3.08E-01	3.78E-01	6.40E-01	3.88E-03	-2.30E+01	1.30E-10	-1.83E+01	1.94E-11	4.00E+00	5.75E-02	5.66E-02	6.01E-01
24	9.99E-15	0.00E+00	3.93E-09	7.97E-10	5.58E-01	9.01E-02	1.37E-01	4.84E-03	-1.82E+01	-1.92E+01	1.18E-01	-1.87E-02	3.25E-01	2.88E-01	6.49E-01	2.72E-02	-2.31E+01	1.24E-10	-2.06E+01	2.75E-10	4.00E+00	6.35E-02	4.60E-02	6.05E-01
25	1.39E-14	2.00E+00	4.48E-09	6.92E-10	9.86E-01	8.68E-02	5.41E-01	1.50E-02	-2.01E+01	-1.89E+01	2.15E-01	-4.92E-01	1.27E-01	4.96E-01	4.83E-01	9.04E-03	-2.17E+01	5.36E-11	-1.87E+01	5.56E-11	4.00E+00	1.12E-01	7.37E-02	6.27E-01
26	2.11E-14	1.00E+00	8.84E-09	6.51E-10	9.70E-01	7.60E-02	4.97E-01	2.41E-01	-1.86E+01	-1.92E+01	-1.37E+00	-9.98E-02	6.52E-02	5.66E-01	6.16E+00	2.55E-02	-2.19E+01	4.72E-11	-1.83E+01	1.09E-11	1.00E+00	2.11E-02	1.08E-01	6.13E-01
27	3.99E-15	1.00E+00	6.37E-09	8.16E-10	3.85E-01	1.18E-01	4.62E-01	6.67E-01	-1.87E+01	-1.97E+01	5.24E-01	-1.62E-01	4.88E-02	1.97E-01	1.87E+00	3.04E-03	-2.35E+01	1.49E-10	-1.89E+01	9.02E-11	1.00E+00	1.11E-01	6.61E-02	6.58E-01
28	9.15E-15	2.00E+00	5.19E-09	1.06E-09	6.60E-01	9.72E-02	1.79E-01	5.93E-01	-2.04E+01	-1.87E+01	-1.90E-01	-7.36E-01	3.81E-01	4.33E-01	5.46E+00	2.98E-02	-2.29E+01	1.15E-10	-2.00E+01	2.18E-10	1.00E+00	7.35E-02	2.84E-02	6.47E-01
29	7.86E-15	0.00E+00	2.75E-09	5.83E-10	7.77E-01	7.66E-02	4.76E-01	2.15E-01	-1.81E+01	-1.84E+01	-2.98E-02	2.22E-01	2.99E-01	3.86E-02	3.73E+00	2.41E-02	-2.24E+01	1.00E-10	-1.90E+01	9.76E-11	1.00E+00	1.00E-01	7.84E-02	6.09E-01
30	1.28E-16	2.00E+00	1.34E-09	1.03E-09	5.47E-02	1.16E-01	4.16E-02	4.56E-01	-1.96E+01	-1.89E+01	3.09E-01	4.06E-01	1.76E-01	1.55E-01	6.19E-01	3.28E-03	-2.14E+01	2.23E-11	-1.92E+01	1.42E-10	4.00E+00	5.03E-02	7.21E-02	4.91E-01
31	2.95E-14	1.00E+00	4.37E-09	4.90E-10	7.86E-01	5.28E-02	5.93E-02	3.25E-01	-1.98E+01	-2.00E+01	-1.51E-01	1.34E+00	3.91E-01	4.66E-01	2.46E-01	1.01E-02	-2.16E+01	4.22E-11	-1.75E+01	1.09E-11	4.00E+00	9.73E-02	1.09E-01	5.82E-01
32	5.13E-15	0.00E+00	8.98E-10	8.99E-10	4.30E-01	1.00E-01	5.29E-01	6.52E-01	-1.80E+01	-1.86E+01	-7.84E-01	8.62E-01	3.18E-01	3.85E-01	6.59E-01	5.79E-03	-2.37E+01	1.71E-10	-1.87E+01	4.59E-11	1.00E+00	8.46E-02	7.95E-02	7.32E-01
33	2.61E-14	0.00E+00	3.18E-09	1.02E-09	6.20E-01	1.31E-01	1.22E-01	3.12E-01	-1.91E+01	-1.91E+01	4.74E-01	1.24E-01	8.90E-02	1.51E-01	8.45E-01	2.71E-03	-2.20E+01	5.59E-11	-1.94E+01	1.44E-10	1.00E+00	6.45E-02	7.51E-02	7.24E-01
34	2.70E-14	1.00E+00	5.36E-09	2.45E-10	4.26E-02	2.76E-02	3.25E-01	1.54E-01	-1.79E+01	-1.93E+01	-8.67E-01	-4.34E-01	2.20E-01	7.89E-03	3.21E-01	1.58E-03	-2.20E+01	7.26E-11	-1.96E+01	2.30E-10	4.00E+00	6.78E-02	1.72E-02	6.21E-01
35	6.75E-15	0.00E+00	1.53E-09	9.83E-10	5.87E-01	9.57E-02	4.39E-01	9.39E-01	-1.77E+01	-1.84E+01	2.26E-01	-1.77E+00	2.34E-01	5.56E-01	3.65E-01	6.29E-03	-2.12E+01	1.56E-11	-1.93E+01	1.26E-10	1.00E+00	8.00E-02	1.97E-01	7.53E-01
36	1.55E-14	2.00E+00	1.71E-09	8.37E-10	6.83E-01	3.71E-03	1.39E-01	5.27E-01	-1.90E+01	-1.83E+01	-7.11E-01	-1.92E-01	3.67E-01	2.53E-01	6.90E-01	5.02E-03	-2.37E+01	1.81E-10	-1.88E+01	6.91E-11	1.00E+00	1.14E-01	6.03E-02	8.42E-01
37	1.81E-14	0.00E+00	4.87E-09	1.22E-09	9.49E-01	4.07E-02	2.27E-01	9.88E-01	-1.91E+01	-1.96E+01	7.83E-01	-1.72E-01	2.83E-01	1.77E-03	7.50E+00	1.43E-02	-2.38E+01	1.76E-10	-1.87E+01	6.63E-11	1.00E+00	1.02E-01	6.00E-02	7.42E-01
38	2.19E-14	2.00E+00	3.80E-09	6.11E-11	1.89E-02	1.77E-02	3.81E-01	6.28E-01	-1.83E+01	-1.89E+01	2.11E-01	-2.09E-01	1.67E-01	5.93E-02	5.01E+00	2.92E-03	-2.39E+01	1.87E-10	-1.71E+01	1.09E-11	4.00E+00	5.99E-02	6.71E-02	6.51E-01
39	6.40E-15	2.00E+00	3.90E-10	4.13E-10	8.78E-01	1.50E-01	2.98E-01	2.33E-01	-2.00E+01	-1.81E+01	-2.16E-01	-5.84E-02	7.06E-02	4.83E-01	4.30E+00	1.35E-03	-2.29E+01	1.26E-10	-1.93E+01	1.48E-10	1.00E+00	6.59E-02	3.24E-02	6.16E-01
40	2.31E-14	1.00E+00	7.20E-09	6.99E-10	6.70E-01	1.02E-01	3.54E-01	9.72E-01	-1.95E+01	-1.85E+01	-4.90E-01	-7.92E-01	2.85E-01	1.91E-01	2.79E-01	1.75E-02	-2.34E+01	1.64E-10	-1.94E+01	1.28E-10	1.00E+00	7.45E-02	7.60E-02	5.73E-01
41	1.15E-14	1.00E+00	3.85E-09	8.02E-10	3.59E-01	3.40E-02	8.64E-02	7.13E-02	-1.81E+01	-1.82E+01	-7.73E-01	-3.39E-01	2.59E-01	5.42E-02	5.74E+00	1.88E-02	-2.10E+01	4.83E-12	-1.73E+01	1.09E-11	1.00E+00	4.71E-02	9.16E-02	7.14E-01
42	2.99E-14	2.00E+00	2.38E-09	5.00E-10	8.41E-01	1.04E-01	3.92E-01	3.62E-01	-1.89E+01	-1.88E+01	-8.84E-02	6.95E-01	5.74E-02	1.62E-01	1.39E-01	1.50E-02	-2.16E+01	4.44E-11	-1.87E+01	6.23E-11	4.00E+00	2.48E-02	7.69E-02	6.78E-01
43	2.52E-14	0.00E+00	8.19E-09	9.29E-10	9.67E-02	5.88E-02	2.07E-01	1.67E-01	-1.85E+01	-1.94E+01	9.20E-02	-6.80E-01	2.38E-01	1.93E-01	2.98E-01	2.33E-02	-2.31E+01	1.36E-10	-1.91E+01	1.18E-10	1.00E+00	8.81E-02	9.48E-02	7.41E-01
44	2.49E-14	0.00E+00	9.11E-09	1.42E-11	1.55E-01	1.12E-01	1.61E-02	2.77E-01	-1.97E+01	-1.87E+01	-3.13E-01	5.03E-02	3.16E-01	2.58E-01	4.14E+00	1.62E-02	-2.26E+01	9.41E-11	-1.84E+01	1.34E-11	1.00E+00	9.34E-02	4.14E-02	6.92E-01
45	8.42E-16	0.00E+00	8.96E-09	5.41E-10	3.32E-01	5.05E-02	2.04E-01	3.85E-01	-1.92E+01	-1.80E+01	-3.52E-01	7.18E-01	2.50E-01	5.07E-01	9.35E-01	9.77E-03	-2.40E+01	1.91E-10	-1.95E+01	1.78E-10	1.00E+00	8.67E-02	8.39E-02	7.01E-01

Table PAR-11. LHS Sampled Values (100 vectors) Replicate 3 — Continued

Parameter	1	2	3	4	5	6	7	8	9	10	11	12	14	15	16	17	18	19	20	21	22	23	24	25
Vector	STEEL	WAS_AREA	WAS_AREA	WAS_AREA	CELLULS	WAS_AREA	WAS_AREA	WAS_AREA	DRZ_PCS	CONC_PCS	SOLU4	SOLTH4	CONC_PCS	CONC_PCS	CONC_PCS	S_HALITE	S_HALITE	S_HALITE	S_MB139	S_MB139	S_MB139	S_MB139	S_MB139	S_MB139
Num.	CORRMCO2	PROBDEG	GRATMICI	GRATMICH	FBETA	SAT_RGAS	SAT_RBRN	SAT_WICK	PRMX_LOG	PRMX_LOG	SOLCIM	SOLCIM	SAT_RGAS	SAT_RBRN	PORE_DIS	POROSITY	PRMX_LOG	COMP_RCK	PRMX_LOG	COMP_RCK	RELP_MOD	SAT_RBRN	SAT_RGAS	PORE_DIS
46	9.68E-15	1.00E+00	3.60E-09	8.26E-10	8.93E-01	2.03E-02	2.35E-01	7.15E-01	-1.95E+01	-1.79E+01	8.12E-01	2.43E-01	2.75E-01	2.01E-02	8.83E-01	5.98E-03	-2.15E+01	2.77E-11	-1.85E+01	5.08E-11	4.00E+00	1.33E-01	8.50E-02	6.50E-01
47	1.34E-14	0.00E+00	8.67E-09	7.36E-10	3.69E-01	6.75E-02	1.61E-01	4.83E-02	-1.89E+01	-2.01E+01	-2.23E-01	5.67E-01	2.39E-02	1.65E-01	6.29E+00	1.90E-02	-2.11E+01	8.40E-12	-1.88E+01	8.94E-11	1.00E+00	7.30E-02	1.13E-01	6.32E-01
48	1.84E-14	0.00E+00	8.33E-09	4.01E-10	5.08E-01	1.02E-01	2.11E-01	1.71E-01	-1.77E+01	-1.86E+01	-4.06E-02	1.19E-01	1.63E-01	5.51E-01	3.11E+00	5.64E-03	-2.25E+01	9.93E-11	-1.86E+01	5.47E-11	1.00E+00	1.26E-01	6.35E-02	5.72E-01
49	2.80E-15	2.00E+00	1.30E-09	2.80E-10	1.05E-01	3.07E-02	7.64E-02	7.85E-01	-1.73E+01	-1.85E+01	-9.08E-01	-2.19E-01	3.46E-01	2.57E-02	8.95E-01	3.49E-03	-2.13E+01	1.94E-11	-1.86E+01	3.61E-11	1.00E+00	9.98E-02	1.03E-01	5.35E-01
50	2.84E-14	0.00E+00	4.77E-09	1.91E-10	2.37E-01	1.09E-01	5.44E-01	4.33E-01	-1.93E+01	-2.05E+01	6.27E-01	-6.60E-01	2.44E-01	2.85E-02	1.91E-01	2.87E-02	-2.25E+01	9.36E-11	-1.84E+01	1.09E-11	1.00E+00	8.55E-02	2.16E-02	7.04E-01
51	9.36E-15	2.00E+00	8.59E-09	2.60E-10	2.05E-01	1.34E-01	3.63E-01	9.52E-01	-1.84E+01	-1.76E+01	-3.33E-01	1.99E-01	1.85E-01	3.18E-01	5.28E+00	2.48E-02	-2.14E+01	2.98E-11	-1.91E+01	9.86E-11	4.00E+00	6.96E-02	7.14E-02	7.86E-01
52	1.07E-14	0.00E+00	5.71E-09	5.01E-11	7.53E-02	3.68E-02	4.49E-01	6.47E-01	-1.95E+01	-2.00E+01	7.25E-02	-4.25E-02	1.36E-02	1.76E-01	4.43E+00	1.54E-02	-2.36E+01	1.45E-10	-1.91E+01	1.24E-10	1.00E+00	1.09E-01	7.88E-02	6.12E-01
53	7.31E-15	0.00E+00	8.08E-09	1.50E-10	8.07E-01	4.46E-02	2.52E-01	1.99E-01	-1.86E+01	-1.89E+01	5.54E-01	1.90E-01	1.72E-01	4.72E-01	7.00E-01	2.17E-02	-2.40E+01	1.88E-10	-1.79E+01	1.09E-11	4.00E+00	5.24E-02	1.36E-01	6.20E-01
54	2.73E-14	0.00E+00	6.42E-09	5.49E-10	9.69E-01	1.25E-01	2.39E-02	5.06E-01	-1.71E+01	-1.94E+01	2.76E-01	-1.97E-01	3.13E-02	3.73E-01	4.01E+00	4.20E-03	-2.16E+01	5.13E-11	-1.89E+01	9.28E-11	1.00E+00	7.83E-02	1.00E-01	6.25E-01
55	8.01E-15	1.00E+00	5.09E-09	3.32E-10	1.40E-01	7.03E-02	2.38E-01	2.69E-01	-1.78E+01	-1.95E+01	-1.96E-01	-4.17E-01	3.41E-01	4.66E-02	7.92E-01	1.22E-02	-2.19E+01	6.36E-11	-1.80E+01	1.09E-11	1.00E+00	8.13E-02	1.40E-02	6.11E-01
56	2.68E-14	0.00E+00	4.91E-10	8.68E-10	3.44E-01	4.66E-02	3.20E-01	9.49E-01	-1.99E+01	-1.97E+01	-1.14E+00	2.29E-01	5.29E-02	3.07E-01	4.10E-01	1.05E-02	-2.12E+01	8.90E-12	-1.85E+01	1.09E-11	1.00E+00	7.74E-02	2.48E-02	6.36E-01
57	1.67E-14	0.00E+00	6.02E-09	1.24E-09	4.68E-01	7.43E-02	2.79E-01	3.14E-02	-1.90E+01	-2.00E+01	-1.77E-01	-1.16E+00	2.30E-01	2.46E-01	1.70E+00	8.17E-03	-2.35E+01	1.66E-10	-1.87E+01	5.88E-11	4.00E+00	9.51E-02	8.91E-02	5.20E-01
58	1.30E-14	2.00E+00	3.53E-09	6.19E-10	9.55E-01	2.96E-02	1.14E-01	7.77E-01	-1.82E+01	-1.81E+01	1.88E-01	-1.87E-01	7.54E-02	1.23E-01	7.73E-01	2.92E-02	-2.33E+01	1.42E-10	-1.88E+01	6.09E-11	4.00E+00	1.58E-01	9.29E-02	5.53E-01
59	2.28E-14	0.00E+00	3.65E-09	6.43E-11	1.70E-01	1.07E-02	1.94E-01	8.46E-01	-1.96E+01	-1.83E+01	9.03E-01	-9.32E-02	3.79E-01	4.15E-01	3.88E-01	2.61E-02	-2.21E+01	6.81E-11	-1.92E+01	1.10E-10	1.00E+00	4.11E-02	7.28E-02	4.91E-01
60	1.23E-14	1.00E+00	2.53E-09	4.81E-10	8.85E-01	6.13E-02	4.70E-02	1.14E-01	-1.82E+01	-1.83E+01	1.57E-01	-3.05E-01	3.90E-02	1.55E-02	9.85E-01	2.58E-02	-2.23E+01	8.18E-11	-1.86E+01	4.46E-11	4.00E+00	6.67E-02	8.28E-02	7.15E-01
61	1.92E-14	2.00E+00	2.23E-09	7.11E-10	2.67E-01	8.73E-02	4.26E-01	4.15E-01	-1.78E+01	-1.99E+01	-6.26E-02	3.42E-01	1.18E-01	4.55E-01	2.99E+00	9.49E-03	-2.39E+01	1.82E-10	-1.80E+01	1.09E-11	4.00E+00	9.68E-02	5.62E-02	6.98E-01
62	5.50E-15	2.00E+00	4.92E-09	3.83E-10	5.26E-01	1.39E-01	5.05E-01	3.44E-01	-1.84E+01	-1.91E+01	-2.83E-01	-1.24E-01	3.57E-01	3.63E-01	7.08E+00	5.44E-03	-2.10E+01	4.63E-12	-1.91E+01	1.04E-10	1.00E+00	9.91E-02	6.81E-02	7.76E-01
63	3.38E-15	1.00E+00	6.10E-09	3.18E-10	5.38E-01	1.13E-01	1.70E-01	7.67E-01	-1.97E+01	-1.85E+01	-3.84E-01	-5.29E-02	1.33E-01	1.87E-01	2.26E-01	6.60E-03	-2.37E+01	1.83E-10	-1.81E+01	1.09E-11	4.00E+00	7.78E-03	1.14E-01	7.21E-01
64	1.04E-14	0.00E+00	6.65E-10	1.10E-09	3.05E-01	1.33E-01	1.78E-02	4.29E-01	-1.89E+01	-1.99E+01	-1.40E-01	6.42E-01	9.75E-02	4.07E-01	3.86E+00	7.32E-03	-2.34E+01	1.59E-10	-1.79E+01	1.09E-11	4.00E+00	1.74E-01	1.00E-01	6.63E-01
65	2.31E-14	1.00E+00	8.26E-09	5.31E-10	5.78E-01	1.27E-01	8.96E-02	9.06E-01	-1.86E+01	-1.88E+01	-4.04E-01	-9.15E-01	1.51E-01	7.42E-02	6.05E-01	1.46E-03	-2.15E+01	3.96E-11	-2.09E+01	2.75E-10	4.00E+00	1.22E-01	9.37E-02	6.44E-01
66	2.42E-14	0.00E+00	1.99E-09	4.37E-10	1.25E-01	9.43E-02	5.49E-01	8.91E-01	-1.93E+01	-1.82E+01	1.99E-01	-3.24E-02	2.63E-01	1.81E-01	1.96E-01	1.19E-02	-2.11E+01	1.11E-11	-1.95E+01	1.49E-10	1.00E+00	9.13E-02	8.83E-02	6.52E-01
67	1.96E-14	1.00E+00	1.48E-09	2.72E-11	2.19E-01	1.21E-01	6.61E-02	1.40E-01	-1.91E+01	-1.81E+01	-4.71E-01	-5.23E-01	2.95E-01	4.47E-01	4.33E-01	2.29E-02	-2.38E+01	1.74E-10	-1.92E+01	1.39E-10	4.00E+00	9.21E-02	8.24E-02	6.01E-01
68	2.40E-14	0.00E+00	4.36E-09	1.08E-09	2.85E-01	6.78E-04	5.01E-01	6.10E-01	-1.99E+01	-1.75E+01	-1.55E+00	-2.45E-02	2.26E-01	1.58E-01	2.24E+00	1.72E-03	-2.33E+01	1.49E-10	-1.97E+01	1.90E-10	4.00E+00	1.08E-01	1.72E-01	6.53E-01
69	1.74E-15	1.00E+00	6.95E-09	9.06E-10	8.35E-02	8.98E-02	4.08E-01	8.71E-01	-1.93E+01	-1.97E+01	-1.18E-01	-4.98E-03	9.51E-04	7.70E-02	7.57E-01	9.90E-03	-2.18E+01	6.07E-11	-1.89E+01	7.85E-11	1.00E+00	1.01E-01	1.51E-01	5.60E-01
70	1.24E-14	0.00E+00	1.09E-09	5.91E-10	1.13E-01	4.63E-02	4.24E-01	9.17E-01	-1.90E+01	-1.74E+01	-1.67E-01	-1.48E-01	1.04E-01	5.77E-01	6.77E+00	2.96E-02	-2.21E+01	6.67E-11	-1.82E+01	2.15E-11	4.00E+00	7.20E-02	5.85E-02	6.04E-01
71	2.18E-14	0.00E+00	6.74E-09	1.19E-09	6.59E-01	1.57E-02	1.06E-01	8.30E-01	-1.85E+01	-1.90E+01	-1.23E-01	3.14E-02	1.04E-01	1.25E-01	7.29E-01	6.09E-03	-2.21E+01	8.32E-11	-1.85E+01	2.80E-11	1.00E+00	6.53E-02	6.38E-02	6.66E-01
72	3.02E-14	0.00E+00	8.68E-10	1.66E-10	2.26E-01	2.36E-02	4.74E-03	9.66E-01	-1.82E+01	-2.02E+01	-2.50E-01	-3.69E-01	3.57E-02	5.35E-01	4.93E+00	8.51E-03	-2.36E+01	1.64E-10	-1.92E+01	1.34E-10	4.00E+00	8.07E-02	1.26E-01	7.09E-01
73	1.57E-14	1.00E+00	6.66E-09	2.32E-10	6.19E-01	5.61E-02	3.03E-01	5.75E-01	-2.05E+01	-1.88E+01	-1.53E-01	-1.00E+00	8.49E-02	1.47E-01	3.29E+00	1.28E-02	-2.13E+01	2.52E-11	-1.76E+01	1.09E-11	1.00E+00	6.97E-02	8.05E-02	6.68E-01
74	3.07E-14	2.00E+00	4.20E-09	1.86E-10	8.11E-01	3.84E-02	3.52E-01	2.29E-01	-1.94E+01	-1.90E+01	8.83E-01	9.89E-01	1.84E-01	3.41E-01	2.41E+00	6.40E-03	-2.15E+01	3.21E-11	-2.02E+01	1.97E-10	1.00E+00	7.16E-02	9.82E-02	6.88E-01
75	2.91E-15	1.00E+00	7.72E-09	1.13E-09	2.11E-02	1.41E-01	3.80E-01	4.79E-01	-1.88E+01	-1.81E+01	-1.01E-01	9.14E-01	2.89E-01	6.30E-02	7.83E+00	7.66E-03	-2.19E+01	4.97E-11	-1.89E+01	7.99E-11	4.00E+00	8.03E-02	7.09E-02	6.41E-01
76	1.69E-14	0.00E+00	5.58E-10	7.48E-10	2.42E-01	1.38E-01	3.34E-01	8.59E-01	-1.90E+01	-1.94E+01	6.78E-01	2.08E-01	3.04E-01	5.22E-01	9.17E-01	4.31E-03	-2.31E+01	1.43E-10	-1.86E+01	6.44E-11	1.00E+00	6.03E-02	6.24E-02	6.40E-01
77	2.04E-14	0.00E+00	3.02E-09	9.13E-10	4.12E-01	1.48E-01	6.84E-02	6.96E-01	-1.80E+01	-1.92E+01	4.79E-02	1.69E-01	3.76E-01	4.58E-01	5.05E-01	2.79E-02	-2.25E+01	9.56E-11	-1.90E+01	1.14E-10	4.00E+00	1.12E-01	1.06E-01	6.86E-01
78	2.59E-14	0.00E+00	1.89E-09	1.64E-10	3.98E-01	4.93E-02	1.51E-01	8.97E-02	-1.86E+01	-1.78E+01	3.55E-01	-2.34E-01	1.41E-01	3.33E-01	6.40E+00	1.39E-02	-2.11E+01	2.15E-11	-1.98E+01	2.06E-10	1.00E+00	8.35E-02	6.87E-02	6.30E-01
79	2.78E-14	0.00E+00	7.30E-09	1.01E-09	2.96E-01	1.23E-01	3.88E-01	9.29E-01	-1.92E+01	-1.90E+01	-2.43E-01	-7.66E-02	1.91E-01	1.88E-02	8.12E-01	2.47E-02	-2.24E+01	1.11E-10	-1.90E+01	9.40E-11	4.00E+00	5.06E-02	1.02E-01	6.33E-01
80	1.61E-14	0.00E+00	1.69E-09	6.74E-10	9.03E-01	6.43E-02	2.68E-01	3.51E-01	-1.94E+01	-1.78E+01	-1.83E-01	2.85E-01	2.05E-01	3.56E-02	6.03E+00	5.19E-03	-2.33E+01	1.61E-10	-1.87E+01	5.17E-11	4.00E+00	9.05E-02	5.40E-02	5.98E-01
81	1.90E-14	2.00E+00	3.13E-09	9.65E-10	6.08E-02	1.05E-02	4.73E-01	6.03E-02	-1.83E+01	-1.72E+01	-9.37E-02	-6.30E-02	1.75E-02	5.70E-01	1.17E-01	8.83E-03	-2.32E+01	1.33E-10	-1.91E+01	1.05E-10	4.00E+00	9.26E-02	7.02E-02	6.07E-01
82	1.73E-14	1.00E+00	6.94E-09	6.06E-10	7.68E-01	8.52E-02	4.53E-01	9.91E-01	-1.79E+01	-1.92E+01	1.43E-01	-6.98E-02	3.93E-01	1.07E-01	8.05E+00	1.67E-02	-2.36E+01	1.50E-10	-1.98E+01	2.48E-10	1.00E+00	3.66E-02	5.12E-02	5.96E-01
83	3.80E-15	0.00E+00	4.04E-09	8.90E-11	9.22E-01	2.16E-02	2.17E-01	4.47E-01	-1.94E+01	-1.91E+01	2.41E-02	1.49E-01	4.07E-02	1.76E-01	8.62E-01	4.87E-03	-2.22E+01	8.59E-11	-1.93E+01	1.53E-10	4.00E+00	7.94E-02	8.97E-02	6.26E-01
84	8.34E-15	0.00E+00	2.52E-09	1.17E-11	7.53E-01	1.44E-01	6.88E-03	7.20E-01	-1.96E+01	-1.90E+01	2.28E-02	-2.95E-01	3.99E-01	2.76E-01	2.66E+00	2.02E-03	-2.29E+01	1.20E-10	-1.91E+01	8.53E-11	4.00E+00	6.14E-02	1.07E-01	5.86E-01
85	2.50E-15	2.00E+00	5.58E-09	1.05E-10	7.33E-01	7.34E-03	2.60E-01	2.82E-01	-1.87E+01	-1.87E+01	1.74E-01	-8.70E-01	2.79E-01	2.81E-01	4.56E+00	7.69E-03	-2.22E+01	7.40E-11	-1.83E+01	2.46E-11	4.00E+00	1.03E-01	9.09E-02	6.90E-01
86	4.90E-15	0.00E+00	6.11E-09	9.43E-10	5.51E-03	6.86E-02	3.61E-02	4.84E-01	-1.95E+01	-1.83E+01	2.42E-01	-1.64E+00	1.59E-01	1.12E-01	4.56E-01	2.08E-02	-2.21E+01	7.98E-11	-1.82E+01	1.09E-11	4.00E+00	8.30E-02	8.40E-02	6.28E-01
87	6.18E-15	2.00E+00	6.85E-09	8.18E-11	5.67E-01	2.68E-02	1.60E-01	8.62E-01	-1.87E+01	-1.96E+01	-4.11E-01	1.37E-01	1.00E-02	5.14E-01	4.71E-01	1.58E-02	-2.27E+01	1.21E-10	-1.90E+01	8.71E-11	1.00E+00	8.75E-02	3.59E-02	5.45E-01
88	2.02E-14	0.00E+00	8.99E-09	2.95E-10	4.35E-01	1.19E-01	2.88E-01	8.16E-01	-1.90E+01	-1.74E+01	1.07E-01	1.17E-02	1.14E-01	1.36E-01	2.91E+00	2.59E-03	-2.27E+01	1.23E-10	-1.85E+01	4.13E-11	1.00E+00	8.85E-02	1.32E-01	6.81E-01
89	2.64E-14	2.00E+00	4.17E-09	2.68E-10	3.74E-01	7.99E-02	3.72E-01	5.39E-01	-1.83E+01	-1.86E+01	-1.76E-02	9.35E-02	1.48E-01	9.48E-02	2.22E+00	1.95E-02	-2.26E+01	1.04E-10	-1.97E+01	2.56E-10	4.00E+00	7.59E-02	1.31E-01	6.56E-01
90	1.19E-14	0.00E+00	7.32E-09	1.27E-09	1.96E-01	1.28E-02	2.86E-01	2.58E-01	-1.89E+01	-1.98E+01	-6.79E-03	-4.60E-01	3.37E-01	5.86E-01	7.16E+00	2.12E-03	-2.12E+01	2.71E-11	-1.88E+01	7.03E-11	4.00E+00	7.80E-02	5.31E-02	6.31E-01
91	2.82E-14	0.00E+00	7.81E-09	1.32E-10	7.43E-01	5.46E-02	3.06E-01	7.08E-01	-1.76E+01	-1.84E+01	-7.52E-02	-2.47E-01	8.13E-02	2.37E-01	4.70E+00	2.66E-02	-2.18E+01	5.94E-11	-1.90E+01	1.02E-10	4.00E+00	9.45E-02	8.11E-02	5.66E-01

