HLWYM HEmails

From: Randall Fedors
Sent: Tuesday, February 13, 2007 4:35 AM
To: 'sstothoff@swri.org'
Subject: RE: DOE thermal conductivity value for host rock
Attachments: DataFiles-TPA50_RFedors.wpd

Stu,

I found the place where I had described the external files (see attached). Of course, the PA staff also has these questionnaires. Sitakanta collected these and did who knows what with them.

Sorry I didn't find them sooner,
Randy

>>> Chandrika Manepally <cmanepally@cnwra.swri.edu> 02/12/07 6:30 PM >>>
Randy
Please send me your tpa questionnaires when you get a chance. I'm filling in the parameter spreadsheet and could use it for justification.
I was also wondering about DOE representation of parameter variation in TSPA. Do you know where we can access this list of these parameters (say in a AMR or part of TSPA-LA documentation)?
I'll check with PA staff here and see if they have something useful.

Thanks!
-Chandrika

-----Original Message-----
From: Randall Fedors [mailto:RWF@nrc.gov]
Sent: Monday, February 12, 2007 3:12 PM
To: Chandrika Manepally
Cc: kdas@cnwra.swri.edu
Subject: Re: DOE thermal conductivity value for host rock

Yes.
Including some accounting for lithophysae?
--Randy

>>> Chandrika Manepally <cmanepally@cnwra.swri.edu> 02/12/2007 4:05 PM >>>

Randy
I was looking into the basis for kth for host rock in TPA.
Should we modify the range? DOE has modified its values in its detailed process models (MSTHM uses a higher value for dry kth now compared to previous versions). Something we need to think about..

-Chandrika

Hearing Identifier: HLW_YuccaMountain_Hold_EX
Email Number: 136

Mail Envelope Properties (Randall.Fedors@nrc.gov20070213043456)

Subject: RE: DOE thermal conductivity value for host rock
Sent Date: 2/13/2007 4:34:56 AM
Received Date: 2/13/2007 4:34:56 AM
From: Randall Fedors

Created By: Randall.Fedors@nrc.gov

Recipients:
"'sstothoff@swri.org'" <sstothoff@swri.org>
Tracking Status: None

Post Office:

Files	**Size**	**Date & Time**
MESSAGE	1403	2/13/2007 4:34:56 AM
DataFiles-TPA50_RFedors.wpd	813734	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

Data Questionnaire for TPA Version 5.0

Auxiliary Input Data

Part 1. Identification

The following questionnaire deals with the auxiliary input data files used in the TPA Version 5.0 code. These files typically provide large amounts of data in arrays, often to represent time-dependent curves or response surface tables for complex parameters. This questionnaire represents a series of interactions that will take place between process modelers and performance assessors to ensure that a consistent set of standards were used in developing the data, including treatment of uncertainty. In this questionnaire, staff members are requested to provide qualitative and quantitative arguments, original data and documentation (as applicable) that were used to choose and develop the auxiliary data files. Please provide sufficient information so that the data files could be reproduced. Because of the limited time available prior to the TPA production runs, please respond by **January 10, 2004.**

1a. Name: Randy Fedors

1b. Name of Auxiliary Data File: bunitdem.dat

1c. Use of the Auxiliary File in TPA

Description of File *(kind of data, how data used by which TPA module, units of measure, format of file)*:

Description of file appears in Appendix H.

This is the description of the file as it appears in the TPA User's Guide, 2002.

The ITYM preprocessor software obtains bedrock type from the data file *bunitdem.dat*. This DEM assigns a bedrock unit to each pixel in the repository discretization according to the geologic map of Day et al. (1998). The same discretization is used for all other DEM listed in table H-2. The discretization consists of 199 columns and 300 rows with the lower left (SW) grid coordinate (545010, 4074000) expressed in UTM NAD27 easting and northing (m). The grid size is 30 m × 30 m. Bedrock unit data correspond to pixels beginning at the upper left-hand (NW) corner of the grid and continuing to the right every 30 m. The second row of pixels from the top of the grid moving left to right comprise the next set of bedrock unit, and so forth for all 300 rows of bedrock type. The first 15 lines and last 5 lines of the file *bunitdem.dat* are provided below.

```
# DEM of bedrock unit for each pixel; used in ITYM preprocessor software.
NROWS 300
NCOLS 199
XLLCORNER   545010
YLLCORNER  4074000
CELLSIZE 30
NODATA_VALUE -9999
1
1
1
1
```

```
1
1
1
1
     .
     .
     .
1
1
1
1
1
```

Part 2. Examination of Current Data *(Please refer to the current auxiliary input files for TPA and their descriptions in Appendix B or H of the TPA user's manual (Mohanty et al. 2002. Check as applicable.)*

	Fully Agree	Agree	Disagree	Fully Disagree
Data file description is acceptable	■	□	□	□
Current data is satisfactory	■	□	□	□
Data uncertainties are dealt with	□	□	■	□
Data should be updated	■	□	□	□

(Provide written comments if needed. For example, you might provide a better file description or you might supply a data update that better reflects current knowledge. If you supply new data below, continue this questionnaire presuming that data is in use. If you believe the data should be updated, but cannot do so at this time, when might it be available? Attach extra sheets of paper if needed.)

Comments on current data:

This file is a spatial representation of the surficial geology above the repository and is derived primarily from the geological map of Day et al. (1998). The information is used in the ITYM preprocessor to determine spatially dependent hydrological properties for the calculation of net infiltration.

Uncertainties in the geological map are not likely important to subarea averages of net infiltration.

The spatial coverage of this external file needs to be updated using the license application repository footprint instead of the modified EDA-II design currently used by TPA 5.0.

Part 3. Origin of the Data and Related Information *(Please outline the source of data and other information that you employed when choosing which data was most suitable and when deciding how to accommodate any uncertainties. Provide associated electronic files such as Excel spreadsheets and Mathcad worksheets; cite published reports or attach hard copies.)*

□ **Electronic file(s) provided** □ **Hard copy(ies) attached** ■ **Hard copy in library**

Comments on data source *(Attach extra sheets of paper if needed.)*:

Stothoff scientific notebook #163 describes the translation of the geological map to the 30-m x 30-m pixels of the bunitdem.dat file. The referenced for the geological map is Day, W.C., C.J. Potter, D. Sweetkind, R.P. Dickerson, and C.A. San Juan. "Bedrock Geologic Map of the

Central Block Area, Yucca Mountain, Nye County, Nevada." U.S. Geological Survey Miscellaneous Investigation Series, Map I–2601. Scale 1:6,000. 1998.

Part 4. Types and Potential Effects of Uncertainty *(Bearing in mind the scope of application of TPA, what general categories of uncertainty affect values in the auxiliary file? Some sources of uncertainty might be more important than others. Please select one or more categories of uncertainty below and rank their importance as **H**igh, **M**edium or **L**ow. Finally, indicate whether the uncertainty sources are now included in your data file or elsewhere in TPA - perhaps associated with another parameter.)*

	Type or cause of uncertainty	Rank (H, M or L)	Covered in your file? (Yes or No)
☐	no uncertainty: values are well known	___	___
☐	random errors in measurement	___	___
☐	systematic or biased errors in measurement	___	___
■	scarce applicable data or measurements	_L_	_N_
☐	extrapolations in time or space needed in conditioning the data for use in TPA	___	___
☐	underlying models, data and understanding are empirical - theoretical support is weak	___	___
☐	natural variability at different times	___	___
■	natural variability from place to place	_L_	_N_
☐	imprecise understanding of the data or model	___	___
☐	potential correlations and dependencies not quantified	___	___
☐	other _____*(please specify)*	___	___

(You might believe that some source of uncertainty should be ranked highly, but have also decided that this uncertainty could not be adequately covered in TPA. You might even have chosen to use a single constant value or values for the auxiliary data. Please comment on why you believe that significant uncertainties exist but those uncertainties are 'missing' in that they have not been captured using, for example, a PDF.)

Comments on missing uncertainties: *(Attach extra sheets of paper if needed.)*

Geological mapping can be an imprecise science when there is poor exposure of bedrock and a limited number of boreholes. Thin surficial cover leads to uncertainty in mapping contacts or delineating fault traces and orientations.

Part 5. Rationale Supporting Data Choices *(Please document information you employed in specifying data, including PDF attributes if applicable. Select as many as apply; sample choices include:*

***Obs** - abundance of appropriate laboratory or field observations and good understanding,*
***Exp** - sparse data but practical experience and knowledge of similar systems,*
***Alog** - known behavior of analogous situations, and*
***Rel** - closely related studies conducted elsewhere.)*

		Obs	Exp	Alog	Rel	Other
	Constant value(s) supplied as a single point, time series, table or array	■	☐	☐	☐	☐
PDF:	**upper and lower bounds** (or unbounded)	☐	☐	☐	☐	☐
	most likely values (for normal, lognormal, triangular)	☐	☐	☐	☐	☐

shape (symmetrical like normal, skewed like lognormal)	☐	☐	☐	☐	☐
discrete values or ranges (e.g., piecewise uniform to weight particular values or ranges of values)	☐	☐	☐	☐	☐
Correlated (i.e., are data to other parameters?)	☐	☐	☐	☐	☐
Other data (as described in Section 1c)	☐	☐	☐	☐	☐

*(Please elaborate on the following and related questions. What '**Other**' arguments have you invoked? Are the source of observed data (**Obs)** noted in Part 3? What practical experience (**Exp**) or related studies (**Rel**) best pertains to the TPA application? What is the relevance of the analogous behavior (**Alog**)? What arguments and reasoning support the choice of PDF bounds, shape and so forth? Have all important correlations been identified and specified?)*

Comments on data rationale: *(Attach extra sheets of paper if needed.)*
The geological map of Day, et al. (1998) is taken as a known for these analyses. No additional effort is warranted, except to update the file to cover the expanded area of the repository footprint in the license application. The current data covers the smaller area of the EDA-II design repository.

Part 6. Other Comments *(Please comment on any other issues that may impinge on the suitability of your data. For example, there may be strong qualifications on its use in extrapolations or its applicability under particular conditions. You may also be aware of new laboratory or field studies that might serve as a fresh source of information. Attach extra sheets of paper if needed.)*

The spatial extent needs to be updated for the license application repository footprint.

RF Randy Fedors 7/14/04
Name of Responder and Date

Please return to Sitakanta Mohanty (drop it in the mailbox).

Data Questionnaire for TPA Version 5.0

Auxiliary Input Data

Part 1. Identification

The following questionnaire deals with the auxiliary input data files used in the TPA Version 5.0 code. These files typically provide large amounts of data in arrays, often to represent time-dependent curves or response surface tables for complex parameters. This questionnaire represents a series of interactions that will take place between process modelers and performance assessors to ensure that a consistent set of standards were used in developing the data, including treatment of uncertainty. In this questionnaire, staff members are requested to provide qualitative and quantitative arguments, original data and documentation (as applicable) that were used to choose and develop the auxiliary data files. Please provide sufficient information so that the data files could be reproduced. Because of the limited time available prior to the TPA production runs, please respond by **January 10, 2004.**

1a. Name: Randy Fedors

1b. Name of Auxiliary Data File: careadem.dat

1c. Use of the Auxiliary File in TPA

Description of File *(kind of data, how data used by which TPA module, units of measure, format of file)*:

`Description of file appears in Appendix:` n/a; the next revision of Appendix H, Description of ITYM Preprocessor, will include the description provided below.

This file did not exist in TPA 4.0. New information is provided below.

The ITYM preprocessor software obtains upslope area from the data file careadem.dat to use for estimation of the contribution of runon in estimating net infiltration. This DEM assigns a value of upslope area to each pixel in the repository discretization according to a count of upslope pixels that would contribute water to the specified pixel; area of the pixel is accounted for. The same discretization is used for all other spatially-dependent data files listed in table H-2. The discretization consists of 199 columns and 300 rows with the lower left (SW) grid coordinate (545010, 4074000) expressed in UTM NAD27 easting and northing (m). The grid size is 30 m × 30 m. Upslope area data correspond to pixels beginning at the upper left-hand (NW) corner of the grid and continuing to the right every 30 m. The second row of pixels from the top of the grid moving left to right comprise the next set of bedrock unit, and so forth for all 300 rows of bedrock type. The first 15 lines and last 5 lines of the file careadem.dat are provided below.

```
NROWS 300
NCOLS 199
XLLCORNER   545010
YLLCORNER  4074000
CELLSIZE 30
NODATA_VALUE -9999
132.962
1090.82
1234.18
241.903
```

11525.6
40978.6
41490.2
35103.7
35575.9
.
.
.
93.8056
121.219
73.1133
137.273
63.1389

Part 2. Examination of Current Data *(Please refer to the current auxiliary input files for TPA and their descriptions in Appendix B or H of the TPA user's manual (Mohanty et al. 2002. Check as applicable.)*

	Fully Agree	Agree	Disagree	Fully Disagree
Data file description is acceptable	■	□	□	□
Current data is satisfactory	□	□	■	□
Data uncertainties are dealt with	□	□	■	□
Data should be updated	■	□	□	□

(Provide written comments if needed. For example, you might provide a better file description or you might supply a data update that better reflects current knowledge. If you supply new data below, continue this questionnaire presuming that data is in use. If you believe the data should be updated, but cannot do so at this time, when might it be available? Attach extra sheets of paper if needed.)

Comments on current data:
The data is derived from digital elevation data at 30 m intervals provided by the U.S. government. Simple routing algorithms were used to count upslope pixels at any location. The upslope area is used in the ITYM preprocessor to account for the runon contribution to net infiltration. The equation relating upslope area and upslope soil depth to runon and net infiltration is derived from process level modeling of the upper Split Wash Watershed on Yucca Mountain using the code KINEROS2.

The current data should be used until TPA 5.0 is updated to reflect the license application repository area, then careadem.dat should be updated to cover the expanded area of the license application repository.

Part 3. Origin of the Data and Related Information *(Please outline the source of data and other information that you employed when choosing which data was most suitable and when deciding how to accommodate any uncertainties. Provide associated electronic files such as Excel spreadsheets and Mathcad worksheets; cite published reports or attach hard copies.)*

□ **Electronic file(s) provided** □ **Hard copy(ies) attached**

Comments on data source *(Attach extra sheets of paper if needed.)*:
The elevations were obtained from the U.S. Geological Survey, who supply 30-m pixel DEM (Digital Elevation Model) data for most areas of the country.

Part 4. Types and Potential Effects of Uncertainty *(Bearing in mind the scope of application of TPA, what general categories of uncertainty affect values in the auxiliary file? Some sources of uncertainty might be more important than others. Please select one or more categories of uncertainty below and rank their importance as **H**igh, **M**edium or **L**ow. Finally, indicate whether the uncertainty sources are now included in your data file or elsewhere in TPA - perhaps associated with another parameter.)*

Type or cause of uncertainty	Rank (H, M or L)	Covered in your file? (Yes or No)
☐ no uncertainty: values are well known	___	___
☐ random errors in measurement	___	___
■ systematic or biased errors in measurement	_L_	_N_
☐ scarce applicable data or measurements	___	___
☐ extrapolations in time or space needed in conditioning the data for use in TPA	___	___
☐ underlying models, data and understanding are empirical - theoretical support is weak	___	___
☐ natural variability at different times	___	___
☐ natural variability from place to place	___	___
☐ imprecise understanding of the data or model	___	___
☐ potential correlations and dependencies not quantified	___	___
	___	___
☐ other _____*(please specify)*	___	___

(You might believe that some source of uncertainty should be ranked highly, but have also decided that this uncertainty could not be adequately covered in TPA. You might even have chosen to use a single constant value or values for the auxiliary data. Please comment on why you believe that significant uncertainties exist but those uncertainties are 'missing' in that they have not been captured using, for example, a PDF.)

Comments on missing uncertainties: *(Attach extra sheets of paper if needed.)*
All digital elevation model data at 30-m are an approximation, but the DEM data are the best available data covering the entire site.

Part 5. Rationale Supporting Data Choices *(Please document information you employed in specifying data, including PDF attributes if applicable. Select as many as apply; sample choices include:*
***Obs** - abundance of appropriate laboratory or field observations and good understanding,*
***Exp** - sparse data but practical experience and knowledge of similar systems,*
***Alog** - known behavior of analogous situations, and*
***Rel** - closely related studies conducted elsewhere.)*

	Obs	Exp	Alog	Rel	Other
Constant value(s) supplied as a single point, time series, table or array	■	☐	☐	☐	☐
PDF: upper and lower bounds (or unbounded)	☐	☐	☐	☐	☐
most likely values (for normal, lognormal, triangular)	☐	☐	☐	☐	☐
shape (symmetrical like normal, skewed like lognormal)	☐	☐	☐	☐	☐
discrete values or ranges (e.g., piecewise uniform to weight particular values or ranges of values)	☐	☐	☐	☐	☐
Correlated (i.e., are data to other parameters?)	☐	☐	☐	☐	☐

Other data (as described in Section 1c) ☐ ☐ ☐ ☐ ☐

*(Please elaborate on the following and related questions. What '**Other**' arguments have you invoked? Are the source of observed data (**Obs)** noted in Part 3? What practical experience (**Exp**) or related studies (**Rel**) best pertains to the TPA application? What is the relevance of the analogous behavior (**Alog**)? What arguments and reasoning support the choice of PDF bounds, shape and so forth? Have all important correlations been identified and specified?)*

Comments on data rationale: *(Attach extra sheets of paper if needed.)*
Upslope area is directly estimated from the U. S. Geological Survey 30-m pixel DEM, which is considered reliable for the scale of calculations used in ITYM for the TPA 5.0.

Part 6. Other Comments *(Please comment on any other issues that may impinge on the suitability of your data. For example, there may be strong qualifications on its use in extrapolations or its applicability under particular conditions. You may also be aware of new laboratory or field studies that might serve as a fresh source of information. Attach extra sheets of paper if needed.)*

The spatial extent needs to be updated for the license application repository footprint.

Randy Fedors 7/14/04
Name of Responder and Date

RF

Please return to Sitakanta Mohanty (drop it in the mailbox).

