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SCIENTIFIC NOTEBOOK 376-1 E

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Joanne Damours

SCIENTIFIC NOTEBOOK

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for

Center for Nuclear Waste Regulatory Analyses
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INITIAL ENTRIES

Scientific Notebook 376

Issued to Joanne Damours

Issue Date: November 11, 1999

Account Number: 20.01402.762

Participants: Joanne Damours and John Emmerling
Bayesian Systems, Inc.
Gaithersburg, MD

Development of a Graphic Post-processor for TPA Version 4.0 Code

Objective: document activities related to the development of a graphic post-processor for TPA Version 4.0 Code.

Joanne Damours

1-17-00

Decided to update our proposal based on the memorandum from Osvaldo.

3-7-00

Wrote focus statement to be sure that Doug and I keep on track with the project.

4-24-00

Decided to bring John Emmerling onto the project to do the user interface coding for the GPP. Concerned about delivering late and feel that John can move us forward more rapidly.

4-30-00

John Emmerling started working in Java 1.3 for deployment and performance and scheduling. Making things run as applets or as applications.

9-5-00

Wrote the following Quick Reference Guide for deliver with beta software 9-6-00:

Quick Reference Guide
"Repository Performance Visualization"
Graphical Post-Processor for TPA 4.0
Beta Delivery
9/6/00

To start, double click on the desktop icon you have created.

Step 1 - Select a TPA run

Before creating a plot, you must select a TPA run.

- On the main window, select "File" from the pull-down menu, then "TPA Run," then "New"
- Next identify location of the folder for the TPA run you wish to use, by clicking on the "Testruns" pull-down menu.
- Select the drive where the run is located.
- Double click on the displayed folders to move from folder to folder.
- When you see the name of the folder where the run is located, single click on the folder, then click on the "Open" button.

As soon as a TPA run has been selected, the Plot Control and View Control windows will be displayed.

Step 2 – Create a plot

Use the Plot Control window to define a plot.

- First, enter the name of a plot you wish to create. (Note that the current release does not support importing "Old" or image files.)
- Select log or linear scale using the radio buttons.
- Select a variable to plot by making a single click on the variable name.
- Using the radio buttons on the left, select "Raw" or "Derived." If you select derived data for the variable, identify the percentiles you wish to display. Use the Control key to select the percentiles individually, or the shift key to select a group (like Windows).
- "Alt Tab" to the View Control window. A "View" is the same thing as a tab on the main window.

Step 3 – Create a view

On the View Control window you identify where and how you want the plot to be displayed.

To place the plot on the "Trial Tab" view:

- First, click on the "Existing" radio button after the "Select View" label.
- Be sure that "Trial View" is displayed on the pull-down menu to the right of the "Existing" button.
- Select the "Plot" radio button after the "Select Plot/Image" label. (Note that displaying saved images is not available in this release.)
- Be sure that the name of the plot you want to draw is showing on the pull-down menu to the right of the "Plot" radio button.
- Click on the "Apply" button at the bottom of the window.

To create a new view and attach your plot to that view:

- First, click on the "New" radio button after the "Select View" label.
- Enter the name of the new view to the right.
- Now that the view has been created, go to the pull-down menu just below the field where you entered the new name and select that name from the list.
- Select the "Plot" radio button after the "Select Plot/Image" label. (Note that displaying saved images is not available in this release.)
- Be sure that the name of the plot you want to draw is showing on the pull-down menu to the right of the "Plot" radio button.

- Click on the "Apply" button at the bottom of the window.

Step 4 – Add another variable to the plot

Return to the Plot Control window. (Note that with this release there is no way to delete a variable from a plot.

- Select "Plot" and "Old" and pick the name of the plot you want to change from the pull-down list to the right.
- In the "Field" frame click on the "New" radio button. A new field tab will be created.
- Single click on the variable name to be added to the plot.
- Using the radio buttons on the left, select "Raw" or "Derived." If you select derived data for the variable, identify the percentiles you wish to display. Use the Control key to select the percentiles individually, or the shift key to select a group (like Windows).
- "Alt Tab" to the View Control window.
- Be sure that the view where you want the modified report displayed has been selected.
- Click on the "Apply" button.

To add more variables follow the above steps.

Step 5 - To select parameters

To select a range of parameters for a variable.

- On the Plot Control window, select the "Parameters not viewed" pull-down.
- Click on the parameter that you wish to view.
- Using the slider bars select a minimum and maximum for the parameter.
- "Alt Tab" to the View Control window.
- Be sure that the view where you want the modified report displayed has been selected.
- Click on the "Apply" button.

Step 6 – Create a scatter plot for peak dose

This is a special case.

- Select the variable "Peak Dose."
- Percentiles and parameters do not apply.
- The plot displayed when Peak Dose is selected is a scatter plot.

Step 7 – Snap a plot as a JPG file

With the plot visible on the Main Window, select "Plot" from the pull-down menu and "Snap."

Wrote the following Delivery Document for 9-6-00 Beta Test Delivery.

"Repository Performance Visualization" Graphical Post-Processor for TPA 4.0 Beta Delivery 9/6/00

Section 1 – Summary of Delivery

This beta delivery meets the all of the requirements in the Software Requirements Document except those listed in Section 2. Section 3 is a list of known bugs.

This is beta software and we have focused on getting essential functions into the code and realize that there are still some bugs. Some sequences of user actions will not lead to the desired results so we have written a quick reference guide that includes steps to achieve the desired results. Please note that the bugs are associated with the user interface and not with the reading of TPA data and plotting it.

The delivery consists of
- CD with source code
- Installation instructions with sample TPA input data and output JPG
- This delivery document
- Quick Reference Guide

Section 2 - Capabilities deferred from this delivery

This section describes the capabilities deferred from this beta delivery.

Export to a tabular format or CSV file
Agreed to be lower priority than exporting to JPG files and deferred.

Legend
Deferred due to time constraints.

Ability for user to change the background color of plots
This capability useful for creating plots appropriate for publication and presentations. This was considered to be of lower priority that other capabilities and was deferred.

Ability for user to select to put boxes around plots

This was considered low priority and deferred. This will be important when plots are displayed side by side on "View."

Reading and displaying JPG files of plots that have already been created and saved.

Deferred due to time constraints. With this release, plots can be saved and then clicked on through a web browser and viewed.

Capability to visualize the influence of parameters on variables which are displayed as percentiles.

Deferred due to time constraints.

Capability to enhance the visualization of one TPA output variable by indicating the degree to which its high or low values might be associated with high or low values of a second TPA output variable.

Deferred due to time constraints.

Capability to view plots side-by-side on a single "view."

With this release plots can be exported to JPG files and put next to each other.
Deferred due to time constraints.