Table PAR-11. LHS Sampled Values (100 vectors) Replicate 3 — Continued

Parameter	1	2	3	4	5	6	7	8	9	10	11	12	14	15	16	17	18	19	20	21	22	23	24	25
Vector	STEEL	WAS_AREA	WAS_AREA	WAS_AREA	CELLULS	WAS_AREA	WAS_AREA	WAS_AREA	DRZ_PCS	CONC_PCS	SOLU4	SOLTH4	CONC_PCS	CONC_PCS	CONC_PCS	S_HALITE	S_HALITE	S_HALITE	S_MB139	S_MB139	S_MB139	S_MB139	S_MB139	S_MB139
Num.	CORRMCO2	PROBDEG	GRATMICI	GRATMICH	FBETA	SAT_RGAS	SAT_RBRN	SAT_WICK	PRMX_LOG	PRMX_LOG	SOLCIM	SOLCIM	SAT_RGAS	SAT_RBRN	PORE_DIS	POROSITY	PRMX_LOG	COMP_RCK	PRMX_LOG	COMP_RCK	RELP_MOD	SAT_RBRN	SAT_RGAS	PORE_DIS
92	2.87E-14	2.00E+00	9.48E-09	6.32E-10	4.01E-01	1.44E-01	4.44E-01	6.18E-01	-1.92E+01	-1.83E+01	1.38E-01	9.71E-02	2.56E-01	2.67E-01	1.57E+00	1.36E-02	-2.31E+01	1.53E-10	-1.91E+01	1.17E-10	1.00E+00	1.16E-01	3.41E-02	5.76E-01
93	1.80E-14	2.00E+00	2.67E-09	3.76E-10	7.24E-01	4.00E-02	5.11E-01	6.70E-01	-1.85E+01	-1.84E+01	1.73E-04	-8.59E-02	1.37E-01	8.22E-02	2.42E-01	1.12E-02	-2.30E+01	1.09E-10	-1.84E+01	3.04E-11	1.00E+00	1.27E-01	3.72E-02	6.64E-01
94	1.01E-15	2.00E+00	1.00E-09	9.56E-10	1.86E-01	4.58E-03	1.85E-01	2.98E-01	-1.79E+01	-1.96E+01	-2.32E-01	4.40E-02	3.71E-01	9.16E-02	2.03E+00	2.81E-02	-2.28E+01	1.33E-10	-1.99E+01	1.74E-10	1.00E+00	7.64E-02	1.16E-01	6.71E-01
95	1.98E-14	1.00E+00	2.09E-09	6.68E-10	5.42E-01	1.46E-01	3.69E-01	1.85E-01	-2.00E+01	-1.88E+01	-9.87E-01	4.57E-01	2.64E-01	1.12E-02	5.10E+00	2.14E-02	-2.32E+01	1.56E-10	-1.82E+01	1.09E-11	1.00E+00	8.99E-02	1.40E-01	5.90E-01
96	1.47E-14	0.00E+00	7.93E-09	9.90E-10	5.91E-01	2.90E-03	2.47E-01	7.39E-01	-1.87E+01	-1.89E+01	-2.06E-01	-1.15E-02	3.33E-01	3.25E-01	3.49E+00	4.66E-03	-2.20E+01	7.59E-11	-1.89E+01	9.58E-11	1.00E+00	7.56E-02	1.40E-02	6.37E-01
97	8.78E-15	0.00E+00	1.83E-09	7.69E-10	6.32E-01	8.37E-02	4.34E-01	5.60E-01	-1.89E+01	-1.79E+01	3.62E-02	1.67E-01	1.10E-01	2.22E-01	1.20E+00	2.05E-02	-2.17E+01	5.55E-11	-1.89E+01	1.08E-10	4.00E+00	5.50E-02	4.87E-02	6.43E-01
98	2.37E-14	0.00E+00	9.27E-09	1.15E-09	7.01E-01	3.56E-02	5.00E-02	8.06E-01	-1.92E+01	-1.87E+01	-2.86E-01	3.58E-01	1.23E-01	1.01E-01	3.59E-01	8.60E-03	-2.25E+01	8.90E-11	-1.93E+01	1.21E-10	1.00E+00	3.29E-02	7.75E-02	6.79E-01
99	1.09E-14	1.00E+00	4.65E-09	7.51E-10	6.06E-01	1.28E-01	5.14E-01	7.41E-01	-1.75E+01	-1.91E+01	-4.43E-01	-4.81E-01	4.53E-02	4.22E-01	1.45E+00	2.38E-02	-2.23E+01	8.70E-11	-1.86E+01	3.92E-11	4.00E+00	6.84E-02	1.04E-01	6.35E-01
100	2.07E-15	0.00E+00	7.96E-09	6.35E-10	9.99E-01	1.14E-01	3.43E-01	3.98E-01	-1.76E+01	-1.80E+01	-4.61E-01	-1.44E-01	3.51E-01	5.39E-01	1.65E-01	9.19E-03	-2.19E+01	4.63E-11	-1.83E+01	1.09E-11	1.00E+00	1.05E-01	9.71E-02	6.17E-01

Table PAR-11. LHS Sampled Values (100 vectors) Replicate 3 — Continued

Parameter	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*34*	*35*	*36*	*37*	*38*	*39*	*40*	*41*	*42*	*43*	*44*	*45*	*46*	*47*	*48*	*49*
Vector Num.	*S_HALITE PRESSURE*	*CASTILER PRESSURE*	*CASTILER PRMX_LOG*	*CASTILER COMP_RCK*	*BH_SAND PRMX_LOG*	*DRZ_1 PRMX_LOG*	*CONC_PLG PRMX_LOG*	*SOLAM3 SOLSIM*	*SOLAM3 SOLCIM*	*SOLPU3 SOLSIM*	*SOLPU3 SOLCIM*	*SOLPU4 SOLSIM*	*SOLPU4 SOLCIM*	*SOLU4 SOLSIM*	*SOLU6 SOLSIM*	*SOLU6 SOLCIM*	*SOLTH4 SOLSIM*	*PHUMOX3 PHUMCIM*	*GLOBAL OXSTAT*	*CULEBRA MINP_FAC*	*GLOBAL TRANSIDX*	*GLOBAL CLIMTIDX*	*CULEBRA HMBLKLT*
1	1.31E+07	1.41E+07	-1.32E+01	4.35E-11	-1.38E+01	-1.51E+01	-1.73E+01	-1.97E+00	1.98E-01	-3.81E-01	-1.94E-02	-1.81E-01	-7.97E-01	6.61E-02	-1.83E-01	-4.80E-01	-4.56E-01	1.40E+00	2.34E-01	1.35E+01	4.49E-01	1.00E+00	1.44E-01
2	1.19E+07	1.41E+07	-1.01E+01	3.45E-11	-1.33E+01	-1.34E+01	-1.88E+01	-2.10E-01	-1.31E-01	6.16E-02	-6.85E-02	9.58E-01	1.11E-01	-4.63E-01	-1.78E+00	-2.12E-01	-1.44E-01	1.45E+00	8.50E-01	2.02E+02	8.04E-01	1.07E+00	4.04E-01
3	1.22E+07	1.34E+07	-1.27E+01	4.20E-11	-1.50E+01	-1.66E+01	-1.86E+01	8.67E-02	5.27E-01	-1.10E-02	-7.58E-02	1.42E-01	-3.97E-01	-3.17E-01	2.42E-01	2.72E-01	-1.28E-01	1.37E+00	4.30E-01	9.36E+02	5.24E-01	1.10E+00	3.71E-01
4	1.24E+07	1.48E+07	-1.35E+01	6.39E-11	-1.54E+01	-1.89E+01	-1.83E+01	-2.21E-01	-9.25E-01	5.33E-02	-5.83E-01	-1.67E-01	-3.29E-01	2.30E-01	-2.60E-01	1.54E-01	-4.23E-01	1.49E+00	4.07E-01	8.57E+01	8.63E-01	1.19E+00	4.40E-01
5	1.27E+07	1.57E+07	-1.25E+01	4.61E-11	-1.17E+01	-1.67E+01	-1.81E+01	3.05E-01	2.87E-02	-4.96E-01	1.95E-01	7.33E-01	-2.45E-01	-1.67E-01	-2.50E-01	-1.15E-01	-2.97E-01	3.89E-01	6.06E-01	3.92E+02	1.57E-03	1.09E+00	1.37E-01
6	1.19E+07	1.44E+07	-1.15E+01	6.13E-11	-1.62E+01	-1.82E+01	-1.70E+01	-1.81E-01	-4.18E-01	2.15E-01	-2.27E-01	-1.08E-01	-5.36E-01	-1.56E+00	-7.90E-02	-1.89E-02	-7.90E-02	1.15E+00	2.55E-01	3.07E+02	3.87E-01	1.03E+00	2.66E-01
7	1.35E+07	1.36E+07	-1.19E+01	4.94E-11	-1.31E+01	-1.26E+01	-1.86E+01	9.55E-01	4.47E-02	1.20E+00	-1.42E-01	-3.57E-01	-2.12E-01	-9.92E-02	9.24E-01	-6.48E-01	3.89E-02	6.23E-01	3.99E-01	4.79E+02	3.24E-02	1.16E+00	2.93E-01
8	1.28E+07	1.27E+07	-1.31E+01	5.67E-11	-1.32E+01	-1.89E+01	-1.79E+01	-5.28E-01	-1.49E-01	4.23E-01	-3.56E-01	2.28E-03	3.79E-01	-6.69E-01	2.27E-01	2.38E-01	-2.40E-01	1.20E+00	2.03E-01	2.17E+02	2.13E-01	1.17E+00	3.67E-01
9	1.25E+07	1.45E+07	-1.03E+01	2.40E-11	-1.46E+01	-1.86E+01	-1.83E+01	-2.48E-01	2.09E-01	-2.03E-01	-6.03E-02	-1.31E-02	-1.46E-01	4.60E-01	-1.64E-01	9.12E-01	1.75E-01	1.50E+00	6.68E-01	7.78E+01	9.33E-02	1.23E+00	1.16E-01
10	1.36E+07	1.24E+07	-1.09E+01	4.74E-11	-1.57E+01	-1.34E+01	-1.78E+01	7.70E-01	-7.47E-02	4.75E-01	-1.16E-01	6.32E-02	-4.28E-01	8.37E-02	2.79E-02	5.45E-01	5.82E-01	1.40E+00	9.72E-01	2.38E+02	8.78E-01	1.15E+00	3.51E-01
11	1.12E+07	1.43E+07	-1.43E+01	7.31E-11	-1.39E+01	-1.29E+01	-1.87E+01	-1.86E-03	5.79E-01	-7.49E-01	-3.08E-01	-2.23E-01	-1.46E+00	9.80E-01	-8.41E-02	-1.72E-01	-2.71E-01	9.82E-01	1.30E-01	7.25E+02	6.34E-01	1.51E+00	2.30E-01
12	1.35E+07	1.44E+07	-1.27E+01	5.24E-11	-1.43E+01	-1.28E+01	-1.81E+01	-1.38E-01	-9.70E-01	8.14E-01	3.85E-02	3.52E-02	6.74E-01	-4.11E-01	6.52E-01	9.71E-02	-2.04E-01	9.62E-01	3.08E-02	6.48E+02	6.85E-01	1.99E+00	9.71E-02
13	1.12E+07	1.34E+07	-1.16E+01	3.15E-11	-1.29E+01	-1.78E+01	-1.84E+01	-4.18E-01	-4.40E-01	6.25E-01	9.31E-02	9.47E-01	5.13E-02	2.80E-01	3.68E-01	-1.93E-01	-8.85E-01	8.65E-01	1.02E-01	9.97E+02	5.41E-01	1.20E+00	3.52E-01
14	1.19E+07	1.53E+07	-1.36E+01	7.46E-11	-1.51E+01	-1.82E+01	-1.73E+01	2.34E-01	8.90E-02	-5.64E-02	5.01E-01	2.39E-01	2.89E-01	5.04E-01	-3.89E-02	1.22E-01	-9.03E-01	1.51E+00	4.73E-01	1.24E+02	7.57E-01	1.11E+00	3.91E-01
15	1.28E+07	1.23E+07	-1.24E+01	7.15E-11	-1.39E+01	-1.39E+01	-1.80E+01	-1.71E-01	8.81E-01	-1.28E+00	2.13E-01	-1.30E-01	-2.97E-01	-4.27E-01	-2.35E-01	9.21E-02	-6.55E-01	1.11E+00	5.76E-01	1.38E+02	5.19E-01	1.01E+00	1.09E-01
16	1.36E+07	1.56E+07	-1.17E+01	5.58E-11	-1.37E+01	-1.87E+01	-1.88E+01	3.50E-01	-2.90E-01	-6.11E-01	-1.48E-01	-9.76E-02	6.05E-02	-2.33E-01	-2.90E-02	-9.61E-01	4.07E-01	1.36E+00	1.23E-01	8.35E+02	1.76E-01	1.24E+00	4.70E-01
17	1.16E+07	1.51E+07	-1.14E+01	4.83E-11	-1.21E+01	-1.43E+01	-1.71E+01	-2.37E-01	-2.03E-01	9.64E-02	-4.76E-01	1.22E-01	-1.22E+00	3.20E-01	-1.36E-01	-7.65E-02	-5.55E-01	2.56E-01	8.28E-01	8.02E+02	5.84E-01	2.02E+00	3.62E-01
18	1.36E+07	1.21E+07	-1.13E+01	3.97E-11	-1.52E+01	-1.35E+01	-1.73E+01	-4.82E-01	6.82E-01	-8.95E-02	1.28E-02	-2.50E-03	-1.59E-01	2.49E-01	-4.60E-02	-2.74E-01	-2.16E-01	1.56E+00	3.76E-01	9.68E+01	9.33E-01	2.25E+00	1.77E-01
19	1.24E+07	1.27E+07	-1.18E+01	5.44E-11	-1.57E+01	-1.49E+01	-1.84E+01	3.25E-02	6.64E-02	5.82E-01	-3.03E-01	-4.97E-01	5.24E-01	1.24E+00	-9.59E-02	9.76E-01	-6.74E-02	3.52E-01	4.89E-01	3.40E+01	7.17E-01	1.04E+00	1.87E-01
20	1.35E+07	1.30E+07	-1.19E+01	4.30E-11	-1.45E+01	-1.69E+01	-1.72E+01	-4.58E-01	-3.32E-01	-2.68E-01	1.11E+00	-2.60E-01	-9.59E-01	-6.08E-01	-4.37E-01	-2.48E-01	7.10E-02	7.01E-01	8.71E-01	8.41E+02	9.06E-01	1.16E+00	5.00E-01
21	1.17E+07	1.38E+07	-1.23E+01	6.42E-11	-1.28E+01	-1.91E+01	-1.87E+01	-2.68E-01	-7.94E-03	-4.02E-02	-5.45E-01	-3.57E-01	-4.61E-01	-9.54E-01	7.79E-01	-1.95E-01	1.24E-01	1.41E+00	9.59E-01	2.48E+01	3.72E-01	1.00E+00	1.67E-01
22	1.20E+07	1.39E+07	-1.18E+01	5.31E-11	-1.28E+01	-1.31E+01	-1.75E+01	7.18E-01	-1.18E-01	-1.88E-01	1.20E-01	-1.83E+00	1.72E-01	-3.16E-02	8.99E-02	4.09E-01	-7.59E-01	1.01E+00	9.66E-01	1.59E+02	1.18E-01	1.25E+00	1.92E-01
23	1.27E+07	1.55E+07	-1.22E+01	4.20E-11	-1.61E+01	-1.59E+01	-1.85E+01	-1.02E-01	-4.87E-01	7.26E-01	4.82E-01	-1.14E-01	6.01E-01	7.71E-02	-3.33E-01	-1.51E+00	-1.12E+00	1.45E+00	9.90E-01	1.46E+02	6.48E-01	1.15E+00	2.22E-01
24	1.32E+07	1.27E+07	-1.21E+01	4.69E-11	-1.36E+01	-1.26E+01	-1.85E+01	6.39E-02	-2.18E-02	2.11E-01	-4.98E-02	-1.79E-01	-2.08E-01	-2.50E-01	-5.53E-01	8.13E-01	-9.02E-02	1.53E+00	1.79E-01	8.27E+02	6.67E-01	1.12E+00	3.43E-01
25	1.15E+07	1.41E+07	-1.24E+01	7.72E-11	-1.59E+01	-1.65E+01	-1.85E+01	-7.05E-02	1.70E-01	-9.30E-01	-6.42E-01	8.89E-02	-1.36E-01	-1.33E-01	-1.07E-01	-4.86E-03	9.74E-01	4.39E-01	1.52E-01	2.61E+02	5.25E-02	1.87E+00	4.77E-01
26	1.35E+07	1.19E+07	-1.12E+01	3.56E-11	-1.15E+01	-1.37E+01	-1.71E+01	-1.39E+00	-9.51E-02	1.89E-01	-2.39E-01	2.51E-01	7.19E-02	1.73E-01	-1.19E-01	-5.37E-01	-1.73E-01	1.39E+00	4.16E-01	2.94E+02	1.60E-02	1.75E+00	2.67E-01
27	1.21E+07	1.22E+07	-1.19E+01	5.12E-11	-1.46E+01	-1.57E+01	-1.86E+01	-4.94E-02	1.33E-01	-8.35E-01	1.79E-01	-2.76E-01	8.39E-01	-2.24E-01	-1.31E-01	-4.53E-01	6.52E-01	1.49E+00	5.60E-01	9.16E+02	1.98E-01	1.09E+00	1.52E-01
28	1.32E+07	1.48E+07	-1.30E+01	9.02E-11	-1.10E+01	-1.63E+01	-1.87E+01	3.77E-02	2.45E-01	2.27E-01	7.44E-01	-8.04E-01	-1.67E+00	-2.13E-01	-2.05E-01	-5.79E-01	-1.49E-01	1.42E+00	3.08E-01	8.61E+02	4.57E-01	1.20E+00	7.78E-02
29	1.34E+07	1.28E+07	-1.11E+01	3.29E-11	-1.16E+01	-1.64E+01	-1.87E+01	6.30E-03	-4.76E-01	-5.07E-01	1.38E-01	6.96E-01	-7.39E-01	-1.18E-01	6.28E-01	6.96E-02	5.07E-02	1.60E+00	6.75E-01	6.25E+02	2.77E-01	2.11E+00	3.04E-01
30	1.31E+07	1.47E+07	-1.28E+01	8.22E-11	-1.27E+01	-1.36E+01	-1.87E+01	-3.85E-01	-9.84E-02	-1.74E-01	-1.75E+00	2.35E-01	-2.36E-01	-7.55E-02	-1.90E-01	2.22E-01	-4.84E-01	1.59E+00	8.82E-01	7.38E+02	1.85E-01	1.17E+00	3.95E-01
31	1.36E+07	1.49E+07	-1.22E+01	6.06E-11	-1.35E+01	-1.48E+01	-1.86E+01	-3.53E-01	-2.01E-01	-6.96E-01	9.78E-01	6.23E-01	-9.39E-02	-7.46E-01	2.09E-01	-3.63E-01	4.95E-01	1.56E+00	2.92E-01	2.42E+02	9.95E-01	1.04E+00	1.26E-01
32	1.21E+07	1.32E+07	-1.17E+01	6.61E-11	-1.22E+01	-1.60E+01	-1.73E+01	-1.90E-01	-2.27E-01	-4.70E-02	-8.17E-01	-8.60E-01	-7.02E-01	-1.85E+00	-1.04E+00	-1.10E-01	-1.22E-01	8.35E-01	6.42E-02	5.49E+02	6.24E-01	2.14E+00	1.83E-01
33	1.13E+07	1.31E+07	-1.29E+01	6.65E-11	-1.21E+01	-1.40E+01	-1.73E+01	-6.90E-01	4.39E-01	-1.11E-01	-2.32E-01	1.99E-01	-1.18E-01	1.42E-01	-3.16E-01	-1.99E+00	1.06E-01	9.38E-01	6.17E-01	3.49E+02	8.37E-01	1.93E+00	3.30E-01
34	1.20E+07	1.38E+07	-1.33E+01	9.10E-11	-1.31E+01	-1.66E+01	-1.78E+01	-6.91E-02	-4.11E-01	7.98E-01	1.69E-01	3.96E-01	-2.74E-01	2.14E-01	-3.99E-01	7.97E-01	1.83E-01	1.47E+00	3.27E-01	2.85E+02	6.11E-01	1.20E+00	1.97E-01
35	1.18E+07	1.30E+07	-1.04E+01	4.28E-11	-1.29E+01	-1.41E+01	-1.90E+01	1.23E-01	-1.20E-01	7.80E-02	1.46E-01	-1.51E-02	-8.16E-02	3.65E-02	-1.05E-03	-2.27E-01	-1.98E-01	1.52E+00	2.80E-01	1.87E+02	7.25E-01	1.01E+00	2.53E-01
36	1.28E+07	1.38E+07	-1.28E+01	8.48E-11	-1.41E+01	-1.92E+01	-1.76E+01	9.83E-02	-1.65E-01	-9.52E-02	6.62E-01	8.44E-01	9.77E-01	-6.18E-02	-2.11E-01	1.40E-02	-4.33E-01	1.38E+00	1.96E-01	1.94E+02	1.66E-01	1.60E+00	1.19E-01
37	1.11E+07	1.23E+07	-1.12E+01	4.16E-11	-1.49E+01	-1.54E+01	-1.77E+01	5.25E-02	2.87E-01	5.50E-01	-4.83E-01	5.09E-01	-2.11E-02	-3.57E-01	-4.12E-01	-1.87E-01	2.04E-01	1.48E+00	4.39E-01	8.94E+02	1.41E-01	1.14E+00	1.74E-01
38	1.18E+07	1.33E+07	-1.20E+01	5.15E-11	-1.54E+01	-1.30E+01	-1.80E+01	-1.14E-01	-1.19E+00	3.09E-01	3.27E-02	-9.11E-01	-4.78E-01	-4.30E-02	-4.86E-02	-3.89E-01	-1.37E-01	5.68E-01	6.93E-01	3.56E+02	4.85E-01	1.04E+00	8.20E-02
39	1.34E+07	1.53E+07	-1.28E+01	5.75E-11	-1.26E+01	-1.45E+01	-1.75E+01	1.13E-01	-8.56E-01	-7.65E-02	2.15E-01	2.37E-02	-3.17E-01	1.22E-01	8.63E-01	-1.19E-01	1.31E-01	7.87E-01	7.47E-02	8.57E+02	7.25E-02	1.06E+00	2.00E-01
40	1.14E+07	1.47E+07	-1.06E+01	4.67E-11	-1.25E+01	-1.28E+01	-1.80E+01	-7.80E-01	3.74E-01	-2.23E-01	-9.69E-01	4.96E-01	-1.75E-01	-8.52E-01	8.39E-01	8.88E-01	-2.48E-01	8.99E-01	8.62E-02	6.72E+02	4.32E-01	1.05E+00	3.98E-01
41	1.14E+07	1.51E+07	-1.15E+01	5.72E-11	-1.55E+01	-1.88E+01	-1.90E+01	-1.72E+00	-1.67E-01	8.57E-02	-2.46E-01	5.12E-02	-8.81E-02	-5.46E-02	-1.07E-02	1.86E-01	-4.81E-02	1.57E+00	4.93E-01	7.43E+02	8.11E-01	1.21E+00	1.49E-01
42	1.14E+07	1.49E+07	-1.24E+01	7.82E-11	-1.49E+01	-1.61E+01	-1.76E+01	-1.08E-01	-7.62E-01	-2.92E-01	-1.36E-02	-8.38E-02	1.07E-01	1.63E-01	-9.66E-01	-4.08E-01	1.62E-01	1.07E+00	7.86E-01	7.07E+02	2.02E-01	1.10E+00	3.39E-01
43	1.38E+07	1.54E+07	-1.10E+01	3.52E-11	-1.24E+01	-1.90E+01	-1.88E+01	-1.24E-01	-5.34E-01	-2.21E-01	-1.30E-01	-2.04E-01	-4.93E-02	-1.63E-01	-9.82E-02	-1.32E-01	-2.16E-02	7.59E-02	8.41E-01	4.29E+02	8.96E-01	1.25E+00	4.34E-01
44	1.11E+07	1.45E+07	-1.19E+01	6.87E-11	-1.44E+01	-1.29E+01	-1.80E+01	-1.80E-01	-4.03E-02	-3.55E-01	5.62E-01	-1.35E-01	2.04E-01	7.59E-01	-4.92E-01	1.72E-01	6.67E-03	1.43E+00	5.43E-02	9.26E+02	7.65E-01	1.18E+00	3.37E-01
45	1.25E+07	1.59E+07	-1.23E+01	4.54E-11	-1.48E+01	-1.33E+01	-1.82E+01	-4.24E-02	-2.36E-01	-1.98E+00	-3.97E-01	1.02E+00	8.50E-01	3.20E-02	1.45E-01	-2.04E-01	-1.16E-01	1.49E-01	4.51E-01	1.68E+02	2.70E-01	1.04E+00	3.82E-01