Data Questionnaire for TPA Version 5.0

Auxiliary Input Data

Part 1. Identification

The following questionnaire deals with the auxiliary input data files used in the TPA Version 5.0 code. These files typically provide large amounts of data in arrays, often to represent time-dependent curves or response surface tables for complex parameters. This questionnaire represents a series of interactions that will take place between process modelers and performance assessors to ensure that a consistent set of standards were used in developing the data, including treatment of uncertainty. In this questionnaire, staff members are requested to provide qualitative and quantitative arguments, original data and documentation (as applicable) that were used to choose and develop the auxiliary data files. Please provide sufficient information so that the data files could be reproduced. Because of the limited time available prior to the TPA production runs, please respond by **January 10, 2004.**

1a. Name: Randy Fedors

1b. Name of Auxiliary Data File: cdepdem.dat

1c. Use of the Auxiliary File in TPA

Description of File *(kind of data, how data used by which TPA module, units of measure, format of file)*:

`Description of file appears in Appendix:` n/a; n/a; the next revision of Appendix H, Description of ITYM Preprocessor, will include the description provided below.

This file did not exist in TPA 4.0. New information is provided below.

The ITYM preprocessor software obtains upslope average soil depth (m) from the data file cdepdem.dat to use for estimation of the contribution of runon in estimating net infiltration. This DEM assigns a value of upslope average soil depth to each pixel in the repository discretization according to the average soil depth of all upslope pixels that would contribute water to the specified pixel. The same discretization is used for all other spatially-dependent data files listed in table H-2. The discretization consists of 199 columns and 300 rows with the lower left (SW) grid coordinate (545010, 4074000) expressed in UTM NAD27 easting and northing (m). The grid size is 30 m × 30 m. Average upslope soil depth data correspond to pixels beginning at the upper left-hand (NW) corner of the grid and continuing to the right every 30 m. The second row of pixels from the top of the grid moving left to right comprise the next set of bedrock unit, and so forth for all 300 rows of bedrock type. The first 15 lines and last 5 lines of the file cdepdem.dat are provided below.

```
NROWS 300
NCOLS 199
XLLCORNER   545010
YLLCORNER  4074000
CELLSIZE 30
NODATA_VALUE -9999
1.12909
0.799209
3.94997
```

5.91172
3.52102
0.10177
0.086721
0.114273
0.0847346
.
.
.
5.01199
4.1582
7.69001
4.51291
10.3097

Part 2. Examination of Current Data *(Please refer to the current auxiliary input files for TPA and their descriptions in Appendix B or H of the TPA user's manual (Mohanty et al. 2002. Check as applicable.)*

	Fully Agree	Agree	Disagree	Fully Disagree
Data file description is acceptable	■	□	□	□
Current data is satisfactory	□	□	■	□
Data uncertainties are dealt with	□	□	■	□
Data should be updated	■	□	□	□

(Provide written comments if needed. For example, you might provide a better file description or you might supply a data update that better reflects current knowledge. If you supply new data below, continue this questionnaire presuming that data is in use. If you believe the data should be updated, but cannot do so at this time, when might it be available? Attach extra sheets of paper if needed.)

Comments on current data:
The data is derived by averaging the soil depth values from soildem.dat for the pixels that are upslope of the specified pixel. To determine the upslope pixels, the U.S. Geological Survey DEM used in elevdem.dat is processed using a simple routing algorithm to delineate upslope pixels from each pixel location. The average upslope soil depth is used in the ITYM preprocessor to account for the runon contribution to net infiltration. The equation relating upslope area and upslope average soil depth to runon and net infiltration is derived from process level modeling of the upper Split Wash Watershed on Yucca Mountain using the code KINEROS2.

The current data should be used until TPA 5.0 is updated to reflect the license application repository area, then cdepdem.dat should be updated to cover the expanded area of the license application repository.

Part 3. Origin of the Data and Related Information *(Please outline the source of data and other information that you employed when choosing which data was most suitable and when deciding how to accommodate any uncertainties. Provide associated electronic files such as Excel spreadsheets and Mathcad worksheets; cite published reports or attach hard copies.)*

□ **Electronic file(s) provided** □ **Hard copy(ies) attached**

Comments on data source *(Attach extra sheets of paper if needed.)*:

The elevations were obtained from the U.S. Geological Survey, who supply 30-m pixel DEM (Digital Elevation Model) data for most areas of the country; this data is contained in elevdem.dat. The soil depths were obtained from soildem.dat. The uncertainty is soil depths is not believed to significantly affect average upslope soil depths. The soil depth for each pixel are consistent with qualitative observations of soil depths at Yucca Mountain.

Part 4. Types and Potential Effects of Uncertainty *(Bearing in mind the scope of application of TPA, what general categories of uncertainty affect values in the auxiliary file? Some sources of uncertainty might be more important than others. Please select one or more categories of uncertainty below and rank their importance as **H**igh, **M**edium or **L**ow. Finally, indicate whether the uncertainty sources are now included in your data file or elsewhere in TPA - perhaps associated with another parameter.)*

Type or cause of uncertainty	Rank (H, M or L)	Covered in your file? (Yes or No)
☐ no uncertainty: values are well known	___	___
☐ random errors in measurement	___	___
■ systematic or biased errors in measurement	_L_	_N_
☐ scarce applicable data or measurements	___	___
☐ extrapolations in time or space needed in conditioning the data for use in TPA	___	___
☐ underlying models, data and understanding are empirical - theoretical support is weak	___	___
☐ natural variability at different times	___	___
☐ natural variability from place to place	___	___
☐ imprecise understanding of the data or model	___	___
☐ potential correlations and dependencies not quantified	___	___
	___	___
☐ other _____ *(please specify)*	___	___

(You might believe that some source of uncertainty should be ranked highly, but have also decided that this uncertainty could not be adequately covered in TPA. You might even have chosen to use a single constant value or values for the auxiliary data. Please comment on why you believe that significant uncertainties exist but those uncertainties are 'missing' in that they have not been captured using, for example, a PDF.)

Comments on missing uncertainties: *(Attach extra sheets of paper if needed.)*
Uncertainty in average soil depth is dependent on uncertainty in the USGS digital elevation model and the CNWRA soil depth model. All digital elevation model data at 30-m are an approximation, but the DEM data are the best available data covering the entire site. The soil depths in soildem.dat are based on the CNWRA soil depth model and are qualitatively similar to the soil depth estimates used by DOE in the USGS (2001, Simulation of Net Infiltration for Modern and Potential Future Climates. ANLNBS-HS-000032 REV 00 ICN 02.).

Part 5. Rationale Supporting Data Choices *(Please document information you employed in specifying data, including PDF attributes if applicable. Select as many as apply; sample choices include:*
***Obs** - abundance of appropriate laboratory or field observations and good understanding,*
***Exp** - sparse data but practical experience and knowledge of similar systems,*
***Alog** - known behavior of analogous situations, and*
***Rel** - closely related studies conducted elsewhere.)*

	Obs	Exp	Alog	Rel	Other
Constant value(s) supplied as a single point, time series, table or array	☐	☐	☐	☐	☐

PDF: upper and lower bounds (or unbounded)	☐	☐	☐	☐	☐
most likely values (for normal, lognormal, triangular)	☐	☐	☐	☐	☐
shape (symmetrical like normal, skewed like lognormal)	☐	☐	☐	☐	☐
discrete values or ranges (e.g., piecewise uniform to weight particular values or ranges of values)	☐	☐	☐	☐	☐
Correlated (i.e., are data to other parameters?)	☐	☐	☐	☐	☐
Other data (as described in Section 1c)	☐	☐	☐	☐	☐

*(Please elaborate on the following and related questions. What '**Other**' arguments have you invoked? Are the source of observed data (**Obs**) noted in Part 3? What practical experience (**Exp**) or related studies (**Rel**) best pertains to the TPA application? What is the relevance of the analogous behavior (**Alog**)? What arguments and reasoning support the choice of PDF bounds, shape and so forth? Have all important correlations been identified and specified?)*

Comments on data rationale: *(Attach extra sheets of paper if needed.)*
The upslope average slope depth data set is directly dependent on two other external files, elevdem.dat and soildepth.dat. The rational supporting those other data sets is discussed in the other corresponding questionnaires.

Part 6. Other Comments *(Please comment on any other issues that may impinge on the suitability of your data. For example, there may be strong qualifications on its use in extrapolations or its applicability under particular conditions. You may also be aware of new laboratory or field studies that might serve as a fresh source of information. Attach extra sheets of paper if needed.)*

The spatial extent needs to be updated for the license application repository footprint.

Randy Fedors 7/14/04
Name of Responder and Date

RF

Please return to Sitakanta Mohanty (drop it in the mailbox).

Data Questionnaire for TPA Version 5.0
Auxiliary Input Data

Part 1. Identification

The following questionnaire deals with the auxiliary input data files used in the TPA Version 5.0 code. These files typically provide large amounts of data in arrays, often to represent time-dependent curves or response surface tables for complex parameters. This questionnaire represents a series of interactions that will take place between process modelers and performance assessors to ensure that a consistent set of standards were used in developing the data, including treatment of uncertainty. In this questionnaire, staff members are requested to provide qualitative and quantitative arguments, original data and documentation (as applicable) that were used to choose and develop the auxiliary data files. Please provide sufficient information so that the data files could be reproduced. Because of the limited time available prior to the TPA production runs, please respond by **January 10, 2004.**

1a. Name: Randy Fedors

1b. Name of Auxiliary Data File: climato1.dat

1c. Use of the Auxiliary File in TPA

Description of File *(kind of data, how data used by which TPA module, units of measure, format of file)*:

Description of file appears in Appendix: B

This is the description of the file as it appears in the TPA User's Guide, 2002.

The file *climato1.dat* contains data utilized by UZFLOW to determine the climatic conditions (i.e., distributions for temperature and precipitation). Specifically, the information in *climato1.dat* is the distributed perturbation data that are used to calculate the time-varying mean annual precipitation and the mean annual temperature. The data from this file are utilized to add "noise" to mean annual precipitation and mean annual temperature. The first 20 lines and last 5 lines of this file are listed below.

```
 -5.7053335e-01
 -1.0290445e+00
 -1.1575096e+00
  9.8697251e-01
  1.2410360e+00
 -3.0644614e-01
 -1.9374674e-01
  1.1952564e+00
 -1.1220900e+00
  6.9738339e-01
 -5.2758746e-01
 -8.1619222e-01
 -2.0944012e-01
 -1.7963021e+00
  8.7311825e-01
 -1.4202760e-01
 -1.4503307e-01
 -5.1493563e-01
```

```
-3.9668029e-01
-7.5092842e-01

  .
  .
  .

-8.6848566e-01
-7.6236354e-01
-7.6825708e-01
-1.5438075e+00
-5.7736113e-01
```

Part 2. Examination of Current Data *(Please refer to the current auxiliary input files for TPA and their descriptions in Appendix B or H of the TPA user's manual (Mohanty et al. 2002. Check as applicable.)*

	Fully Agree	Agree	Disagree	Fully Disagree
Data file description is acceptable	■	□	□	□
Current data is satisfactory	■	□	□	□
Data uncertainties are dealt with	■	□	□	□
Data should be updated	□	□	■	□

(Provide written comments if needed. For example, you might provide a better file description or you might supply a data update that better reflects current knowledge. <u>If you supply new data below</u>, continue this questionnaire presuming that data is in use. If you believe the data should be updated, but cannot do so at this time, when might it be available? Attach extra sheets of paper if needed.)

Comments on current data:

The description in part 1c remains unchanged from that originally provided as part of this questionnaire process.

Climato1.dat provides intermediate scale variations in precipitation and temperature. Intermediate scale variations are on the order of multi-decade to century to millenia. Small-scale variations are inherently included in process-level modeling used to develop the net infiltration response surface in TPA. Large-scale variations are included in the climato2.dat file as climate change.

The climatic noise in climato1.dat has a mean value of 0 and a standard deviation of 1, which apparently was not based on precipitation (long records, tree-ring data, etc...) or other meteorological data. Clearly, correlation was used to develop the data set, but the correlation length was not back calculated for this questionnaire.

The climato1.dat climate noise was not used in TPA 3.2 and 4.x because the marked changes in flux led to difficulties with NEFTRAN simulations of transport (according to NRC and CNWRA Performance Assessment staff). Testing would be needed to determine if the NEFTRAN limitation still occurs in TPA 5.0. If not, then the data set should be evaluated for updating or clarification of correlation structure.

Part 3. Origin of the Data and Related Information *(Please outline the source of data and other information that you employed when choosing which data was most suitable and when deciding how to accommodate any uncertainties. Provide associated electronic files such as Excel spreadsheets and Mathcad worksheets; cite published reports or attach hard copies.)*

□ **Electronic file(s) provided** □ **Hard copy(ies) attached**

Comments on data source *(Attach extra sheets of paper if needed.)*:
The source of this data is unknown. Stuart Stothoff possibly provided the data set, but no reference to is was noted in his scientific notebook (#163).

Part 4. Types and Potential Effects of Uncertainty *(Bearing in mind the scope of application of TPA, what general categories of uncertainty affect values in the auxiliary file? Some sources of uncertainty might be more important than others. Please select one or more categories of uncertainty below and rank their importance as **H**igh, **M**edium or **L**ow. Finally, indicate whether the uncertainty sources are now included in your data file or elsewhere in TPA - perhaps associated with another parameter.)*

	Type or cause of uncertainty	Rank (H, M or L)	Covered in your file? (Yes or No)
□	no uncertainty: values are well known	___	___
□	random errors in measurement	___	___
□	systematic or biased errors in measurement	___	___
■	scarce applicable data or measurements	_L_	_N_
□	extrapolations in time or space needed in conditioning the data for use in TPA	___	___
□	underlying models, data and understanding are empirical - theoretical support is weak	___	___
■	natural variability at different times	_L_	_N_
■	natural variability from place to place	_L_	_N_
□	imprecise understanding of the data or model	___	___
□	potential correlations and dependencies not quantified	___	___
		___	___
□	other _____ *(please specify)*	___	___

(You might believe that some source of uncertainty should be ranked highly, but have also decided that this uncertainty could not be adequately covered in TPA. You might even have chosen to use a single constant value or values for the auxiliary data. Please comment on why you believe that significant uncertainties exist but those uncertainties are 'missing' in that they have not been captured using, for example, a PDF.)

Comments on missing uncertainties: *(Attach extra sheets of paper if needed.)*
This question is answered with respect to the uncertainty in the statistical parameters of the climate uncertainty. Although there is uncertainty in decadel to millenia precipitation and temperature, there is scarce data to support the mean, standard deviation, and correlation structure.

Part 5. Rationale Supporting Data Choices *(Please document information you employed in specifying data, including PDF attributes if applicable. Select as many as apply; sample choices include:*
***Obs** - abundance of appropriate laboratory or field observations and good understanding,*
***Exp** - sparse data but practical experience and knowledge of similar systems,*
***Alog** - known behavior of analogous situations, and*
***Rel** - closely related studies conducted elsewhere.)*

	Obs	Exp	Alog	Rel	Other
Constant value(s) supplied as a single point, time series, table or array	□	■	□	□	□
PDF: upper and lower bounds (or unbounded)	□	□	□	□	□
most likely values (for normal,	□	□	□	□	□

lognormal, triangular)					
shape (symmetrical like normal, skewed like lognormal)	☐	☐	☐	☐	☐
discrete values or ranges (e.g., piecewise uniform to weight particular values or ranges of values)	☐	☐	☐	☐	☐
Correlated (i.e., are data to other parameters?)	☐	☐	☐	☐	☐
Other data (as described in Section 1c)	☐	☐	☐	☐	☐

*(Please elaborate on the following and related questions. What '**Other**' arguments have you invoked? Are the source of observed data (**Obs)** noted in Part 3? What practical experience (**Exp**) or related studies (**Rel**) best pertains to the TPA application? What is the relevance of the analogous behavior (**Alog**)? What arguments and reasoning support the choice of PDF bounds, shape and so forth? Have all important correlations been identified and specified?)*

Comments on data rationale: *(Attach extra sheets of paper if needed.)*
No further evaluation of the climato1.dat data set is recommended until it is determined if TPA 5.0 can utilize it.

Part 6. Other Comments *(Please comment on any other issues that may impinge on the suitability of your data. For example, there may be strong qualifications on its use in extrapolations or its applicability under particular conditions. You may also be aware of new laboratory or field studies that might serve as a fresh source of information. Attach extra sheets of paper if needed.)*

Randy Fedors 7/15/04
RF Name of Responder and Date

Please return to Sitakanta Mohanty (drop it in the mailbox).