Plotting of Average infiltration per repository, Average reflux per repository and Average diversion per repository

Deferred due to time constraints.

Section 3 – Known bugs

When exporting JPG files, the date, time, name of software (GPP) and version number are not included.

Title of plot is not showing on the plot.

A default field needs to be identified so a "default" plot can be created.

Long names need to be substituted for short names of parameters.

Fonts on plots need to be changed to be more legible for printed documents.

When a user tries to add a third field is added to a plot, the second field name changes instead of the third field being added.

Radio buttons are not "grouped" for the Select Plot Image feature on the View Control window.

Importing image files is not enabled under the Select Plot Image feature on the View Control window.

View Layout is not enabled on the View Control window.

View Borders is not enabled on the View Control window.

Once you have added a field to a plot, there is no way of removing that field from the plot.

Deleting views is not enabled on the View Control window.

Entries into Scientific Notebook No. 376E for the period November 11, 1999 to September 12, 2000 have been made by

_____

Joanne Damours Date

Entries into Scientific Notebook No. 376E for pages 1 to 10 have been made by

_____

Joanne Damours Date

No original text entered into this Scientific Notebook has been removed.

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Joanne Damours Date

Draft user document submitted on Oct-12-2000: "User Doc 10-12-00.doc"

Application submitted on Oct-20-2000: gpp-00-10-20.zip

Application revised and submitted on Nov-21-2000: gpp-00-11-21.zip

Application revised and submitted on Jan-01-2001: gpp-01-01-01.zip

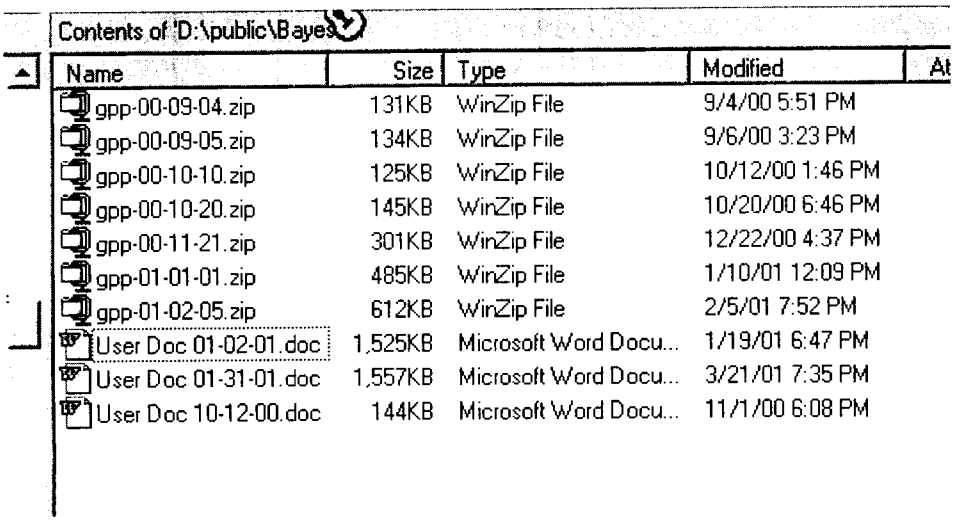
User document revised, second draft submitted on Jan-02-2001: "User Doc 01-02-01.doc"

User document revised, third draft submitted on Jan-31-2001: "User Doc 01-31-01.doc"

Application revised and submitted on Feb-05-2001: gpp-01-02-05.zip

As of April 11, 2001, the GPP application and user document are still evolving.

Contents of disk submitted to QA records on April 11, 2001:


Contents of 'D:\public\Bayes'

Name	Size	Type	Modified
gpp-00-09-04.zip	131KB	WinZip File	9/4/00 5:51 PM
gpp-00-09-05.zip	134KB	WinZip File	9/6/00 3:23 PM
gpp-00-10-10.zip	125KB	WinZip File	10/12/00 1:46 PM
gpp-00-10-20.zip	145KB	WinZip File	10/20/00 6:46 PM
gpp-00-11-21.zip	301KB	WinZip File	12/22/00 4:37 PM
gpp-01-01-01.zip	485KB	WinZip File	1/10/01 12:09 PM
gpp-01-02-05.zip	612KB	WinZip File	2/5/01 7:52 PM
User Doc 01-02-01.doc	1,525KB	Microsoft Word Docu...	1/19/01 6:47 PM
User Doc 01-31-01.doc	1,557KB	Microsoft Word Docu...	3/21/01 7:35 PM
User Doc 10-12-00.doc	144KB	Microsoft Word Docu...	11/1/00 6:08 PM

Entries into Scientific Notebook No. 376E for the period September 12, 2000 to April 11, 2001 have been made by

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Joanne Damours Date

Entries into Scientific Notebook No. 376E for pages 11 to 12 have been made by

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Joanne Damours Date

No original text entered into this Scientific Notebook has been removed.

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Joanne Damours Date

The application was modified to fix minor bugs, display correct tick labels when a logarithmic scale is selected, and improve the internal documentation. A new version was delivered on September 6, 2001.

Dr. Pensado from the CNWRA evaluated the application and indicated that it was not working properly. He also indicated that headers of the java source code should be updated.

A new version of the application was delivered on September 30, 2001. An updated visad.jar library was delivered with the application.

Updated electronic files have been submitted to QA records as part of Scientific Notebook 375.

Entries into Scientific Notebook No. 376E for the period April 11, 2001 to October 10, 2001 have been made by

10/11/2001

FOV Joanne Damours Date

Entries into Scientific Notebook No. 376E for pages 13 to 14 have been made by

10/11/2001

FOV Joanne Damours Date

No original text entered into this Scientific Notebook has been removed.

10/11/2001

FOV Joanne Damours Date

Entries into Scientific Notebook No. 376E for the period April 11, 2001 to October 10, 2001 have been made by

_____

Joanne Damours Date

Entries into Scientific Notebook No. 376E for pages 13 to 14 have been made by

_____

Joanne Damours Date

No original text entered into this Scientific Notebook has been removed.

_____

Joanne Damours Date

This electronic scientific notebook, which was used to record the development of the TPA graphical post processor (GPP), is closed. This notebook is a developers journal and I do not believe that anyone could use the information contained herein to reproduce the development of the GPP. All information needed to replicate the final GPP is in the source code, which is contained in QA records.

Joanne Withrow 3/28/2002

Scientific Notebook 376

Issued to Joanne Damours
11/11/99

Entries by Joanne Damours and John Emmerling

Bayesian Systems, Inc.
Gaithersburg, MD

Development of a Graphic Post-processor for TPA Version 4.0 Code

Charge number: 20.01402.762

Joanne Damours

1-17-00

Decided to update our proposal based on the memorandum from Osvaldo.