Table PAR-11. LHS Sampled Values (100 vectors) Replicate 3 — Continued

Parameter	26	27	28	29	30	31	32	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
Vector	S_HALITE	CASTILER	CASTILER	CASTILER	BH_SAND	DRZ_1	CONC_PLG	SOLAM3	SOLAM3	SOLPU3	SOLPU3	SOLPU4	SOLPU4	SOLU4	SOLU6	SOLU6	SOLTH4	PHUMOX3	GLOBAL	CULEBRA	GLOBAL	GLOBAL	CULEBRA
Num.	PRESSURE	PRESSURE	PRMX_LOG	COMP_RCK	PRMX_LOG	PRMX_LOG	PRMX_LOG	SOLSIM	SOLCIM	SOLSIM	SOLCIM	SOLSIM	SOLCIM	SOLSIM	SOLSIM	SOLCIM	SOLSIM	PHUMCIM	OXSTAT	MINP_FAC	TRANSIDX	CLIMTIDX	HMBLKLT
46	1.32E+07	1.54E+07	-1.09E+01	3.64E-11	-1.38E+01	-1.68E+01	-1.78E+01	-3.07E-02	7.90E-01	-1.60E-01	1.10E-01	-9.61E-01	9.24E-01	8.57E-01	-4.62E-01	1.99E-01	-2.11E-01	1.40E+00	3.83E-01	7.66E+02	3.17E-01	1.23E+00	4.86E-01
47	1.11E+07	1.24E+07	-1.18E+01	4.47E-11	-1.57E+01	-1.72E+01	-1.75E+01	1.58E-01	6.07E-03	-1.15E-01	7.79E-01	3.03E-01	-2.58E-01	-3.03E-01	9.85E-02	-9.46E-02	-6.04E-01	4.15E-01	9.45E-01	4.82E+02	4.99E-01	1.68E+00	3.12E-01
48	1.18E+07	1.16E+07	-1.14E+01	3.93E-11	-1.47E+01	-1.31E+01	-1.89E+01	-7.70E-01	3.47E-01	1.16E-01	8.02E-01	-4.20E-01	4.87E-01	-1.77E-01	-1.15E-01	-8.67E-01	-1.79E-01	9.03E-01	1.67E-01	4.49E+02	6.91E-01	1.13E+00	4.25E-01
49	1.30E+07	1.31E+07	-1.20E+01	3.80E-11	-1.20E+01	-1.44E+01	-1.81E+01	8.41E-01	9.80E-01	1.44E-01	-9.71E-02	8.69E-01	4.39E-02	-9.24E-01	-7.06E-01	-1.27E-01	2.17E-01	2.45E-01	3.68E-01	5.03E+02	7.34E-01	1.11E+00	2.82E-01
50	1.27E+07	1.32E+07	-1.26E+01	4.40E-11	-1.19E+01	-1.85E+01	-1.85E+01	4.62E-01	-6.02E-02	-2.45E-01	-2.15E-01	-6.62E-02	-1.27E-01	-1.46E-01	-1.70E-01	2.04E-01	-4.77E-01	1.47E+00	2.68E-01	3.27E+02	3.07E-01	1.15E+00	2.35E-01
51	1.13E+07	1.68E+07	-1.12E+01	2.96E-11	-1.20E+01	-1.32E+01	-1.79E+01	8.64E-01	2.24E-01	-1.03E-01	-3.21E-02	-1.65E-01	-6.37E-02	-2.38E-01	-2.27E-01	7.87E-02	-4.05E-03	1.43E+00	8.65E-01	3.74E+02	9.78E-01	1.72E+00	2.41E-01
52	1.39E+07	1.65E+07	-1.26E+01	7.35E-11	-1.34E+01	-1.48E+01	-1.84E+01	-2.84E-01	2.33E-02	-1.29E-01	-1.55E-01	1.48E-01	-4.05E-02	-1.05E-01	-5.78E-02	3.93E-02	-4.09E-01	5.98E-01	4.62E-01	6.52E+02	5.72E-01	2.05E+00	7.00E-02
53	1.37E+07	1.42E+07	-1.13E+01	6.47E-11	-1.19E+01	-1.71E+01	-1.82E+01	-1.97E-01	2.32E-01	9.80E-01	-3.75E-01	-2.19E-01	-6.08E-01	6.50E-01	-2.99E-01	-5.42E-02	-2.29E-01	1.53E+00	9.16E-01	8.17E+02	4.09E-01	1.06E+00	2.20E-01
54	1.26E+07	1.59E+07	-1.18E+01	7.00E-11	-1.13E+01	-1.76E+01	-1.86E+01	9.03E-01	1.30E-01	-2.06E-02	-1.06E-03	4.61E-02	3.42E-01	-2.64E-01	-3.43E-01	-1.80E-01	-1.91E-01	1.24E+00	6.38E-01	5.18E+02	6.75E-02	1.81E+00	2.46E-01
55	1.23E+07	1.28E+07	-1.08E+01	4.07E-11	-1.12E+01	-1.41E+01	-1.70E+01	-9.30E-02	-1.77E-01	-8.26E-01	6.92E-04	-2.01E-01	1.60E-01	1.87E-01	7.05E-02	-1.61E-01	-3.45E-01	1.52E+00	8.19E-01	6.91E+02	3.41E-01	1.24E+00	4.52E-01
56	1.17E+07	1.18E+07	-1.16E+01	3.78E-11	-1.40E+01	-1.50E+01	-1.89E+01	2.24E-01	-3.51E-01	1.67E-01	-2.82E-01	2.23E-01	-4.41E-01	8.10E-01	-2.01E-01	-9.06E-01	-3.84E-01	4.69E-01	6.87E-01	6.70E+02	4.18E-01	1.14E+00	4.60E-01
57	1.12E+07	1.37E+07	-1.31E+01	6.71E-11	-1.11E+01	-1.79E+01	-1.72E+01	5.84E-01	-1.99E+00	-2.01E-01	-1.34E-01	-5.20E-01	2.47E-01	-8.06E-01	-2.84E-01	-2.17E-01	8.40E-02	3.01E-01	8.05E-01	8.85E+02	9.49E-01	1.08E+00	2.86E-01
58	1.26E+07	1.26E+07	-1.30E+01	5.39E-11	-1.45E+01	-1.58E+01	-1.88E+01	-9.30E-01	-2.40E-01	-1.08E+00	-3.22E-01	-2.68E-02	-9.12E-01	5.86E-02	-6.09E-01	-1.32E-02	3.63E-01	1.70E-01	5.28E-01	4.93E+02	5.08E-01	1.21E+00	5.43E-02
59	1.27E+07	1.21E+07	-1.32E+01	6.91E-11	-1.59E+01	-1.58E+01	-1.79E+01	-8.37E-02	-2.60E-01	-3.18E-01	-3.81E-02	7.55E-02	1.94E-01	1.50E-01	1.74E-01	-4.29E-02	3.14E-01	1.27E+00	7.94E-01	3.64E+02	6.58E-01	1.91E+00	4.58E-01
60	1.15E+07	1.35E+07	-1.36E+01	6.22E-11	-1.22E+01	-1.72E+01	-1.81E+01	-2.25E-01	1.61E-01	1.58E-01	-9.77E-02	-2.48E-01	-1.67E-01	-1.03E+00	1.05E+00	-2.43E-01	-1.83E-01	1.29E+00	1.12E-01	5.43E+00	8.56E-01	1.58E+00	4.78E-01
61	1.17E+07	1.35E+07	-1.36E+01	5.83E-11	-1.33E+01	-1.57E+01	-1.82E+01	-1.23E+00	9.83E-02	1.35E-01	-8.28E-02	-1.67E+00	2.37E-01	-1.90E-01	-2.40E-02	6.52E-01	5.47E-01	1.42E+00	5.94E-01	9.67E+02	2.22E-01	1.22E+00	4.28E-01
62	1.38E+07	1.39E+07	-1.40E+01	9.43E-11	-1.48E+01	-1.78E+01	-1.76E+01	-4.38E-01	-5.16E-02	-3.11E-02	-4.38E-01	-8.06E-02	5.84E-01	9.84E-02	-2.16E-01	-2.54E-02	2.47E-01	6.90E-01	9.88E-01	9.74E+02	8.84E-01	1.03E+00	2.99E-01
63	1.22E+07	1.13E+07	-1.30E+01	6.19E-11	-1.23E+01	-1.37E+01	-1.82E+01	1.86E-01	-1.41E-01	-4.76E-01	-4.66E-02	-4.24E-02	2.26E-01	-4.41E-01	-3.71E-01	3.19E-01	-3.61E-01	1.38E-01	6.27E-01	5.76E+02	4.70E-01	2.17E+00	6.28E-02
64	1.29E+07	1.26E+07	-1.17E+01	4.01E-11	-1.14E+01	-1.55E+01	-1.77E+01	-4.93E-01	-6.16E-01	-1.59E-01	5.57E-02	-7.24E-02	-1.86E-01	-1.95E-02	-1.57E-01	1.10E-01	-9.81E-01	1.51E+00	3.17E-01	4.03E+02	3.37E-01	1.07E+00	4.90E-01
65	1.22E+07	1.29E+07	-1.14E+01	3.91E-11	-1.44E+01	-1.51E+01	-1.89E+01	-1.57E-01	-1.52E+00	-4.40E-01	-1.62E-01	-7.44E-01	-3.71E-01	1.13E-01	2.19E-01	-1.11E+00	-1.53E-01	1.55E+00	7.58E-01	7.56E+02	2.42E-02	1.97E+00	5.74E-02
66	1.33E+07	1.28E+07	-1.38E+01	8.31E-11	-1.18E+01	-1.73E+01	-1.81E+01	-8.11E-02	4.88E-01	1.91E-01	8.81E-01	-6.04E-02	1.38E-01	9.32E-03	-6.34E-02	-8.39E-02	-6.09E-02	6.41E-01	7.28E-01	5.98E+02	4.69E-01	1.03E+00	4.11E-01
67	1.21E+07	1.29E+07	-1.39E+01	4.79E-11	-1.41E+01	-1.75E+01	-1.83E+01	1.46E-01	1.54E-01	9.28E-01	-7.34E-01	1.76E-01	-1.08E-01	-2.70E-01	-1.49E+00	-1.29E+00	-1.10E-01	1.41E+00	9.38E-01	3.34E+02	8.90E-02	1.54E+00	4.65E-01
68	1.16E+07	1.42E+07	-1.25E+01	5.54E-11	-1.53E+01	-1.60E+01	-1.79E+01	-3.58E-01	-3.08E-03	3.97E-01	6.11E-01	-1.33E+00	-1.22E-01	-1.24E-01	8.28E-02	3.58E-01	-2.30E-01	1.44E+00	7.15E-01	5.90E+02	4.97E-02	1.12E+00	4.45E-01
69	1.28E+07	1.62E+07	-1.24E+01	5.27E-11	-1.40E+01	-1.39E+01	-1.77E+01	1.37E-01	-2.75E-01	-4.13E-03	2.76E-01	-4.10E-01	-2.20E-01	-1.81E-01	-1.80E-01	-1.48E-01	1.13E+00	1.46E+00	1.47E-01	5.61E+01	8.27E-01	2.08E+00	2.15E-01
70	1.11E+07	1.31E+07	-1.33E+01	8.13E-11	-1.60E+01	-1.92E+01	-1.74E+01	2.07E-01	-2.11E-01	-1.22E-01	1.60E-01	1.05E-01	-1.63E-01	-3.63E-02	-3.79E-01	-2.64E-01	3.32E-02	1.58E+00	4.42E-02	4.63E+02	6.09E-01	1.84E+00	1.62E-01
71	1.38E+07	1.22E+07	-1.22E+01	5.93E-11	-1.63E+01	-1.77E+01	-1.81E+01	-3.24E-01	6.29E-01	-1.67E-01	-1.70E-01	4.05E-01	-2.24E-01	-5.33E-01	5.40E-01	-2.82E-02	-6.97E-02	5.55E-01	9.04E-01	9.02E+02	8.44E-01	2.19E+00	2.77E-01
72	1.32E+07	1.46E+07	-1.22E+01	5.06E-11	-1.13E+01	-1.77E+01	-1.71E+01	-1.62E-01	8.30E-02	-3.32E-01	-2.52E-01	1.86E-01	-1.71E-03	6.18E-01	7.08E-01	-3.61E-02	8.47E-01	1.57E+00	5.82E-01	2.25E+02	4.26E-01	1.07E+00	4.50E-01
73	1.38E+07	1.39E+07	-1.10E+01	2.45E-11	-1.42E+01	-1.54E+01	-1.76E+01	-1.47E-01	-6.70E-01	-7.42E-02	-2.21E-01	-4.70E-01	-1.83E-02	-1.44E-01	-1.49E-01	-6.72E-02	1.43E-01	1.38E+00	1.17E-02	6.15E+02	7.78E-01	1.10E+00	3.85E-01
74	1.12E+07	1.23E+07	-1.11E+01	2.78E-11	-1.12E+01	-1.85E+01	-1.76E+01	-1.39E-02	-3.12E-01	2.30E-02	7.66E-02	-9.26E-02	-7.41E-02	-9.70E-02	1.33E-01	1.31E-01	-2.04E-02	1.19E+00	5.34E-01	4.56E+01	3.66E-01	1.23E+00	7.46E-02
75	1.33E+07	1.17E+07	-1.23E+01	7.64E-11	-1.27E+01	-1.81E+01	-1.88E+01	-3.70E-02	-3.62E-01	-4.03E-01	-8.55E-02	-1.24E-01	-6.22E-02	4.06E-01	9.71E-01	-7.09E-01	-2.54E-01	7.43E-01	3.38E-01	2.77E+02	6.80E-01	1.79E+00	3.76E-01
76	1.21E+07	1.36E+07	-1.17E+01	5.47E-11	-1.53E+01	-1.75E+01	-1.82E+01	-2.33E-01	-6.81E-02	1.28E-01	-1.06E-01	-1.52E-01	-1.44E-01	-4.72E-01	-1.62E-02	-9.90E-02	7.33E-01	3.60E-01	9.22E-01	1.06E+02	1.54E-01	1.23E+00	2.97E-01
77	1.29E+07	1.25E+07	-1.09E+01	3.06E-11	-1.56E+01	-1.81E+01	-1.73E+01	2.44E-01	-8.65E-02	-1.49E-01	3.72E-01	-3.89E-01	-3.83E-01	-6.66E-02	1.96E-01	5.77E-02	8.87E-01	1.33E+00	7.64E-01	9.84E+02	2.51E-01	1.08E+00	1.70E-01
78	1.17E+07	1.61E+07	-1.20E+01	3.65E-11	-1.61E+01	-1.46E+01	-1.71E+01	-3.12E-01	-2.18E-01	-6.44E-02	-1.86E-01	-1.41E-01	-2.91E-02	-1.31E+00	4.20E-01	-2.86E-01	-1.56E+00	1.48E+00	3.52E-01	9.40E+02	3.56E-01	1.09E+00	9.15E-02
79	1.31E+07	1.31E+07	-1.44E+01	8.64E-11	-1.58E+01	-1.26E+01	-1.75E+01	2.04E-02	8.31E-01	-2.31E-01	-8.52E-01	-7.17E-01	4.50E-01	-6.44E-01	3.07E-01	-2.31E-01	-4.15E-02	1.59E+00	6.47E-01	5.62E+02	1.37E-01	1.64E+00	4.21E-01
80	1.16E+07	1.44E+07	-1.27E+01	4.10E-11	-1.17E+01	-1.83E+01	-1.89E+01	-1.45E-01	9.32E-01	1.04E-02	-1.97E-01	-2.42E-01	-2.39E-01	9.02E-01	4.15E-03	1.59E-01	-3.02E-02	2.01E-01	7.32E-01	8.71E+02	9.80E-01	1.12E+00	6.61E-02
81	1.13E+07	1.33E+07	-1.01E+01	2.61E-11	-1.16E+01	-1.80E+01	-1.76E+01	-1.28E-01	-2.97E-02	-2.53E-01	-1.56E+00	-2.84E-02	7.11E-01	-1.13E-02	4.56E-01	-4.99E-01	6.44E-01	1.58E+00	7.01E-01	9.56E+02	9.60E-01	1.15E+00	2.06E-01
82	1.15E+07	1.35E+07	-1.21E+01	4.45E-11	-1.18E+01	-1.47E+01	-1.72E+01	-3.93E-01	-1.50E-02	-2.41E-01	7.05E-02	-1.91E-01	1.89E-02	5.78E-01	5.60E-01	-3.53E-01	9.37E-01	5.25E-01	6.53E-01	1.73E+02	9.23E-01	1.11E+00	2.10E-01
83	1.23E+07	1.15E+07	-1.26E+01	6.27E-11	-1.14E+01	-1.73E+01	-1.80E+01	1.38E+00	-1.91E-01	-4.49E-01	-1.24E-01	-4.33E-01	7.96E-01	-3.58E-01	5.81E-02	6.29E-01	-1.64E-01	1.54E+00	5.64E-01	5.51E+02	9.10E-01	1.13E+00	1.57E-01
84	1.20E+07	1.30E+07	-1.04E+01	3.44E-11	-1.55E+01	-1.93E+01	-1.83E+01	-5.96E-02	5.11E-02	-3.66E-01	-1.09E+00	-1.24E+00	3.55E-02	-3.25E-01	1.15E-01	4.96E-01	-6.67E-01	1.09E+00	5.13E-01	3.12E+02	5.52E-01	1.21E+00	3.26E-01
85	1.23E+07	1.20E+07	-1.41E+01	7.93E-11	-1.51E+01	-1.53E+01	-1.72E+01	2.63E-01	-1.09E-01	-1.43E-01	-2.44E-02	7.78E-01	-1.95E+00	-7.91E-02	1.88E-01	-7.30E-02	2.63E-01	1.44E+00	7.78E-01	7.95E+02	1.24E-01	1.05E+00	2.49E-01
86	1.25E+07	1.21E+07	-1.07E+01	5.03E-11	-1.24E+01	-1.65E+01	-1.71E+01	-8.76E-01	1.89E-01	4.38E-02	2.31E-01	-4.92E-02	9.42E-02	3.80E-01	1.29E-01	-4.45E-01	2.02E-01	2.94E-01	3.45E-01	4.15E+02	2.40E-01	1.12E+00	1.03E-01
87	1.18E+07	1.37E+07	-1.16E+01	4.59E-11	-1.31E+01	-1.94E+01	-1.84E+01	-2.87E-01	1.28E+00	-1.82E-01	9.41E-01	-5.65E-01	-2.01E-01	-1.32E-01	-2.38E-01	-3.38E-01	-3.21E-01	1.39E+00	9.86E-02	6.88E+02	2.95E-01	1.17E+00	3.20E-01
88	1.26E+07	1.26E+07	-1.37E+01	7.08E-11	-1.11E+01	-1.56E+01	-1.77E+01	-2.03E-01	-5.67E-01	-1.37E-01	-1.79E-01	1.62E-01	-8.55E-01	-2.73E-02	-1.65E+00	2.31E-01	-5.53E-02	1.54E+00	4.45E-01	3.85E+02	7.01E-01	1.19E+00	4.10E-01
89	1.34E+07	1.29E+07	-1.13E+01	4.96E-11	-1.49E+01	-1.88E+01	-1.74E+01	1.95E-01	-7.97E-02	-5.38E-02	-4.56E-01	-3.37E-01	-9.86E-02	1.94E-01	-6.17E-01	-7.53E-01	-1.41E+00	1.02E-01	5.50E-03	7.11E+02	7.98E-01	1.14E+00	3.58E-01
90	1.37E+07	1.34E+07	-1.15E+01	3.07E-11	-1.37E+01	-1.69E+01	-1.72E+01	6.26E-01	7.25E-01	-2.13E-01	-1.27E+00	-2.36E-01	6.32E-03	-1.99E-01	-7.79E-01	-4.21E-01	1.67E-02	1.47E+00	2.29E-01	6.50E+01	6.00E-01	1.20E+00	1.08E-01
91	1.30E+07	1.25E+07	-1.34E+01	7.55E-11	-1.26E+01	-1.43E+01	-1.87E+01	-9.83E-01	-8.06E-01	2.79E-02	-9.44E-01	-2.90E-01	1.30E+00	-2.02E-01	-1.42E-01	5.74E-01	-1.04E-01	4.94E-01	5.04E-01	4.58E+02	3.24E-01	1.08E+00	1.29E-01