Data Questionnaire for TPA Version 5.0
Auxiliary Input Data

Part 1. Identification

The following questionnaire deals with the auxiliary input data files used in the TPA Version 5.0 code. These files typically provide large amounts of data in arrays, often to represent time-dependent curves or response surface tables for complex parameters. This questionnaire represents a series of interactions that will take place between process modelers and performance assessors to ensure that a consistent set of standards were used in developing the data, including treatment of uncertainty. In this questionnaire, staff members are requested to provide qualitative and quantitative arguments, original data and documentation (as applicable) that were used to choose and develop the auxiliary data files. Please provide sufficient information so that the data files could be reproduced. Because of the limited time available prior to the TPA production runs, please respond by **January 10, 2004.**

1a. Name: Randy Fedors

1b. Name of Auxiliary Data File: climato2.dat

1c. Use of the Auxiliary File in TPA

Description of File *(kind of data, how data used by which TPA module, units of measure, format of file)*:

Description of file appears in Appendix: B

UZFLOW reads three columns of data from *climato2.dat*. The first column is time in 1,000-years steps from 0 year to 100,000 years. The second and third columns are the fraction of full glacial *mean annual precipitation* and *mean annual temperature*, respectively. These data represent the variance from present-day precipitation and temperature conditions (0 at 0 year) to glacial conditions (1 at 50,000 years) and back to the equivalent of present-day conditions at 100,000 years. With these data, calculations performed in UZFLOW generate time-varying climatic conditions that provide distributions for *mean annual precipitation* and *mean annual temperature*. The first 21 lines and last 5 lines of *climato2.dat* are presented below.

```
0 0 0
1000 0.364364174 0.364364174
2000 0.50775941 0.50775941
3000 0.586599682 0.586599682
4000 0.632253812 0.632253812
5000 0.655878738 0.655878738
6000 0.655878738 0.655878738
7000 0.655878738 0.655878738
8000 0.655878738 0.655878738
9000 0.655878738 0.655878738
10000 0.655878738 0.655878738
11000 0.66734938 0.66734938
12000 0.678820022 0.678820022
13000 0.690290664 0.690290664
```

```
14000 0.701761306 0.701761306
15000 0.713231949 0.713231949
16000 0.724702591 0.724702591
17000 0.736173233 0.736173233
18000 0.747643875 0.747643875
19000 0.759114517 0.759114517
20000 0.770585159 0.770585159
  .
  .
  .
96000 -0.0615372 -0.0615372
97000 -0.0541378 -0.0541378
98000 -0.0416805 -0.0416805
99000 -0.024316 -0.024316
100000 -0.00225362 -0.00225362
```

Part 2. Examination of Current Data *(Please refer to the current auxiliary input files for TPA and their descriptions in Appendix B or H of the TPA user's manual (Mohanty et al. 2002. Check as applicable.)*

	Fully Agree	Agree	Disagree	Fully Disagree
Data file description is acceptable	■	□	□	□
Current data is satisfactory	■	□	□	□
Data uncertainties are dealt with	□	■	□	□
Data should be updated	■	□	□	□

(Provide written comments if needed. For example, you might provide a better file description or you might supply a data update that better reflects current knowledge. <u>If you supply new data below</u>, continue this questionnaire presuming that data is in use. If you believe the data should be updated, but cannot do so at this time, when might it be available? Attach extra sheets of paper if needed.)

Comments on current data:
The description and data in climato2.dat have been changed, please use the description noted in part 1c above.

TPA 4.0 User Manual cites NRC (1997) as the basis for equation 4-1 and 4-2 in Mohanty, et al. (2002). This equation could not be found in NRC (1997), nor was any applicable citation noted. Equation 4-1 creates a sine function with a high frequency (1000 to 2000-yr) variation in precipitation; clearly something is missing from the description in Mohanty, et al. (2002). Equation 4-2 may imply that the precipitation data is normalized to the sampled full glacial maximum value, but this is not clear.

Because the DOE estimates for precipitation with climate change are dramatically greater than those used by the NRC, the climato2.dat file was modified. The DOE analyses (CRWMS M&O, 2000; USGS, 2000) since NRC (1997) was completed suggest the modern climate will persist for 600 years, followed by 1400 years of monsoonal climate with 303 mm/yr precipitation. The remaining years to the performance period of 10,000 years are described as glacial transition with an mean case of 323 mm/yr precipitation. Values used DOE precipitation estimates are based on repository averages from USGS (2000). The climato2.dat file was modified with a smoothly increasing fraction such that the first 10,000 years of the file were similar to fractions used by DOE. After full glacial begins at approximately 40,000 years, the remaining years to 100,000 are left unchanged in the climato2.dat file. Thus, maintaining the NRC (1997)

conclusion that 60-80% of the 100,000 year cycle will be glacial climate.

Further revision to the climato2.dat is recommended to more fully support a 100,000 year cycle. the current modifications are intended to focus on the 10,000 year performance period and little attention was paid to the period from 10,000 to 100,000 years. In addition, this data distribution should be revisited after reviewing DOE documents currently being released as part of the license application. The review should account for the temperature decrease (glacial) or temperature unchanged (monsoonal) as precipitation increases for future climates, and the partial correlation with precipitation. The precipitation and temperature fractions in the climato2.dat external file should be revisited. Temperature and precipitation fractions of full glacial are currently identical. This does not account for a modern climate of hot and dry, and potential future climates of a monsoonal (hot and wet) and glacial (cool and wet). Step changes in MeanAnnualTemperatureIncreaseAtGlacialMaximum[degC] should account for the monsoonal and glacial transition climates.

Part 3. Origin of the Data and Related Information *(Please outline the source of data and other information that you employed when choosing which data was most suitable and when deciding how to accommodate any uncertainties. Provide associated electronic files such as Excel spreadsheets and Mathcad worksheets; cite published reports or attach hard copies.)*

- ☐ **Electronic file(s) provided** ☐ **Hard copy(ies) attached**

Comments on data source *(Attach extra sheets of paper if needed.)*:

CRWMS M&O. Future Climate Analysis. ANL-NBS-HS-000008. Las Vegas, Nevada: Civilian Radioactive Waste Management System Management and Operator. 2000.

Mohanty, et al. Total-System Performance Assessment (TPA) Version 4.0 Code: Module Descriptions and User's Guide. San Antonio, Texas: CNWRA. 2002.

NRC. Issue Resolution Status Report on Methods to Evaluate Climatic Change and Associated Effects at Yucca Mountain. Attachment to June 30, 1997 letter from N.K. Stablein (NRC) to S. Brocum (DOE). 1997.

USGS. Simulation of Net Infiltration for Modern and Future Climates. ANL-NBS-HS-000032 Rev 00. Las Vegas, Nevada: Yucca Mountain Project, U.S. Geological Survey. 2000.

The data set was calculated as follows. A sigmoidal fit to the DOE monsoonal and glacial transition data was for years 0-2000. Chapman (sigmoidal) equation for years 0-2000 can be described as:

a	0.7
b	0.0005
c	.07

f=a(1-e^(-bx))^c

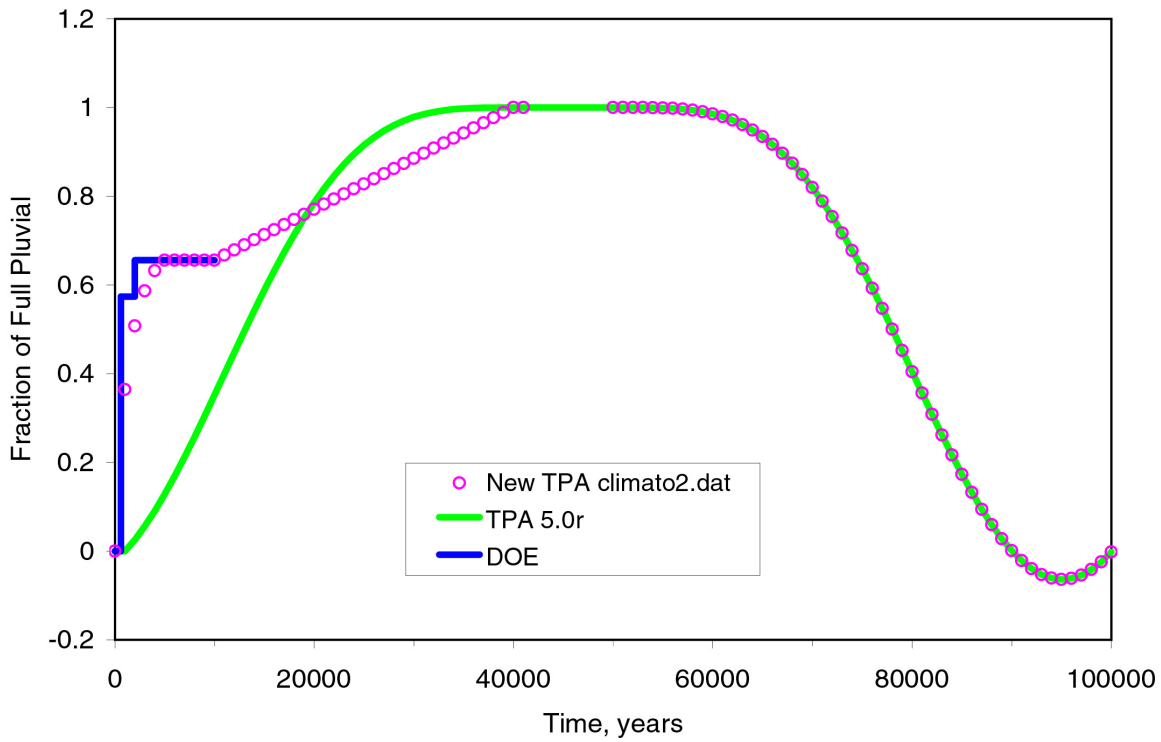
Although a sigmoidal fit may be excessive (a linear interpolation could be used), it gave more flexibility when matching the DOE step changes and in matching previous TPA climato2.dat.

Then the DOE fractions are used from year 3000 to 10,000. Values from 11,000 to 39,000 years were linearly interpolated from the 10,000 and 40,000 year fraction values. The full glacial fraction multiplier is approximately 1 at 40,000, which corresponds to a precipitation

value of 407 if the sampled multiplier is 2.5 (the NRC modern climate has 162.9 mm/yr preciptiation). Following a smooth transition to full glacial at 40,000 years, the remainder of the climato2.dat file was left unchanged.

The DOE fractions are as follows
average monsoonal precipitation over repository footprint = 303 mm/yr
monsoonal fraction = 0.573945
average glacial transition = 323 mm/yr
glacial transition fraction = 0.655879

The figure below illustrates the TPA Version 5.0r climato2.dat, the new recommended data, and the DOE step changes (only for the first 10,000 years).



Part 4. Types and Potential Effects of Uncertainty *(Bearing in mind the scope of application of TPA, what general categories of uncertainty affect values in the auxiliary file? Some sources of uncertainty might be more important than others. Please select one or more categories of uncertainty below and rank their importance as **H**igh, **M**edium or **L**ow. Finally, indicate whether the uncertainty sources are now included in your data file or elsewhere in TPA - perhaps associated with another parameter.)*

Covered in

Type or cause of uncertainty	Rank (H, M or L)	your file? (Yes or No)
☐ no uncertainty: values are well known	___	___
☐ random errors in measurement	___	___
☐ systematic or biased errors in measurement	___	___
☐ scarce applicable data or measurements	_M_	In Part
☐ extrapolations in time or space needed in conditioning the data for use in TPA	_M_	In Part
☐ underlying models, data and understanding are empirical - theoretical support is weak	_M_	In Part
☐ natural variability at different times	_M_	In Part
☐ natural variability from place to place	_L_	In Part
☐ imprecise understanding of the data or model	_M_	In Part
☐ potential correlations and dependencies not quantified	___	___
	___	___
☐ other _____*(please specify)*	___	___

(You might believe that some source of uncertainty should be ranked highly, but have also decided that this uncertainty could not be adequately covered in TPA. You might even have chosen to use a single constant value or values for the auxiliary data. Please comment on why you believe that significant uncertainties exist but those uncertainties are 'missing' in that they have not been captured using, for example, a PDF.)

Comments on missing uncertainties: *(Attach extra sheets of paper if needed.)*
Future climate is highly uncertain. TPA Version 5.0 uses a multiplier to bring in uncertainty, *MeanAnnualPrecipitationMultiplierAtGlacialMaximum*, and the climato1.dat normally distributed climate noise file (though use of climato1.dat may lead to NEFTRAN computational difficulties). Uncertainty is also addressed by conservatively using a glacial transition climate for much of the performance period of 10,000 years.

Part 5. Rationale Supporting Data Choices *(Please document information you employed in specifying data, including PDF attributes if applicable. Select as many as apply; sample choices include:*
Obs *- abundance of appropriate laboratory or field observations and good understanding,*
Exp *- sparse data but practical experience and knowledge of similar systems,*
Alog *- known behavior of analogous situations, and*
Rel *- closely related studies conducted elsewhere.)*

	Obs	Exp	Alog	Rel	Other
Constant value(s) supplied as a single point, time series, table or array	☐	■	☐	■	☐
PDF: upper and lower bounds (or unbounded)	☐	☐	☐	☐	☐
most likely values (for normal, lognormal, triangular)	☐	☐	☐	☐	☐
shape (symmetrical like normal, skewed like lognormal)	☐	☐	☐	☐	☐
discrete values or ranges (e.g., piecewise uniform to weight particular values or ranges of values)	☐	☐	☐	☐	☐
Correlated (i.e., are data to other parameters?)	☐	☐	☐	☐	☐
Other data (as described in Section 1c)	☐	☐	☐	☐	☐

*(Please elaborate on the following and related questions. What '**Other**' arguments have you invoked? Are the source of observed data (**Obs)** noted in Part 3? What practical experience (**Exp**) or related studies (**Rel**) best pertains to the TPA application? What is the relevance of the analogous behavior (**Alog**)? What arguments and reasoning support the choice of PDF bounds, shape and so forth? Have all important correlations been identified and specified?)*

Comments on data rationale: *(Attach extra sheets of paper if needed.)*
DOE analyses of past climates from Owens Lake, the Tule Lake area (across the border in California), Devil Hole (Amargosa Desert immediately south of Yucca Mountain), and packrat midden data near Yucca Mountain all support estimates for the 10,000 performance period. Fundamental to the DOE analyses is that the jet stream shifts to bring modern, monsoonal, and glacial climates to the Yucca Mountain area. The modified climato2.dat file is consistent with NRC (1997) analyses that note 60-80 percent of the 10,000 year performance period should be glacial climate, and that there is a 100,000 Milankovitch cycle where the modern hot and dry climate will return after a full glacial period.

Part 6. Other Comments *(Please comment on any other issues that may impinge on the suitability of your data. For example, there may be strong qualifications on its use in extrapolations or its applicability under particular conditions. You may also be aware of new laboratory or field studies that might serve as a fresh source of information. Attach extra sheets of paper if needed.)*

RF Randy Fedors 7/21/04
Name of Responder and

Date

Please return to Sitakanta Mohanty (drop it in the mailbox).

Data Questionnaire for TPA Version 5.0
Auxiliary Input Data

Part 1. Identification

The following questionnaire deals with the auxiliary input data files used in the TPA Version 5.0 code. These files typically provide large amounts of data in arrays, often to represent time-dependent curves or response surface tables for complex parameters. This questionnaire represents a series of interactions that will take place between process modelers and performance assessors to ensure that a consistent set of standards were used in developing the data, including treatment of uncertainty. In this questionnaire, staff members are requested to provide qualitative and quantitative arguments, original data and documentation (as applicable) that were used to choose and develop the auxiliary data files. Please provide sufficient information so that the data files could be reproduced. Because of the limited time available prior to the TPA production runs, please respond by **January 10, 2004.**

1a. Name: ~~James Winterle~~ Randy Fedors

1b. Name of Auxiliary Data File: dilution.dat

1c. Use of the Auxiliary File in TPA

Description of File *(kind of data, how data used by which TPA module, units of measure, format of file)*:

Description of file appears in Appendix: B

This is the description of the file as it appears in the TPA User's Guide, 2002.

For the residential receptor group, the calculation of the fraction of total plume mass captured from well pumping uses data in *dilution.dat*. The DCAGW module reads data from *dilution.dat* and performs linear interpolation to find capture width, capture thickness, and screen length. The *dilution.dat* file supplies data for well capture width and well capture thickness as functions of pumping rate and aquifer thickness. Additionally, data for the well screen length are provided as a function of pumping rate. The well pumping rate, aquifer thickness, and plume thickness are sampled parameters defined in *tpa.inp*. Using values for capture width, capture thickness, screen length, and plume thickness, along with the sum of all streamtube widths read from *strmtube.dat* file, the fraction of the total plume mass captured by pumping is calculated. A complete listing of *dilution.dat* is presented below.

```
TITLE: TPA4.0 Wellbore dilution data for the saturated zone.
TITLE: (data from R. Fedors 1/5/98 - prepared by rwr)
TITLE: (Updated 9/99)
** (data must be in the following sequence and format
**  with the same pump rates and aquifer thicknesses
**  for capture width and capture thicknesses - the screen
**  length pump rates can be different than those for
**  capture width and thickness)
**
```

```
**
** Number of Values for Pump Rate
  8
**
** Number of Values for Aquifer Thickness
  5
**
**
** Capture Width (meters)
**
**  Pump Rate            Aquifer Thickness
**   (m^3/d)                     (m)
                  300.   475.   650.   825.   1000.
**
        3.4        82.    82.    82.    82.     82.
       10.        142.   142.   142.   142.    142.
       50.        327.   323.   320.   319.    319.
      240.        850.   760.   730.   720.    712.
      430.       1292.  1084.  1010.   984.    966.
      620.       1728.  1378.  1260.  1204.   1178.
      810.       2180.  1662.  1490.  1412.   1370.
     1000.       2590.  1940.  1706.  1600.   1532.
**
**
** Capture Thickness (meters)
**
**  Pump Rate            Aquifer Thickness
**   (m^3/d)                     (m)
                  300.   475.   650.   825.   1000.
**
        3.4        41.    41.    41.    41.     41.
       10.         71.    71.    71.    71.     71.
       50.        150.   156.   158.   159.    159.
      240.        268.   314.   330.   338.    341.
      430.        300.   387.   423.   440.    449.
      620.        300.   427.   485.   513.    529.
      810.        300.   451.   530.   571.    593.
     1000.        300.   464.   564.   617.    646.
**
**
** Screen Length (meters)
**
** Number of Values for Screen Length Pump Rate
  8
**
**  Pump Rate     Screen Length
**   (m^3/d)          (m)
**
        3.4            3.
       10.             3.
       50.             8.
      240.            19.
      430.            27.
```

```
      620.            34.
      810.            40.
     1000.            45.
**
endoffile
```

Part 2. Examination of Current Data *(Please refer to the current auxiliary input files for TPA and their descriptions in Appendix B or H of the TPA user's manual (Mohanty et al. 2002. Check as applicable.)*

	Fully Agree	Agree	Disagree	Fully Disagree
Data file description is acceptable	■	□	□	□
Current data is satisfactory	□	■	□	□
Data uncertainties are dealt with	□	□	■	□
Data should be updated	□	□	□	■

(Provide written comments if needed. For example, you might provide a better file description or you might supply a data update that better reflects current knowledge. If you supply new data below, continue this questionnaire presuming that data is in use. If you believe the data should be updated, but cannot do so at this time, when might it be available? Attach extra sheets of paper if needed.)