3-7-00

Wrote focus statement to be sure that Doug and I keep on track with the project.

4-24-00

Decided to bring John Emmerling onto the project to do the user interface coding for the GPP. Concerned about delivering late and feel that John can move us forward more rapidly.

John Emmerling

4-24-00

Met with Joanne and Doug.

4-30-00

Decided to work in Java 1.3 for deployment and performance and scheduling. Making things run as applets or as applications.

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

SCIENTIFIC NOTEBOOK REVIEW CHECKLIST RECORD

Scientific Notebook No.: #3761E Page Nos: 1-14 Date Turned In: 3/26/02

Accomplished

yes	1. Initial entries per QAP-001
yes	2. Dating of entries
N/A	3. Corrections (crossed out, one line through w/initials/date)
N/A	4. White out not used
yes	5. Page number visible on original notebook
yes	6. In process entries per QAP-001
yes	7. Figure information present
yes	8. Text visible
N/A	9. Electronic Scientific Notebook changes initialed and dated
yes	10. Permanent ink or type only
yes	11. Signing of entries (not required on each page)
yes	12. Statement at the end of the Scientific Notebook.
N/A	13. Electronic media in the scientific notebook properly labeled

Discrepancies have been identified. Yes __ No X; S/N has been closed: Yes ✓ No __

Checker: J. Thomas Addington Date: 3/28/02

==========

The discrepancies identified in this Scientific Notebook Review Checklist have been addressed by:

_____ _____

Signature Date

SCIENTIFIC NOTEBOOK 376 E-2

Section maintained by Osvaldo Pensado

SCIENTIFIC NOTEBOOK

Osvaldo Pensado

Center for Nuclear Waste Regulatory Analyses
Southwest Research Institute
San Antonio, Texas

INITIAL ENTRIES

Scientific Notebook 376

Issued to Joanne Damours

Issue Date: November 11, 1999

Account Number: 20.01402.762

Participants: Osvaldo Pensado

Development of a Graphic Post-processor for TPA Version 4.0 Code

Objective: document activities related to acceptance testing of a graphic post-processor (GPP) for TPA Version 4.0 Code.

The acceptance testing is aimed at verifying that all of the requirements stated in the Software Requirements Document have been fulfilled.

Evaluation of GPP application, Version 11-19-2001
Date 11-28-2001

Installation:

Successful installation was accomplished following instructions explained in the User's Manual. Stefan Mayer also verified that the installation instructions were accurate.

The GPP was installed in the PC named Dakath running Windows NT.

The GPP could was run with the Java™ Development Kit and also with the Java™ Runtime Environment. Testing documented in this Scientific Notebook was completed with the Java™ Development Kit.

Presumably the GPP is compatible with any operating system running Java™ and Java™ 3D. Thus, the GPP should be compatible with Windows 9X, Windows 2000, and Sun Solaris; however, no testing has been performed in these platforms.

Requirement 1:

The SRD of the GPP states that the following variables will be graphically displayed:

1. Mean annual temperature
2. Mean annual precipitation
3. Infiltration per subarea
4. Average infiltration per repository
5. Average reflux per repository
6. Average diversion per repository
7. Fraction of canisters failed
8. Drip shield failure time
9. Water hitting waste package
10. Repository temperature
11. Waste package temperature
12. Waste package relative humidity
13. Release from engineered barrier system per subarea
14. Release from engineered barrier system per repository
15. Release from lower unsaturated zone per subarea
16. Release from lower unsaturated zone per repository
17. Release from saturated zone per subarea
18. Release from saturated zone per repository
19. Current biosphere dose conversion factors
20. Pluvial biosphere dose conversion factors
21. Total dose to the receptor group
22. Peak dose for compliance period

Results of evaluation of requirement 1:

All of the variables are available for graphic display with the following observations:

- Variable 8, Drip Shield Failure Time, is an input parameter to the TPA Code Version 4.0. Thus, it appears listed as an input parameter.

- Variables 14, 16, and 18 are displayed as cumulative releases per radionuclide, in the form of box and whisker plots.

- Variables 20 and 21 are displayed per pathway and per nuclide in the form of box and whisker plots.

Notes:

Version 2001-11-19 was used in the generation of the following plots.

Input TPA data available at

spock:/home/opensado/bayes/

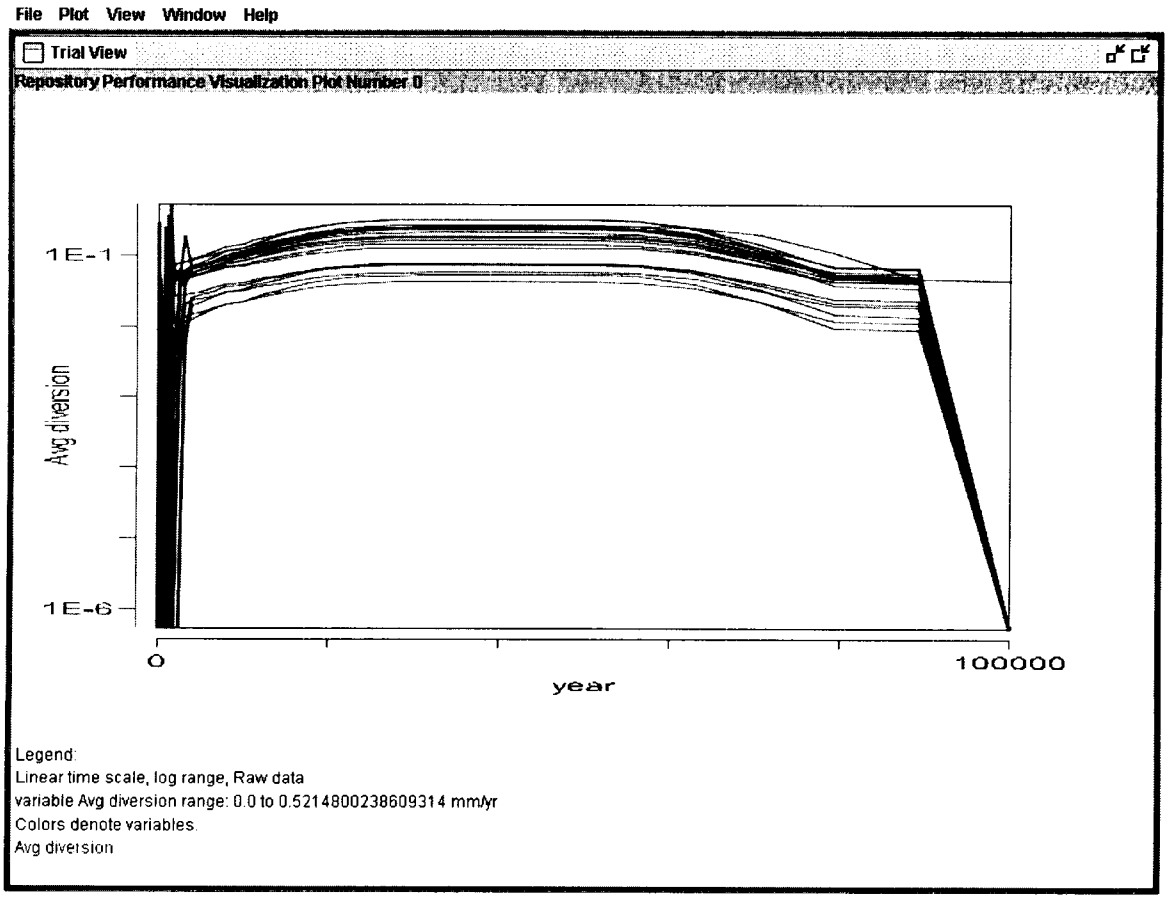
Input data were generated with TPA 4.0, 100 realizations, and base case.
Input data will be attached to this Scientific Notebook, for QA records.