Table PAR-11. LHS Sampled Values (100 vectors) Replicate 3 — Continued

Parameter	26	27	28	29	30	31	32	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
Vector	S_HALITE	CASTILER	CASTILER	CASTILER	BH_SAND	DRZ_1	CONC_PLG	SOLAM3	SOLAM3	SOLPU3	SOLPU3	SOLPU4	SOLPU4	SOLU4	SOLU6	SOLU6	SOLTH4	PHUMOX3	GLOBAL	CULEBRA	GLOBAL	GLOBAL	CULEBRA
Num.	PRESSURE	PRESSURE	PRMX_LOG	COMP_RCK	PRMX_LOG	PRMX_LOG	PRMX_LOG	SOLSIM	SOLCIM	SOLSIM	SOLCIM	SOLSIM	SOLCIM	SOLSIM	SOLSIM	SOLCIM	SOLSIM	PHUMCIM	OXSTAT	MINP_FAC	TRANSIDX	CLIMTIDX	HMBLKLT
92	1.25E+07	1.18E+07	-1.21E+01	4.90E-11	-1.34E+01	-1.71E+01	-1.84E+01	-1.19E-02	-1.57E-01	6.67E-01	1.05E-01	5.91E-01	1.21E-01	-3.84E-01	1.89E-02	-1.56E-01	-3.39E-01	1.58E+00	5.43E-01	6.32E+02	7.83E-01	1.17E+00	3.17E-01
93	1.30E+07	1.37E+07	-1.21E+01	5.98E-11	-1.35E+01	-1.38E+01	-1.75E+01	6.56E-01	-1.36E-01	-1.73E+00	-4.19E-01	-3.11E-01	-4.83E-01	-1.54E-01	1.61E-01	-3.13E-01	-1.97E+00	1.50E+00	9.00E-01	5.35E+02	9.60E-01	1.06E+00	3.07E-01
94	1.23E+07	1.43E+07	-1.18E+01	3.71E-11	-1.50E+01	-1.42E+01	-1.85E+01	-5.64E-01	-1.45E+00	-9.58E-01	4.24E-01	-6.21E-01	1.53E-01	-8.57E-02	-7.40E-01	-1.45E-01	-1.17E-02	1.50E+00	8.33E-01	2.58E+02	1.03E-01	1.22E+00	2.58E-01
95	1.29E+07	1.33E+07	-1.08E+01	3.22E-11	-1.60E+01	-1.62E+01	-1.74E+01	5.18E-01	1.08E-01	2.54E-01	-3.84E-01	1.10E-01	1.89E-01	2.34E-02	-7.33E-02	-7.95E-01	1.10E-01	1.45E+00	2.16E-01	5.26E+02	5.40E-01	1.02E+00	1.34E-01
96	1.24E+07	1.25E+07	-1.13E+01	3.87E-11	-1.30E+01	-1.44E+01	-1.89E+01	1.68E-01	-4.62E-01	-2.65E-02	-2.05E-01	-4.61E-01	-3.55E-01	-2.22E-01	-4.76E-01	2.65E-02	7.52E-01	1.04E+00	2.10E-02	1.12E+02	2.90E-01	1.02E+00	4.92E-01
97	1.33E+07	1.50E+07	-1.05E+01	2.83E-11	-1.23E+01	-1.53E+01	-1.79E+01	-6.55E-01	-4.72E-02	2.48E-01	3.38E-01	2.11E-01	-8.93E-03	-4.85E-01	-8.80E-01	7.34E-01	7.73E-02	8.07E-01	7.46E-01	6.09E+02	2.34E-01	1.19E+00	2.26E-01
98	1.37E+07	1.19E+07	-1.34E+01	5.88E-11	-1.43E+01	-1.84E+01	-1.77E+01	-2.35E-02	-1.84E-01	-4.28E-01	-1.91E-01	-1.56E-01	-4.80E-02	2.19E-01	-9.05E-01	3.45E-03	-9.13E-02	1.55E+00	1.85E-01	7.72E+02	3.92E-01	1.02E+00	8.74E-02
99	1.31E+07	1.27E+07	-1.06E+01	3.35E-11	-1.62E+01	-1.62E+01	-1.78E+01	4.42E-01	-2.47E-01	-5.67E-01	2.38E-01	-3.56E-02	-6.53E-01	-6.57E-03	2.56E-01	1.39E+00	-8.26E-01	7.53E-01	2.85E-01	7.84E+02	5.65E-01	1.18E+00	4.17E-01
100	1.14E+07	1.40E+07	-1.29E+01	6.82E-11	-1.36E+01	-1.50E+01	-1.74E+01	7.31E-02	-3.79E-01	8.72E-01	-7.14E-01	-2.15E-01	-1.90E-01	7.32E-01	4.37E-02	-5.74E-02	2.28E-01	1.23E+00	2.40E-01	4.35E+02	7.42E-01	1.70E+00	2.73E-01

Table PAR-11. LHS Sampled Values (100 vectors) Replicate 3 — Continued

Parameter	50	51	52	53	54	55	56	57	58	60	61	62	63	64	65	66	75
Vector	CULEBRA	CULEBRA	U+6	U+4	PU+3	PU+4	TH+4	AM+3	BOREHOLE	GLOBAL	BOREHOLE	SHFTU	SHFTU	SHFTU	SHFTL_T1	SHFTL_T2	SPALLMOD
Num.	APOROS	DPOROS	MKD_U	MKD_U	MKD_PU	MKD_PU	MKD_TH	MKD_AM	TAUFAIL	PBRINE	DOMEGA	SAT_RBRN	SAT_RGAS	PRMX_LOG	PRMX_LOG	PRMX_LOG	RNDSPALL
1	9.77E-03	1.53E-01	3.78E-04	1.16E+00	8.85E-02	2.00E+00	7.03E+00	3.78E-01	1.88E+01	3.39E-01	6.77E+00	1.24E-01	1.01E-01	-1.97E+01	-1.86E+01	-2.07E+01	5.98E-02
2	1.72E-04	1.12E-01	3.13E-03	7.50E-01	3.49E-01	3.31E+00	1.49E+00	3.73E-01	1.86E-01	5.73E-01	5.65E+00	1.60E-01	1.60E-01	-1.75E+01	-1.81E+01	-1.93E+01	1.10E-01
3	8.34E-03	1.65E-01	2.26E-04	9.07E+00	2.94E-01	7.13E-01	8.83E+00	2.00E-01	8.53E-02	5.47E-01	7.53E+00	5.14E-01	9.65E-02	-1.80E+01	-1.87E+01	-1.97E+01	1.74E-01
4	1.61E-03	1.85E-01	3.03E-04	3.60E+00	2.09E-02	6.79E+00	2.27E+00	2.96E-01	5.36E+00	5.95E-01	6.10E+00	4.31E-01	1.25E-01	-1.77E+01	-1.73E+01	-2.02E+01	4.04E-02
5	1.61E-04	2.42E-01	1.57E-02	1.45E+00	4.73E-02	4.48E+00	7.70E-01	1.33E-01	1.31E+00	7.67E-02	7.19E+00	3.45E-01	2.94E-01	-1.79E+01	-1.84E+01	-2.00E+01	3.22E-01
6	8.55E-04	1.10E-01	1.32E-02	5.05E+00	5.16E-02	3.88E+00	1.94E+00	1.09E-01	1.66E+00	4.66E-01	1.97E+01	7.67E-02	2.47E-01	-1.74E+01	-1.81E+01	-1.98E+01	6.52E-01
7	1.58E-03	1.85E-01	3.23E-04	8.75E-01	2.04E-01	1.23E+00	6.89E+00	1.78E-01	6.76E+01	2.69E-01	6.90E+00	3.63E-01	3.09E-01	-1.83E+01	-1.78E+01	-1.86E+01	9.08E-01
8	6.74E-03	1.81E-01	2.60E-04	6.61E+00	2.50E-01	5.88E+00	1.76E+00	7.82E-02	4.29E+01	5.07E-01	4.30E+00	1.89E-02	9.05E-02	-1.87E+01	-1.80E+01	-1.86E+01	2.43E-01
9	1.00E-03	1.20E-01	7.93E-04	1.19E+00	5.65E-02	4.55E+00	1.02E+00	5.32E-02	4.50E+00	9.84E-02	7.48E+00	5.01E-01	1.07E-01	-1.99E+01	-1.83E+01	-2.03E+01	4.45E-01
10	6.44E-03	1.86E-01	2.29E-03	2.12E+00	2.59E-01	1.38E+00	1.25E+00	1.71E-01	3.41E+00	1.67E-01	6.17E+00	3.32E-01	2.58E-01	-2.00E+01	-1.82E+01	-2.11E+01	8.71E-01
11	7.83E-03	1.74E-01	3.29E-03	3.24E+00	1.03E-01	2.19E+00	9.11E-01	9.49E-02	2.63E-01	4.43E-02	8.25E+00	1.05E-01	1.69E-01	-1.73E+01	-1.83E+01	-2.02E+01	8.05E-01
12	1.24E-04	1.62E-01	7.17E-03	8.40E-01	3.17E-02	1.52E+00	6.64E+00	7.65E-02	2.51E-01	4.17E-01	7.90E+00	1.85E-01	2.86E-01	-1.87E+01	-1.76E+01	-1.90E+01	2.17E-01
13	1.06E-03	1.58E-01	1.45E-03	1.69E+00	5.24E-02	1.71E+00	8.06E-01	2.88E-02	2.19E-01	5.14E-01	7.17E+00	5.50E-01	3.18E-01	-1.86E+01	-1.72E+01	-1.98E+01	9.84E-01
14	1.22E-03	1.02E-01	6.60E-04	1.48E+00	6.16E-02	8.89E-01	1.57E+00	2.66E-02	2.68E+01	1.29E-01	5.91E+00	1.46E-02	2.91E-01	-1.96E+01	-1.88E+01	-2.08E+01	6.10E-01
15	9.40E-03	1.35E-01	1.09E-02	8.10E+00	2.48E-02	1.81E+00	5.91E+00	4.20E-02	2.88E+01	5.81E-01	1.23E+01	4.03E-01	3.43E-01	-1.87E+01	-1.82E+01	-1.91E+01	6.38E-01
16	3.20E-03	1.87E-01	2.08E-04	1.35E+00	1.68E-01	9.60E-01	3.55E+00	2.28E-02	4.00E+01	2.03E-01	1.35E+01	3.73E-02	1.68E-01	-1.82E+01	-1.80E+01	-1.94E+01	3.57E-02
17	7.90E-04	1.51E-01	1.33E-03	1.84E+00	2.45E-01	3.81E+00	4.32E+00	5.75E-02	3.02E+01	3.60E-01	9.72E+00	0	6.91E-02	-1.88E+01	-1.80E+01	-2.00E+01	8.85E-01
18	3.02E-03	2.22E-01	2.21E-04	5.63E+00	8.24E-02	4.64E+00	5.32E+00	3.63E-02	4.02E+00	2.27E-01	6.52E+00	4.92E-02	3.13E-01	-1.77E+01	-1.78E+01	-1.92E+01	1.85E-01
19	8.13E-03	1.30E-01	2.38E-03	4.38E+00	1.41E-01	1.56E+00	2.87E+00	3.48E-02	1.17E+00	2.49E-01	8.22E+00	2.01E-01	2.20E-01	-1.84E+01	-1.71E+01	-2.08E+01	9.20E-01
20	2.47E-03	1.48E-01	4.07E-03	2.92E+00	3.92E-02	2.32E+00	2.14E+00	1.83E-01	1.59E+01	1.51E-02	7.76E+00	1.41E-01	5.35E-02	-1.79E+01	-1.75E+01	-1.89E+01	9.75E-01
21	1.90E-03	1.17E-01	4.79E-03	7.13E-01	3.39E-02	3.95E+00	5.00E+00	2.74E-02	5.31E-02	3.43E-01	1.61E+01	1.36E-01	3.47E-01	-1.80E+01	-1.85E+01	-2.02E+01	4.92E-01
22	5.09E-04	1.16E-01	7.06E-04	9.93E+00	3.75E-02	4.82E+00	9.64E-01	1.14E-01	4.20E-01	2.73E-01	8.16E+00	1.01E-02	1.72E-01	-1.79E+01	-1.82E+01	-1.88E+01	8.97E-01
23	3.96E-03	1.93E-01	1.30E-03	3.30E+00	2.89E-02	1.94E+00	2.05E+00	1.36E-01	1.07E+01	3.83E-01	1.25E+01	2.71E-01	1.98E-01	-1.81E+01	-1.80E+01	-1.92E+01	9.30E-01
24	1.05E-04	1.37E-01	3.12E-05	1.09E+00	6.44E-02	1.11E+00	1.12E+00	8.74E-02	1.47E+01	4.09E-01	9.37E+00	6.98E-02	2.05E-01	-1.87E+01	-1.88E+01	-1.92E+01	5.54E-01
25	2.58E-04	1.85E-01	7.73E-04	7.45E+00	1.07E-01	9.90E-01	2.66E+00	2.02E-01	1.16E-01	4.90E-01	1.01E+01	1.12E-01	2.13E-01	-2.00E+01	-1.87E+01	-2.17E+01	2.51E-01
26	1.88E-04	1.16E-01	9.60E-04	7.52E+00	1.31E-01	3.20E+00	4.47E+00	9.50E-02	2.89E+00	4.22E-01	8.30E+00	5.35E-01	3.01E-01	-1.70E+01	-1.76E+01	-2.13E+01	7.29E-01
27	2.80E-04	1.10E-01	5.74E-05	3.16E+00	1.15E-01	9.67E+00	2.25E+00	2.39E-02	7.33E+01	5.19E-01	9.93E+00	6.56E-02	2.43E-01	-1.89E+01	-1.76E+01	-1.82E+01	4.55E-01
28	2.72E-03	1.12E-01	1.13E-02	2.14E+00	4.32E-02	1.17E+00	2.62E+00	1.01E-01	5.12E-01	5.60E-01	6.96E+00	2.91E-01	8.75E-02	-2.02E+01	-1.81E+01	-1.97E+01	1.21E-01
29	5.41E-03	1.39E-01	5.65E-04	9.29E-01	2.22E-02	4.90E+00	4.62E+00	3.47E-01	7.92E-02	2.22E-01	7.39E+00	5.64E-02	2.60E-02	-1.85E+01	-1.89E+01	-1.95E+01	9.96E-01
30	4.85E-03	1.88E-01	8.64E-04	7.30E-01	1.24E-01	2.57E+00	4.76E+00	1.31E-01	1.23E+01	5.23E-02	7.98E+00	4.12E-01	3.57E-01	-1.78E+01	-1.89E+01	-2.04E+01	7.97E-01
31	1.78E-03	1.72E-01	2.42E-04	8.73E+00	3.15E-01	7.19E+00	1.28E+00	3.34E-02	5.31E-01	1.18E-01	4.80E+00	4.32E-01	3.07E-01	-1.95E+01	-1.85E+01	-2.01E+01	4.63E-01
32	1.68E-03	1.67E-01	7.45E-05	3.36E+00	2.31E-02	1.43E+00	9.89E-01	3.23E-01	1.97E+01	4.52E-01	7.98E+00	5.38E-01	3.29E-01	-1.97E+01	-1.79E+01	-2.10E+01	6.16E-01
33	1.13E-04	1.64E-01	1.08E-04	5.84E+00	2.77E-01	5.60E+00	8.29E+00	3.90E-01	1.29E+01	6.78E-02	8.06E+00	2.77E-01	3.90E-01	-1.83E+01	-1.89E+01	-1.99E+01	7.07E-01
34	1.16E-04	1.98E-01	5.31E-03	9.53E+00	3.00E-01	2.69E+00	1.32E+00	6.18E-02	3.98E-01	5.36E-01	1.02E+01	3.71E-01	4.03E-02	-1.82E+01	-1.86E+01	-1.89E+01	1.42E-01
35	1.91E-03	1.83E-01	1.79E-03	2.67E+00	1.05E-01	8.99E+00	1.38E+00	4.93E-02	1.40E+01	3.14E-01	1.57E+01	4.56E-01	7.74E-02	-1.78E+01	-1.99E+01	-2.05E+01	4.00E-01
36	2.54E-03	1.42E-01	1.63E-03	1.37E+00	2.12E-01	8.07E+00	1.83E+00	3.64E-01	5.00E+00	2.37E-01	1.05E+01	3.80E-01	1.46E-01	-1.85E+01	-1.78E+01	-2.03E+01	9.41E-01
37	4.06E-03	1.79E-01	4.63E-03	7.00E+00	1.50E-01	1.89E+00	9.07E+00	4.72E-02	7.43E-01	1.77E-02	7.26E+00	9.19E-02	6.72E-02	-1.95E+01	-1.89E+01	-2.01E+01	2.92E-01
38	9.79E-04	1.14E-01	3.73E-05	3.97E+00	6.78E-02	2.27E+00	3.26E+00	2.37E-01	9.94E-02	8.66E-02	7.30E+00	2.14E-02	3.64E-01	-1.92E+01	-1.79E+01	-2.10E+01	4.11E-01
39	1.26E-03	1.40E-01	6.37E-04	2.42E+00	2.36E-01	9.01E+00	3.29E+00	5.96E-02	1.99E-01	2.93E-01	9.10E+00	1.29E-01	1.50E-01	-1.74E+01	-1.82E+01	-1.95E+01	1.94E-01
40	2.40E-04	1.83E-01	9.55E-05	2.53E+00	2.38E-02	4.31E+00	2.47E+00	1.67E-01	4.70E+01	4.79E-02	8.11E+00	1.50E-01	1.86E-01	-1.89E+01	-1.74E+01	-2.06E+01	2.27E-01
41	6.16E-04	2.35E-01	6.01E-03	2.22E+00	1.86E-01	9.70E-01	4.08E+00	1.22E-01	6.33E+01	4.38E-01	8.64E+00	4.80E-03	1.77E-01	-1.76E+01	-1.71E+01	-2.20E+01	6.89E-01
42	5.33E-04	1.04E-01	4.56E-04	9.10E-01	8.66E-02	1.64E+00	7.08E+00	3.17E-02	1.71E+01	5.52E-01	4.45E+00	2.11E-01	3.84E-02	-1.82E+01	-1.76E+01	-2.08E+01	8.68E-01
43	6.63E-04	1.06E-01	3.24E-05	3.92E+00	7.99E-02	3.42E+00	7.40E-01	3.39E-01	3.71E+01	4.98E-01	1.08E+01	1.18E-01	2.25E-01	-1.78E+01	-1.95E+01	-2.01E+01	5.10E-01
44	9.02E-03	1.14E-01	1.14E-04	1.16E+00	2.77E-02	4.24E+00	8.42E+00	5.15E-02	1.73E+00	3.90E-01	5.20E+00	2.62E-01	1.53E-01	-1.70E+01	-1.88E+01	-1.99E+01	5.27E-01
45	1.18E-03	1.73E-01	7.74E-03	7.18E+00	7.24E-02	3.50E+00	5.16E+00	5.47E-02	5.94E+00	5.01E-01	6.74E+00	1.13E-01	1.89E-01	-1.89E+01	-1.83E+01	-1.96E+01	8.14E-01