Comments on current data:
The description and values have not been changed.

The values do not need to be updated unless the Part 63 regulations are changed. Part 63 specifies that all radionuclides are captured and that 3000 ac-ft is pumped form the well(s). Therefore, the concentration need not consider the effect of borehole dilution. While the model for borehole dilution is not used under the Part 63 regulation, it is retained in the TPA code in case future changes to the regulations or interpretation of the regulations are made.

If and when the borehole dilution model needs to be used, the data could be updated to support larger pumping rates. The original design of the module considered wells supporting small residential communities at 5 km, not irrigation wells at 18 km. To apply this approach to distances of 18 km, an analysis would be needed to account for the width of the streamtubes and the switch from the tuff to the alluvium in the transport pathway. To better support borehole dilution, numerical modeling of the flow legs in the tuff and alluvium would be needed. The existing basis was developed using analytical solutions to groundwater flow and transport. David Farrell began some numerical modeling using either the PORFLOW or BIGFLOW numerical code. These analyses have not yet been completed or documented.

When the regulations are changed or reinterpreted, uncertainty in the data provided in the external file will be assessed.

Part 3. Origin of the Data and Related Information *(Please outline the source of data and other information that you employed when choosing which data was most suitable and when deciding how to accommodate any uncertainties. Provide associated electronic files such as Excel spreadsheets and Mathcad worksheets; cite published reports or attach hard copies.)*

□ **Electronic file(s) provided** ■ **Hard copy(ies) attached**

Comments on data source *(Attach extra sheets of paper if needed.)*:
For archival purposes, an informal writeup summarizing conceptual model, equations, and

results is attached. This description provides the supporting bases for the tables in dilution.dat.

Part 4. Types and Potential Effects of Uncertainty *(Bearing in mind the scope of application of TPA, what general categories of uncertainty affect values in the auxiliary file? Some sources of uncertainty might be more important than others. Please select one or more categories of uncertainty below and rank their importance as **H**igh, **M**edium or **L**ow. Finally, indicate whether the uncertainty sources are now included in your data file or elsewhere in TPA - perhaps associated with another parameter.)*

Type or cause of uncertainty	Rank (H, M or L)	Covered in your file? (Yes or No)
☐ no uncertainty: values are well known	___	___
☐ random errors in measurement	___	___
☐ systematic or biased errors in measurement	___	___
■ scarce applicable data or measurements	_M_	_N_
☐ extrapolations in time or space needed in conditioning the data for use in TPA	___	___
■ underlying models, data and understanding are empirical - theoretical support is weak	_M_	_N_
■ natural variability at different times	_L_	_N_
■ natural variability from place to place	_L_	_N_
☐ imprecise understanding of the data or model	___	___
☐ potential correlations and dependencies not quantified	___	___
☐ other _____*(please specify)*	___	___

(You might believe that some source of uncertainty should be ranked highly, but have also decided that this uncertainty could not be adequately covered in TPA. You might even have chosen to use a single constant value or values for the auxiliary data. Please comment on why you believe that significant uncertainties exist but those uncertainties are 'missing' in that they have not been captured using, for example, a PDF.)

Comments on missing uncertainties: *(Attach extra sheets of paper if needed.)*
Additional work to address uncertainties is not warranted because use of this external data set is now precluded by federal regulation (18 km distance, capture all radionuclides).

Part 5. Rationale Supporting Data Choices *(Please document information you employed in specifying data, including PDF attributes if applicable. Select as many as apply; sample choices include:*
***Obs** - abundance of appropriate laboratory or field observations and good understanding,*
***Exp** - sparse data but practical experience and knowledge of similar systems,*
***Alog** - known behavior of analogous situations, and*
***Rel** - closely related studies conducted elsewhere.)*

	Obs	Exp	Alog	Rel	Other
Constant value(s) supplied as a single point, time series, table or array	☐	☐	☐	☐	☐
PDF: upper and lower bounds (or unbounded)	☐	☐	☐	☐	☐
most likely values (for normal, lognormal, triangular)	☐	☐	☐	☐	☐
shape (symmetrical like normal, skewed like lognormal)	☐	☐	☐	☐	☐
discrete values or ranges	☐	☐	☐	☐	☐

(e.g., piecewise uniform to weight particular values or ranges of values)					
Correlated (i.e., are data to other parameters?)	☐	☐	☐	☐	☐
Other data (as described in Section 1c)	☐	☐	☐	☐	☐

*(Please elaborate on the following and related questions. What '**Other**' arguments have you invoked? Are the source of observed data (**Obs)** noted in Part 3? What practical experience (**Exp**) or related studies (**Rel**) best pertains to the TPA application? What is the relevance of the analogous behavior (**Alog**)? What arguments and reasoning support the choice of PDF bounds, shape and so forth? Have all important correlations been identified and specified?)*

Comments on data rationale: *(Attach extra sheets of paper if needed.)*
Reassessment of the values and possibility of introducing or changing constant parameters to sampled parameters to address uncertainties is not warranted because use of this external data set is now precluded by federal regulation (Part 63 specification of 18 km distance, capture all radionuclides in well pumping annual 3000 ac-ft). New data and a better rationale can be generated if and when the module will be used again.

Part 6. Other Comments *(Please comment on any other issues that may impinge on the suitability of your data. For example, there may be strong qualifications on its use in extrapolations or its applicability under particular conditions. You may also be aware of new laboratory or field studies that might serve as a fresh source of information. Attach extra sheets of paper if needed.)*

_____
_____
_____
_____

R. Fedors 7/13/04, updated 8/30/04

Signature/Date

Please return to Sitakanta Mohanty (drop it in RF the mailbox).

Data Questionnaire for TPA Version 5.0

Auxiliary Input Data

Part 1. Identification

The following questionnaire deals with the auxiliary input data files used in the TPA Version 5.0 code. These files typically provide large amounts of data in arrays, often to represent time-dependent curves or response surface tables for complex parameters. This questionnaire represents a series of interactions that will take place between process modelers and performance assessors to ensure that a consistent set of standards were used in developing the data, including treatment of uncertainty. In this questionnaire, staff members are requested to provide qualitative and quantitative arguments, original data and documentation (as applicable) that were used to choose and develop the auxiliary data files. Please provide sufficient information so that the data files could be reproduced. Because of the limited time available prior to the TPA production runs, please respond by **January 10, 2004.**

1a. Name: ~~Chandrika Manepally~~ Randy Fedors

1b. Name of Auxiliary Data File: drythick.dat

1c. Use of the Auxiliary File in TPA

Description of File *(kind of data, how data used by which TPA module, units of measure, format of file)*:

Description of file appears in Appendix: B

This is the description of the file as it appears in the TPA User's Guide, 2002.

When the user selects the reflux3 model, calculations performed in the NFENV module utilize the data in *drythick.dat.* The dry-out zone modeled in the TPA code is the region above the drift and below the condensate zone where heat from the drift vaporizes water that resides in the rock pore volume. This vapor moves upward to the condensate zone where the temperature is below boiling. For water to flow onto the waste package from the reflux zone, the water must either penetrate the dry-out zone or the dry-out zone thickness must be zero. The data in *drythick.dat* provide the dry-out zone thickness in meters at 18 different time steps beginning at 1 year through 900 years. These values were derived from MULTIFLO simulations performed offline. A complete listing of *drythick.dat* is presented as follows.

```
18
  1    1.0    0.0
  2   10.0    0.1
  3   20.0    1.0
  4   30.0    1.5
  5   40.0    1.7
  6   50.0    1.5
  7   60.0    1.5
  8   70.0    1.8
  9   80.0    2.9
 10  100.0    4.6
 11  200.0    7.3
 12  300.0    7.4
 13  500.0    6.6
```

```
 14  600.0    5.6
 15  700.0    4.7
 16  800.0    3.8
 17  900.0    2.7
 18 1000.0    0.0
```

Part 2. Examination of Current Data *(Please refer to the current auxiliary input files for TPA and their descriptions in Appendix B or H of the TPA user's manual (Mohanty et al. 2002. Check as applicable.)*

	Fully Agree	Agree	Disagree	Fully Disagree
Data file description is acceptable	■	□	□	□
Current data is satisfactory	□	□	■	□
Data uncertainties are dealt with	□	□	■	□
Data should be updated	■	□	□	□

(Provide written comments if needed. For example, you might provide a better file description or you might supply a data update that better reflects current knowledge. <u>If you supply new data below</u>, continue this questionnaire presuming that data is in use. If you believe the data should be updated, but cannot do so at this time, when might it be available? Attach extra sheets of paper if needed.)

Comments on current data:
Please use the corrected description provided in part 1c. Previously, 17 records were specified at the first data record. The use of 17 records instead of 18 incorrectly kept the dryout thickness at 2.7 m for the entire performance period. This correction has already been made in the actual external file used by TPA 5.0.

CNWRA work is currently underway to update the dryout.dat data set, but is not yet available for use. The current data is derived from two-dimensional, dual-continuum, thermohydrologic modeling using MULTIFLO Version 1.2 as described in Hughson (2000). Table 3-1 of Hughson (2000) contains the dryout thickness data. Updated dryout thickness values should utilize a refined grid, the EDA-II or license application heat load, and thermohydrological property values consistent with license application DOE models.

It is not clear what the DOE thermohydrological models estimate for dryout thickness. The DOE maintains that no water will preferentially breach the dryout zone, thus no estimate of dryout thickness is needed. A drift wall temperature threshold of 100 °C is being recommended for TSPAI usage (Bechtel SAIC Company, LLC, 2003, Abstraction of Drift Seepage) to determine when the vaporization barrier is no longer prominent (vaporization barrier is synonymous with dryout thickness).

Part 3. Origin of the Data and Related Information *(Please outline the source of data and other information that you employed when choosing which data was most suitable and when deciding how to accommodate any uncertainties. Provide associated electronic files such as Excel spreadsheets and Mathcad worksheets; cite published reports or attach hard copies.)*

■ **Electronic file(s) provided** □ **Hard copy(ies) attached**

Comments on data source *(Attach extra sheets of paper if needed.)*:
Word Perfect file of Hughson (2000) provided on cdrom; Thermal Effects on Flow Process-Level Sensitivity Analysis Status Report, CNWRA Letter Report.

Part 4. Types and Potential Effects of Uncertainty *(Bearing in mind the scope of application of TPA, what general categories of uncertainty affect values in the auxiliary file? Some sources of uncertainty might be more important than others. Please select one or more categories of uncertainty below and rank their importance as **H**igh, **M**edium or **L**ow. Finally, indicate whether the uncertainty sources are now included in your data file or elsewhere in TPA - perhaps associated with another parameter.)*

Type or cause of uncertainty	Rank (H, M or L)	Covered in your file? (Yes or No)
☐ no uncertainty: values are well known	___	___
☐ random errors in measurement	___	___
☐ systematic or biased errors in measurement	___	___
☐ scarce applicable data or measurements	___	___
☐ extrapolations in time or space needed in conditioning the data for use in TPA	_M_	_N_
☐ underlying models, data and understanding are empirical - theoretical support is weak	___	___
☐ natural variability at different times	___	___
☐ natural variability from place to place	_M_	_N_
☐ imprecise understanding of the data or model	_M_	_N_
☐ potential correlations and dependencies not quantified	___	___
	___	___
☐ other _____ *(please specify)*	___	___

(You might believe that some source of uncertainty should be ranked highly, but have also decided that this uncertainty could not be adequately covered in TPA. You might even have chosen to use a single constant value or values for the auxiliary data. Please comment on why you believe that significant uncertainties exist but those uncertainties are 'missing' in that they have not been captured using, for example, a PDF.)

Comments on missing uncertainties: *(Attach extra sheets of paper if needed.)*
Uncertainty in dryout thickness is complexly linked to the uncertainties in the thermohdyrological model used to develop the data set. Heterogeneity, locations along drifts, effects of drift degradation are not the only uncertainties. Defining the dryout thickness has proved to be elusive. Historically, dryout thickness has been estimated based on location of the boiling isotherm. The dryout thickness, however, is highly sensitive to estimates of the boiling temperature; dryout thicknesses can more than double if 96 °C is used instead of 97 °C for the boiling point temperature. Dryout thickness based on saturations is another possibility, but a "dry" saturation level needs to be determined along a continuum of saturations near the "dry" end of conditions for the rock (note that "dry" is not dry). Also, note that a conservative choice for dryout thickness is difficult to determine because there are confounding influences (a thick dryout zone means it is more difficult to breach the long distance, but there is more water present in the condensate zone with which to preferentially breach the dryout zone).

To improve the applicability of the dryout.dat data set, TPA 5.0 should be changed to link the dryout thickness to the driftwall temperatures. TPA 5.0 uses the same dryout thickness data regardless of driftwall or waste package temperature. For example, edge locations never get above boiling, yet the full dryout thickness is still applied. Or, drift degradation will significantly elevate temperatures and delay the return of water to the drift wall, yet the same dryout thickness would be applied. Linking the dryout thickness to the drift wall temperatures would require additional analyses that are not yet complete.

Part 5. Rationale Supporting Data Choices *(Please document information you employed in specifying data, including PDF attributes if applicable. Select as many as apply; sample choices include:*

Obs *- abundance of appropriate laboratory or field observations and good understanding,*
Exp *- sparse data but practical experience and knowledge of similar systems,*
Alog *- known behavior of analogous situations, and*
Rel *- closely related studies conducted elsewhere.)*

	Obs	Exp	Alog	Rel	Other
Constant value(s) supplied as a single point, time series, table or array	☐	■	☐	☐	☐
PDF: upper and lower bounds (or unbounded)	☐	☐	☐	☐	☐
most likely values (for normal, lognormal, triangular)	☐	☐	☐	☐	☐
shape (symmetrical like normal, skewed like lognormal)	☐	☐	☐	☐	☐
discrete values or ranges (e.g., piecewise uniform to weight particular values or ranges of values)	☐	☐	☐	☐	☐
Correlated (i.e., are data to other parameters?)	☐	☐	☐	☐	☐
Other data (as described in Section 1c)	☐	☐	☐	☐	☐

*(Please elaborate on the following and related questions. What '**Other**' arguments have you invoked? Are the source of observed data (**Obs)** noted in Part 3? What practical experience (**Exp**) or related studies (**Rel**) best pertains to the TPA application? What is the relevance of the analogous behavior (**Alog**)? What arguments and reasoning support the choice of PDF bounds, shape and so forth? Have all important correlations been identified and specified?)*

Comments on data rationale: *(Attach extra sheets of paper if needed.)*
Hughson (2000) provided a dryout thickness time profile that was applicable to the center location of the repository. Hughson (2000) used thermohydrological property values and heat loads available at that time.

Part 6. Other Comments *(Please comment on any other issues that may impinge on the suitability of your data. For example, there may be strong qualifications on its use in extrapolations or its applicability under particular conditions. You may also be aware of new laboratory or field studies that might serve as a fresh source of information. Attach extra sheets of paper if needed.)*

RF Randy Fedors 7/14/04
Name of Responder and Date

Please return to Sitakanta Mohanty (drop it in the mailbox).

Data Questionnaire for TPA Version 5.0
Auxiliary Input Data

The following questionnaire deals with the auxiliary input data files used in the TPA Version 5.0 code. These files typically provide large amounts of data in arrays, often to represent time-dependent curves or response surface tables for complex parameters. This questionnaire represents a series of interactions that will take place between process modelers and performance assessors to ensure that a consistent set of standards were used in developing the data, including treatment of uncertainty. In this questionnaire, staff members are requested to provide qualitative and quantitative arguments, original data and documentation (as applicable) that were used to choose and develop the auxiliary data files. Please provide sufficient information so that the data files could be reproduced. Because of the limited time available prior to the TPA production runs, please respond by **January 10, 2004.**

Part 1. Identification

1a. Name: Randy Fedors

1b. Name of Auxiliary Data File: elevdem.dat

1c. Use of the Auxiliary File in TPA

Description of File *(kind of data, how data used by which TPA module, units of measure, format of file)*:

Description of file appears in Appendix: H

This is the description of the file as it appears in the TPA User's Guide, 2002.

The ITYM preprocessor software obtains ground surface elevations (m) from the data file *elevdem.dat*. A DEM is used to assign a ground surface elevation to each pixel in the repository discretization. The same discretization is utilized to generate all of the DEM files listed in table H-2. The discretization consists of 199 columns and 300 rows with the lower left (SW) grid coordinate (545010, 4074000) expressed in Universal Transverse Mercator (UTM) NAD27 easting and northing (m). The grid size is 30 m × 30 m. Ground surface elevation data correspond to pixels beginning at the upper left-hand (NW) corner of the grid and continuing to the right every 30 m. The second row of pixels from the top of the grid moving left to right comprise the next set of ground surface elevations, and so forth for all 300 rows. The first 20 lines and last 5 lines of the file *elevdem.dat* are provided below.

```
# DEM of ground surface elevation [m] for each pixel
# Coordinate system is UTM NAD27 [m]
NROWS 300
NCOLS 199
XLLCORNER   545010
YLLCORNER  4074000
CELLSIZE 30
NODATA_VALUE -9999
1460
1460
1462
1469
```

```
1472
1477
1481
1485
1491
1497
1505
1510
  .
  .
  .
1142
1135
1129
1121
1116
```

Part 2. Examination of Current Data *(Please refer to the current auxiliary input files for TPA and their descriptions in Appendix B or H of the TPA user's manual (Mohanty et al. 2002. Check as applicable.)*

	Fully Agree	Agree	Disagree	Fully Disagree
Data file description is acceptable	■	□	□	□
Current data is satisfactory	■	□	□	□
Data uncertainties are dealt with	□	□	■	□
Data should be updated	■	□	□	□

(Provide written comments if needed. For example, you might provide a better file description or you might supply a data update that better reflects current knowledge. If you supply new data below, continue this questionnaire presuming that data is in use. If you believe the data should be updated, but cannot do so at this time, when might it be available? Attach extra sheets of paper if needed.)