The file gpp.properties was modified with a text editor to contain the following entries:

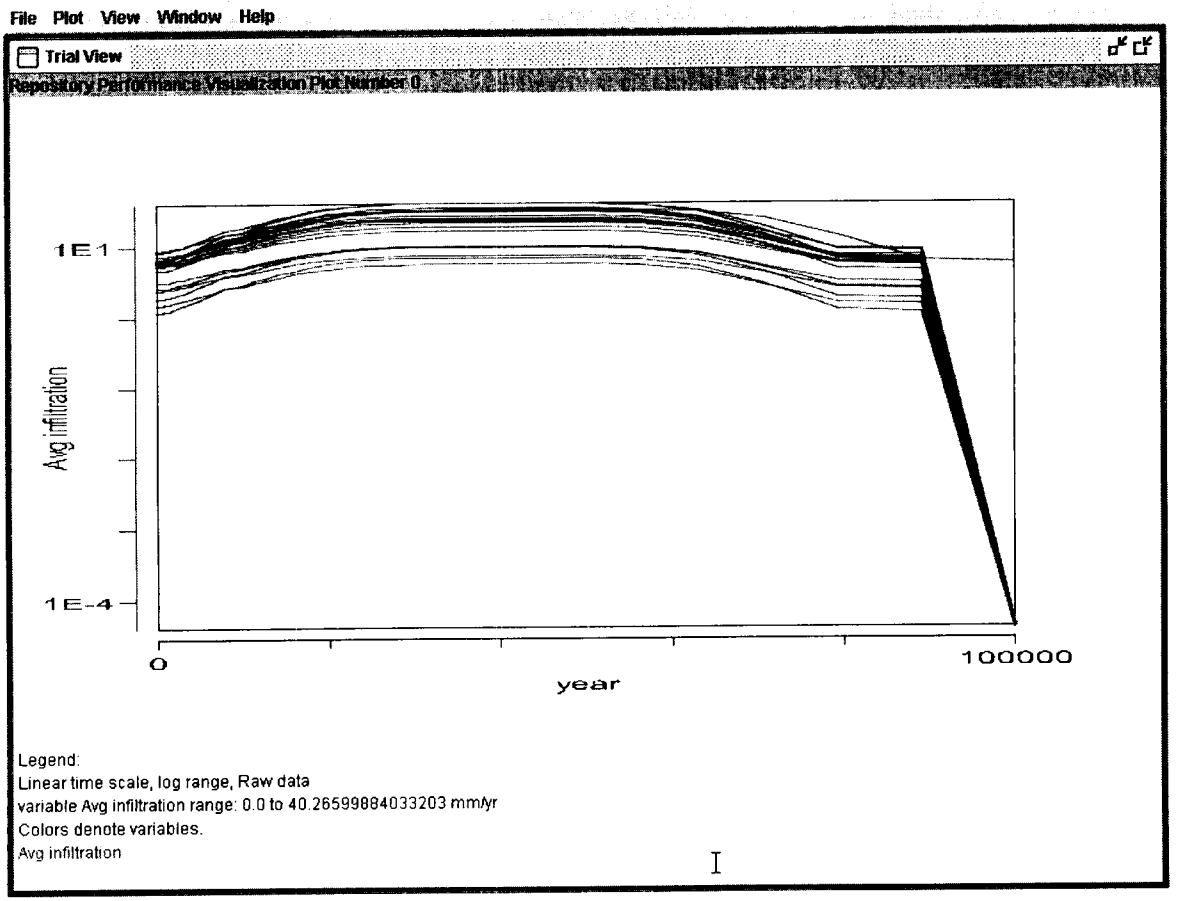
```
which_subarea=3
num_realizations=20
param_percentiles=10,50,100
nuclide_of_interest=none
```

The GPP application was launched after modification of the gpp.properties file to make sure that such changes were detected.