Table PAR-11. LHS Sampled Values (100 vectors) Replicate 3 — Continued

Parameter	50	51	52	53	54	55	56	57	58	60	61	62	63	64	65	66	75
Vector	CULEBRA	CULEBRA	U+6	U+4	PU+3	PU+4	TH+4	AM+3	BOREHOLE	GLOBAL	BOREHOLE	SHFTU	SHFTU	SHFTU	SHFTL_T1	SHFTL_T2	SPALLMOD
Num.	APOROS	DPOROS	MKD_U	MKD_U	MKD_PU	MKD_PU	MKD_TH	MKD_AM	TAUFAIL	PBRINE	DOMEGA	SAT_RBRN	SAT_RGAS	PRMX_LOG	PRMX_LOG	PRMX_LOG	RNDSPALL
46	3.38E-03	1.73E-01	1.72E-04	4.89E+00	3.28E-02	8.28E-01	2.35E+00	8.52E-02	3.47E-01	4.80E-01	8.89E+00	4.68E-01	2.81E-01	-1.84E+01	-1.90E+01	-2.05E+01	1.53E-01
47	4.38E-04	1.89E-01	4.26E-04	1.05E+00	2.79E-02	6.40E+00	2.13E+00	3.10E-01	5.68E+00	1.41E-01	7.31E+00	1.33E-01	2.78E-01	-1.93E+01	-1.77E+01	-1.80E+01	3.82E-03
48	2.72E-04	1.80E-01	4.29E-03	7.93E-01	3.67E-02	1.76E+00	1.19E+00	1.19E-01	5.53E-02	2.60E-01	1.18E+01	3.06E-01	2.33E-02	-1.90E+01	-1.77E+01	-2.18E+01	8.28E-01
49	1.42E-03	1.01E-01	3.02E-03	5.23E+00	5.88E-02	3.12E+00	2.53E+00	6.63E-02	3.11E-01	4.59E-01	7.80E+00	4.65E-02	2.52E-01	-1.80E+01	-1.80E+01	-2.06E+01	6.73E-01
50	7.05E-04	1.59E-01	4.97E-04	6.74E+00	9.89E-02	2.08E+00	7.97E+00	1.91E-01	1.05E-01	1.52E-01	6.31E+00	1.99E-01	4.00E-01	-1.88E+01	-1.76E+01	-1.98E+01	8.36E-01
51	3.32E-04	1.68E-01	8.50E-05	2.60E+00	2.31E-01	2.72E+00	1.64E+00	3.99E-02	6.83E-01	2.15E-01	1.34E+01	5.69E-01	1.19E-01	-2.04E+01	-1.79E+01	-2.04E+01	8.55E-01
52	3.57E-03	1.19E-01	2.01E-03	6.26E+00	4.79E-02	1.51E+00	3.04E+00	4.43E-02	7.97E+00	7.38E-02	1.26E+01	5.89E-01	1.07E-02	-1.71E+01	-1.77E+01	-2.13E+01	2.07E-01
53	2.29E-04	1.60E-01	1.00E-02	9.46E+00	9.73E-02	7.65E+00	4.72E+00	5.57E-02	8.73E-01	2.28E-01	7.64E+00	3.34E-02	1.10E-01	-1.91E+01	-1.87E+01	-1.93E+01	4.34E-01
54	3.69E-03	1.33E-01	1.19E-04	1.79E+00	1.37E-01	9.43E+00	5.48E+00	6.97E-02	9.18E-02	1.97E-01	7.89E+00	3.21E-01	3.70E-01	-1.90E+01	-1.69E+01	-2.09E+01	3.47E-01
55	4.44E-03	1.69E-01	5.68E-03	1.96E+00	1.75E-01	5.10E+00	5.66E+00	2.41E-01	1.83E+00	5.94E-01	1.15E+01	5.63E-01	1.64E-01	-1.84E+01	-1.92E+01	-1.94E+01	3.62E-01
56	5.04E-03	1.11E-01	1.03E-03	8.80E+00	2.99E-02	7.05E+00	1.53E+00	3.00E-02	5.00E+01	1.73E-01	8.47E+00	2.36E-01	5.63E-02	-1.92E+01	-1.84E+01	-2.01E+01	6.54E-02
57	7.25E-03	2.50E-01	6.30E-05	2.81E+00	2.67E-01	1.45E+00	3.69E+00	1.84E-01	9.01E+00	1.38E-01	7.08E+00	2.40E-01	1.21E-01	-1.81E+01	-1.83E+01	-2.15E+01	5.75E-01
58	1.47E-03	1.66E-01	1.60E-04	2.26E+00	3.34E-01	5.28E+00	9.43E-01	4.29E-02	1.51E+00	3.78E-01	1.39E+01	3.88E-01	2.65E-01	-1.76E+01	-1.81E+01	-1.94E+01	9.50E-01
59	1.75E-04	1.32E-01	1.90E-02	1.62E+00	3.54E-02	2.48E+00	1.34E+00	2.56E-01	7.06E+00	1.87E-01	1.07E+01	1.74E-01	1.43E-01	-1.98E+01	-1.77E+01	-2.11E+01	1.12E-01
60	1.94E-04	1.08E-01	6.68E-03	7.80E+00	5.38E-02	2.63E+00	3.53E+00	2.57E-02	2.22E+00	1.08E-01	6.70E+00	5.97E-01	1.29E-02	-1.80E+01	-1.85E+01	-2.01E+01	7.49E-01
61	4.67E-04	1.22E-01	1.50E-02	1.41E+00	4.38E-02	9.75E+00	8.51E-01	3.81E-02	1.04E+01	3.58E-01	6.88E+00	6.25E-02	4.48E-02	-1.83E+01	-1.94E+01	-2.09E+01	7.11E-01
62	1.57E-04	1.77E-01	2.64E-03	4.53E+00	2.15E-02	1.26E+00	2.95E+00	3.08E-02	4.68E-01	2.87E-02	8.35E+00	5.58E-01	3.22E-01	-1.94E+01	-1.82E+01	-1.88E+01	5.45E-01
63	3.86E-04	1.74E-01	1.42E-02	1.59E+00	4.96E-02	7.82E-01	3.75E+00	1.04E-01	1.00E+00	2.76E-01	1.16E+01	2.67E-02	1.81E-01	-1.77E+01	-1.94E+01	-2.03E+01	1.40E-01
64	3.26E-04	1.47E-01	1.92E-04	3.80E+00	2.79E-01	8.09E-01	3.17E+00	4.62E-02	1.73E-01	3.10E-01	2.14E+01	9.23E-02	5.13E-02	-1.92E+01	-1.75E+01	-1.93E+01	3.08E-01
65	3.67E-04	1.13E-01	3.64E-03	8.31E+00	3.11E-02	7.34E-01	1.92E+00	1.62E-01	7.42E+00	5.30E-01	5.41E+00	1.79E-01	2.54E-01	-1.88E+01	-1.84E+01	-2.04E+01	6.64E-01
66	1.14E-03	1.78E-01	4.81E-05	2.48E+00	9.45E-02	1.21E+00	7.63E+00	2.10E-01	2.03E-01	3.00E-01	1.20E+01	1.66E-03	1.38E-01	-1.76E+01	-1.74E+01	-2.05E+01	7.87E-01
67	5.84E-04	2.31E-01	1.43E-04	4.06E+00	5.82E-02	8.19E+00	7.85E+00	2.50E-02	2.06E+00	5.55E-01	8.12E+00	2.20E-01	2.19E-01	-1.89E+01	-1.86E+01	-2.16E+01	7.60E-01
68	2.00E-04	1.44E-01	5.45E-04	9.67E-01	3.62E-01	6.56E+00	7.31E+00	1.50E-01	3.82E-01	2.44E-01	6.48E+00	4.95E-01	3.00E-01	-1.82E+01	-1.88E+01	-2.09E+01	2.74E-01
69	8.18E-04	1.71E-01	2.06E-03	2.79E+00	2.40E-02	7.45E+00	9.93E+00	8.29E-02	2.73E+00	5.27E-01	7.44E+00	1.24E-01	6.11E-02	-1.86E+01	-1.85E+01	-1.97E+01	6.00E-01
70	4.31E-04	1.63E-01	6.92E-05	1.74E+00	1.12E-01	1.66E+00	4.19E+00	7.46E-02	1.08E+00	3.90E-02	1.10E+01	2.81E-01	3.40E-01	-1.78E+01	-1.92E+01	-1.85E+01	9.63E-01
71	4.32E-03	1.65E-01	5.35E-05	1.11E+00	4.10E-02	4.06E+00	3.93E+00	2.40E-02	5.86E-02	5.86E-01	6.99E+00	1.93E-01	3.50E-01	-1.79E+01	-1.90E+01	-2.00E+01	5.89E-01
72	3.61E-04	1.43E-01	1.34E-04	1.24E+00	2.05E-02	8.65E-01	9.14E-01	2.77E-01	4.28E+00	3.32E-01	7.59E+00	8.12E-02	3.87E-01	-1.83E+01	-1.87E+01	-1.95E+01	5.31E-01
73	5.51E-03	1.70E-01	8.06E-03	9.55E-01	3.87E-01	2.21E+00	3.40E+00	1.15E-01	3.30E+01	4.27E-01	1.46E+01	1.54E-01	3.94E-01	-1.99E+01	-1.84E+01	-2.05E+01	3.16E-01
74	6.30E-03	2.05E-01	7.47E-05	8.47E-01	4.23E-02	1.09E+00	1.73E+00	2.21E-02	9.58E+00	1.77E-01	1.12E+01	1.62E-01	3.55E-02	-1.83E+01	-1.84E+01	-2.02E+01	4.88E-01
75	2.36E-04	1.17E-01	8.24E-05	5.95E+00	3.08E-01	3.65E+00	2.03E+00	1.49E-01	3.35E-01	2.57E-01	5.05E+00	8.64E-02	2.01E-01	-1.91E+01	-1.82E+01	-2.19E+01	5.12E-01
76	2.22E-03	1.29E-01	9.07E-03	1.54E+00	3.99E-01	7.65E-01	7.83E-01	1.27E-01	1.24E+00	2.94E-01	5.01E+00	4.81E-01	7.57E-02	-1.78E+01	-1.87E+01	-1.87E+01	7.36E-01
77	8.80E-04	1.79E-01	1.77E-02	3.51E+00	7.67E-02	5.18E+00	6.53E+00	2.28E-01	2.50E+01	2.85E-01	6.44E+00	3.93E-01	2.73E-01	-1.75E+01	-1.75E+01	-2.14E+01	3.78E-01
78	4.06E-04	1.55E-01	1.08E-03	5.51E+00	1.96E-01	3.08E+00	1.15E+00	3.67E-02	6.30E-01	4.46E-01	7.82E+00	4.36E-02	2.63E-01	-1.95E+01	-1.91E+01	-2.14E+01	8.46E-01
79	7.10E-03	1.55E-01	1.26E-04	2.06E+00	3.75E-01	7.70E+00	7.10E-01	1.57E-01	1.46E+00	3.95E-01	9.58E+00	2.53E-01	1.35E-01	-1.81E+01	-1.73E+01	-1.96E+01	3.98E-01
80	1.37E-04	1.15E-01	4.85E-04	1.26E+00	1.57E-01	6.13E+00	5.85E+00	2.65E-01	5.36E+01	4.71E-01	1.01E+01	4.72E-01	3.25E-01	-1.85E+01	-1.84E+01	-1.95E+01	1.65E-01
81	5.79E-03	1.09E-01	6.40E-03	6.48E+00	9.11E-02	2.89E+00	2.39E+00	2.83E-01	7.47E-02	1.26E-01	7.41E+00	1.65E-01	1.31E-01	-1.86E+01	-1.71E+01	-1.87E+01	2.87E-01
82	5.56E-04	1.90E-01	2.69E-03	3.72E+00	1.94E-01	2.10E+00	4.05E+00	9.09E-02	1.41E-01	5.68E-01	9.10E+00	9.87E-02	2.33E-01	-1.76E+01	-1.79E+01	-2.07E+01	4.72E-01
83	3.13E-04	1.82E-01	9.49E-03	4.25E+00	7.00E-02	5.57E+00	1.08E+00	1.43E-01	3.64E+01	4.30E-01	5.78E+00	3.58E-01	3.35E-01	-1.77E+01	-1.81E+01	-2.23E+01	3.39E-01
84	6.47E-04	1.26E-01	4.63E-05	3.10E+00	1.22E-01	6.28E+00	9.40E+00	8.06E-02	1.28E-01	3.24E-01	8.37E+00	3.39E-01	8.38E-02	-1.81E+01	-1.75E+01	-1.91E+01	5.62E-01
85	1.36E-03	1.06E-01	3.46E-05	1.29E+00	4.52E-02	1.13E+00	1.46E+00	2.21E-01	6.65E+00	4.01E-01	7.71E+00	5.80E-01	1.87E-02	-1.84E+01	-1.71E+01	-2.15E+01	7.17E-02
86	9.15E-04	1.76E-01	4.35E-05	1.03E+00	7.45E-02	2.79E+00	1.42E+00	2.06E-02	3.08E+00	3.72E-01	6.60E+00	4.43E-01	1.92E-01	-1.93E+01	-1.86E+01	-2.04E+01	3.54E-01
87	2.98E-04	1.88E-01	1.83E-03	4.73E+00	2.18E-01	8.99E-01	1.16E+00	2.49E-01	2.17E+01	2.09E-01	6.59E+00	1.69E-01	2.69E-01	-1.81E+01	-1.77E+01	-1.91E+01	7.77E-01
88	2.32E-03	1.18E-01	1.22E-02	1.67E+00	2.26E-01	9.36E-01	1.78E+00	2.16E-02	8.82E-01	4.83E-01	7.03E+00	1.92E-01	3.80E-01	-1.93E+01	-1.72E+01	-1.90E+01	6.98E-01
89	4.77E-03	1.61E-01	1.69E-02	8.19E-01	6.38E-02	8.48E+00	1.07E+00	1.05E-01	6.47E-02	1.10E-01	6.39E+00	1.45E-01	2.40E-01	-1.85E+01	-1.90E+01	-2.00E+01	2.64E-01
90	1.27E-04	1.05E-01	3.76E-03	7.59E-01	1.79E-01	1.32E+00	6.31E+00	4.81E-02	2.33E+01	1.02E-01	6.67E+00	7.37E-02	6.83E-03	-1.77E+01	-1.79E+01	-2.06E+01	3.84E-01
91	2.08E-03	1.50E-01	9.73E-05	1.89E+00	1.17E-01	1.04E+00	8.65E+00	3.30E-01	2.32E+00	8.90E-02	5.55E+00	4.62E-01	3.03E-02	-1.91E+01	-1.93E+01	-1.84E+01	4.29E-01

Table PAR-11. LHS Sampled Values (100 vectors) Replicate 3 — Continued

Parameter	*50*	*51*	*52*	*53*	*54*	*55*	*56*	*57*	*58*	*60*	*61*	*62*	*63*	*64*	*65*	*66*	*75*
Vector	*CULEBRA*	*CULEBRA*	*U+6*	*U+4*	*PU+3*	*PU+4*	*TH+4*	*AM+3*	*BOREHOLE*	*GLOBAL*	*BOREHOLE*	*SHFTU*	*SHFTU*	*SHFTU*	*SHFTL_T1*	*SHFTL_T2*	*SPALLMOD*
Num.	*APOROS*	*DPOROS*	*MKD_U*	*MKD_U*	*MKD_PU*	*MKD_PU*	*MKD_TH*	*MKD_AM*	*TAUFAIL*	*PBRINE*	*DOMEGA*	*SAT_RBRN*	*SAT_RGAS*	*PRMX_LOG*	*PRMX_LOG*	*PRMX_LOG*	*RNDSPALL*
92	*2.11E-03*	*1.01E-01*	*3.86E-04*	*4.48E+00*	*1.59E-01*	*1.33E+00*	*5.03E+00*	*6.48E-02*	*6.05E+01*	*5.94E-02*	*1.74E+01*	*3.13E-01*	*3.79E-01*	*-1.71E+01*	*-1.93E+01*	*-2.18E+01*	*8.03E-02*
93	*1.01E-04*	*2.16E-01*	*3.39E-04*	*9.96E-01*	*1.65E-01*	*1.05E+00*	*2.75E+00*	*2.08E-02*	*5.88E-01*	*3.52E-01*	*4.63E+00*	*2.31E-01*	*1.14E-01*	*-1.72E+01*	*-1.80E+01*	*-2.02E+01*	*2.30E-01*
94	*7.45E-04*	*1.20E-01*	*1.21E-03*	*6.05E+00*	*1.45E-01*	*2.43E+00*	*6.07E+00*	*2.82E-02*	*1.40E-01*	*2.20E-02*	*9.41E+00*	*5.26E-01*	*3.64E-01*	*-1.80E+01*	*-1.78E+01*	*-1.99E+01*	*1.85E-02*
95	*2.16E-04*	*1.83E-01*	*1.79E-04*	*4.86E+00*	*2.59E-02*	*7.43E-01*	*8.22E-01*	*2.98E-01*	*7.98E-01*	*4.56E-01*	*7.67E+00*	*5.09E-01*	*9.28E-02*	*-1.75E+01*	*-1.84E+01*	*-1.96E+01*	*6.25E-01*
96	*4.83E-04*	*1.76E-01*	*1.54E-03*	*5.34E+00*	*2.69E-02*	*5.78E+00*	*2.85E+00*	*3.96E-02*	*2.49E+00*	*1.59E-01*	*6.34E+00*	*4.19E-01*	*3.74E-01*	*-1.73E+01*	*-1.81E+01*	*-1.92E+01*	*9.38E-01*
97	*2.82E-03*	*1.68E-01*	*5.78E-05*	*8.05E+00*	*3.50E-02*	*1.85E+00*	*8.89E-01*	*3.27E-02*	*2.76E-01*	*1.85E-01*	*4.59E+00*	*3.18E-02*	*2.28E-01*	*-1.72E+01*	*-1.83E+01*	*-2.12E+01*	*9.44E-02*
98	*1.47E-04*	*2.13E-01*	*4.07E-05*	*2.97E+00*	*7.87E-02*	*8.72E+00*	*1.60E+00*	*2.17E-01*	*6.88E-02*	*3.19E-01*	*8.68E+00*	*1.80E-01*	*2.47E-03*	*-1.89E+01*	*-1.83E+01*	*-2.03E+01*	*6.47E-01*
99	*1.39E-04*	*1.27E-01*	*9.04E-04*	*2.34E+00*	*3.41E-01*	*3.56E+00*	*9.57E+00*	*6.38E-02*	*3.78E+00*	*3.65E-01*	*6.81E+00*	*2.98E-01*	*2.10E-01*	*-1.86E+01*	*-1.85E+01*	*-1.98E+01*	*7.63E-01*
100	*3.11E-03*	*1.23E-01*	*2.88E-04*	*2.02E+00*	*1.32E-01*	*2.97E+00*	*7.32E-01*	*7.16E-02*	*1.54E-01*	*1.49E-01*	*7.10E+00*	*1.04E-01*	*3.54E-01*	*-1.76E+01*	*-1.82E+01*	*-1.88E+01*	*2.98E-02*

Table PAR-12. LHS Sampled Values for the Spall Model (50 vectors) Only 1 Replicate

Vector Num.	Parameter			
	SPALLMOD REPIPORE	SPALLMOD REPIPERM	SPALLMOD TENSLSTR	SPALLMOD PARTDIAM
1	5.17E-01	3.97E-13	1.38E+05	4.69E-02
2	3.77E-01	5.77E-14	1.25E+05	3.88E-03
3	6.24E-01	3.90E-14	1.47E+05	7.72E-02
4	6.41E-01	5.49E-14	1.39E+05	2.13E-03
5	4.91E-01	7.22E-14	1.52E+05	1.11E-02
6	6.32E-01	8.81E-13	1.66E+05	2.96E-03
7	5.69E-01	4.28E-14	1.64E+05	2.39E-02
8	6.04E-01	2.42E-14	1.55E+05	3.80E-02
9	5.33E-01	7.55E-13	1.30E+05	1.07E-02
10	6.12E-01	1.03E-13	1.60E+05	7.51E-02
11	4.85E-01	3.05E-13	1.23E+05	5.82E-02
12	5.38E-01	2.81E-13	1.31E+05	6.79E-02
13	4.52E-01	1.27E-12	1.50E+05	5.60E-02
14	4.70E-01	1.72E-12	1.65E+05	1.64E-02
15	4.96E-01	1.00E-12	1.37E+05	3.51E-03
16	3.59E-01	2.74E-14	1.54E+05	4.60E-03
17	4.61E-01	3.46E-14	1.44E+05	4.98E-03
18	3.51E-01	2.62E-13	1.63E+05	4.10E-02
19	4.46E-01	6.33E-14	1.26E+05	4.06E-03
20	5.85E-01	1.96E-13	1.44E+05	2.08E-02
21	4.36E-01	1.10E-13	1.21E+05	8.34E-02
22	6.02E-01	1.82E-12	1.29E+05	6.48E-03
23	3.73E-01	1.18E-13	1.67E+05	1.50E-02
24	4.62E-01	3.53E-13	1.50E+05	1.16E-03
25	5.88E-01	1.24E-12	1.33E+05	1.76E-03

Vector Num.	Parameter			
	SPALLMOD REPIPORE	SPALLMOD REPIPERM	SPALLMOD TENSLSTR	SPALLMOD PARTDIAM
26	3.97E-01	1.76E-13	1.48E+05	2.17E-02
27	6.18E-01	4.75E-14	1.53E+05	3.43E-02
28	4.37E-01	2.13E-13	1.42E+05	1.24E-03
29	4.77E-01	4.51E-13	1.47E+05	1.23E-02
30	4.02E-01	2.89E-14	1.39E+05	1.04E-03
31	5.20E-01	1.64E-13	1.55E+05	1.51E-03
32	6.51E-01	1.39E-12	1.62E+05	8.34E-03
33	6.38E-01	7.16E-13	1.35E+05	2.73E-03
34	3.68E-01	5.05E-13	1.58E+05	2.06E-03
35	3.85E-01	8.31E-13	1.29E+05	9.83E-02
36	5.11E-01	1.40E-13	1.59E+05	5.84E-03
37	5.45E-01	8.09E-14	1.27E+05	1.44E-02
38	4.21E-01	2.04E-12	1.34E+05	1.64E-03
39	5.94E-01	4.58E-13	1.70E+05	4.84E-02
40	5.63E-01	7.35E-14	1.22E+05	2.89E-02
41	5.26E-01	2.31E-12	1.43E+05	3.17E-02
42	4.30E-01	6.55E-13	1.26E+05	3.18E-03
43	3.92E-01	1.13E-12	1.35E+05	7.96E-03
44	4.08E-01	1.55E-12	1.69E+05	2.56E-02
45	5.51E-01	2.23E-13	1.45E+05	1.84E-02
46	5.79E-01	5.84E-13	1.21E+05	5.57E-03
47	5.03E-01	9.51E-14	1.61E+05	1.40E-03
48	4.14E-01	1.28E-13	1.68E+05	9.49E-03
49	5.58E-01	3.53E-14	1.41E+05	7.40E-03
50	6.57E-01	3.24E-13	1.56E+05	2.32E-03

Table PAR-13. Borehole, Blowout and Drill Mud Parameters

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
3470	BLOWOUT	Material for direct brine release calculations	GAS_MIN	Gas rate cut-off	Constant	mscf/day	1.00E+02
3250	BLOWOUT	Material for direct brine release calculations	HREPO	Height of repository at burial time in CUTTINGS model	Constant	m	3.96E+00
3471	BLOWOUT	Material for direct brine release calculations	MAXFLOW	Maximum blowout flow	Constant	s	9.50E+05
3472	BLOWOUT	Material for direct brine release calculations	MINFLOW	Minimum blowout flow	Constant	s	2.59E+05
3246	BLOWOUT	Material for direct brine release calculations	PARTDIA	Waste Particle Diameter in CUTTINGS Model	Log uniform	m	2.80E-03
3456	BLOWOUT	Material for direct brine release calculations	RE_CAST	External drainage radius for the Castile formation	Constant	m	1.14E+02
3253	BLOWOUT	Material for direct brine release calculations	RGAS	Gas Constant for Hydrogen	Constant	N*m/kg/K	4.12E+03
3247	BLOWOUT	Material for direct brine release calculations	RHOS	Waste Particle Density in CUTTINGS_S Model	Constant	kg/m^3	2.65E+03
3473	BLOWOUT	Material for direct brine release calculations	THCK_CAS	Thickness of the Castile Brine Reservoir	Constant	m	1.26E+02
3258	BLOWOUT	Material for direct brine release calculations	TREPO	Temperature of repository in CUTTINGS model	Constant	K	3.00E+02
23	BOREHOLE	Borehole and Fill	CAP_MOD	Model number, capillary pressure model	Constant	NONE	2.00E+00
3242	BOREHOLE	Borehole and Fill	COLDIA	Drill collar diameter in CUTTINGS model	Constant	m	2.03E-01
25	BOREHOLE	Borehole and Fill	COMP_RCK	Bulk Compressibility	Constant	Pa^{-1}	2.64E-09
26	BOREHOLE	Borehole and Fill	DIAMMOD	Modern or current diameter	Constant	m	3.11E-01
27	BOREHOLE	Borehole and Fill	DOMEGA	Drill string angular velocity (0)	Cumulative	rad/s	Sampled Value
3122	BOREHOLE	Borehole and Fill	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
3244	BOREHOLE	Borehole and Fill	L1	Drill collar length in CUTTINGS model	Constant	m	1.83E+02
29	BOREHOLE	Borehole and Fill	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
3120	BOREHOLE	Borehole and Fill	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	5.60E-01
3121	BOREHOLE	Borehole and Fill	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	-3.46E-01
3241	BOREHOLE	Borehole and Fill	PIPED	Drill pipe diameter in CUTTINGS model	Constant	m	1.14E-01