Comments on current data:
A revised description is provided in part 1c. Apparently there was an error, possibly in creation of this questionnaire, such that part of itym.dat was included in the first 20 and last 5 lines of elevdem.dat.

The data comes from the U.S. Geological Survey cartography division. It is freely provided on the web. This DEM (digital elevation model) is from the NW Busted Butte quadrangle. There are likely errors in the data that are not addressed here. Using a single representative elevation for a 30 m by 30 m area, while not realistic, is sufficient for use with the net infiltration model. In addition, elevations of USGS contour maps and control points can be off by a meter or more, but relative elevations within the map are generally more accurate. Elevation data should be considered a known.

Data should be updated for license application repository footprint. Projected areas of the license application repository based on presentations may be sufficient to determine the footprint area.

Part 3. Origin of the Data and Related Information *(Please outline the source of data and other information that you employed when choosing which data was most suitable and when deciding how to accommodate any uncertainties. Provide associated electronic files such as Excel spreadsheets and Mathcad worksheets; cite published reports or attach hard copies.)*

□ **Electronic file(s) provided** □ **Hard copy(ies) attached**

Comments on data source *(Attach extra sheets of paper if needed.)*:
The elevation data was obtained from the U.S. Geological Survey.

Part 4. Types and Potential Effects of Uncertainty *(Bearing in mind the scope of application of TPA, what general categories of uncertainty affect values in the auxiliary file? Some sources of uncertainty might be more important than others. Please select one or more categories of uncertainty below and rank their importance as **H**igh, **M**edium or **L**ow. Finally, indicate whether the uncertainty sources are now included in your data file or elsewhere in TPA - perhaps associated with another parameter.)*

	Type or cause of uncertainty	Rank (H, M or L)	Covered in your file? (Yes or No)
□	no uncertainty: values are well known	___	___
■	random errors in measurement	_L_	_N_
■	systematic or biased errors in measurement	_L_	_N_
■	scarce applicable data or measurements	_L_	_N_
□	extrapolations in time or space needed in conditioning the data for use in TPA	___	___
□	underlying models, data and understanding are empirical - theoretical support is weak	___	___
□	natural variability at different times	___	___
□	natural variability from place to place	___	___
□	imprecise understanding of the data or model	___	___
□	potential correlations and dependencies not quantified	___	___
□	other _____*(please specify)*	___	___

(You might believe that some source of uncertainty should be ranked highly, but have also decided that this uncertainty could not be adequately covered in TPA. You might even have chosen to use a single constant value or values for the auxiliary data. Please comment on why you believe that significant uncertainties exist but those uncertainties are 'missing' in that they have not been captured using, for example, a PDF.)

Comments on missing uncertainties: *(Attach extra sheets of paper if needed.)*
Uncertainty in 30 m by 30 m pixel elevation data is derived from topographic contour maps, which are generally derived from satellite and air photos. Control points in the Yucca Mountain error help to tie-down elevations at specific locations. These surveyed-in control points can be in error both in elevations (several meters) and horizontal placement (up to 10 m) in the YM area based on staff experience. In an average sense, these errors and uncertainties are not worth considering in the net infiltration calculations.

Part 5. Rationale Supporting Data Choices *(Please document information you employed in specifying data, including PDF attributes if applicable. Select as many as apply; sample choices include:*
***Obs** - abundance of appropriate laboratory or field observations and good understanding,*
***Exp** - sparse data but practical experience and knowledge of similar systems,*
***Alog** - known behavior of analogous situations, and*
***Rel** - closely related studies conducted elsewhere.)*

	Obs	Exp	Alog	Rel	Other
Constant value(s) supplied as a single point, time series, table or array	□	□	□	□	■
PDF: upper and lower bounds	□	□	□	□	□

(or unbounded)					
most likely values (for normal, lognormal, triangular)	☐	☐	☐	☐	☐
shape (symmetrical like normal, skewed like lognormal)	☐	☐	☐	☐	☐
discrete values or ranges (e.g., piecewise uniform to weight particular values or ranges of values)	☐	☐	☐	☐	☐
Correlated (i.e., are data to other parameters?)	☐	☐	☐	☐	☐
Other data (as described in Section 1c)	☐	☐	☐	☐	☐

*(Please elaborate on the following and related questions. What '**Other**' arguments have you invoked? Are the source of observed data (**Obs**) noted in Part 3? What practical experience (**Exp**) or related studies (**Rel**) best pertains to the TPA application? What is the relevance of the analogous behavior (**Alog**)? What arguments and reasoning support the choice of PDF bounds, shape and so forth? Have all important correlations been identified and specified?)*

Comments on data rationale: *(Attach extra sheets of paper if needed.)*
Elevation data is considered known, or reliable, data for its intended use in the TPA.

Part 6. Other Comments *(Please comment on any other issues that may impinge on the suitability of your data. For example, there may be strong qualifications on its use in extrapolations or its applicability under particular conditions. You may also be aware of new laboratory or field studies that might serve as a fresh source of information. Attach extra sheets of paper if needed.)*

The spatial extent needs to be updated for the license application repository footprint.

Randy Fedors 7/29/04
RF Name of Responder and Date

Please return to Sitakanta Mohanty (drop it in the mailbox).

Data Questionnaire for TPA Version 5.0
Auxiliary Input Data

Part 1. Identification

The following questionnaire deals with the auxiliary input data files used in the TPA Version 5.0 code. These files typically provide large amounts of data in arrays, often to represent time-dependent curves or response surface tables for complex parameters. This questionnaire represents a series of interactions that will take place between process modelers and performance assessors to ensure that a consistent set of standards were used in developing the data, including treatment of uncertainty. In this questionnaire, staff members are requested to provide qualitative and quantitative arguments, original data and documentation (as applicable) that were used to choose and develop the auxiliary data files. Please provide sufficient information so that the data files could be reproduced. Because of the limited time available prior to the TPA production runs, please respond by **January 10, 2004.**

1a. Name: Randy Fedors

1b. Name of Auxiliary Data File: itym.dat

1c. Use of the Auxiliary File in TPA

Description of File *(kind of data, how data used by which TPA module, units of measure, format of file)*:

Description of file appears in Appendix:

This is the control file for executing the ITYM preprocessor, which creates spatially dependent tables of mean and standard deviation of net infiltration for selected climates (temperature and precipitation) that span the full expected range of TPA 5.0 climates. The produced tables are interpolated in UZFLOW for the specific climate relevant to the current realization.

This is the description of the file as it appears in the TPA User's Guide, 2002.

The first 24 lines and the last 5 lines of the input control file *itym.dat* described in section H-4.1 are provided below.

```
# Input control file itym.dat for ITYM preprocessor software version 1.0,
TPA 4.0
###### Size of Tables ######

num_MAP_table 3
num_MAT_table 5
num_pixel_merge                                          4
num_realize_per_table                                    500

###### Options ######

PathwaySum    MaxOnly
Sampling      Allow
RegrForm      TPA4
zElevDEM      elevdem.dat
zWindDEM      winddem.dat
zSoilDEM      soildem.dat
zBUnitDEM     bunitdem.dat
```

```
zSUnitDEM     sunitdem.dat
zMASWtbl      maswtbl.dat
zDTBLout      maidtbl.dat

###### Minimum, Maximum, and Typical Values ######

MAP_min[mm/yr]                                          50
MAP_max[mm/yr]                                          800
MAT_min[degreeC]                                        0
MAT_max[degreeC]                                        22
base_elev[km] 1.4

#Do not change any record below this line

    .
    .
    .
MergeSet
MergeDEMNameID   tr
MergeVolCase     tr      carfill      soilfill      unfilled
MergeSet
```

Part 2. Examination of Current Data *(Please refer to the current auxiliary input files for TPA and their descriptions in Appendix B or H of the TPA user's manual (Mohanty et al. 2002. Check as applicable.)*

	Fully Agree	Agree	Disagree	Fully Disagree
Data file description is acceptable	■	□	□	□
Current data is satisfactory	□	■	□	□
Data uncertainties are dealt with	■	□	□	□
Data should be updated	□	■	□	□

(Provide written comments if needed. For example, you might provide a better file description or you might supply a data update that better reflects current knowledge. If you supply new data below, continue this questionnaire presuming that data is in use. If you believe the data should be updated, but cannot do so at this time, when might it be available? Attach extra sheets of paper if needed.)

Comments on current data:
Do not change the description or values in the itym.dat file at this time.

This is the input file for the ITYM preprocessor used to generate two files used by the UZFLOW module of TPA 5.0, a file with mean values for the log of infiltration and a file with the standard deviations. The output files contain tables for a number of climates, each table contains the spatially variable mean or standard deviation of infiltration. By passing the mean and standard deviation to TPA, UZFLOW can then use a self-consistent sampling scheme, instead of ITYM sampling for uncertainty for the TPA code

The input values in the itym.dat file are USFIC staffs best estimates. Mean values of hydraulic properties are generally based on Flint (1998) and Flint, et al. (1996). Values for uncertainty parameters in itym.dat should be considered expert judgement of USFIC staff. Conceptual model and geological information are included as inputs, and are poorly supported (e.g., percentage of fractures filled with caliche or soil, or not filled at all). A review of all values of inputs in itym.dat is warranted, but is considered low priority by USFIC staff because little change in net infiltration results is expected. This qualified support for the values led to the

boxes being checked as “Agree” for current data is satisfactory and data should be updated.

Part 3. Origin of the Data and Related Information *(Please outline the source of data and other information that you employed when choosing which data was most suitable and when deciding how to accommodate any uncertainties. Provide associated electronic files such as Excel spreadsheets and Mathcad worksheets; cite published reports or attach hard copies.)*

- ☐ **Electronic file(s) provided** ☐ **Hard copy(ies) attached**

Comments on data source *(Attach extra sheets of paper if needed.)*:
Much of the development of the ITYM preprocessor was done by Stuart Stothoff, hence his scientific notebook (#163) should be used as a reference.

Flint, L. (1998). Characterization of Hydrogeologic Units Using Matrix Properties, Yucca Mountain, Nevada. USGS Water Resources-Investigations Report 97-4243. Denver, Colorado: U.S. Geological Survey.

Flint, A.L., J.A. Hevesi, and L.E. Flint, 1996. Conceptual and Numerical Model of Infiltration for the Yucca Mountain Area, Nevada, U.S. Geological Survey Water Resources Investigation Report (draft, never completed), Milestone 3GUI623M, Denver, CO, U.S. Geological Survey.

Part 4. Types and Potential Effects of Uncertainty *(Bearing in mind the scope of application of TPA, what general categories of uncertainty affect values in the auxiliary file? Some sources of uncertainty might be more important than others. Please select one or more categories of uncertainty below and rank their importance as **H**igh, **M**edium or **L**ow. Finally, indicate whether the uncertainty sources are now included in your data file or elsewhere in TPA - perhaps associated with another parameter.)*

Type or cause of uncertainty	Rank (H, M or L)	Covered in your file? (Yes or No)
☐ no uncertainty: values are well known	___	___
☐ random errors in measurement	_L_	_Y_
☐ systematic or biased errors in measurement	_L_	_Y_
☐ scarce applicable data or measurements	_M_	_Y_
☐ extrapolations in time or space needed in conditioning the data for use in TPA	_L_	_Y__
☐ underlying models, data and understanding are empirical - theoretical support is weak	_L_	_Y__
☐ natural variability at different times	___	___
☐ natural variability from place to place	_M_	_Y_
☐ imprecise understanding of the data or model	___	___
☐ potential correlations and dependencies not quantified	_M_	_Y_
	___	___
☐ other _____ *(please specify)*	___	___

(You might believe that some source of uncertainty should be ranked highly, but have also decided that this uncertainty could not be adequately covered in TPA. You might even have chosen to use a single constant value or values for the auxiliary data. Please comment on why you believe that significant uncertainties exist but those uncertainties are ‘missing’ in that they have not been captured using, for example, a PDF.)

Comments on missing uncertainties: *(Attach extra sheets of paper if needed.)*

There is a wide assortment of parameters in the itym.dat file, with the type of uncertainty varying between all the parameters. The ITYM preprocessor was intended to factor in the uncertainty, and the uncertainty in the uncertainty for important parameters.

Part 5. Rationale Supporting Data Choices *(Please document information you employed in specifying data, including PDF attributes if applicable. Select as many as apply; sample choices include:*

Obs *- abundance of appropriate laboratory or field observations and good understanding,*
Exp *- sparse data but practical experience and knowledge of similar systems,*
Alog *- known behavior of analogous situations, and*
Rel *- closely related studies conducted elsewhere.)*

	Obs	Exp	Alog	Rel	Other
Constant value(s) supplied as a single point, time series, table or array	☐	☐	☐	☐	☐
PDF: upper and lower bounds (or unbounded)	☐	☐	☐	☐	☐
most likely values (for normal, lognormal, triangular)	☐	☐	☐	☐	☐
shape (symmetrical like normal, skewed like lognormal)	☐	☐	☐	☐	☐
discrete values or ranges (e.g., piecewise uniform to weight particular values or ranges of values)	☐	☐	☐	☐	☐
Correlated (i.e., are data to other parameters?)	☐	☐	☐	☐	☐
Other data (as described in Section 1c)	☐	☐	☐	☐	☐

*(Please elaborate on the following and related questions. What '**Other**' arguments have you invoked? Are the source of observed data (**Obs**) noted in Part 3? What practical experience (**Exp**) or related studies (**Rel**) best pertains to the TPA application? What is the relevance of the analogous behavior (**Alog**)? What arguments and reasoning support the choice of PDF bounds, shape and so forth? Have all important correlations been identified and specified?)*

Comments on data rationale: *(Attach extra sheets of paper if needed.)*
There is a wide range of parameters in the net infiltration model (ITYM). Checking a large number of the boxes for the question seemed meaningless. Lognormal and normal distributions are used throughout, correlations are included as deemed important by USFIC staff. Multipliers are used for some parameters, such as soil depth at each pixel or wind speed. Constant values are used for some parameters, such as elevation. Testing by USFIC staff suggest that mean values settle down after approximately 500 realizations.

Part 6. Other Comments *(Please comment on any other issues that may impinge on the suitability of your data. For example, there may be strong qualifications on its use in extrapolations or its applicability under particular conditions. You may also be aware of new laboratory or field studies that might serve as a fresh source of information. Attach extra sheets of paper if needed.)*

RF

Randy Fedors 7/31/04
Name of Responder and Date

Please return to Sitakanta Mohanty (drop it in the mailbox).

Data Questionnaire for TPA Version 5.0

Auxiliary Input Data

Part 1. Identification

The following questionnaire deals with the auxiliary input data files used in the TPA Version 5.0 code. These files typically provide large amounts of data in arrays, often to represent time-dependent curves or response surface tables for complex parameters. This questionnaire represents a series of interactions that will take place between process modelers and performance assessors to ensure that a consistent set of standards were used in developing the data, including treatment of uncertainty. In this questionnaire, staff members are requested to provide qualitative and quantitative arguments, original data and documentation (as applicable) that were used to choose and develop the auxiliary data files. Please provide sufficient information so that the data files could be reproduced. Because of the limited time available prior to the TPA production runs, please respond by **January 10, 2004.**

1a. Name: Randy Fedors

1b. Name of Auxiliary Data File: maidtbl.dat

1c. Use of the Auxiliary File in TPA

Description of File *(kind of data, how data used by which TPA module, units of measure, format of file)*:

Description of file appears in Appendix: B

This file is currently not used by UZFLOW. Instead, maydtbl.dat (log of net infiltration) is used in its place. The spatially-dependent net infiltration values in maidtbl.dat are created by the preprocessor ITYM.

This is the description of the file as it appears in the TPA User's Guide, 2002.

The module UZFLOW obtains mean annual infiltration (mm/yr) from the data file *maidtbl.dat* for a range of precipitation and temperature values. The six header lines describe the number of columns and rows of data, the southwest corner map position in Universal Transverse Mercator NAD27 (m) easting and northing coordinates, the cell size in m, and a flag for no data value. The cell size is variable and is limited in the infiltration tabulator for Yucca Mountain preprocessor (Appendix H) to values that are multiples of 30. The remainder of the file is a series of digital elevation models stacked one on another. For each digital elevation model, the relevant precipitation (mm/yr) and temperature (degrees Celcius) are listed as VAR1 and VAR2 followed by the infiltration values (mm/yr) corresponding to cell blocks beginning at the upper left-hand corner of the grid and continuing to the right (east) for each cell block. The second row of cell blocks from the top (to the north of the first row) of the grid moving left to right comprise the next set of soil depths, and so forth for all of the rows of the infiltration map. The last record in the file is an end of file flag. The first 20 lines (excluding the header lines) and last 7 lines of the file *maidtbl.dat* are provided below.

```
# DEM table of expected MAI [mm/yr] for each pixel
# Table is a function of mean annual precipitation [mm/yr] and MAT [C]
# Coordinate system is UTM NAD27 [m]
# File generated on Thu Mar 23 06:47:17 2000
NCOLS      49
NROWS      75
```

```
XLLCORNER   545010.000000
YLLCORNER  4074000.000000
CELLSIZE      120.000000
NODATA_VALUE    -9999.000000
VAR1  1.0000000E+02
VAR2  0.0000000E+00
 7.23192569E+00
 8.11515613E+00
 8.57002278E+00
 8.79862242E+00
 8.60854144E+00
 7.50135501E+00
 9.37095935E+00
 9.73997409E+00
 .
 .
 .
 1.23902228E+02
 1.10734377E+02
 1.06025492E+02
 1.06066394E+02
 1.03847387E+02
 1.04049763E+02
NCOLS 0
```

Part 2. Examination of Current Data *(Please refer to the current auxiliary input files for TPA and their descriptions in Appendix B or H of the TPA user's manual (Mohanty et al. 2002. Check as applicable.)*

	Fully Agree	Agree	Disagree	Fully Disagree
Data file description is acceptable	■	□	□	□
Current data is satisfactory	■	□	□	□
Data uncertainties are dealt with	■	□	□	□
Data should be updated	□	□	■	□

(Provide written comments if needed. For example, you might provide a better file description or you might supply a data update that better reflects current knowledge. <u>If you supply new data below</u>, continue this questionnaire presuming that data is in use. If you believe the data should be updated, but cannot do so at this time, when might it be available? Attach extra sheets of paper if needed.)