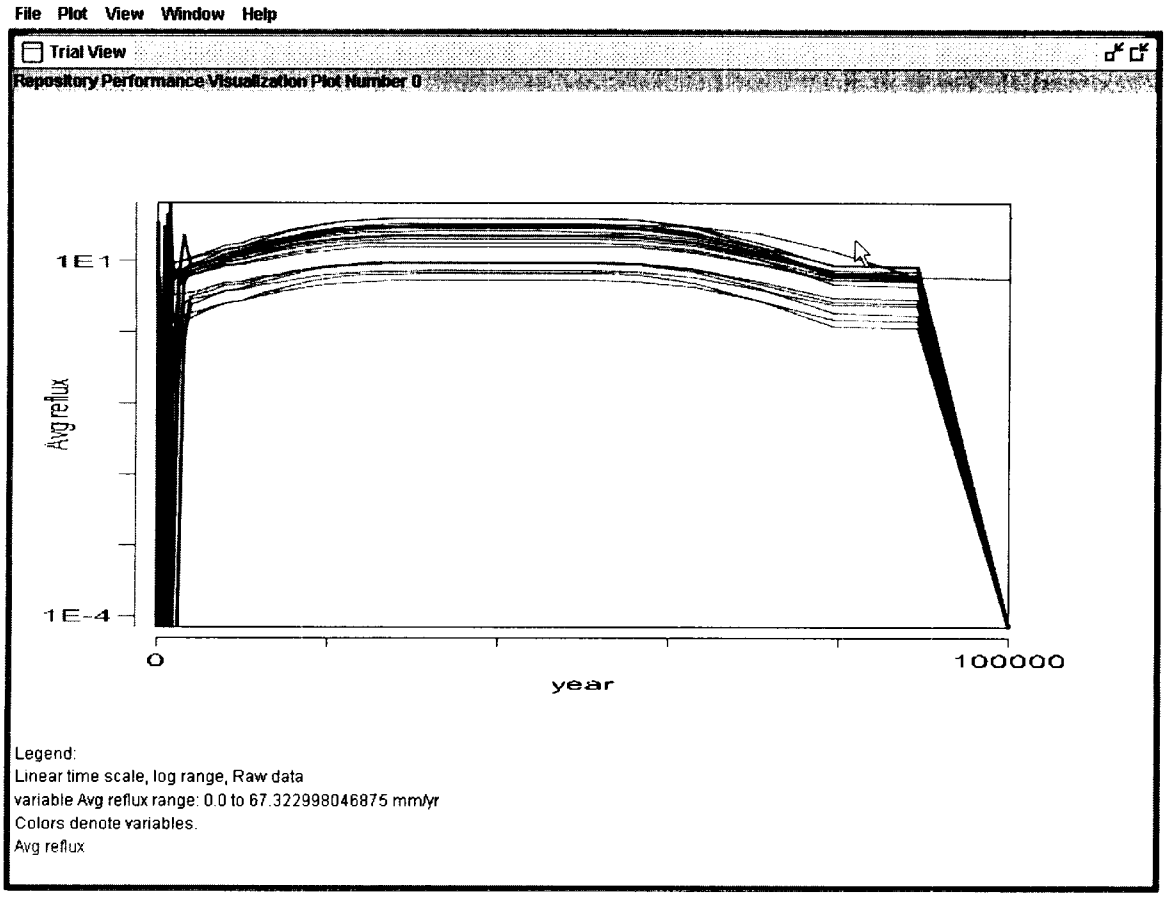
Sample plots generated with the GPP are next displayed. Plots corresponding to each of the elements for Requirement 1 are included. The x and y scales were adjusted to be linear or logarithmic so that an adequate display of the data would be achieved.



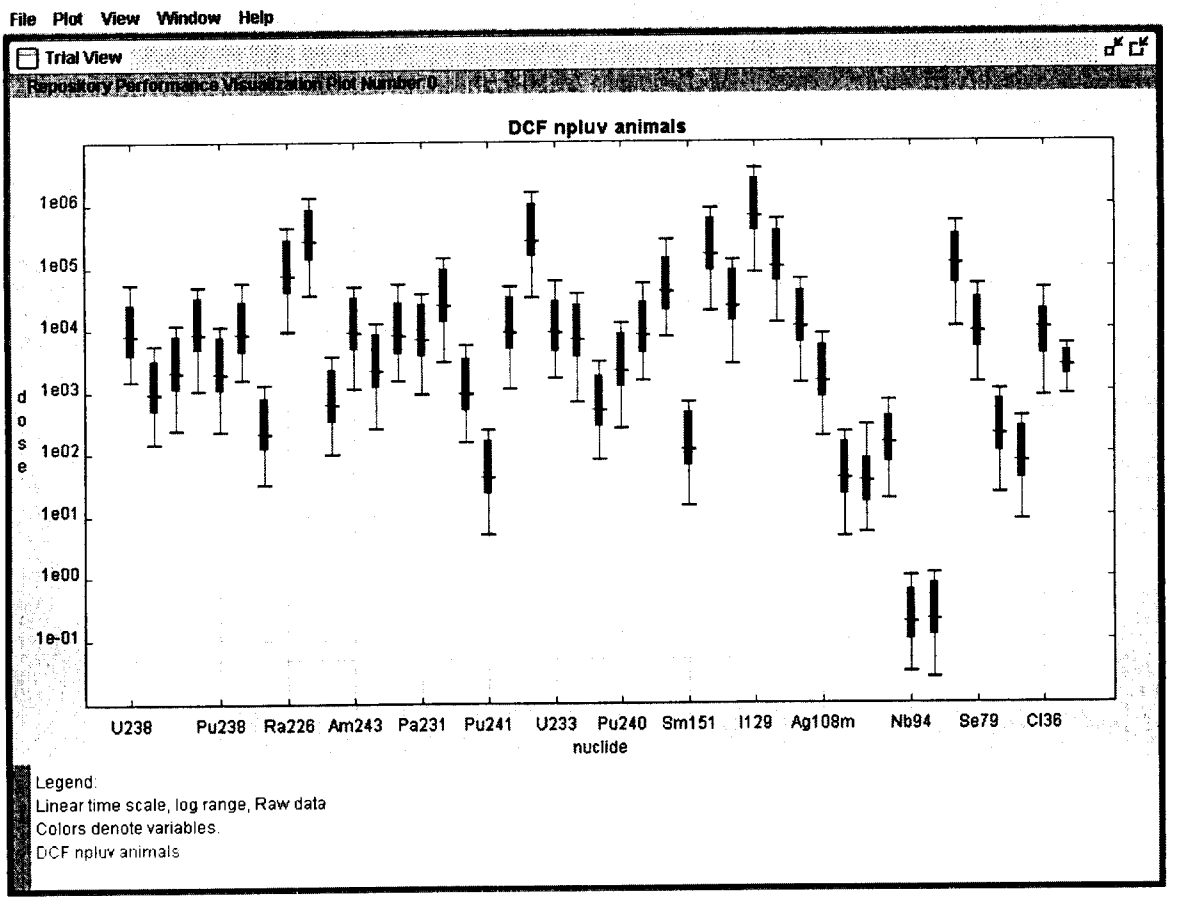
Average diversion.