Table PAR-13. Borehole, Blowout and Drill Mud Parameters — Continued

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
32	BOREHOLE	Borehole and Fill	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
30	BOREHOLE	Borehole and Fill	PORE_DIS	Brooks-Corey pore distribution parameter	Constant	NONE	9.40E-01
31	BOREHOLE	Borehole and Fill	POROSITY	Effective porosity	Constant	NONE	5.00E-02
34	BOREHOLE	Borehole and Fill	PRMX_LOG	Log of intrinsic permeability, X-direction	Normal	$log(m^2)$	-1.25E+01
35	BOREHOLE	Borehole and Fill	PRMY_LOG	Log of intrinsic permeability, Y-direction	Normal	$log(m^2)$	-1.25E+01
36	BOREHOLE	Borehole and Fill	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Normal	$log(m^2)$	-1.25E+01
40	BOREHOLE	Borehole and Fill	RELP_MOD	Model number, relative permeability model	Constant	NONE	4.00E+00
41	BOREHOLE	Borehole and Fill	SAT_RBRN	Residual Brine Saturation	Constant	NONE	2.00E-01
42	BOREHOLE	Borehole and Fill	SAT_RGAS	Residual Gas Saturation	Constant	NONE	2.00E-01
2254	BOREHOLE	Borehole and Fill	TAUFAIL	Effective shear strength for erosion (rfail)	Log uniform	Pa	Sampled Value
3414	BOREHOLE	Borehole and Fill	WUF	Unit of Waste	Constant	Curies	2.48E+00
171	DRILLMUD	Drilling Mud	DNSFLUID	Brine Density	Cumulative	kg/m^3	1.21E+03
172	DRILLMUD	Drilling Mud	VISCO	Viscosity	Cumulative	Pa*s	9.17E-03
173	DRILLMUD	Drilling Mud	YLDSTRSS	Yield Stress Point	Cumulative	Pa	4.40E+00

Table PAR-14. Borehole (Concrete Plug) Parameters

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
3150	CONC_PLG	Concrete Plug, surface and Rustler	CAP_MOD	Model number, capillary pressure model	Constant	NONE	1.00E+00
3148	CONC_PLG	Concrete Plug, surface and Rustler	COMP_RCK	Bulk Compressibility	Constant	Pa^{-1}	3.80E-10
3156	CONC_PLG	Concrete Plug, surface and Rustler	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
3151	CONC_PLG	Concrete Plug, surface and Rustler	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
3157	CONC_PLG	Concrete Plug, surface and Rustler	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	0.00E+00
3158	CONC_PLG	Concrete Plug, surface and Rustler	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	0.00E+00
3155	CONC_PLG	Concrete Plug, surface and Rustler	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
3154	CONC_PLG	Concrete Plug, surface and Rustler	PORE_DIS	Brooks-Corey pore distribution parameter	Constant	NONE	9.40E-01
3147	CONC_PLG	Concrete Plug, surface and Rustler	POROSITY	Effective porosity	Constant	NONE	3.20E-01
3192	CONC_PLG	Concrete Plug, surface and Rustler	PRMY_LOG	Log of intrinsic permeability, Y-direction	Uniform	$\log(m^2)$	-1.80E+01
3193	CONC_PLG	Concrete Plug, surface and Rustler	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Uniform	$\log(m^2)$	-1.80E+01
3149	CONC_PLG	Concrete Plug, surface and Rustler	RELP_MOD	Model number, relative permeability model	Constant	NONE	4.00E+00
3152	CONC_PLG	Concrete Plug, surface and Rustler	SAT_RBRN	Residual Brine Saturation	Constant	NONE	0.00E+00
3153	CONC_PLG	Concrete Plug, surface and Rustler	SAT_RGAS	Residual Gas Saturation	Constant	NONE	0.00E+00

Table PAR-15. Borehole (Open) Parameters

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
3138	BH_OPEN	Borehole Unrestricted	CAP_MOD	Model number, capillary pressure model	Constant	NONE	1.00E+00
3136	BH_OPEN	Borehole Unrestricted	COMP_RCK	Bulk Compressibility	Constant	Pa^{-1}	0.00E+00
3144	BH_OPEN	Borehole Unrestricted	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
3139	BH_OPEN	Borehole Unrestricted	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
3145	BH_OPEN	Borehole Unrestricted	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	0.00E+00
3146	BH_OPEN	Borehole Unrestricted	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	0.00E+00
3143	BH_OPEN	Borehole Unrestricted	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
3142	BH_OPEN	Borehole Unrestricted	PORE_DIS	Brooks-Corey pore distribution parameter	Constant	NONE	7.00E-01
3135	BH_OPEN	Borehole Unrestricted	POROSITY	Effective porosity	Constant	NONE	3.20E-01
3134	BH_OPEN	Borehole Unrestricted	PRMX_LOG	Log of intrinsic permeability, X-direction	Constant	$log(m^2)$	-9.00E+00
3186	BH_OPEN	Borehole Unrestricted	PRMY_LOG	Log of intrinsic permeability, Y-direction	Constant	$log(m^2)$	-9.00E+00
3187	BH_OPEN	Borehole Unrestricted	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Constant	$log(m^2)$	-9.00E+00
3137	BH_OPEN	Borehole Unrestricted	RELP_MOD	Model number, relative permeability model	Constant	NONE	5.00E+00
3140	BH_OPEN	Borehole Unrestricted	SAT_RBRN	Residual Brine Saturation	Constant	NONE	0.00E+00
3141	BH_OPEN	Borehole Unrestricted	SAT_RGAS	Residual Gas Saturation	Constant	NONE	0.00E+00

Table PAR-16. Borehole (Silty Sand) Parameters

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
3162	BH_SAND	Borehole filled with silty sand	CAP_MOD	Model number, capillary pressure model	Constant	NONE	1.00E+00
3160	BH_SAND	Borehole filled with silty sand	COMP_RCK	Bulk Compressibility	Constant	Pa^{-1}	0.00E+00
3168	BH_SAND	Borehole filled with silty sand	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
3163	BH_SAND	Borehole filled with silty sand	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
3169	BH_SAND	Borehole filled with silty sand	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	0.00E+00
3170	BH_SAND	Borehole filled with silty sand	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	0.00E+00
3167	BH_SAND	Borehole filled with silty sand	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
3166	BH_SAND	Borehole filled with silty sand	PORE_DIS	Brooks-Corey pore distribution parameter	Constant	NONE	9.40E-01
3159	BH_SAND	Borehole filled with silty sand	POROSITY	Effective porosity	Constant	NONE	3.20E-01
3184	BH_SAND	Borehole filled with silty sand	PRMX_LOG	Log of intrinsic permeability, X-direction	Uniform	$log(m^2)$	Sampled Value
3190	BH_SAND	Borehole filled with silty sand	PRMY_LOG	Log of intrinsic permeability, Y-direction	Uniform	$log(m^2)$	Applied Value See BH_SAND PRMX_LOG
3191	BH_SAND	Borehole filled with silty sand	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Uniform	$log(m^2)$	Applied Value See BH_SAND PRMX_LOG
3161	BH_SAND	Borehole filled with silty sand	RELP_MOD	Model number, relative permeability model	Constant	NONE	4.00E+00
3164	BH_SAND	Borehole filled with silty sand	SAT_RBRN	Residual Brine Saturation	Constant	NONE	0.00E+00
3165	BH_SAND	Borehole filled with silty sand	SAT_RGAS	Residual Gas Saturation	Constant	NONE	0.00E+00

Table PAR-17. Borehole (Creep) Parameters

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
3174	BH_CREEP	Creep Borehole Fill	CAP_MOD	Model number, capillary pressure model	Constant	NONE	1.00E+00
3172	BH_CREEP	Creep Borehole Fill	COMP_RCK	Bulk Compressibility	Constant	Pa^{-1}	0.00E+00
3180	BH_CREEP	Creep Borehole Fill	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
3175	BH_CREEP	Creep Borehole Fill	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
3181	BH_CREEP	Creep Borehole Fill	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	0.00E+00
3182	BH_CREEP	Creep Borehole Fill	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	0.00E+00
3179	BH_CREEP	Creep Borehole Fill	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
3178	BH_CREEP	Creep Borehole Fill	PORE_DIS	Brooks-Corey pore distribution parameter	Constant	NONE	9.40E-01
3171	BH_CREEP	Creep Borehole Fill	POROSITY	Effective porosity	Constant	NONE	3.20E-01
3183	BH_CREEP	Creep Borehole Fill	PRMX_LOG	Log of intrinsic permeability, X-direction	Uniform	$log(m^2)$	-1.35E+01
3188	BH_CREEP	Creep Borehole Fill	PRMY_LOG	Log of intrinsic permeability, Y-direction	Uniform	$log(m^2)$	-1.35E+01
3189	BH_CREEP	Creep Borehole Fill	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Uniform	$log(m^2)$	-1.35E+01
3173	BH_CREEP	Creep Borehole Fill	RELP_MOD	Model number, relative permeability model	Constant	NONE	4.00E+00
3176	BH_CREEP	Creep Borehole Fill	SAT_RBRN	Residual Brine Saturation	Constant	NONE	0.00E+00
3177	BH_CREEP	Creep Borehole Fill	SAT_RGAS	Residual Gas Saturation	Constant	NONE	0.00E+00

Table PAR-18. DRSPALL Parameters

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
3675	SPALLMOD	Material developed for DRSPALL	ANNUROUG	Absolute wall roughness of wellbore annulus	Constant	m	5.00E-05
3662	SPALLMOD	Material developed for DRSPALL	BIOTBETA	Biot's beta for waste	Constant	NONE	1.00E+00
3652	SPALLMOD	Material developed for DRSPALL	COHESION	Cohesion of waste	Constant	Pa	1.40E+05
3677	SPALLMOD	Material developed for DRSPALL	DDZPERM	Permeability of drilling-damaged zone (DDZ)	Constant	m2	1.00E-14
3659	SPALLMOD	Material developed for DRSPALL	DDZTHICK	Thickness of drilling-damaged zone (DDZ)	Constant	m	1.60E-01
3674	SPALLMOD	Material developed for DRSPALL	DRILRATE	Drill penetration rate through Salado	Constant	m/s	4.45E-03
3668	SPALLMOD	Material developed for DRSPALL	DRZPERM	DRZ Permeability for DRSPALL	Constant	m^2	1.00E-15
3654	SPALLMOD	Material developed for DRSPALL	FFSTRESS	Isotropic in-situ stress in waste area	Constant	Pa	1.49E+07
3657	SPALLMOD	Material developed for DRSPALL	FRICTANG	Friction angle of waste	Constant	deg	4.58E+01
3671	SPALLMOD	Material developed for DRSPALL	MUDPRATE	Typical volumetric mud pumping rate for drilling in Salado	Constant	(m3)/s	2.02E-02
3673	SPALLMOD	Material developed for DRSPALL	MUDSOLMX	Solids volume fraction in drill mud that causes choking of flow	Constant	NONE	6.15E-01
3670	SPALLMOD	Material developed for DRSPALL	MUDSOLVE	Exponent on mud slurry viscosity power law	Constant	NONE	-1.50E+00
3667	SPALLMOD	Material developed for DRSPALL	PARTDIAM	Particle diameter of disaggregated waste	Loguniform	m	1.00E-02
3660	SPALLMOD	Material developed for DRSPALL	PIPEID	Inner diameter of drill pipe (where OD = 0.1143 m)	Constant	m	9.72E-02
3663	SPALLMOD	Material developed for DRSPALL	PIPEROUG	Absolute wall roughness of drill pipe	Constant	m	5.00E-05
3672	SPALLMOD	Material developed for DRSPALL	POISRAT	Poisson's ratio for waste	Constant	NONE	3.80E-01
3651	SPALLMOD	Material developed for DRSPALL	REFPRS	Atmospheric pressure at sea level	Constant	Pa	1.02E+05
3666	SPALLMOD	Material developed for DRSPALL	REPIPERM	Waste permeability to gas local to intrusion borehole	Loguniform	m2	2.40E-13

Table PAR-18. DRSPALL Parameters — Continued

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
3655	SPALLMOD	Material developed for DRSPALL	REPOSTOP	Elevation of roof in excavated area	Constant	m	3.85E+02
3664	SPALLMOD	Material developed for DRSPALL	SALTDENS	Density of solid cuttings from the Salado	Constant	kg/m3	2.18E+03
3669	SPALLMOD	Material developed for DRSPALL	SHAPEFAC	Shape factor for disaggregated waste particles	Constant	NONE	1.00E-01
3661	SPALLMOD	Material developed for DRSPALL	STPDVOLR	Mud ejection rate that turns off drilling	Constant	$(m^3)/s$	1.00E+03
3656	SPALLMOD	Material developed for DRSPALL	STPPVOLR	Mud ejection rate that turns off mud pump	Constant	$(m^3)/s$	1.00E+03
3658	SPALLMOD	Material developed for DRSPALL	SURFELEV	Elevation of land surface at WIPP site	Constant	m	1.04E+03
3676	SPALLMOD	Material developed for DRSPALL	TENSLSTR	Tensile strength of waste	Uniform	Pa	1.45E+05

Table PAR-19. Shaft Material Parameters

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
3051	CONC_MON	Concrete Monolith	CAP_MOD	Model number, capillary pressure model	Constant	NONE	2.00E+00
3052	CONC_MON	Concrete Monolith	COMP_RCK	Bulk Compressibility	Constant	Pa^{-1}	6.00E-11
3053	CONC_MON	Concrete Monolith	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
3054	CONC_MON	Concrete Monolith	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
3055	CONC_MON	Concrete Monolith	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	5.60E-01
3056	CONC_MON	Concrete Monolith	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	-3.46E-01
3124	CONC_MON	Concrete Monolith	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
3057	CONC_MON	Concrete Monolith	PORE_DIS	Brooks-Corey pore distribution parameter	Cumulative	NONE	9.40E-01
3058	CONC_MON	Concrete Monolith	POROSITY	Effective porosity	Constant	NONE	5.00E-02
3059	CONC_MON	Concrete Monolith	PRMX_LOG	Log of intrinsic permeability, X-direction	Constant	$log(m^2)$	-1.40E+01
3060	CONC_MON	Concrete Monolith	PRMY_LOG	Log of intrinsic permeability, Y-direction	Constant	$log(m^2)$	-1.40E+01
3061	CONC_MON	Concrete Monolith	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Constant	$log(m^2)$	-1.40E+01
3062	CONC_MON	Concrete Monolith	RELP_MOD	Model number, relative permeability model	Constant	NONE	4.00E+00
3115	CONC_MON	Concrete Monolith	SAT_IBRN	Initial Brine Saturation	Constant	NONE	1.00E+00
3063	CONC_MON	Concrete Monolith	SAT_RBRN	Residual Brine Saturation	Cumulative	NONE	2.00E-01
3064	CONC_MON	Concrete Monolith	SAT_RGAS	Residual Gas Saturation	Uniform	NONE	2.00E-01
3562	SHFTL_T1	Lower portion of simplified shaft from 0 - 200 years	COMP_POR	Pore volume compressibility	Constant	Pa^{-1}	4.28E-09
3563	SHFTL_T1	Lower portion of simplified shaft from 0 - 200 years	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
3564	SHFTL_T1	Lower portion of simplified shaft from 0 - 200 years	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
3565	SHFTL_T1	Lower portion of simplified shaft from 0 - 200 years	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	5.60E-01
3566	SHFTL_T1	Lower portion of simplified shaft from 0 - 200 years	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	-3.46E-01

Table PAR-19. Shaft Material Parameters — Continued

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
3567	SHFTL_T1	Lower portion of simplified shaft from 0 - 200 years	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
3568	SHFTL_T1	Lower portion of simplified shaft from 0 - 200 years	POROSITY	Effective porosity	Constant	NONE	1.13E-01
3569	SHFTL_T1	Lower portion of simplified shaft from 0 - 200 years	PRMX_LOG	Log of intrinsic permeability, X-direction	Cumulative	$\log(m^2)$	Sampled Value
3570	SHFTL_T1	Lower portion of simplified shaft from 0 - 200 years	RELP_MOD	Model number, relative permeability model	Constant	NONE	4.00E+00
3571	SHFTL_T1	Lower portion of simplified shaft from 0 - 200 years	SAT_IBRN	Initial Brine Saturation	Constant	NONE	5.34E-01
3572	SHFTL_T2	Lower portion of simplified shaft from 200 - 10,000 years	COMP_POR	Pore volume compressibility	Constant	Pa^{-1}	4.28E-09
3573	SHFTL_T2	Lower portion of simplified shaft from 200 - 10,000 years	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
3574	SHFTL_T2	Lower portion of simplified shaft from 200 - 10,000 years	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
3575	SHFTL_T2	Lower portion of simplified shaft from 200 - 10,000 years	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	5.60E-01
3576	SHFTL_T2	Lower portion of simplified shaft from 200 - 10,000 years	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	-3.46E-01
3577	SHFTL_T2	Lower portion of simplified shaft from 200 - 10,000 years	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
3578	SHFTL_T2	Lower portion of simplified shaft from 200 - 10,000 years	POROSITY	Effective porosity	Constant	NONE	1.13E-01
3579	SHFTL_T2	Lower portion of simplified shaft from 200 - 10,000 years	PRMX_LOG	Log of intrinsic permeability, X-direction	Cumulative	$\log(m^2)$	Sampled Value
3580	SHFTL_T2	Lower portion of simplified shaft from 200 - 10,000 years	RELP_MOD	Model number, relative permeability model	Constant	NONE	4.00E+00
3581	SHFTL_T2	Lower portion of simplified shaft from 200 - 10,000 years	SAT_IBRN	Initial Brine Saturation	Constant	NONE	5.34E-01
3550	SHFTU	Upper portion of simplified shaft	COMP_POR	Pore volume compressibility	Constant	Pa^{-1}	2.05E-08
3551	SHFTU	Upper portion of simplified shaft	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
3552	SHFTU	Upper portion of simplified shaft	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
3553	SHFTU	Upper portion of simplified shaft	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	5.60E-01

Table PAR-19. Shaft Material Parameters — Continued

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
3554	SHFTU	Upper portion of simplified shaft	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	-3.46E-01
3555	SHFTU	Upper portion of simplified shaft	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
3556	SHFTU	Upper portion of simplified shaft	POROSITY	Effective porosity	Constant	NONE	2.91E-01
3557	SHFTU	Upper portion of simplified shaft	PRMX_LOG	Log of intrinsic permeability, X-direction	Cumulative	$log(m^2)$	Sampled Value
3558	SHFTU	Upper portion of simplified shaft	RELP_MOD	Model number, relative permeability model	Constant	NONE	4.00E+00
3559	SHFTU	Upper portion of simplified shaft	SAT_IBRN	Initial Brine Saturation	Constant	NONE	7.96E-01
3560	SHFTU	Upper portion of simplified shaft	SAT_RBRN	Residual Brine Saturation	Cumulative	NONE	Sampled Value
3561	SHFTU	Upper portion of simplified shaft	SAT_RGAS	Residual Gas Saturation	Uniform	NONE	Sampled Value

Table PAR-20. Panel Closure Parameters

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
3514	CONC_PCS	Concrete portion of PCS	CAP_MOD	Model number, capillary pressure model	Constant	NONE	2.00E+00
3515	CONC_PCS	Concrete portion of PCS	COMP_RCK	Bulk Compressibility	Constant	Pa^{-1}	6.00E-11
3517	CONC_PCS	Concrete portion of PCS	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
3518	CONC_PCS	Concrete portion of PCS	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
3519	CONC_PCS	Concrete portion of PCS	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	5.60E-01
3520	CONC_PCS	Concrete portion of PCS	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	-3.46E-01
3521	CONC_PCS	Concrete portion of PCS	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
3522	CONC_PCS	Concrete portion of PCS	PORE_DIS	Brooks-Corey pore distribution parameter	Cumulative	NONE	Sampled Value
3523	CONC_PCS	Concrete portion of PCS	POROSITY	Effective porosity	Constant	NONE	5.00E-02
3525	CONC_PCS	Concrete portion of PCS	PRMX_LOG	Log of intrinsic permeability, X-direction	Triangular	$log(m^2)$	Sampled Value
3526	CONC_PCS	Concrete portion of PCS	PRMY_LOG	Log of intrinsic permeability, Y-direction	Triangular	$log(m^2)$	Applied Value See CONC_PCS PRMX_LOG
3527	CONC_PCS	Concrete portion of PCS	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Triangular	$log(m^2)$	Applied Value See CONC_PCS PRMX_LOG
3529	CONC_PCS	Concrete portion of PCS	RELP_MOD	Model number, relative permeability model	Constant	NONE	4.00E+00
3531	CONC_PCS	Concrete portion of PCS	SAT_RBRN	Residual Brine Saturation	Cumulative	NONE	Sampled Value
3532	CONC_PCS	Concrete portion of PCS	SAT_RGAS	Residual Gas Saturation	Uniform	NONE	Sampled Value
3533	DRZ_PCS	DRZ directly above concrete portion of panel closure	CAP_MOD	Model number, capillary pressure model	Constant	NONE	1.00E+00
3534	DRZ_PCS	DRZ directly above concrete portion of panel closure	COMP_RCK	Bulk Compressibility	Constant	Pa^{-1}	7.41E-10
3535	DRZ_PCS	DRZ directly above concrete portion of panel closure	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
3536	DRZ_PCS	DRZ directly above concrete portion of panel closure	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
3537	DRZ_PCS	DRZ directly above concrete portion of panel closure	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	0.00E+00

Table PAR-20. Panel Closure Parameters — Continued

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
3538	DRZ_PCS	DRZ directly above concrete portion of panel closure	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	0.00E+00
3539	DRZ_PCS	DRZ directly above concrete portion of panel closure	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
3540	DRZ_PCS	DRZ directly above concrete portion of panel closure	PORE_DIS	Brooks-Corey pore distribution parameter	Constant	NONE	7.00E-01
3541	DRZ_PCS	DRZ directly above concrete portion of panel closure	POROSITY	Effective porosity	Cumulative	NONE	1.29E-02
3542	DRZ_PCS	DRZ directly above concrete portion of panel closure	PRMX_LOG	Log of intrinsic permeability, X-direction	Triangular	$\log(m^2)$	Sampled Value
3543	DRZ_PCS	DRZ directly above concrete portion of panel closure	PRMY_LOG	Log of intrinsic permeability, Y-direction	Triangular	$\log(m^2)$	Applied Value See DRZ_PCS PRMX_LOG
3544	DRZ_PCS	DRZ directly above concrete portion of panel closure	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Triangular	$\log(m^2)$	Applied Value See DRZ_PCS PRMX_LOG
3546	DRZ_PCS	DRZ directly above concrete portion of panel closure	SAT_RBRN	Residual Brine Saturation	Constant	NONE	0.00E+00
3547	DRZ_PCS	DRZ directly above concrete portion of panel closure	SAT_RGAS	Residual Gas Saturation	Constant	NONE	0.00E+00

Table PAR-21. Santa Rosa Formation Parameters

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
336	SANTAROS	Santa Rosa Formation	CAP_MOD	Model number, capillary pressure model	Constant	NONE	1.00E+00
337	SANTAROS	Santa Rosa Formation	COMP_RCK	Bulk Compressibility	Constant	Pa^{-1}	1.00E-08
2768	SANTAROS	Santa Rosa Formation	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
339	SANTAROS	Santa Rosa Formation	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
2769	SANTAROS	Santa Rosa Formation	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	0.00E+00
2770	SANTAROS	Santa Rosa Formation	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	0.00E+00
342	SANTAROS	Santa Rosa Formation	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
340	SANTAROS	Santa Rosa Formation	PORE_DIS	Brooks-Corey pore distribution parameter	Constant	NONE	6.44E-01
341	SANTAROS	Santa Rosa Formation	POROSITY	Effective porosity	Constant	NONE	1.75E-01
343	SANTAROS	Santa Rosa Formation	PRESSURE	Brine far-field pore pressure	Constant	Pa	1.01E+05
344	SANTAROS	Santa Rosa Formation	PRMX_LOG	Log of intrinsic permeability, X-direction	Constant	$log(m^2)$	-1.00E+01
345	SANTAROS	Santa Rosa Formation	PRMY_LOG	Log of intrinsic permeability, Y-direction	Constant	$log(m^2)$	-1.00E+01
346	SANTAROS	Santa Rosa Formation	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Constant	$log(m^2)$	-1.00E+01
349	SANTAROS	Santa Rosa Formation	RELP_MOD	Model number, relative permeability model	Constant	NONE	4.00E+00
350	SANTAROS	Santa Rosa Formation	SAT_IBRN	Initial Brine Saturation	Constant	NONE	8.36E-02
351	SANTAROS	Santa Rosa Formation	SAT_RBRN	Residual Brine Saturation	Constant	NONE	8.36E-02
352	SANTAROS	Santa Rosa Formation	SAT_RGAS	Residual Gas Saturation	Constant	NONE	7.71E-02