Comments on current data:
This data is output from the ITYM preprocessor for TPA 5.0. The data in this file is in natural space, whereas data in log10 space (maydtbl.dat) is used by UZFLOW in TPA 5.0. This file is a relict from the time when data from natural space was used by UZFLOW. No basis is needed for this external file. Note estimates of mean annual net infiltration in natural space and log10 space are developed differently, hence, the two files are not expected to agree exactly (when one is transformed).

Part 3. Origin of the Data and Related Information *(Please outline the source of data and other information that you employed when choosing which data was most suitable and when deciding how to accommodate any uncertainties. Provide associated electronic files such as Excel spreadsheets and Mathcad worksheets; cite published reports or attach hard copies.)*

□ **Electronic file(s) provided** □ **Hard copy(ies) attached**

Comments on data source *(Attach extra sheets of paper if needed.)*:
File no used, no references needed.

Part 4. Types and Potential Effects of Uncertainty *(Bearing in mind the scope of application of TPA, what general categories of uncertainty affect values in the auxiliary file? Some sources of uncertainty might be more important than others. Please select one or more categories of uncertainty below and rank their importance as **H**igh, **M**edium or **L**ow. Finally, indicate whether the uncertainty sources are now included in your data file or elsewhere in TPA - perhaps associated with another parameter.)*

Type or cause of uncertainty	Rank (H, M or L)	Covered in your file? (Yes or No)
☐ no uncertainty: values are well known	___	___
☐ random errors in measurement	___	___
☐ systematic or biased errors in measurement	___	___
☐ scarce applicable data or measurements	___	___
☐ extrapolations in time or space needed in conditioning the data for use in TPA	___	___
☐ underlying models, data and understanding are empirical - theoretical support is weak	___	___
☐ natural variability at different times	___	___
☐ natural variability from place to place	___	___
☐ imprecise understanding of the data or model	___	___
☐ potential correlations and dependencies not quantified	___	___
	___	___
☐ other _____ *(please specify)*	___	___

(You might believe that some source of uncertainty should be ranked highly, but have also decided that this uncertainty could not be adequately covered in TPA. You might even have chosen to use a single constant value or values for the auxiliary data. Please comment on why you believe that significant uncertainties exist but those uncertainties are 'missing' in that they have not been captured using, for example, a PDF.)

Comments on missing uncertainties: *(Attach extra sheets of paper if needed.)*
File not used, no discussion needed.

Part 5. Rationale Supporting Data Choices *(Please document information you employed in specifying data, including PDF attributes if applicable. Select as many as apply; sample choices include:*
***Obs** - abundance of appropriate laboratory or field observations and good understanding,*
***Exp** - sparse data but practical experience and knowledge of similar systems,*
***Alog** - known behavior of analogous situations, and*
***Rel** - closely related studies conducted elsewhere.)*

	Obs	Exp	Alog	Rel	Other
Constant value(s) supplied as a single point, time series, table or array	☐	☐	☐	☐	☐
PDF: upper and lower bounds (or unbounded)	☐	☐	☐	☐	☐
most likely values (for normal, lognormal, triangular)	☐	☐	☐	☐	☐
shape (symmetrical like normal, skewed like lognormal)	☐	☐	☐	☐	☐
discrete values or ranges	☐	☐	☐	☐	☐

(e.g., piecewise uniform to weight particular values or ranges of values)					
Correlated (i.e., are data to other parameters?)	☐	☐	☐	☐	☐
Other data (as described in Section 1c)	☐	☐	☐	☐	☐

*(Please elaborate on the following and related questions. What '**Other**' arguments have you invoked? Are the source of observed data (**Obs)** noted in Part 3? What practical experience (**Exp**) or related studies (**Rel**) best pertains to the TPA application? What is the relevance of the analogous behavior (**Alog**)? What arguments and reasoning support the choice of PDF bounds, shape and so forth? Have all important correlations been identified and specified?)*

Comments on data rationale: *(Attach extra sheets of paper if needed.)*
File not used, no discussion needed.

Part 6. Other Comments *(Please comment on any other issues that may impinge on the suitability of your data. For example, there may be strong qualifications on its use in extrapolations or its applicability under particular conditions. You may also be aware of new laboratory or field studies that might serve as a fresh source of information. Attach extra sheets of paper if needed.)*

Randy Fedors 7/31/04
Name of Responder and Date

Please return to Sitakanta Mohanty (drop it in the RF ***mailbox).***

Data Questionnaire for TPA Version 5.0

Auxiliary Input Data

Part 1. Identification

The following questionnaire deals with the auxiliary input data files used in the TPA Version 5.0 code. These files typically provide large amounts of data in arrays, often to represent time-dependent curves or response surface tables for complex parameters. This questionnaire represents a series of interactions that will take place between process modelers and performance assessors to ensure that a consistent set of standards were used in developing the data, including treatment of uncertainty. In this questionnaire, staff members are requested to provide qualitative and quantitative arguments, original data and documentation (as applicable) that were used to choose and develop the auxiliary data files. Please provide sufficient information so that the data files could be reproduced. Because of the limited time available prior to the TPA production runs, please respond by **January 10, 2004.**

1a. Name: Randy Fedors

1b. Name of Auxiliary Data File: maswtbl.dat

1c. Use of the Auxiliary File in TPA

Description of File *(kind of data, how data used by which TPA module, units of measure, format of file)*:

Description of file appears in Appendix: H

This is the description of the file as it appears in the TPA User's Guide, 2002.

Table mean annual clear-sky shortwave radiation [W/m^2] values for different ground orientations used by ITYM to calculate actual incoming shortwave radiation incident on the ground surface for each pixel across net infiltration domain. Increments in north-south and east-west (YVLLCORNER, XVINCREMENT) are in degrees. The table describes a function of ground surface rotation using east-west rotation (degrees from horizontal) as the row-wise interpolating variable. Similarly, north-south rotation (degrees from horizontal) is the column-wise interpolating variable. The parameters XVLLCORNER and YVLLCORNER span the entire 180 range. The first 35 lines and last 5 lines of the file *maswtbl.dat* are provided below.

```
# Mean annual clear-sky shortwave radiation [W/m2] as a function of ground
orientation; used in ITYM.
NROWS 37
NCOLS 37
XVLLCORNER       90
YVLLCORNER      -90
XVINCREMENT       -5
YVINCREMENT       -5
172.013
155.679
138.16
119.845
102.119
84.1245
66.7618
```

```
50.0491
34.5612
20.5591
9.07223
1.93457
0.0141618
0
0
0
0
0
0
0
0
0
0
0
0.0141618
1.93457
9.07223
20.5591
   .
   .
   .
236.36
221.43
206.316
189.887
172.013
```

Part 2. Examination of Current Data *(Please refer to the current auxiliary input files for TPA and their descriptions in Appendix B or H of the TPA user's manual (Mohanty et al. 2002. Check as applicable.)*

	Fully Agree	Agree	Disagree	Fully Disagree
Data file description is acceptable	■	□	□	□
Current data is satisfactory	■	□	□	□
Data uncertainties are dealt with	□	■	□	□
Data should be updated	□	□	■	□

(Provide written comments if needed. For example, you might provide a better file description or you might supply a data update that better reflects current knowledge. <u>If you supply new data below</u>, continue this questionnaire presuming that data is in use. If you believe the data should be updated, but cannot do so at this time, when might it be available? Attach extra sheets of paper if needed.)

Comments on current data:
The description was modified (editorial changes only), please use the new description provided in part 1c.

Estimates for mean annual incoming short-wave radiation were developed using standard, well-accepted equations that account for the earth's orientation with respect to the sun, the location on the earth (i.e., Yucca Mountain), and the aspect (orientation) of the ground surface compared to horizontal. Estimates have been checked using tables from standard data books.

There is uncertainty in the short-wave radiation reaching the ground surface. The estimates do

not account for the effect of atmosphere and atmospheric variations over the year. For example, cloud cover affect the energy reaching the ground. The fraction of short-wave radiation reaching the ground over that reaching the outer earth's atmosphere is deduced from the data collected at the Desert Rock meteorological station near Mercury, Nevada. The fraction is not likely too different from that at Yucca Mountain (note the meteorological data from Desert Rock was used in the BREATH modeling to create the TPA net infiltration abstraction.

Part 3. Origin of the Data and Related Information *(Please outline the source of data and other information that you employed when choosing which data was most suitable and when deciding how to accommodate any uncertainties. Provide associated electronic files such as Excel spreadsheets and Mathcad worksheets; cite published reports or attach hard copies.)*

☐ **Electronic file(s) provided** ☐ **Hard copy(ies) attached**

Comments on data source *(Attach extra sheets of paper if needed.)*:
Estimates originated by Stuart Stothoff (Scientific Notebook #163) and checked during validation exercises for the ITYM net infiltration abstraction in 2003 by Randy Fedors (Scientific Notebook #227 or #432).

Part 4. Types and Potential Effects of Uncertainty *(Bearing in mind the scope of application of TPA, what general categories of uncertainty affect values in the auxiliary file? Some sources of uncertainty might be more important than others. Please select one or more categories of uncertainty below and rank their importance as **H**igh, **M**edium or **L**ow. Finally, indicate whether the uncertainty sources are now included in your data file or elsewhere in TPA - perhaps associated with another parameter.)*

Type or cause of uncertainty	Rank (H, M or L)	Covered in your file? (Yes or No)
☐ no uncertainty: values are well known	___	___
☐ random errors in measurement	___	___
☐ systematic or biased errors in measurement	_L_	_N_
☐ scarce applicable data or measurements	_L_	_N_
☐ extrapolations in time or space needed in conditioning the data for use in TPA	___	___
☐ underlying models, data and understanding are empirical - theoretical support is weak	___	___
☐ natural variability at different times	_L_	_N_
☐ natural variability from place to place	_L_	_N_
☐ imprecise understanding of the data or model	___	___
☐ potential correlations and dependencies not quantified	___	___
	___	___
☐ other _____ *(please specify)*	___	___

(You might believe that some source of uncertainty should be ranked highly, but have also decided that this uncertainty could not be adequately covered in TPA. You might even have chosen to use a single constant value or values for the auxiliary data. Please comment on why you believe that significant uncertainties exist but those uncertainties are 'missing' in that they have not been captured using, for example, a PDF.)

Comments on missing uncertainties: *(Attach extra sheets of paper if needed.)*

Incoming radiation at the outer earth's atmosphere is well known. Variations and reductions caused by the atmosphere and the uncertainty in the ground surface aspect are not precisely known. These uncertainties were discussed in part 2 of this questionnaire.

Part 5. Rationale Supporting Data Choices *(Please document information you employed in specifying data, including PDF attributes if applicable. Select as many as apply; sample choices include:*

Obs *- abundance of appropriate laboratory or field observations and good understanding,*
Exp *- sparse data but practical experience and knowledge of similar systems,*
Alog *- known behavior of analogous situations, and*
Rel *- closely related studies conducted elsewhere.)*

	Obs	Exp	Alog	Rel	Other
Constant value(s) supplied as a single point, time series, table or array	■	☐	☐	☐	☐
PDF: upper and lower bounds (or unbounded)	☐	☐	☐	☐	☐
most likely values (for normal, lognormal, triangular)	☐	☐	☐	☐	☐
shape (symmetrical like normal, skewed like lognormal)	☐	☐	☐	☐	☐
discrete values or ranges (e.g., piecewise uniform to weight particular values or ranges of values)	☐	☐	☐	☐	☐
Correlated (i.e., are data to other parameters?)	☐	☐	☐	☐	☐
Other data (as described in Section 1c)	☐	☐	☐	☐	☐

*(Please elaborate on the following and related questions. What '**Other**' arguments have you invoked? Are the source of observed data (**Obs**) noted in Part 3? What practical experience (**Exp**) or related studies (**Rel**) best pertains to the TPA application? What is the relevance of the analogous behavior (**Alog**)? What arguments and reasoning support the choice of PDF bounds, shape and so forth? Have all important correlations been identified and specified?)*

Comments on data rationale: *(Attach extra sheets of paper if needed.)*
Rationale was discussed in part 2 of this questionnaire. There is no reason to update the data at this time.

Part 6. Other Comments *(Please comment on any other issues that may impinge on the suitability of your data. For example, there may be strong qualifications on its use in extrapolations or its applicability under particular conditions. You may also be aware of new laboratory or field studies that might serve as a fresh source of information. Attach extra sheets of paper if needed.)*

RF

Randy Fedors 7/31/04
Name of Responder and Date

Please return to Sitakanta Mohanty (drop it in the mailbox).

Data Questionnaire for TPA Version 5.0

Auxiliary Input Data

Part 1. Identification

The following questionnaire deals with the auxiliary input data files used in the TPA Version 5.0 code. These files typically provide large amounts of data in arrays, often to represent time-dependent curves or response surface tables for complex parameters. This questionnaire represents a series of interactions that will take place between process modelers and performance assessors to ensure that a consistent set of standards were used in developing the data, including treatment of uncertainty. In this questionnaire, staff members are requested to provide qualitative and quantitative arguments, original data and documentation (as applicable) that were used to choose and develop the auxiliary data files. Please provide sufficient information so that the data files could be reproduced. Because of the limited time available prior to the TPA production runs, please respond by **January 10, 2004.**

1a. Name: Randy Fedors

1b. Name of Auxiliary Data File: maydtbl.dat

1c. Use of the Auxiliary File in TPA

Description of File *(kind of data, how data used by which TPA module, units of measure, format of file)*:

There was no description of this file in the TPA User's Guide, 2002. Please use the description provided below.

The module UZFLOW obtains mean log10 annual infiltration (mm/yr) from the data file maydtbl.dat for a range of precipitation and temperature values. The first six header lines describe the number of columns and rows of data, the southwest corner map position in Universal Transverse Mercator NAD27 (m) easting and northing coordinates, the cell size in m, and a flag for no data value. The cell size is variable and is limited in the infiltration tabulator for Yucca Mountain preprocessor (Appendix H) to values that are multiples of 30. The remainder of the file is a series of digital elevation models stacked one on another. For each digital elevation model, the relevant precipitation (mm/yr) and temperature (degrees Celsius) are listed as VAR1 and VAR2 followed by the log10 infiltration values (mm/yr) corresponding to cell blocks beginning at the upper left-hand corner of the grid and continuing to the right (east) for each cell block. The second row of cell blocks from the top (to the north of the first row) of the grid moving left to right comprise the next set of soil depths, and so forth for all of the rows of the log10 infiltration map. The last record in the file is an end of file flag. The first 20 lines (excluding the header lines) and last 7 lines of the file maydtbl.dat are provided below.

```
# DEM table of expected log10(MAI [mm/yr]) for each pixel
# Table is a function of MAP [mm/yr] and MAT [C]
# Coordinate system is UTM NAD27 [m]
# Run started Fri Dec 20 15:18:01 2002
NCOLS      49
NROWS      75
XLLCORNER   545010.000000
YLLCORNER  4074000.000000
```

```
CELLSIZE      120.000000
NODATA_VALUE    -9999.000000
VAR1  1.0000000E+02
VAR2  0.0000000E+00
 1.84727232E-01
 2.76993825E-01
 2.97543201E-01
 3.11149514E-01
 2.91550381E-01
 2.58269354E-01
 3.41522453E-01
 3.56020867E-01
      .
      .
      .
 1.46827512E+00
 1.40541279E+00
 1.40250898E+00
 1.46275548E+00
NCOLS 0
```

Part 2. Examination of Current Data *(Please refer to the current auxiliary input files for TPA and their descriptions in Appendix B or H of the TPA user's manual (Mohanty et al. 2002. Check as applicable.)*

	Fully Agree	Agree	Disagree	Fully Disagree
Data file description is acceptable	■	□	□	□
Current data is satisfactory	■	□	□	□
Data uncertainties are dealt with	■	□	□	□
Data should be updated	□	■	□	□

(Provide written comments if needed. For example, you might provide a better file description or you might supply a data update that better reflects current knowledge. <u>If you supply new data below</u>, continue this questionnaire presuming that data is in use. If you believe the data should be updated, but cannot do so at this time, when might it be available? Attach extra sheets of paper if needed.)

Comments on current data:
A description is now provided for this external file in part 1c, please use this new description in the TPA manual update.

The external data set is derived from the ITYM preprocessor that can be run prior to running TPA code. ITYM creates this file and the standard deviation file (smaydtbl.dat) for use by the UZFLOW module in TPA. Sampling in TPA 5.0 from maydtbl.dat and maydtbl.dat is based on the tpa.inp parameter *UZFLOWHydraulicPropertyUncertaintyDeviation[N(0,1)]*. The distribution defined by *UZFLOWHydraulicPropertyUncertaintyDeviation[N(0,1)]* and the external files maydtbl.dat and smaydtbl.dat accounts for uncertainty.

The spatial extent of maydtbl.dat needs to be updated for the spatial extent of the license application repository.

Part 3. Origin of the Data and Related Information *(Please outline the source of data and other information that you employed when choosing which data was most suitable and when deciding how to accommodate any uncertainties. Provide associated electronic files such as Excel spreadsheets and Mathcad worksheets; cite published reports or attach hard copies.)*

- ☐ **Electronic file(s) provided**
- ☐ **Hard copy(ies) attached**

Comments on data source *(Attach extra sheets of paper if needed.)*:
The data for external file maydtbl.dat is generated by running the ITYM preprocessor prior to running the TPA code. The basecase values for this file were generated by USFIC staff using the itym.dat basecase input for ITYM. The basecase maydtbl.dat is provided by USFIC staff so that general users of TPA 5.0 need not run ITYM to generate a file.