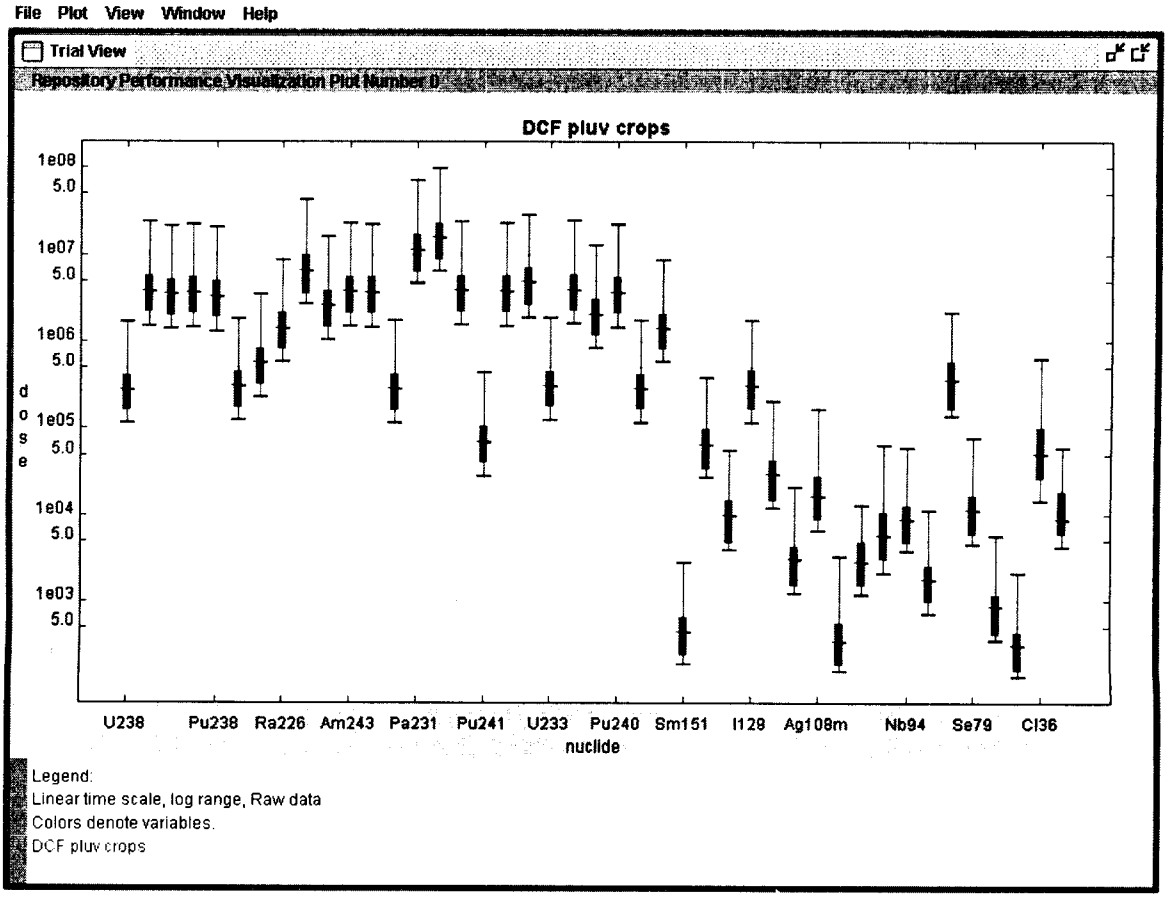
Average infiltration



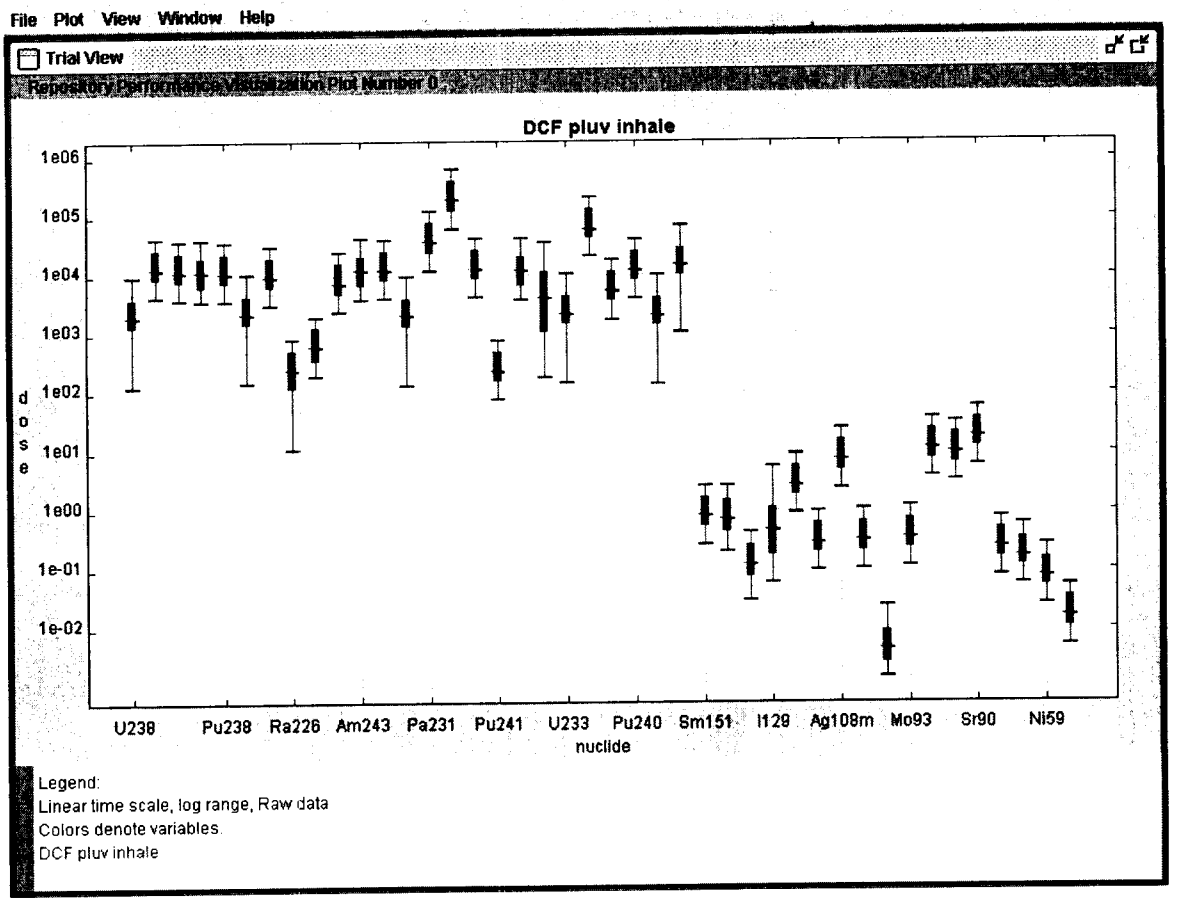
Average reflux



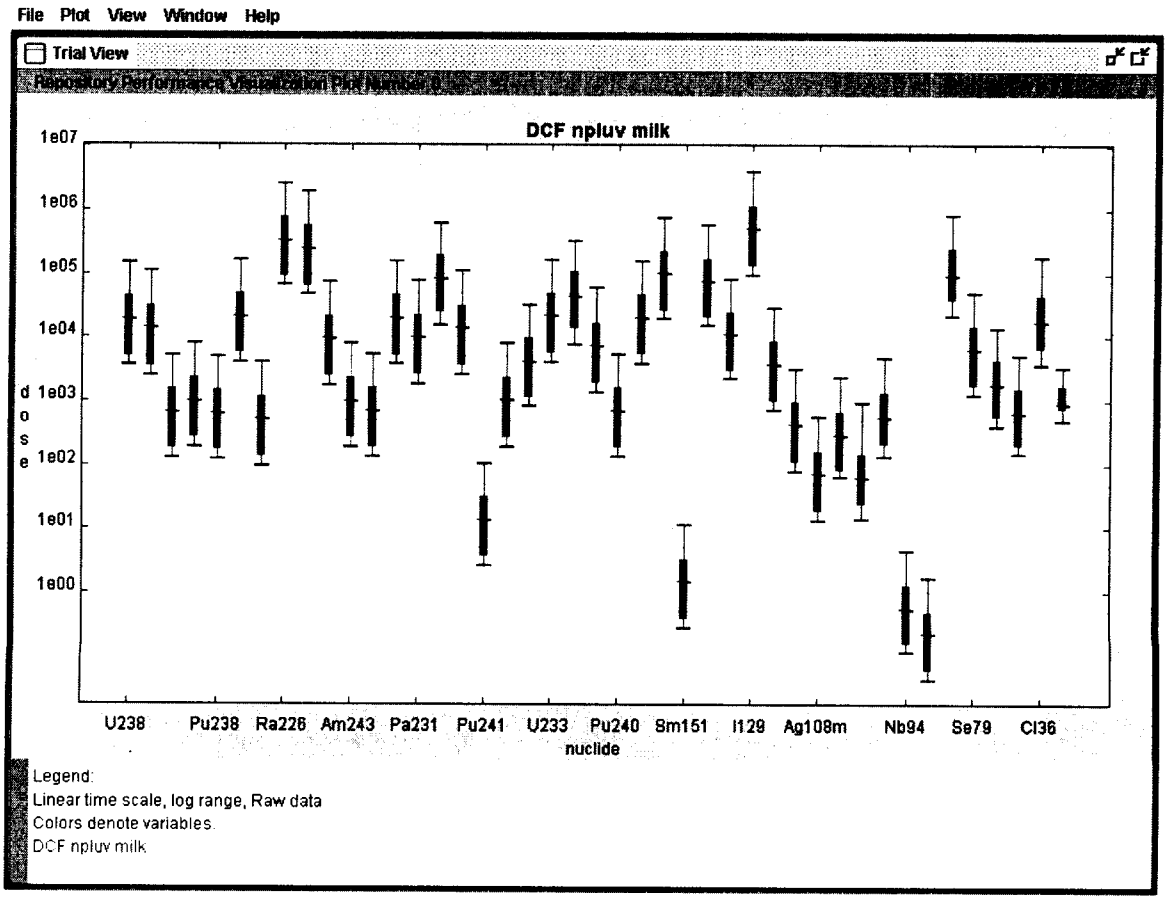