Table PAR-22. Dewey Lake Formation

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
153	DEWYLAKE	Dewey Lake Red Beds	CAP_MOD	Model number, capillary pressure model	Constant	NONE	2.00E+00
154	DEWYLAKE	Dewey Lake Red Beds	COMP_RCK	Bulk Compressibility	Constant	Pa^{-1}	1.00E-08
2696	DEWYLAKE	Dewey Lake Red Beds	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
156	DEWYLAKE	Dewey Lake Red Beds	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
2697	DEWYLAKE	Dewey Lake Red Beds	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	2.60E-01
2698	DEWYLAKE	Dewey Lake Red Beds	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	-3.48E-01
159	DEWYLAKE	Dewey Lake Red Beds	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
157	DEWYLAKE	Dewey Lake Red Beds	PORE_DIS	Brooks-Corey pore distribution parameter	Constant	NONE	6.44E-01
158	DEWYLAKE	Dewey Lake Red Beds	POROSITY	Effective porosity	Student	NONE	1.43E-01
161	DEWYLAKE	Dewey Lake Red Beds	PRMX_LOG	Log of intrinsic permeability, X-direction	Constant	$log(m^2)$	-1.63E+01
162	DEWYLAKE	Dewey Lake Red Beds	PRMY_LOG	Log of intrinsic permeability, Y-direction	Constant	$log(m^2)$	-1.63E+01
163	DEWYLAKE	Dewey Lake Red Beds	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Constant	$log(m^2)$	-1.63E+01
166	DEWYLAKE	Dewey Lake Red Beds	RELP_MOD	Model number, relative permeability model	Constant	NONE	4.00E+00
167	DEWYLAKE	Dewey Lake Red Beds	SAL_USAT	Average saturation, unsaturated zones	Constant	NONE	8.36E-02
168	DEWYLAKE	Dewey Lake Red Beds	SAT_IBRN	Initial Brine Saturation	Constant	NONE	1.00E+00
169	DEWYLAKE	Dewey Lake Red Beds	SAT_RBRN	Residual Brine Saturation	Constant	NONE	8.36E-02
170	DEWYLAKE	Dewey Lake Red Beds	SAT_RGAS	Residual Gas Saturation	Constant	NONE	7.71E-02

Table PAR-23. Forty-Niner Member of the Rustler Formation Parameters

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
2085	FORTYNIN	Forty Niner Member	CAP_MOD	Model number, capillary pressure model	Constant	NONE	1.00E+00
2238	FORTYNIN	Forty Niner Member	COMP_RCK	Bulk Compressibility	Constant	Pa^{-1}	0.00E+00
2715	FORTYNIN	Forty Niner Member	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
2239	FORTYNIN	Forty Niner Member	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
2716	FORTYNIN	Forty Niner Member	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	0.00E+00
2717	FORTYNIN	Forty Niner Member	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	0.00E+00
2718	FORTYNIN	Forty Niner Member	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
2087	FORTYNIN	Forty Niner Member	PORE_DIS	Brooks-Corey pore distribution parameter	Constant	NONE	7.00E-01
2088	FORTYNIN	Forty Niner Member	POROSITY	Effective porosity	Student	NONE	8.20E-02
2899	FORTYNIN	Forty Niner Member	PRMX_LOG	Log of intrinsic permeability, X-direction	Constant	$log(m^2)$	-3.50E+01
2900	FORTYNIN	Forty Niner Member	PRMY_LOG	Log of intrinsic permeability, Y-direction	Constant	$log(m^2)$	-3.50E+01
2901	FORTYNIN	Forty Niner Member	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Constant	$log(m^2)$	-3.50E+01
2093	FORTYNIN	Forty Niner Member	RELP_MOD	Model number, relative permeability model	Constant	NONE	4.00E+00
2240	FORTYNIN	Forty Niner Member	SAT_RBRN	Residual Brine Saturation	Constant	NONE	2.00E-01
2094	FORTYNIN	Forty Niner Member	SAT_RGAS	Residual Gas Saturation	Constant	NONE	2.00E-01

Table PAR-24. Magenta Member of the Rustler Formation Parameters

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
2097	MAGENTA	Magenta Member	CAP_MOD	Model number, capillary pressure model	Constant	NONE	2.00E+00
3016	MAGENTA	Magenta Member	COMP_RCK	Bulk Compressibility	Student	Pa^{-1}	2.64E-10
2725	MAGENTA	Magenta Member	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
2098	MAGENTA	Magenta Member	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
2726	MAGENTA	Magenta Member	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	2.60E-01
2727	MAGENTA	Magenta Member	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	-3.48E-01
2728	MAGENTA	Magenta Member	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
2099	MAGENTA	Magenta Member	PORE_DIS	Brooks-Corey pore distribution parameter	Constant	NONE	6.44E-01
2100	MAGENTA	Magenta Member	POROSITY	Effective porosity	Student	NONE	1.38E-01
2101	MAGENTA	Magenta Member	PRESSURE	Brine far-field pore pressure	Constant	Pa	9.47E+05
2102	MAGENTA	Magenta Member	PRMX_LOG	Log of intrinsic permeability, X-direction	Constant	$log(m^2)$	-1.52E+01
2103	MAGENTA	Magenta Member	PRMY_LOG	Log of intrinsic permeability, Y-direction	Constant	$log(m^2)$	-1.52E+01
2104	MAGENTA	Magenta Member	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Constant	$log(m^2)$	-1.52E+01
2106	MAGENTA	Magenta Member	RELP_MOD	Model number, relative permeability model	Constant	NONE	4.00E+00
2241	MAGENTA	Magenta Member	SAT_RBRN	Residual Brine Saturation	Constant	NONE	8.36E-02
2107	MAGENTA	Magenta Member	SAT_RGAS	Residual Gas Saturation	Constant	NONE	7.71E-02

Table PAR-25. Tamarisk Member of the Rustler Formation Parameters

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
2183	TAMARISK	Tamarisk Member	CAP_MOD	Model number, capillary pressure model	Constant	NONE	1.00E+00
2243	TAMARISK	Tamarisk Member	COMP_RCK	Bulk Compressibility	Constant	Pa^{-1}	0.00E+00
2793	TAMARISK	Tamarisk Member	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
2244	TAMARISK	Tamarisk Member	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
2794	TAMARISK	Tamarisk Member	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	0.00E+00
2795	TAMARISK	Tamarisk Member	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	0.00E+00
2796	TAMARISK	Tamarisk Member	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
2185	TAMARISK	Tamarisk Member	PORE_DIS	Brooks-Corey pore distribution parameter	Constant	NONE	7.00E-01
2186	TAMARISK	Tamarisk Member	POROSITY	Effective porosity	Student	NONE	6.40E-02
2914	TAMARISK	Tamarisk Member	PRMX_LOG	Log of intrinsic permeability, X-direction	Constant	$log(m^2)$	-3.50E+01
2915	TAMARISK	Tamarisk Member	PRMY_LOG	Log of intrinsic permeability, Y-direction	Constant	$log(m^2)$	-3.50E+01
2916	TAMARISK	Tamarisk Member	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Constant	$log(m^2)$	-3.50E+01
2191	TAMARISK	Tamarisk Member	RELP_MOD	Model number, relative permeability model	Constant	NONE	4.00E+00
2245	TAMARISK	Tamarisk Member	SAT_RBRN	Residual Brine Saturation	Constant	NONE	2.00E-01
2192	TAMARISK	Tamarisk Member	SAT_RGAS	Residual Gas Saturation	Constant	NONE	2.00E-01

Table PAR-26. Culebra Member of the Rustler Formation Parameters

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
3487	CULEBRA	Culebra member of the Rustler formation	APOROS	Culebra Advective Porosity	Log uniform	NONE	Sampled Value
119	CULEBRA	Culebra member of the Rustler formation	CAP_MOD	Model number, capillary pressure model	Constant	NONE	2.00E+00
120	CULEBRA	Culebra member of the Rustler formation	COMP_RCK	Bulk Compressibility	Constant	Pa^{-1}	1.00E-10
3483	CULEBRA	Culebra member of the Rustler formation	DISP_L	Longitudinal dispersivity	Constant	m	0.00E+00
3484	CULEBRA	Culebra member of the Rustler formation	DISPT_L	Transverse dispersivity	Constant	m	0.00E+00
843	CULEBRA	Culebra member of the Rustler formation	DNSGRAIN	Material Grain Density	Constant	kg/m^3	2.82E+03
3486	CULEBRA	Culebra member of the Rustler formation	DPOROS	Diffusive Porosity for Culebra Dolomite	Cumulative	NONE	Sampled Value
3474	CULEBRA	Culebra member of the Rustler formation	DTORT	Diffusive Tortuosity	Constant	NONE	1.10E-01
861	CULEBRA	Culebra member of the Rustler formation	FTORT	Fracture Tortuosity	Constant	NONE	1.00E+00
3485	CULEBRA	Culebra member of the Rustler formation	HMBLKLT	Culebra Half Matrix-Block Length	Uniform	m	Sampled Value
2691	CULEBRA	Culebra member of the Rustler formation	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
3419	CULEBRA	Culebra member of the Rustler formation	MINP_FAC	Mining Transmissivity Multiplier	Uniform	NONE	Sampled Value
137	CULEBRA	Culebra member of the Rustler formation	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
2692	CULEBRA	Culebra member of the Rustler formation	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	2.60E-01
2693	CULEBRA	Culebra member of the Rustler formation	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	-3.48E-01
141	CULEBRA	Culebra member of the Rustler formation	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
139	CULEBRA	Culebra member of the Rustler formation	PORE_DIS	Brooks-Corey pore distribution parameter	Constant	NONE	6.44E-01

Table PAR-26. Culebra Member of the Rustler Formation Parameters — Continued

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
140	CULEBRA	Culebra member of the Rustler formation	POROSITY	Effective porosity	Constant	NONE	1.51E-01
142	CULEBRA	Culebra member of the Rustler formation	PRESSURE	Brine far-field pore pressure	Constant	Pa	9.14E+05
143	CULEBRA	Culebra member of the Rustler formation	PRMX_LOG	Log of intrinsic permeability, X-direction	Constant	$\log(m^2)$	-1.31E+01
144	CULEBRA	Culebra member of the Rustler formation	PRMY_LOG	Log of intrinsic permeability, Y-direction	Constant	$\log(m^2)$	-1.31E+01
145	CULEBRA	Culebra member of the Rustler formation	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Constant	$\log(m^2)$	-1.31E+01
148	CULEBRA	Culebra member of the Rustler formation	RELP_MOD	Model number, relative permeability model	Constant	NONE	4.00E+00
149	CULEBRA	Culebra member of the Rustler formation	SAT_IBRN	Initial Brine Saturation	Constant	NONE	1.00E+00
150	CULEBRA	Culebra member of the Rustler formation	SAT_RBRN	Residual Brine Saturation	Constant	NONE	8.36E-02
151	CULEBRA	Culebra member of the Rustler formation	SAT_RGAS	Residual Gas Saturation	Constant	NONE	7.71E-02
3469	CULEBRA	Culebra member of the Rustler formation	SKIN_RES	Skin Resistance	Constant	NONE	0.00E+00

Table PAR-27. Los Medanos (Unnamed Lower) Member of the Rustler Formation Parameters

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
2217	UNNAMED	Unnamed Lower Member of Rustler Formation	CAP_MOD	Model number, capillary pressure model	Constant	NONE	1.00E+00
2218	UNNAMED	Unnamed Lower Member of Rustler Formation	COMP_RCK	Bulk Compressibility	Constant	Pa^{-1}	0.00E+00
2799	UNNAMED	Unnamed Lower Member of Rustler Formation	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
2247	UNNAMED	Unnamed Lower Member of Rustler Formation	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
2800	UNNAMED	Unnamed Lower Member of Rustler Formation	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	0.00E+00
2801	UNNAMED	Unnamed Lower Member of Rustler Formation	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	0.00E+00
2802	UNNAMED	Unnamed Lower Member of Rustler Formation	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
2219	UNNAMED	Unnamed Lower Member of Rustler Formation	PORE_DIS	Brooks-Corey pore distribution parameter	Constant	NONE	7.00E-01
2220	UNNAMED	Unnamed Lower Member of Rustler Formation	POROSITY	Effective porosity	Student	NONE	1.81E-01
2911	UNNAMED	Unnamed Lower Member of Rustler Formation	PRMX_LOG	Log of intrinsic permeability, X-direction	Constant	$log(m^2)$	-3.50E+01
2912	UNNAMED	Unnamed Lower Member of Rustler Formation	PRMY_LOG	Log of intrinsic permeability, Y-direction	Constant	$log(m^2)$	-3.50E+01
2913	UNNAMED	Unnamed Lower Member of Rustler Formation	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Constant	$log(m^2)$	-3.50E+01
2225	UNNAMED	Unnamed Lower Member of Rustler Formation	RELP_MOD	Model number, relative permeability model	Constant	NONE	4.00E+00
2248	UNNAMED	Unnamed Lower Member of Rustler Formation	SAT_RBRN	Residual Brine Saturation	Constant	NONE	2.00E-01
2226	UNNAMED	Unnamed Lower Member of Rustler Formation	SAT_RGAS	Residual Gas Saturation	Constant	NONE	2.00E-01

Table PAR-28. Salado Formation – Intact Halite – Parameters

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
540	S_HALITE	Salado halite, intact	CAP_MOD	Model number, capillary pressure model	Constant	NONE	2.00E+00
541	S_HALITE	Salado halite, intact	COMP_RCK	Bulk Compressibility	Uniform	Pa^{-1}	Sampled Value
2778	S_HALITE	Salado halite, intact	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
542	S_HALITE	Salado halite, intact	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
2779	S_HALITE	Salado halite, intact	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	5.60E-01
2780	S_HALITE	Salado halite, intact	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	-3.46E-01
545	S_HALITE	Salado halite, intact	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
543	S_HALITE	Salado halite, intact	PORE_DIS	Brooks-Corey pore distribution parameter	Cumulative	NONE	7.00E-01
544	S_HALITE	Salado halite, intact	POROSITY	Effective porosity	Cumulative	NONE	Sampled Value
546	S_HALITE	Salado halite, intact	PRESSURE	Brine far-field pore pressure	Uniform	Pa	Sampled Value
547	S_HALITE	Salado halite, intact	PRMX_LOG	Log of intrinsic permeability, X-direction	Uniform	$log(m^2)$	Sampled Value
548	S_HALITE	Salado halite, intact	PRMY_LOG	Log of intrinsic permeability, Y-direction	Uniform	$log(m^2)$	Applied Value See S_HALITE PRMX_LOG
549	S_HALITE	Salado halite, intact	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Uniform	$log(m^2)$	Applied Value See S_HALITE PRMX_LOG
553	S_HALITE	Salado halite, intact	RELP_MOD	Model number, relative permeability model	Delta	NONE	4.00E+00
555	S_HALITE	Salado halite, intact	SAT_RBRN	Residual Brine Saturation	Uniform	NONE	3.00E-01
556	S_HALITE	Salado halite, intact	SAT_RGAS	Residual Gas Saturation	Uniform	NONE	2.00E-01

Table PAR-29. Salado Formation – Brine – Parameters

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
48	BRINESAL	Salado Brine	COMPRES	Brine Compressibility	Constant	Pa^{-1}	3.10E-10
49	BRINESAL	Salado Brine	DNSFLUID	Brine Density	Constant	kg/m^3	1.22E+03
50	BRINESAL	Salado Brine	REF_PRES	Reference pressure for porosity	Constant	Pa	1.01E+05
51	BRINESAL	Salado Brine	REF_TEMP	Reference Temperature	Constant	K	3.00E+02
55	BRINESAL	Salado Brine	VISCO	Viscosity	Constant	Pa*s	2.10E-03
57	BRINESAL	Salado Brine	WTF	Mass fraction of salt in brine	Student	NONE	3.24E-01

Table PAR-30. Salado Formation – Marker Bed 138 – Parameters

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
559	S_MB138	Salado marker bed 138, intact and fractured	CAP_MOD	Model number, capillary pressure model	Constant	NONE	2.00E+00
560	S_MB138	Salado marker bed 138, intact and fractured	COMP_RCK	Bulk Compressibility	Student	Pa^{-1}	8.26E-11
2169	S_MB138	Salado marker bed 138, intact and fractured	DPHIMAX	Incremental increase in porosity relative to intact conditions	Constant	NONE	3.90E-02
2810	S_MB138	Salado marker bed 138, intact and fractured	IFRX	Index for fracture perm. enhancement in X-direction	Constant	NONE	1.00E+00
2813	S_MB138	Salado marker bed 138, intact and fractured	IFRY	Index for fracture perm. enhancement in Y-direction	Constant	NONE	1.00E+00
2816	S_MB138	Salado marker bed 138, intact and fractured	IFRZ	Index for fracture perm. enhancement in Z-direction	Constant	NONE	0.00E+00
2170	S_MB138	Salado marker bed 138, intact and fractured	KMAXLOG	Log of Maximum Permeability in Altered Anhydrite Flow Model Anhydrites	Constant	$log(m^2)$	-9.00E+00
2783	S_MB138	Salado marker bed 138, intact and fractured	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
561	S_MB138	Salado marker bed 138, intact and fractured	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
2784	S_MB138	Salado marker bed 138, intact and fractured	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	2.60E-01
2785	S_MB138	Salado marker bed 138, intact and fractured	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	-3.48E-01
563	S_MB138	Salado marker bed 138, intact and fractured	PF_DELTA	Incremental pressure for full fracture development	Constant	Pa	3.80E+06
565	S_MB138	Salado marker bed 138, intact and fractured	PI_DELTA	Fracture initiation pressure increment	Constant	Pa	2.00E+05
568	S_MB138	Salado marker bed 138, intact and fractured	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
566	S_MB138	Salado marker bed 138, intact and fractured	PORE_DIS	Brooks-Corey pore distribution parameter	Student	NONE	6.44E-01
567	S_MB138	Salado marker bed 138, intact and fractured	POROSITY	Effective porosity	Student	NONE	1.10E-02
570	S_MB138	Salado marker bed 138, intact and fractured	PRMX_LOG	Log of intrinsic permeability, X-direction	Student	$log(m^2)$	-1.89E+01
571	S_MB138	Salado marker bed 138, intact and fractured	PRMY_LOG	Log of intrinsic permeability, Y-direction	Student	$log(m^2)$	-1.89E+01

Table PAR-30. Salado Formation – Marker Bed 138 – Parameters — Continued

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
572	S_MB138	Salado marker bed 138, intact and fractured	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Student	$\log(m^2)$	-1.89E+01
575	S_MB138	Salado marker bed 138, intact and fractured	RELP_MOD	Model number, relative permeability model	Delta	NONE	4.00E+00
577	S_MB138	Salado marker bed 138, intact and fractured	SAT_RBRN	Residual Brine Saturation	Student	NONE	8.36E-02
578	S_MB138	Salado marker bed 138, intact and fractured	SAT_RGAS	Residual Gas Saturation	Student	NONE	7.71E-02
580	S_MB139	Salado marker bed 139, intact and fractured	COMP_RCK	Bulk Compressibility	Student	Pa^{-1}	Sampled Value

Table PAR-31. Salado Formation – Marker Bed 139 – Parameters

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
3185	CONC_PLG	Concrete Plug, surface and Rustler	PRMX_LOG	Log of intrinsic permeability, X-direction	Uniform	$\log(m^2)$	Sampled Value
2905	S_MB139	Salado marker bed 139, intact and fractured	BKLINK	Klinkenberg B Correction Parameters for H2 gas	Constant	Pa	2.71E-01
579	S_MB139	Salado marker bed 139, intact and fractured	CAP_MOD	Model number, capillary pressure model	Constant	NONE	2.00E+00
2177	S_MB139	Salado marker bed 139, intact and fractured	DPHIMAX	Incremental increase in porosity relative to intact conditions	Constant	NONE	3.90E-02
2903	S_MB139	Salado marker bed 139, intact and fractured	EXPKLINK	Klinkenberg b correction parameters for H2 gas	Constant	NONE	-3.41E-01
2811	S_MB139	Salado marker bed 139, intact and fractured	IFRX	Index for fracture perm. enhancement in X-direction	Constant	NONE	1.00E+00
2814	S_MB139	Salado marker bed 139, intact and fractured	IFRY	Index for fracture perm. enhancement in Y-direction	Constant	NONE	1.00E+00
2817	S_MB139	Salado marker bed 139, intact and fractured	IFRZ	Index for fracture perm. enhancement in Z-direction	Constant	NONE	0.00E+00
2178	S_MB139	Salado marker bed 139, intact and fractured	KMAXLOG	Log of Maximum Permeability in Altered Anhydrite Flow Model Anhydrites	Constant	$\log(m^2)$	-9.00E+00
2788	S_MB139	Salado marker bed 139, intact and fractured	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
582	S_MB139	Salado marker bed 139, intact and fractured	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
2789	S_MB139	Salado marker bed 139, intact and fractured	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	2.60E-01
2790	S_MB139	Salado marker bed 139, intact and fractured	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	-3.48E-01
2180	S_MB139	Salado marker bed 139, intact and fractured	PF_DELTA	Incremental pressure for full fracture development	Constant	Pa	3.80E+06
586	S_MB139	Salado marker bed 139, intact and fractured	PI_DELTA	Fracture initiation pressure increment	Constant	Pa	2.00E+05
589	S_MB139	Salado marker bed 139, intact and fractured	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
587	S_MB139	Salado marker bed 139, intact and fractured	PORE_DIS	Brooks-Corey pore distribution parameter	Student	NONE	Sampled Value
588	S_MB139	Salado marker bed 139, intact and fractured	POROSITY	Effective porosity	Student	NONE	1.10E-02

Table PAR-31. Salado Formation – Marker Bed 139 – Parameters — Continued

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
591	S_MB139	Salado marker bed 139, intact and fractured	PRMX_LOG	Log of intrinsic permeability, X-direction	Student	$\log(m^2)$	Sampled Value
592	S_MB139	Salado marker bed 139, intact and fractured	PRMY_LOG	Log of intrinsic permeability, Y-direction	Student	$\log(m^2)$	-1.89E+01
593	S_MB139	Salado marker bed 139, intact and fractured	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Student	$\log(m^2)$	-1.89E+01
596	S_MB139	Salado marker bed 139, intact and fractured	RELP_MOD	Model number, relative permeability model	Delta	NONE	Sampled Value
598	S_MB139	Salado marker bed 139, intact and fractured	SAT_RBRN	Residual Brine Saturation	Student	NONE	Sampled Value
599	S_MB139	Salado marker bed 139, intact and fractured	SAT_RGAS	Residual Gas Saturation	Student	NONE	Sampled Value

Table PAR-32. Salado Formation – Anhydrite a and b, Intact and Fractured – Parameters

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
520	S_ANH_AB	Salado anhydrite beds A and B, intact and fracture	CAP_MOD	Model number, capillary pressure model	Constant	NONE	2.00E+00
521	S_ANH_AB	Salado anhydrite beds A and B, intact and fracture	COMP_RCK	Bulk Compressibility	Student	Pa^{-1}	8.26E-11
2158	S_ANH_AB	Salado anhydrite beds A and B, intact and fracture	DPHIMAX	Incremental increase in porosity relative to intact conditions	Constant	NONE	2.39E-01
2812	S_ANH_AB	Salado anhydrite beds A and B, intact and fracture	IFRX	Index for fracture perm. enhancement in X-direction	Constant	NONE	1.00E+00
2815	S_ANH_AB	Salado anhydrite beds A and B, intact and fracture	IFRY	Index for fracture perm. enhancement in Y-direction	Constant	NONE	1.00E+00
2818	S_ANH_AB	Salado anhydrite beds A and B, intact and fracture	IFRZ	Index for fracture perm. enhancement in Z-direction	Constant	NONE	0.00E+00
2159	S_ANH_AB	Salado anhydrite beds A and B, intact and fracture	KMAXLOG	Log of Maximum Permeability in Altered Anhydrite Flow Model Anhydrites	Constant	$log(m^2)$	-9.00E+00
2773	S_ANH_AB	Salado anhydrite beds A and B, intact and fracture	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
522	S_ANH_AB	Salado anhydrite beds A and B, intact and fracture	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
2774	S_ANH_AB	Salado anhydrite beds A and B, intact and fracture	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	2.60E-01
2775	S_ANH_AB	Salado anhydrite beds A and B, intact and fracture	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	-3.48E-01
524	S_ANH_AB	Salado anhydrite beds A and B, intact and fracture	PF_DELTA	Incremental pressure for full fracture development	Constant	Pa	3.80E+06
526	S_ANH_AB	Salado anhydrite beds A and B, intact and fracture	PI_DELTA	Fracture initiation pressure increment	Constant	Pa	2.00E+05
529	S_ANH_AB	Salado anhydrite beds A and B, intact and fracture	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
527	S_ANH_AB	Salado anhydrite beds A and B, intact and fracture	PORE_DIS	Brooks-Corey pore distribution parameter	Student	NONE	6.44E-01
528	S_ANH_AB	Salado anhydrite beds A and B, intact and fracture	POROSITY	Effective porosity	Student	NONE	1.10E-02
531	S_ANH_AB	Salado anhydrite beds A and B, intact and fracture	PRMX_LOG	Log of intrinsic permeability, X-direction	Student	$log(m^2)$	-1.89E+01
532	S_ANH_AB	Salado anhydrite beds A and B, intact and fracture	PRMY_LOG	Log of intrinsic permeability, Y-direction	Student	$log(m^2)$	-1.89E+01