Part 4. Types and Potential Effects of Uncertainty *(Bearing in mind the scope of application of TPA, what general categories of uncertainty affect values in the auxiliary file? Some sources of uncertainty might be more important than others. Please select one or more categories of uncertainty below and rank their importance as **H**igh, **M**edium or **L**ow. Finally, indicate whether the uncertainty sources are now included in your data file or elsewhere in TPA - perhaps associated with another parameter.)*

Type or cause of uncertainty	Rank (H, M or L)	Covered in your file? (Yes or No)
☐ no uncertainty: values are well known	___	___
☐ random errors in measurement	_L_	_Y_
☐ systematic or biased errors in measurement	_L_	_Y_
☐ scarce applicable data or measurements	_M_	_Y_
☐ extrapolations in time or space needed in conditioning the data for use in TPA	_L_	_Y__
☐ underlying models, data and understanding are empirical - theoretical support is weak	_L_	_Y__
☐ natural variability at different times	___	___
☐ natural variability from place to place	_M_	_Y_
☐ imprecise understanding of the data or model	___	___
☐ potential correlations and dependencies not quantified	_M_	_Y_
	___	___
☐ other _____*(please specify)*	___	___

(You might believe that some source of uncertainty should be ranked highly, but have also decided that this uncertainty could not be adequately covered in TPA. You might even have chosen to use a single constant value or values for the auxiliary data. Please comment on why you believe that significant uncertainties exist but those uncertainties are 'missing' in that they have not been captured using, for example, a PDF.)

Comments on missing uncertainties: *(Attach extra sheets of paper if needed.)*
The maytbl.dat file is generated using the basecase values in the itym.dat file, with the type of uncertainty varying between all the parameters. The ITYM preprocessor was intended to factor in the uncertainty, and the uncertainty in the uncertainty for important parameters.

Part 5. Rationale Supporting Data Choices *(Please document information you employed in specifying data, including PDF attributes if applicable. Select as many as apply; sample choices include:*

***Obs** - abundance of appropriate laboratory or field observations and good understanding,*
***Exp** - sparse data but practical experience and knowledge of similar systems,*

Alog - known behavior of analogous situations, and
Rel - closely related studies conducted elsewhere.)

	Obs	Exp	Alog	Rel	Other
Constant value(s) supplied as a single point, time series, table or array	☐	☐	☐	☐	☐
PDF: upper and lower bounds (or unbounded)	☐	☐	☐	☐	☐
most likely values (for normal, lognormal, triangular)	☐	☐	☐	☐	☐
shape (symmetrical like normal, skewed like lognormal)	☐	☐	☐	☐	☐
discrete values or ranges (e.g., piecewise uniform to weight particular values or ranges of values)	☐	☐	☐	☐	☐
Correlated (i.e., are data to other parameters?)	☐	☐	☐	☐	☐
Other data (as described in Section 1c)	☐	☐	☐	☐	☐

*(Please elaborate on the following and related questions. What '**Other**' arguments have you invoked? Are the source of observed data (**Obs**) noted in Part 3? What practical experience (**Exp**) or related studies (**Rel**) best pertains to the TPA application? What is the relevance of the analogous behavior (**Alog**)? What arguments and reasoning support the choice of PDF bounds, shape and so forth? Have all important correlations been identified and specified?)*

Comments on data rationale: *(Attach extra sheets of paper if needed.)*
There is a wide range of parameters in the net infiltration model (ITYM) used to generate this external file. Checking a large number of the boxes for the question seemed meaningless. In ITYM, lognormal and normal distributions are used throughout, correlations are included as deemed important by USFIC staff. Multipliers are used for some parameters, such as soil depth at each pixel or wind speed. Constant values are used for some parameters, such as elevation. Testing by USFIC staff suggest that mean values settle down after approximately 500 realizations.

Part 6. Other Comments *(Please comment on any other issues that may impinge on the suitability of your data. For example, there may be strong qualifications on its use in extrapolations or its applicability under particular conditions. You may also be aware of new laboratory or field studies that might serve as a fresh source of information. Attach extra sheets of paper if needed.)*

The spatial extent needs to be updated for the license application repository footprint.

RF Randy Fedors 7/31/04
Name of Responder and Date

Please return to Sitakanta Mohanty (drop it in the mailbox).

Data Questionnaire for TPA Version 5.0

Auxiliary Input Data

Part 1. Identification

The following questionnaire deals with the auxiliary input data files used in the TPA Version 5.0 code. These files typically provide large amounts of data in arrays, often to represent time-dependent curves or response surface tables for complex parameters. This questionnaire represents a series of interactions that will take place between process modelers and performance assessors to ensure that a consistent set of standards were used in developing the data, including treatment of uncertainty. In this questionnaire, staff members are requested to provide qualitative and quantitative arguments, original data and documentation (as applicable) that were used to choose and develop the auxiliary data files. Please provide sufficient information so that the data files could be reproduced. Because of the limited time available prior to the TPA production runs, please respond by **January 10, 2004.**

1a. Name: Randy Fedors

1b. Name of Auxiliary Data File: smaydtbl.dat

1c. Use of the Auxiliary File in TPA

Description of File *(kind of data, how data used by which TPA module, units of measure, format of file)*:

There was no description of this file in the TPA User's Guide, 2002. Use the one provided below.

The module UZFLOW obtains standard deviations from the data file smaydtbl.dat to be used with the log10 mean annual infiltration (mm/yr) of file maydtbl.dat for a range of precipitation and temperature values. The first six header lines describe the number of columns and rows of data, the southwest corner map position in Universal Transverse Mercator NAD27 (m) easting and northing coordinates, the cell size in m, and a flag for no data value. The cell size is variable and is limited in the infiltration tabulator for Yucca Mountain (ITYM) preprocessor (Appendix H) to values that are multiples of 30. The remainder of the file is a series of digital elevation models stacked one on another. For each digital elevation model, the relevant precipitation (mm/yr) and temperature (degrees Celsius) are listed as VAR1 and VAR2 followed by the standard deviations of mean annual net infiltration corresponding to cell blocks beginning at the upper left-hand corner of the grid and continuing to the right (east) for each cell block. The second row of cell blocks from the top (to the north of the first row) of the grid moving left to right comprise the next set of standard deviations of mean annual net infiltration, and so forth for all of the rows of the standard deviation map. The last record in the file is an end of file flag. The first 20 lines (excluding the header lines) and last 7 lines of the file smaydtbl.dat are provided below.

```
# DEM table of standard deviation of log10(MAI [mm/yr]) for each pixel
# Table is a function of MAP [mm/yr] and MAT [C]
# Coordinate system is UTM NAD27 [m]
# Run started Fri Dec 20 15:18:01 2002
NCOLS      49
NROWS      75
```

```
XLLCORNER   545010.000000
YLLCORNER  4074000.000000
CELLSIZE      120.000000
NODATA_VALUE    -9999.000000
VAR1  1.0000000E+02
VAR2  0.0000000E+00
 8.44994216E-01
 8.09859611E-01
 8.16263078E-01
 8.20930301E-01
 8.20978348E-01
 8.03584285E-01
 8.23860924E-01
 8.43079319E-01
      .
      .
      .
 9.67625710E-01
 1.04385791E+00
 1.03535410E+00
 9.85416687E-01
NCOLS 0
```

Part 2. Examination of Current Data *(Please refer to the current auxiliary input files for TPA and their descriptions in Appendix B or H of the TPA user's manual (Mohanty et al. 2002. Check as applicable.)*

	Fully Agree	Agree	Disagree	Fully Disagree
Data file description is acceptable	■	□	□	□
Current data is satisfactory	■	□	□	□
Data uncertainties are dealt with	■	□	□	□
Data should be updated	□	■	□	□

(Provide written comments if needed. For example, you might provide a better file description or you might supply a data update that better reflects current knowledge. <u>If you supply new data below</u>, continue this questionnaire presuming that data is in use. If you believe the data should be updated, but cannot do so at this time, when might it be available? Attach extra sheets of paper if needed.)

Comments on current data:
A description is now provided for this external file in part 1c, please use this new description in the TPA manual update.

The external data set is derived from the ITYM preprocessor that can be run prior to running TPA code. ITYM creates this file and the log10 mean net infiltration file (maydtbl.dat) for use by the UZFLOW module in TPA. Sampling in TPA 5.0 from maydtbl.dat and maydtbl.dat is based on the tpa.inp parameter *UZFLOWHydraulicPropertyUncertaintyDeviation[N(0,1)]*. The distribution defined by *UZFLOWHydraulicPropertyUncertaintyDeviation[N(0,1)]* and the external files maydtbl.dat and smaydtbl.dat accounts for uncertainty.

The spatial extent of smaydtbl.dat needs to be updated for the spatial extent of the license

application repository.

Part 3. Origin of the Data and Related Information *(Please outline the source of data and other information that you employed when choosing which data was most suitable and when deciding how to accommodate any uncertainties. Provide associated electronic files such as Excel spreadsheets and Mathcad worksheets; cite published reports or attach hard copies.)*

- ☐ **Electronic file(s) provided** ☐ **Hard copy(ies) attached**

Comments on data source *(Attach extra sheets of paper if needed.)*:
The data for external file smaydtbl.dat is generated by running the ITYM preprocessor prior to running the TPA code. The basecase values for this file were generated by USFIC staff using the itym.dat basecase input for ITYM. The basecase smaydtbl.dat is provided by USFIC staff so that general users of TPA 5.0 need not run ITYM to generate a file.

Part 4. Types and Potential Effects of Uncertainty *(Bearing in mind the scope of application of TPA, what general categories of uncertainty affect values in the auxiliary file? Some sources of uncertainty might be more important than others. Please select one or more categories of uncertainty below and rank their importance as **H**igh, **M**edium or **L**ow. Finally, indicate whether the uncertainty sources are now included in your data file or elsewhere in TPA - perhaps associated with another parameter.)*

Type or cause of uncertainty	Rank (H, M or L)	Covered in your file? (Yes or No)
☐ no uncertainty: values are well known	___	___
☐ random errors in measurement	_L_	_Y_
☐ systematic or biased errors in measurement	_L_	_Y_
☐ scarce applicable data or measurements	_M_	_Y_
☐ extrapolations in time or space needed in conditioning the data for use in TPA	_L_	_Y__
☐ underlying models, data and understanding are empirical - theoretical support is weak	_L_	_Y__
☐ natural variability at different times	___	___
☐ natural variability from place to place	_M_	_Y_
☐ imprecise understanding of the data or model	___	___
☐ potential correlations and dependencies not quantified	_M_	_Y_
	___	___
☐ other _____*(please specify)*	___	___

(You might believe that some source of uncertainty should be ranked highly, but have also decided that this uncertainty could not be adequately covered in TPA. You might even have chosen to use a single constant value or values for the auxiliary data. Please comment on why you believe that significant uncertainties exist but those uncertainties are 'missing' in that they have not been captured using, for example, a PDF.)

Comments on missing uncertainties: *(Attach extra sheets of paper if needed.)*
The smaytbl.dat file is generated using the basecase values in the itym.dat file, with the type of uncertainty varying between all the parameters. The ITYM preprocessor was intended to factor in the uncertainty, and the uncertainty in the uncertainty for important parameters.

Part 5. Rationale Supporting Data Choices *(Please document information you employed in specifying data, including PDF attributes if applicable. Select as many as apply; sample choices include:*

__Obs__ - abundance of appropriate laboratory or field observations and good understanding,
__Exp__ - sparse data but practical experience and knowledge of similar systems,
__Alog__ - known behavior of analogous situations, and
__Rel__ - closely related studies conducted elsewhere.)

	Obs	Exp	Alog	Rel	Other
Constant value(s) supplied as a single point, time series, table or array	☐	☐	☐	☐	☐
PDF: upper and lower bounds (or unbounded)	☐	☐	☐	☐	☐
most likely values (for normal, lognormal, triangular)	☐	☐	☐	☐	☐
shape (symmetrical like normal, skewed like lognormal)	☐	☐	☐	☐	☐
discrete values or ranges (e.g., piecewise uniform to weight particular values or ranges of values)	☐	☐	☐	☐	☐
Correlated (i.e., are data to other parameters?)	☐	☐	☐	☐	☐
Other data (as described in Section 1c)	☐	☐	☐	☐	☐

(Please elaborate on the following and related questions. What '__Other__' arguments have you invoked? Are the source of observed data (__Obs)__ noted in Part 3? What practical experience (__Exp__) or related studies (__Rel__) best pertains to the TPA application? What is the relevance of the analogous behavior (__Alog__)? What arguments and reasoning support the choice of PDF bounds, shape and so forth? Have all important correlations been identified and specified?)

Comments on data rationale: *(Attach extra sheets of paper if needed.)*
There is a wide range of parameters in the net infiltration model (ITYM) used to generate this external file. Checking a large number of the boxes for the question seemed meaningless. In ITYM, lognormal and normal distributions are used throughout, correlations are included as deemed important by USFIC staff. Multipliers are used for some parameters, such as soil depth at each pixel or wind speed. Constant values are used for some parameters, such as elevation. Testing by USFIC staff suggest that mean values settle down after approximately 500 realizations.

Part 6. Other Comments *(Please comment on any other issues that may impinge on the suitability of your data. For example, there may be strong qualifications on its use in extrapolations or its applicability under particular conditions. You may also be aware of new laboratory or field studies that might serve as a fresh source of information. Attach extra sheets of paper if needed.)*

The spatial extent needs to be updated for the license application repository footprint.

Randy Fedors 7/31/04
Name of Responder and Date

RF

Please return to Sitakanta Mohanty (drop it in the mailbox).

Data Questionnaire for TPA Version 5.0

Auxiliary Input Data

Part 1. Identification

The following questionnaire deals with the auxiliary input data files used in the TPA Version 5.0 code. These files typically provide large amounts of data in arrays, often to represent time-dependent curves or response surface tables for complex parameters. This questionnaire represents a series of interactions that will take place between process modelers and performance assessors to ensure that a consistent set of standards were used in developing the data, including treatment of uncertainty. In this questionnaire, staff members are requested to provide qualitative and quantitative arguments, original data and documentation (as applicable) that were used to choose and develop the auxiliary data files. Please provide sufficient information so that the data files could be reproduced. Because of the limited time available prior to the TPA production runs, please respond by **January 10, 2004.**

1a. Name: Randy Fedors

1b. Name of Auxiliary Data File: soildem.dat

1c. Use of the Auxiliary File in TPA

Description of File *(kind of data, how data used by which TPA module, units of measure, format of file)*:

Description of file appears in Appendix: H

The ITYM preprocessor software obtains soil depths (m) from the data file *soildem.dat*. This DEM assigns a soil depth to each pixel in the repository discretization. The same discretization is used for the soil depth data and the ground surface elevation data in *elevdem.dat*, and all other DEM listed in table H-2. The discretization consists of 199 columns and 300 rows with the lower left (SW) grid coordinate (545010, 4074000) expressed in UTM easting and northing (m). The grid size is 30 m × 30 m. Soil depth data correspond to pixels beginning at the upper left-hand (NW) corner of the grid and continuing to the right every 30 m. The second row of pixels from the top of the grid moving left to right comprise the next set of soil depths, and so forth for all 300 rows of soil depths. The first 20 lines and last 5 lines of the file *soildem.dat* are provided below.

```
# DEM of soil depth [m] for each pixel; used in ITYM preprocessor
software.
NROWS 300
NCOLS 199
XLLCORNER   545010
YLLCORNER  4074000
CELLSIZE 30
NODATA_VALUE -9999
0.13615
0.13615
0.435741
0.624657
0.147408
```

```
0.258274
0.159285
0.129658
0.170063
0.129678
0.308515
0.125574
0.130158
    .
    .
    .
0.14188
0.137268
0.142815
0.368732
0.233834
```

Part 2. Examination of Current Data *(Please refer to the current auxiliary input files for TPA and their descriptions in Appendix B or H of the TPA user's manual (Mohanty et al. 2002. Check as applicable.)*

	Fully Agree	Agree	Disagree	Fully Disagree
Data file description is acceptable	■	□	□	□
Current data is satisfactory	■	□	□	□
Data uncertainties are dealt with	□	■	□	□
Data should be updated	□	■	□	□

(Provide written comments if needed. For example, you might provide a better file description or you might supply a data update that better reflects current knowledge. If you supply new data below, continue this questionnaire presuming that data is in use. If you believe the data should be updated, but cannot do so at this time, when might it be available? Attach extra sheets of paper if needed.)

Comments on current data:
Current data and description are okay. Data should be updated to cover expanded area of license application repository when the TPA is modified for the license application.

Soil depth was developed by Stuart Stothoff using a soil balance model. A software requirements description has been completed for the model, and the rest of the TOP-018 requirements must now also be performed.

The soil depth data agrees qualitatively with the DOE soil depth estimates for the same size pixels. The DOE used equations based on borehole data, so thin soils may be poorly represented.

Part 3. Origin of the Data and Related Information *(Please outline the source of data and other information that you employed when choosing which data was most suitable and when deciding how to accommodate any uncertainties. Provide associated electronic files such as Excel spreadsheets and Mathcad worksheets; cite published reports or attach hard copies.)*

□ **Electronic file(s) provided** □ **Hard copy(ies) attached**

Comments on data source *(Attach extra sheets of paper if needed.)*:

Stothoff Scientific Notebook #163.

USGS. 2001. Simulation of Net Infiltration for Modern and Potential Future Climates. ANLNBS-HS-000032 REV 00 ICN 02. U.S. Geological Survey, Yucca Mountain Project.

Part 4. Types and Potential Effects of Uncertainty *(Bearing in mind the scope of application of TPA, what general categories of uncertainty affect values in the auxiliary file? Some sources of uncertainty might be more important than others. Please select one or more categories of uncertainty below and rank their importance as **H**igh, **M**edium or **L**ow. Finally, indicate whether the uncertainty sources are now included in your data file or elsewhere in TPA - perhaps associated with another parameter.)*

Type or cause of uncertainty	Rank (H, M or L)	Covered in your file? (Yes or No)
☐ no uncertainty: values are well known	___	___
☐ random errors in measurement	_M_	_Y_
☐ systematic or biased errors in measurement	_L_	_Y_
☐ scarce applicable data or measurements	_M_	_Y_
☐ extrapolations in time or space needed in conditioning the data for use in TPA	___	___
☐ underlying models, data and understanding are empirical - theoretical support is weak	___	___
☐ natural variability at different times	_L_	_Y_
☐ natural variability from place to place	_M_	_Y_
☐ imprecise understanding of the data or model	___	___
☐ potential correlations and dependencies not quantified	___	___
	___	___
☐ other _____*(please specify)*	___	___

(You might believe that some source of uncertainty should be ranked highly, but have also decided that this uncertainty could not be adequately covered in TPA. You might even have chosen to use a single constant value or values for the auxiliary data. Please comment on why you believe that significant uncertainties exist but those uncertainties are 'missing' in that they have not been captured using, for example, a PDF.)