Dose conversion factors, ingestion of animals, pluvial case



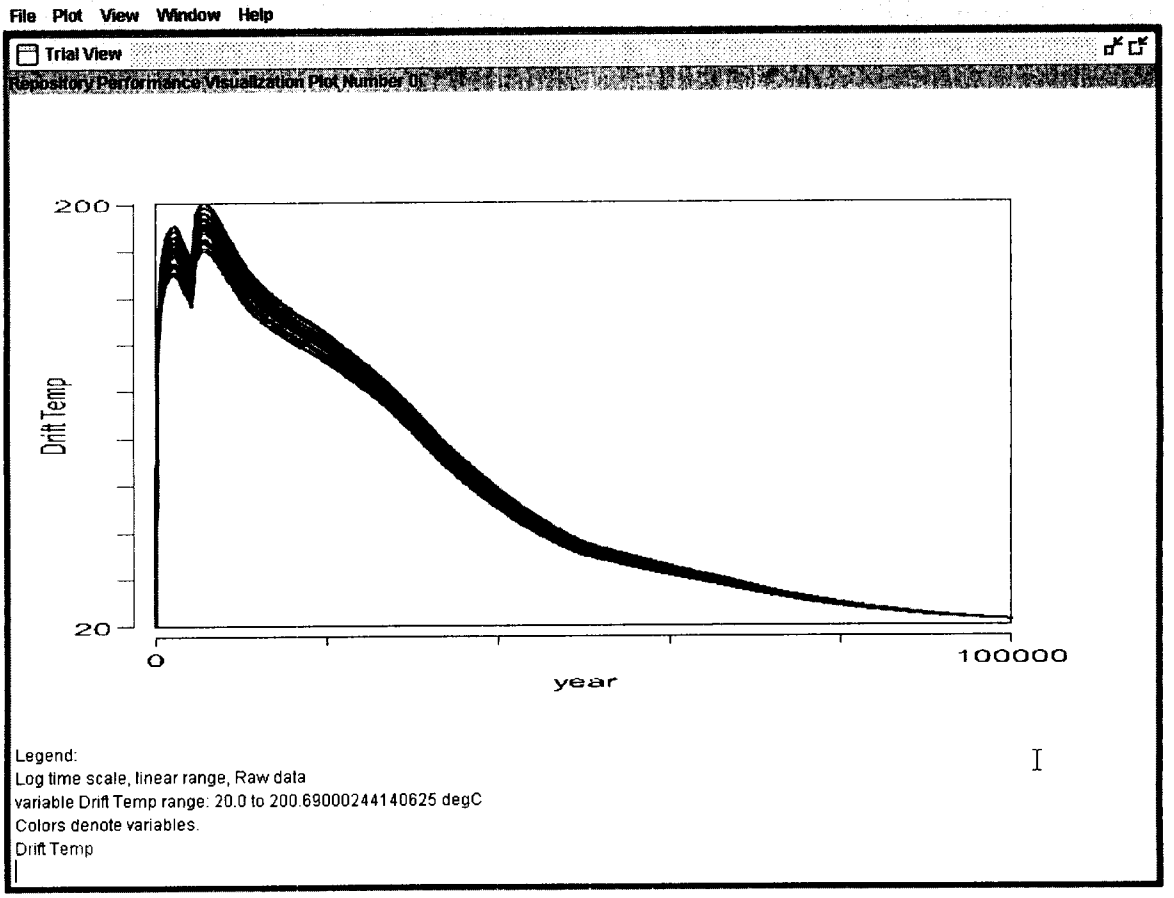
Dose conversion factors, ingestion of crops, pluvial case