Table PAR-32. Salado Formation – Anhydrite a and b, Intact and Fractured – Parameters — Continued

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
533	S_ANH_AB	Salado anhydrite beds A and B, intact and fracture	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Student	$log(m^2)$	-1.89E+01
536	S_ANH_AB	Salado anhydrite beds A and B, intact and fracture	RELP_MOD	Model number, relative permeability model	Delta	NONE	4.00E+00
538	S_ANH_AB	Salado anhydrite beds A and B, intact and fracture	SAT_RBRN	Residual Brine Saturation	Student	NONE	8.36E-02
539	S_ANH_AB	Salado anhydrite beds A and B, intact and fracture	SAT_RGAS	Residual Gas Saturation	Student	NONE	7.71E-02

Table PAR-33. Disturbed Rock Zone Parameters

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
174	DRZ_0	Disturbed rock zone; time period -5 to 0 years	CAP_MOD	Model number, capillary pressure model	Constant	NONE	1.00E+00
175	DRZ_0	Disturbed rock zone; time period -5 to 0 years	COMP_RCK	Bulk Compressibility	Constant	Pa^{-1}	7.41E-10
2701	DRZ_0	Disturbed rock zone; time period -5 to 0 years	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
176	DRZ_0	Disturbed rock zone; time period -5 to 0 years	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
2702	DRZ_0	Disturbed rock zone; time period -5 to 0 years	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	0.00E+00
2703	DRZ_0	Disturbed rock zone; time period -5 to 0 years	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	0.00E+00
179	DRZ_0	Disturbed rock zone; time period -5 to 0 years	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
177	DRZ_0	Disturbed rock zone; time period -5 to 0 years	PORE_DIS	Brooks-Corey pore distribution parameter	Constant	NONE	7.00E-01
178	DRZ_0	Disturbed rock zone; time period -5 to 0 years	POROSITY	Effective porosity	Cumulative	NONE	1.29E-02
181	DRZ_0	Disturbed rock zone; time period -5 to 0 years	PRMX_LOG	Log of intrinsic permeability, X-direction	Constant	$log(m^2)$	-1.70E+01
182	DRZ_0	Disturbed rock zone; time period -5 to 0 years	PRMY_LOG	Log of intrinsic permeability, Y-direction	Constant	$log(m^2)$	-1.70E+01
183	DRZ_0	Disturbed rock zone; time period -5 to 0 years	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Constant	$log(m^2)$	-1.70E+01
186	DRZ_0	Disturbed rock zone; time period -5 to 0 years	RELP_MOD	Model number, relative permeability model	Delta	NONE	4.00E+00
188	DRZ_0	Disturbed rock zone; time period -5 to 0 years	SAT_RBRN	Residual Brine Saturation	Constant	NONE	0.00E+00
189	DRZ_0	Disturbed rock zone; time period -5 to 0 years	SAT_RGAS	Residual Gas Saturation	Constant	NONE	0.00E+00
190	DRZ_1	Disturbed rock zone; time period 0 to 10,000 years	CAP_MOD	Model number, capillary pressure model	Constant	NONE	1.00E+00
191	DRZ_1	Disturbed rock zone; time period 0 to 10,000 years	COMP_RCK	Bulk Compressibility	Constant	Pa^{-1}	7.41E-10
3116	DRZ_1	Disturbed rock zone; time period 0 to 10,000 years	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00

Table PAR-33. Disturbed Rock Zone Parameters — Continued

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
193	DRZ_1	Disturbed rock zone; time period 0 to 10,000 years	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
3128	DRZ_1	Disturbed rock zone; time period 0 to 10,000 years	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	0.00E+00
3129	DRZ_1	Disturbed rock zone; time period 0 to 10,000 years	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	0.00E+00
196	DRZ_1	Disturbed rock zone; time period 0 to 10,000 years	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
194	DRZ_1	Disturbed rock zone; time period 0 to 10,000 years	PORE_DIS	Brooks-Corey pore distribution parameter	Constant	NONE	7.00E-01
195	DRZ_1	Disturbed rock zone; time period 0 to 10,000 years	POROSITY	Effective porosity	Cumulative	NONE	1.29E-02
198	DRZ_1	Disturbed rock zone; time period 0 to 10,000 years	PRMX_LOG	Log of intrinsic permeability, X-direction	Uniform	log(m^2)	Sampled Value
199	DRZ_1	Disturbed rock zone; time period 0 to 10,000 years	PRMY_LOG	Log of intrinsic permeability, Y-direction	Uniform	log(m^2)	Applied Value See DRZ-1 PRMX_LOG
200	DRZ_1	Disturbed rock zone; time period 0 to 10,000 years	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Uniform	log(m^2)	Applied Value See DRZ_1 PRMX_LOG
203	DRZ_1	Disturbed rock zone; time period 0 to 10,000 years	RELP_MOD	Model number, relative permeability model	Delta	NONE	4.00E+00
205	DRZ_1	Disturbed rock zone; time period 0 to 10,000 years	SAT_RBRN	Residual Brine Saturation	Constant	NONE	0.00E+00
206	DRZ_1	Disturbed rock zone; time period 0 to 10,000 years	SAT_RGAS	Residual Gas Saturation	Constant	NONE	0.00E+00

Table PAR-34. Waste Area and Waste Material Parameters

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
651	WAS_AREA	Waste emplacement area and waste	ABSROUGH	Absolute roughness of material	Uniform	m	2.50E-02
652	WAS_AREA	Waste emplacement area and waste	CAP_MOD	Model number, capillary pressure model	Constant	NONE	1.00E+00
653	WAS_AREA	Waste emplacement area and waste	COMP_RCK	Bulk Compressibility	Constant	Pa^{-1}	0.00E+00
2041	WAS_AREA	Waste emplacement area and waste	DCELLCHW	Average density of cellulosics in CH waste	Constant	kg/m^3	5.80E+01
2274	WAS_AREA	Waste emplacement area and waste	DCELLRHW	Average density of cellulosics in RH waste	Constant	kg/m^3	4.50E+00
1992	WAS_AREA	Waste emplacement area and waste	DIRNCCHW	Bulk density of iron containers, CH waste	Constant	kg/m^3	1.70E+02
1993	WAS_AREA	Waste emplacement area and waste	DIRNCRHW	Bulk density of iron containers, RH waste	Constant	kg/m^3	4.80E+02
2040	WAS_AREA	Waste emplacement area and waste	DIRONCHW	Average density of iron-based material in CH waste	Constant	kg/m^3	1.10E+02
2044	WAS_AREA	Waste emplacement area and waste	DIRONRHW	Average density of iron-based material in RH waste	Constant	kg/m^3	1.10E+02
2043	WAS_AREA	Waste emplacement area and waste	DPLASCHW	Average density of plastics in CH waste	Constant	kg/m^3	4.20E+01
2275	WAS_AREA	Waste emplacement area and waste	DPLASRHW	Average density of plastics in CH waste	Constant	kg/m^3	4.90E+00
1995	WAS_AREA	Waste emplacement area and waste	DPLSCCHW	Bulk density of plastic liners, CH waste	Constant	kg/m^3	1.60E+01
2228	WAS_AREA	Waste emplacement area and waste	DPLSCRHW	Bulk density of plastic liners, RH waste	Constant	kg/m^3	1.40E+00
2042	WAS_AREA	Waste emplacement area and waste	DRUBBCHW	Average density of rubber in CH waste	Constant	kg/m^3	1.40E+01
2046	WAS_AREA	Waste emplacement area and waste	DRUBBRHW	Average density of rubber in RH waste	Constant	kg/m^3	3.10E+00
2804	WAS_AREA	Waste emplacement area and waste	KPT	Flag for Permeability Determined Threshold	Constant	NONE	0.00E+00
658	WAS_AREA	Waste emplacement area and waste	PC_MAX	Maximum allowable capillary pressure	Constant	Pa	1.00E+08
2805	WAS_AREA	Waste emplacement area and waste	PCT_A	Threshold Pressure Linear Parameter	Constant	Pa	0.00E+00

Table PAR-34. Waste Area and Waste Material Parameters — Continued

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
2806	WAS_AREA	Waste emplacement area and waste	PCT_EXP	Threshold pressure exponential parameter	Constant	NONE	0.00E+00
661	WAS_AREA	Waste emplacement area and waste	PO_MIN	Minimum brine pressure for capillary model KPC=3	Constant	Pa	1.01E+05
659	WAS_AREA	Waste emplacement area and waste	PORE_DIS	Brooks-Corey pore distribution parameter	Cumulative	NONE	2.89E+00
660	WAS_AREA	Waste emplacement area and waste	POROSITY	Effective porosity	Constant	NONE	8.48E-01
663	WAS_AREA	Waste emplacement area and waste	PRMX_LOG	Log of intrinsic permeability, X-direction	Constant	$log(m^2)$	-1.26E+01
664	WAS_AREA	Waste emplacement area and waste	PRMY_LOG	Log of intrinsic permeability, Y-direction	Constant	$log(m^2)$	-1.26E+01
665	WAS_AREA	Waste emplacement area and waste	PRMZ_LOG	Log of intrinsic permeability, Z-direction	Constant	$log(m^2)$	-1.26E+01
2823	WAS_AREA	Waste emplacement area and waste	PROBDEG	Probability of plastics and rubber biodegradation in event of microbial gas generation	Delta	NONE	Sampled Value
3549	WAS_AREA	Waste emplacement area and waste	PTHRESH	Capillary threshold displacement pressure	Constant	Pa	8.00E+06
668	WAS_AREA	Waste emplacement area and waste	RELP_MOD	Model number, relative permeability model	Constant	NONE	4.00E+00
669	WAS_AREA	Waste emplacement area and waste	SAT_IBRN	Initial Brine Saturation	Constant	NONE	1.50E-02
670	WAS_AREA	Waste emplacement area and waste	SAT_RBRN	Residual Brine Saturation	Uniform	NONE	Sampled Value
671	WAS_AREA	Waste emplacement area and waste	SAT_RGAS	Residual Gas Saturation	Uniform	NONE	Sampled Value
2231	WAS_AREA	Waste emplacement area and waste	SAT_WICK	Index for computing wicking	Uniform	NONE	Sampled Value
2232	WAS_AREA	Waste emplacement area and waste	VOLCHW	BIR total volume of CH waste	Constant	m^3	1.69E+05
2233	WAS_AREA	Waste emplacement area and waste	VOLRHW	BIR total volume of RH waste	Constant	m^3	7.08E+03

Table PAR-35. Waste Chemistry Parameters

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
3447	AM	Americium	CAPMIC	Maximum Concentration of Actinide on Microbe Colloids	Constant	moles/liter	1.00E+00
3310	AM	Americium	CONCINT	Actinide Concentration with Mobile Actinide Intrinsic Colloids	Constant	moles/liter	0.00E+00
3441	AM	Americium	CONCMIN	Actinide Concentration with Mobile Mineral Fragment Colloids	Constant	moles/liter	2.60E-08
3311	AM	Americium	PROPMIC	Moles of Actinide Mobilized on Microbe Colloids per Moles Dissolved	Constant	NONE	3.60E+00
3444	AM+3	Americium III	MD0	Molecular diffusion in pure fluid	Constant	m^2/s	3.00E-10
3482	AM+3	Americium III	MKD_AM	Matrix Partition Coefficient for Americium	Log uniform	m^3/kg	Sampled Value
3458	NP	Neptunium	CAPHUM	Maximum Concentration of Actinide with Mobile Humic Colloids	Constant	moles/liter	1.10E-05
3313	NP	Neptunium	CAPMIC	Maximum Concentration of Actinide on Microbe Colloids	Constant	moles/liter	2.70E-03
3312	NP	Neptunium	CONCINT	Actinide Concentration with Mobile Actinide Intrinsic Colloids	Constant	moles/liter	0.00E+00
3439	NP	Neptunium	CONCMIN	Actinide Concentration with Mobile Mineral Fragment Colloids	Constant	moles/liter	2.60E-08
3314	NP	Neptunium	PROPMIC	Moles of Actinide Mobilized on Microbe Colloids per Moles Dissolved	Constant	NONE	1.20E+01
3429	PHUMOX3	Proportionality Constant, +3 State, Humic Colloids	PHUMCIM	Proportionality Const., Humic Colloids, Castile Brine, MgO controls pH	Cumulative	NONE	Sampled Value
3433	PHUMOX3	Proportionality Constant, +3 State, Humic Colloids	PHUMSIM	Proportionality Const. Of Actinides in Salado Brine w/Humic Colloids, Inorganic	Constant	NONE	1.90E-01
3430	PHUMOX4	Proportionality constant with humic colloids for a	PHUMCIM	Proportionality Const., Humic Colloids, Castile Brine, MgO controls pH	Constant	NONE	6.30E+00
3434	PHUMOX4	Proportionality constant with humic colloids for a	PHUMSIM	Proportionality Const. Of Actinides in Salado Brine w/Humic Colloids, Inorganic	Constant	NONE	6.30E+00
3431	PHUMOX5	Proportionality constant with humic colloids for a	PHUMCIM	Proportionality Const., Humic Colloids, Castile Brine, MgO controls pH	Constant	NONE	7.40E-03

Table PAR-35. Waste Chemistry Parameters — Continued

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
3435	PHUMOX5	Proportionality constant with humic colloids for a	PHUMSIM	Proportionality Const. Of Actinides in Salado Brine w/Humic Colloids, Inorganic	Constant	NONE	9.10E-04
3432	PHUMOX6	Proportionality constant with humic colloids for a	PHUMCIM	Proportionality Const., Humic Colloids, Castile Brine, MgO controls pH	Constant	NONE	5.10E-01
3436	PHUMOX6	Proportionality constant with humic colloids for a	PHUMSIM	Proportionality Const. Of Actinides in Salado Brine w/Humic Colloids, Inorganic	Constant	NONE	1.20E-01
3459	PU	Plutonium	CAPHUM	Maximum Concentration of Actinide with Mobile Humic Colloids	Constant	moles/liter	1.10E-05
3315	PU	Plutonium	CAPMIC	Maximum Concentration of Actinide on Microbe Colloids	Constant	moles/liter	6.80E-05
3316	PU	Plutonium	CONCINT	Actinide Concentration with Mobile Actinide Intrinsic Colloids	Constant	moles/liter	1.00E-09
3440	PU	Plutonium	CONCMIN	Actinide Concentration with Mobile Mineral Fragment Colloids	Constant	moles/liter	2.60E-08
3317	PU	Plutonium	PROPMIC	Moles of Actinide Mobilized on Microbe Colloids per Moles Dissolved	Constant	NONE	3.00E-01
3442	PU+3	Plutonium III	MD0	Molecular diffusion in pure fluid	Constant	m^2/s	3.00E-10
3480	PU+3	Plutonium III	MKD_PU	Matrix Partition Coefficient for Plutonium	Log uniform	m^3/kg	Sampled Value
3443	PU+4	Plutonium IV	MD0	Molecular diffusion in pure fluid	Constant	m^2/s	1.53E-10
3481	PU+4	Plutonium IV	MKD_PU	Matrix Partition Coefficient for Plutonium	Log uniform	m^3/kg	Sampled Value
3263	SOLAM3	Solubility Multiplier for Am+3	SOLCIM	Solubility Mult. in Castile Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	None (see PPR-04-2002, ERMS #524651)	Sampled Value
3262	SOLAM3	Solubility Multiplier for Am+3	SOLSIM	Solubility Mult. in Salado Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	None (see PPR-04-2002, ERMS #524651)	Sampled Value
3628	SOLMOD3	Oxidation state III model	SOLCOC	Solubility in Castile Brine with Organics included Controlled by Mg(OH)2/CaCO3	Constant	moles/liter	1.77E-07
3629	SOLMOD3	Oxidation state III model	SOLCOH	Solubility in Castile Brine with Organics included Controlled by Mg(OH)2/Hydromagnisite buffer(5424)	Constant	moles/liter	1.69E-07

Table PAR-35. Waste Chemistry Parameters — Continued

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
3630	SOLMOD3	Oxidation state III model	SOLSOC	Solubility in Salado Brine with Organics included Controlled by Mg(OH)2/CaCO3	Constant	moles/liter	3.07E-07
3631	SOLMOD3	Oxidation state III model	SOLSOH	Solubility in Salado Brine with Organics included Controlled by Mg(OH)2/Hydromagnisite buffer(5424)	Constant	moles/liter	3.07E-07
3632	SOLMOD4	Oxidation state IV model	SOLCOC	Solubility in Castile Brine with Organics included Controlled by Mg(OH)2/CaCO3	Constant	moles/liter	5.84E-09
3633	SOLMOD4	Oxidation state IV model	SOLCOH	Solubility in Castile Brine with Organics included Controlled by Mg(OH)2/Hydromagnisite buffer(5424)	Constant	moles/liter	2.47E-08
3634	SOLMOD4	Oxidation state IV model	SOLSOC	Solubility in Salado Brine with Organics included Controlled by Mg(OH)2/CaCO3	Constant	moles/liter	1.24E-08
3635	SOLMOD4	Oxidation state IV model	SOLSOH	Solubility in Salado Brine with Organics included Controlled by Mg(OH)2/Hydromagnisite buffer(5424)	Constant	moles/liter	1.19E-08
3636	SOLMOD5	Oxidation state V model	SOLCOC	Solubility in Castile Brine with Organics included Controlled by Mg(OH)2/CaCO3	Constant	moles/liter	2.13E-05
3637	SOLMOD5	Oxidation state V model	SOLCOH	Solubility in Castile Brine with Organics included Controlled by Mg(OH)2/Hydromagnisite buffer(5424)	Constant	moles/liter	5.08E-06
3638	SOLMOD5	Oxidation state V model	SOLSOC	Solubility in Salado Brine with Organics included Controlled by Mg(OH)2/CaCO3	Constant	moles/liter	9.72E-07
3639	SOLMOD5	Oxidation state V model	SOLSOH	Solubility in Salado Brine with Organics included Controlled by Mg(OH)2/Hydromagnisite buffer(5424)	Constant	moles/liter	1.02E-06
3640	SOLMOD6	Oxidation state VI model	SOLCOC	Solubility in Castile Brine with Organics included Controlled by Mg(OH)2/CaCO3	Constant	moles/liter	8.80E-06
3641	SOLMOD6	Oxidation state VI model	SOLCOH	Solubility in Castile Brine with Organics included Controlled by Mg(OH)2/Hydromagnisite buffer(5424)	Constant	moles/liter	8.80E-06
3642	SOLMOD6	Oxidation state VI model	SOLSOC	Solubility in Salado Brine with Organics included Controlled by Mg(OH)2/CaCO3	Constant	moles/liter	8.70E-06
3643	SOLMOD6	Oxidation state VI model	SOLSOH	Solubility in Salado Brine with Organics included Controlled by Mg(OH)2/Hydromagnisite buffer(5424)	Constant	moles/liter	8.70E-06

Table PAR-35. Waste Chemistry Parameters — Continued

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
3264	SOLPU3	Solubility Multiplier for Pu+3	SOLCIM	Solubility Mult. in Castile Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	None (see PPR-04-2002, ERMS #524651)	Sampled Value
3265	SOLPU3	Solubility Multiplier for Pu+3	SOLSIM	Solubility Mult. in Salado Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	None (see PPR-04-2002, ERMS #524651)	Sampled Value
3389	SOLPU4	Solubility Multiplier for Pu+4	SOLCIM	Solubility Mult. in Castile Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	None (see PPR-04-2002, ERMS #524651)	Sampled Value
3266	SOLPU4	Solubility Multiplier for Pu+4	SOLSIM	Solubility Mult. in Salado Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	None (see PPR-04-2002, ERMS #524651)	Sampled Value
3627	SOLTH4	Solubility Multiplier for Th+4	SOLCIM	Solubility Mult. in Castile Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	None (see PPR-04-2002, ERMS #524651)	Sampled Value
3393	SOLTH4	Solubility Multiplier for Th+4	SOLSIM	Solubility Mult. in Salado Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	None (see PPR-04-2002, ERMS #524651)	Sampled Value
3626	SOLU4	Solubility Multiplier for U+4	SOLCIM	Solubility Mult. in Castile Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	None (see PPR-04-2002, ERMS #524651)	Sampled Value
3390	SOLU4	Solubility Multiplier for U+4	SOLSIM	Solubility Mult. in Salado Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	None (see PPR-04-2002, ERMS #524651)	Sampled Value
3392	SOLU6	Solubility Multiplier for U+6	SOLCIM	Solubility Mult. in Castile Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	None (see PPR-04-2002, ERMS #524651)	Sampled Value
3391	SOLU6	Solubility Multiplier for U+6	SOLSIM	Solubility Mult. in Salado Brine, Inorganic Chem Controlled by Mg(OH)2-MgCO3	Cumulative	None (see PPR-04-2002, ERMS #524651)	Sampled Value

Table PAR-35. Waste Chemistry Parameters — Continued

Parameter Id #	Material	Material Description	Property	Property Description	Distribution Type	Units	Value
3461	TH	Thorium	CAPHUM	Maximum Concentration of Actinide with Mobile Humic Colloids	Constant	moles/liter	1.10E-05
3318	TH	Thorium	CAPMIC	Maximum Concentration of Actinide on Microbe Colloids	Constant	moles/liter	1.90E-03
3319	TH	Thorium	CONCINT	Actinide Concentration with Mobile Actinide Intrinsic Colloids	Constant	moles/liter	0.00E+00
3437	TH	Thorium	CONCMIN	Actinide Concentration with Mobile Mineral Fragment Colloids	Constant	moles/liter	2.60E-08
3320	TH	Thorium	PROPMIC	Moles of Actinide Mobilized on Microbe Colloids per Moles Dissolved	Constant	NONE	3.10E+00
3449	TH+4	Thorium IV	MD0	Molecular diffusion in pure fluid	Constant	m^2/s	1.53E-10
3478	TH+4	Thorium IV	MKD_TH	Matrix Partition Coefficient for Thorium	Log uniform	m^3/kg	Sampled Value
3460	U	Uranium	CAPHUM	Maximum Concentration of Actinide with Mobile Humic Colloids	Constant	moles/liter	1.10E-05
3308	U	Uranium	CAPMIC	Maximum Concentration of Actinide on Microbe Colloids	Constant	moles/liter	2.10E-03
3307	U	Uranium	CONCINT	Actinide Concentration with Mobile Actinide Intrinsic Colloids	Constant	moles/liter	0.00E+00
3438	U	Uranium	CONCMIN	Actinide Concentration with Mobile Mineral Fragment Colloids	Constant	moles/liter	2.60E-08
3309	U	Uranium	PROPMIC	Moles of Actinide Mobilized on Microbe Colloids per Moles Dissolved	Constant	NONE	2.10E-03
3446	U+4	Uranium IV	MD0	Molecular diffusion in pure fluid	Constant	m^2/s	1.53E-10
3479	U+4	Uranium IV	MKD_U	Matrix Partition Coefficient for Uranium	Log uniform	m^3/kg	Sampled Value
3448	U+6	Uranium VI	MD0	Molecular diffusion in pure fluid	Constant	m^2/s	4.26E-10
3475	U+6	Uranium VI	MKD_U	Matrix Partition Coefficient for Uranium	Log uniform	m^3/kg	Sampled Value