Comments on missing uncertainties: *(Attach extra sheets of paper if needed.)*
Soil depth for a 30 m by 30 m pixel is difficult to measure because of the irregular bedrock surface; for soil covered areas, there may still be half the area consisting of exposed bedrock or talus. ITYM uses a multiplier on the basecase soil depth data to account for uncertainty.

Soil depths may change with climate, possibly becoming more uniform. The multiplier in ITYM leads to a spatial scaling, hence future soils may be poorly represented.

Part 5. Rationale Supporting Data Choices *(Please document information you employed in specifying data, including PDF attributes if applicable. Select as many as apply; sample choices include:*
***Obs** - abundance of appropriate laboratory or field observations and good understanding,*
***Exp** - sparse data but practical experience and knowledge of similar systems,*
***Alog** - known behavior of analogous situations, and*
***Rel** - closely related studies conducted elsewhere.)*

	Obs	Exp	Alog	Rel	Other
Constant value(s) supplied as a single					

point, time series, table or array	☐	■	☐	☐	☐
PDF: upper and lower bounds (or unbounded)	☐	☐	☐	☐	☐
most likely values (for normal, lognormal, triangular)	☐	☐	☐	☐	☐
shape (symmetrical like normal, skewed like lognormal)	☐	☐	☐	☐	☐
discrete values or ranges (e.g., piecewise uniform to weight particular values or ranges of values)	☐	☐	☐	☐	☐
Correlated (i.e., are data to other parameters?)	☐	☐	☐	☐	☐
Other data (as described in Section 1c)	☐	☐	☐	☐	☐

*(Please elaborate on the following and related questions. What '**Other**' arguments have you invoked? Are the source of observed data (**Obs**) noted in Part 3? What practical experience (**Exp**) or related studies (**Rel**) best pertains to the TPA application? What is the relevance of the analogous behavior (**Alog**)? What arguments and reasoning support the choice of PDF bounds, shape and so forth? Have all important correlations been identified and specified?)*

Comments on data rationale: *(Attach extra sheets of paper if needed.)*
Soil depth model was being re-assessed in 2003 with the help of the consultant Stu Stothoff, who along with Fedors were not able to complete the revised model.

Part 6. Other Comments *(Please comment on any other issues that may impinge on the suitability of your data. For example, there may be strong qualifications on its use in extrapolations or its applicability under particular conditions. You may also be aware of new laboratory or field studies that might serve as a fresh source of information. Attach extra sheets of paper if needed.)*

The spatial extent needs to be updated for the license application repository footprint.

Randy Fedors 7/31/04
Name of Responder and Date

RF

Please return to Sitakanta Mohanty (drop it in the mailbox).

Data Questionnaire for TPA Version 5.0

Auxiliary Input Data

Part 1. Identification

The following questionnaire deals with the auxiliary input data files used in the TPA Version 5.0 code. These files typically provide large amounts of data in arrays, often to represent time-dependent curves or response surface tables for complex parameters. This questionnaire represents a series of interactions that will take place between process modelers and performance assessors to ensure that a consistent set of standards were used in developing the data, including treatment of uncertainty. In this questionnaire, staff members are requested to provide qualitative and quantitative arguments, original data and documentation (as applicable) that were used to choose and develop the auxiliary data files. Please provide sufficient information so that the data files could be reproduced. Because of the limited time available prior to the TPA production runs, please respond by **January 10, 2004.**

1a. Name: Randy Fedors

1b. Name of Auxiliary Data File: sunitdem.dat

1c. Use of the Auxiliary File in TPA

Description of File *(kind of data, how data used by which TPA module, units of measure, format of file)*:

Description of file appears in Appendix: H

This is the description of the file as it appears in the TPA User's Guide, 2002.

The ITYM preprocessor software obtains soil type from the data file *sunitdem.dat*. This DEM assigns a soil type to each pixel in the repository discretization based on TRW Environmental Safety Systems, Inc. (1997). The same discretization is used for all other DEM listed in table H-2. The discretization consists of 199 columns and 300 rows with the lower left grid coordinate (545010, 4074000) expressed in UTM NAD27 easting and northing (m). The grid size is 30 × 30 m. Soil type data correspond to pixels beginning at the upper left-hand (NW) corner of the grid and continuing to the right every 30 m. The second row of pixels from the top of the grid moving left to right comprise the next set of soil types, and so forth for all 300 rows of soil types. The first 15 lines and last 5 lines of the file *sunitdem.dat* are provided below.

```
# DEM of soil type for each pixel; used in ITYM preprocessor software.
NROWS 300
NCOLS 199
XLLCORNER   545010
YLLCORNER  4074000
CELLSIZE 30
NODATA_VALUE -9999
1
1
3
```

1
5
5
5
5
.
.
.
5
5
5
5
5

Part 2. Examination of Current Data *(Please refer to the current auxiliary input files for TPA and their descriptions in Appendix B or H of the TPA user's manual (Mohanty et al. 2002. Check as applicable.)*

	Fully Agree	Agree	Disagree	Fully Disagree
Data file description is acceptable	■	□	□	□
Current data is satisfactory	■	□	□	□
Data uncertainties are dealt with	□	■	□	□
Data should be updated	■	□	□	□

(Provide written comments if needed. For example, you might provide a better file description or you might supply a data update that better reflects current knowledge. If you supply new data below, continue this questionnaire presuming that data is in use. If you believe the data should be updated, but cannot do so at this time, when might it be available? Attach extra sheets of paper if needed.)

Comments on current data:
Current data and description are okay for the EDA-II repository design. The soil map should be expanded for the expanded license application repository design.

The soil map is extracted from DOE maps of soil types. Although there are uncertainties in the DOE map, they do not likely affect results in an average sense.

Part 3. Origin of the Data and Related Information *(Please outline the source of data and other information that you employed when choosing which data was most suitable and when deciding how to accommodate any uncertainties. Provide associated electronic files such as Excel spreadsheets and Mathcad worksheets; cite published reports or attach hard copies.)*

□ **Electronic file(s) provided** □ **Hard copy(ies) attached**

Comments on data source *(Attach extra sheets of paper if needed.)*:
DOE. 2000. Yucca Mountain Site Description.

DOE. Yucca Mountain Project Site Characterization Atlas, Volume 1 (includes geology and soils). 1997.

Part 4. Types and Potential Effects of Uncertainty *(Bearing in mind the scope of application of TPA, what general categories of uncertainty affect values in the auxiliary file? Some sources of uncertainty might be more important than others. Please select one or more categories of uncertainty below and rank their importance as **H**igh, **M**edium or **L**ow. Finally, indicate whether the uncertainty sources are now included in your data file or elsewhere in*

TPA - perhaps associated with another parameter.)

Type or cause of uncertainty	Rank (H, M or L)	Covered in your file? (Yes or No)
☐ no uncertainty: values are well known	___	___
☐ random errors in measurement	___	___
☐ systematic or biased errors in measurement	___	___
☐ scarce applicable data or measurements	___	___
☐ extrapolations in time or space needed in conditioning the data for use in TPA	___	___
☐ underlying models, data and understanding are empirical - theoretical support is weak	___	___
☐ natural variability at different times	___	___
☐ natural variability from place to place	_L_	_N_
☐ imprecise understanding of the data or model	___	___
☐ potential correlations and dependencies not quantified	___	___
☐ other ___Mapping uncertainties____*(please specify)*	_L_	_N_

(You might believe that some source of uncertainty should be ranked highly, but have also decided that this uncertainty could not be adequately covered in TPA. You might even have chosen to use a single constant value or values for the auxiliary data. Please comment on why you believe that significant uncertainties exist but those uncertainties are 'missing' in that they have not been captured using, for example, a PDF.)

Comments on missing uncertainties: *(Attach extra sheets of paper if needed.)*
Soils map is best available information on soil types. It likely contains error, e.g., scale of mapping likely misses contacts and subarea heterogeneity.

Part 5. Rationale Supporting Data Choices *(Please document information you employed in specifying data, including PDF attributes if applicable. Select as many as apply; sample choices include:*
Obs *- abundance of appropriate laboratory or field observations and good understanding,*
Exp *- sparse data but practical experience and knowledge of similar systems,*
Alog *- known behavior of analogous situations, and*
Rel *- closely related studies conducted elsewhere.)*

	Obs	Exp	Alog	Rel	Other
Constant value(s) supplied as a single point, time series, table or array	■	☐	☐	☐	☐
PDF: upper and lower bounds (or unbounded)	☐	☐	☐	☐	☐
most likely values (for normal, lognormal, triangular)	☐	☐	☐	☐	☐
shape (symmetrical like normal, skewed like lognormal)	☐	☐	☐	☐	☐
discrete values or ranges (e.g., piecewise uniform to weight particular values or ranges of values)	☐	☐	☐	☐	☐
Correlated (i.e., are data to other parameters?)	☐	☐	☐	☐	☐
Other data (as described in Section 1c)	☐	☐	☐	☐	☐

*(Please elaborate on the following and related questions. What '**Other**' arguments have you invoked? Are the source of observed data (**Obs**) noted in Part 3? What practical experience (**Exp**) or related studies (**Rel**) best*

*pertains to the TPA application? What is the relevance of the analogous behavior (**Alog**)? What arguments and reasoning support the choice of PDF bounds, shape and so forth? Have all important correlations been identified and specified?)*

Comments on data rationale: *(Attach extra sheets of paper if needed.)*
Best available information, and it is likely sufficient for the intended use according to USFIC expert judgement.

Part 6. Other Comments *(Please comment on any other issues that may impinge on the suitability of your data. For example, there may be strong qualifications on its use in extrapolations or its applicability under particular conditions. You may also be aware of new laboratory or field studies that might serve as a fresh source of information. Attach extra sheets of paper if needed.)*

The spatial extent needs to be updated for the license application repository footprint.

RF

Randy Fedors 7/31/04
Name of Responder and Date

Please return to Sitakanta Mohanty (drop it in the mailbox).

Data Questionnaire for TPA Version 5.0

Auxiliary Input Data

Part 1. Identification

The following questionnaire deals with the auxiliary input data files used in the TPA Version 5.0 code. These files typically provide large amounts of data in arrays, often to represent time-dependent curves or response surface tables for complex parameters. This questionnaire represents a series of interactions that will take place between process modelers and performance assessors to ensure that a consistent set of standards were used in developing the data, including treatment of uncertainty. In this questionnaire, staff members are requested to provide qualitative and quantitative arguments, original data and documentation (as applicable) that were used to choose and develop the auxiliary data files. Please provide sufficient information so that the data files could be reproduced. Because of the limited time available prior to the TPA production runs, please respond by **January 10, 2004.**

1a. Name: Randy Fedors

1b. Name of Auxiliary Data File: winddem.dat

1c. Use of the Auxiliary File in TPA

Description of File *(kind of data, how data used by which TPA module, units of measure, format of file)*:

Description of file appears in Appendix: H

This is the description of the file as it appears in the TPA User's Guide, 2002.

The ITYM preprocessor software obtains wind speed (m/s) from the data file *winddem.dat*. This DEM is used to assign a wind speed to each pixel in the repository discretization. The same discretization is utilized to generate all of the DEM listed in table H-2. The discretization consists of 199 columns and 300 rows with the lower left (SW) grid coordinate (545010, 4074000) expressed in UTM NAD27 easting and northing (m). The grid size is 30 m × 30 m. Ground surface elevation data correspond to pixels beginning at the upper left-hand (NW) corner of the grid and continuing to the right every 30 m. The second row of pixels from the top of the grid moving left to right comprise the next set of ground surface elevations, and so forth for all 300 rows. The first 20 lines and last 5 lines of the file *winddem.dat* are provided below.

```
# DEM of wind speed [m/s] for each pixel; used in ITYM preprocessor
software.
NROWS 300
NCOLS 199
XLLCORNER   545010
YLLCORNER  4074000
CELLSIZE 30
NODATA_VALUE -9999
3.90536
3.92542
```

```
3.981
3.92809
3.78322
3.59776
3.4067
3.31308
3.30678
3.38482
3.3542
3.29629
3.22809
    .
    .
    .
3.23755
3.22683
3.24639
3.24542
3.24828
```

Part 2. Examination of Current Data *(Please refer to the current auxiliary input files for TPA and their descriptions in Appendix B or H of the TPA user's manual (Mohanty et al. 2002. Check as applicable.)*

	Fully Agree	Agree	Disagree	Fully Disagree
Data file description is acceptable	■	□	□	□
Current data is satisfactory	■	□	□	□
Data uncertainties are dealt with	□	■	□	□
Data should be updated	■	□	□	□

(Provide written comments if needed. For example, you might provide a better file description or you might supply a data update that better reflects current knowledge. If you supply new data below, continue this questionnaire presuming that data is in use. If you believe the data should be updated, but cannot do so at this time, when might it be available? Attach extra sheets of paper if needed.)

Comments on current data:
Current data and description are sufficient for intended use in ITYM preprocessor. Data should be updated for expanded area of license application repository design when TPA updates from EDA-II design.

Stuart Stothoff developed the spatial distribution of wind speed across Yucca Mountain by accounting for the predominant wind direction, blocking by ridges, and ground surface aspect.

Part 3. Origin of the Data and Related Information *(Please outline the source of data and other information that you employed when choosing which data was most suitable and when deciding how to accommodate any uncertainties. Provide associated electronic files such as Excel spreadsheets and Mathcad worksheets; cite published reports or attach hard copies.)*

□ **Electronic file(s) provided** □ **Hard copy(ies) attached**

Comments on data source *(Attach extra sheets of paper if needed.)*:
Stuart Stothoff Scientific Notebook #163.

Part 4. Types and Potential Effects of Uncertainty *(Bearing in mind the scope of application of TPA, what general categories of uncertainty affect values in the auxiliary file? Some sources of uncertainty might be more important than others. Please select one or more categories of uncertainty below and rank their importance as **H**igh, **M**edium or **L**ow. Finally, indicate whether the uncertainty sources are now included in your data file or elsewhere in TPA - perhaps associated with another parameter.)*

Type or cause of uncertainty	Rank (H, M or L)	Covered in your file? (Yes or No)
☐ no uncertainty: values are well known	___	___
☐ random errors in measurement	___	___
☐ systematic or biased errors in measurement	___	___
☐ scarce applicable data or measurements	_L_	_Y_
☐ extrapolations in time or space needed in conditioning the data for use in TPA	___	___
☐ underlying models, data and understanding are empirical - theoretical support is weak	___	___
☐ natural variability at different times	_L_	_Y_
☐ natural variability from place to place	_L_	_Y_
☐ imprecise understanding of the data or model	___	___
☐ potential correlations and dependencies not quantified	___	___
	___	___
☐ other _____*(please specify)*	___	___

(You might believe that some source of uncertainty should be ranked highly, but have also decided that this uncertainty could not be adequately covered in TPA. You might even have chosen to use a single constant value or values for the auxiliary data. Please comment on why you believe that significant uncertainties exist but those uncertainties are 'missing' in that they have not been captured using, for example, a PDF.)

Comments on missing uncertainties: *(Attach extra sheets of paper if needed.)*
Mean annual wind speed probably does not change much from year to year, but the effect of variability within that year and spatial variability likely affect evaporation. ITYM uses a multiplier to account for the uncertainty, however, the affect on net infiltration is not significant based on informal testing of ITYM abstraction and BREATH process-level models.

Part 5. Rationale Supporting Data Choices *(Please document information you employed in specifying data, including PDF attributes if applicable. Select as many as apply; sample choices include:*
***Obs** - abundance of appropriate laboratory or field observations and good understanding,*
***Exp** - sparse data but practical experience and knowledge of similar systems,*
***Alog** - known behavior of analogous situations, and*
***Rel** - closely related studies conducted elsewhere.)*

	Obs	Exp	Alog	Rel	Other
Constant value(s) supplied as a single point, time series, table or array	☐	■	☐	☐	☐
PDF: upper and lower bounds (or unbounded)	☐	☐	☐	☐	☐
most likely values (for normal, lognormal, triangular)	☐	☐	☐	☐	☐
shape (symmetrical like normal, skewed like lognormal)	☐	☐	☐	☐	☐

discrete values or ranges (e.g., piecewise uniform to weight particular values or ranges of values)	☐	☐	☐	☐	☐
Correlated (i.e., are data to other parameters?)	☐	☐	☐	☐	☐
Other data (as described in Section 1c)	☐	☐	☐	☐	☐

*(Please elaborate on the following and related questions. What '**Other**' arguments have you invoked? Are the source of observed data (**Obs)** noted in Part 3? What practical experience (**Exp**) or related studies (**Rel**) best pertains to the TPA application? What is the relevance of the analogous behavior (**Alog**)? What arguments and reasoning support the choice of PDF bounds, shape and so forth? Have all important correlations been identified and specified?)*

Comments on data rationale: *(Attach extra sheets of paper if needed.)*
Wind speed is used to help account for evaporation. Annual averages do not vary much. Short term temporal and spatial variations are important for short term results. However, mean annual net infiltration averages out these variations.

Part 6. Other Comments *(Please comment on any other issues that may impinge on the suitability of your data. For example, there may be strong qualifications on its use in extrapolations or its applicability under particular conditions. You may also be aware of new laboratory or field studies that might serve as a fresh source of information. Attach extra sheets of paper if needed.)*

The spatial extent needs to be updated for the license application repository footprint.

Randy Fedors 7/31/04
Name of Responder and Date

Please return to Sitakanta Mohanty (drop it RF ***in the mailbox).***