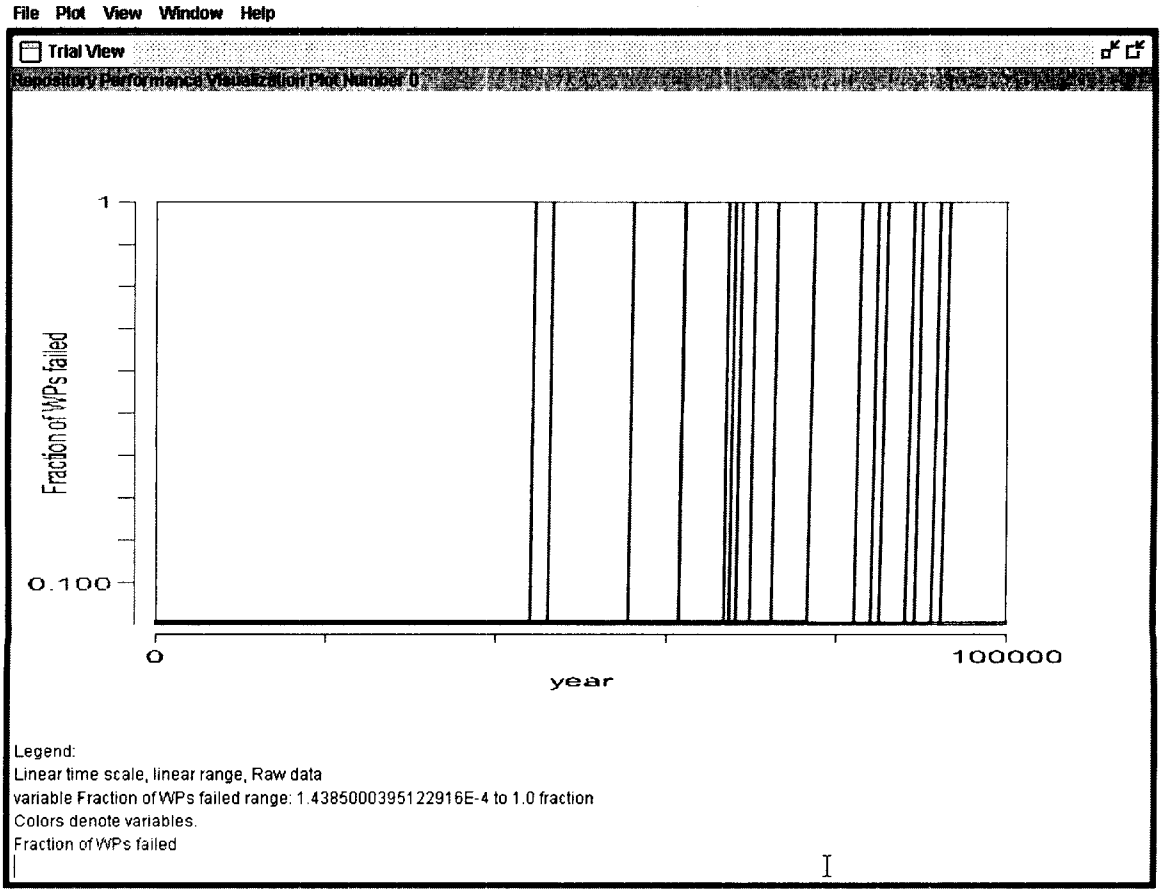
Dose conversion factors, inhalation, pluvial case



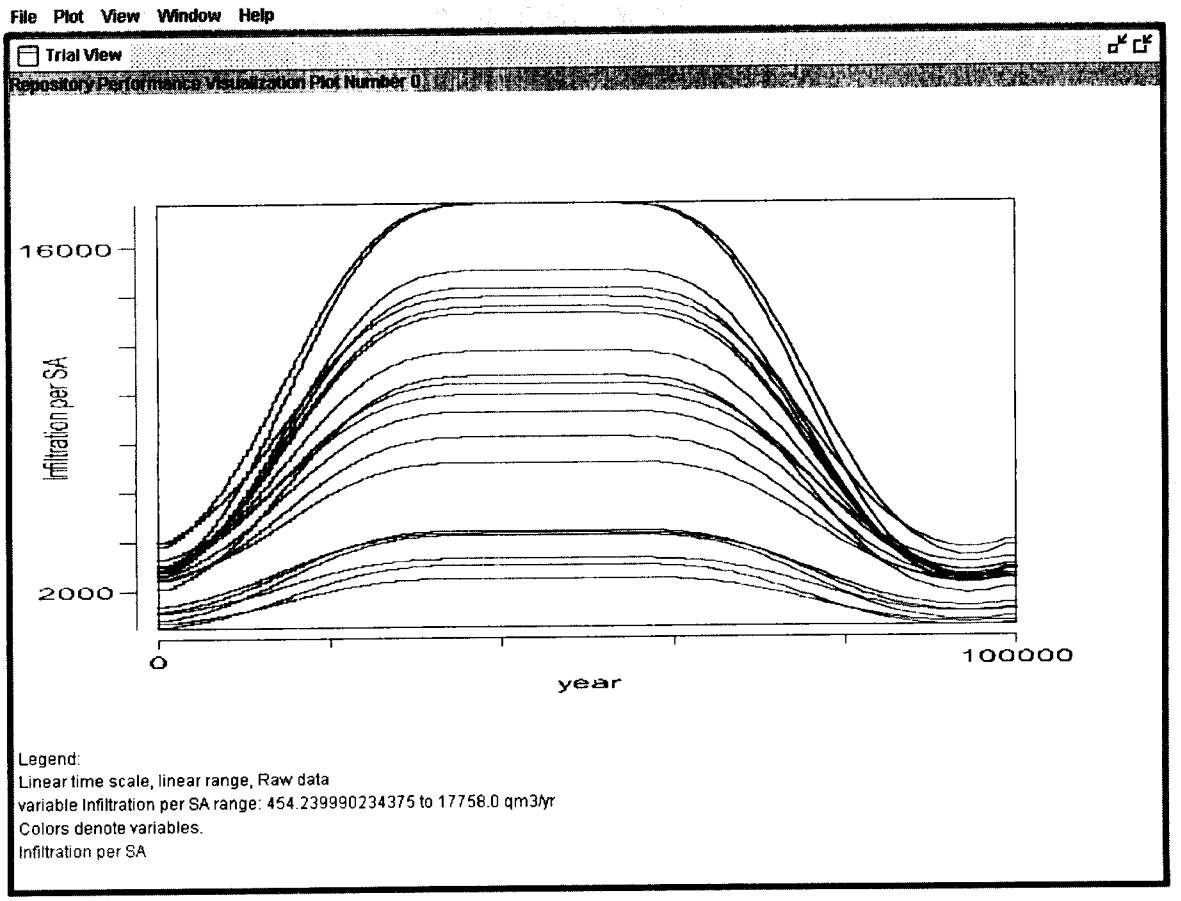
Dose conversion factors, drinking of milk, non pluvial case



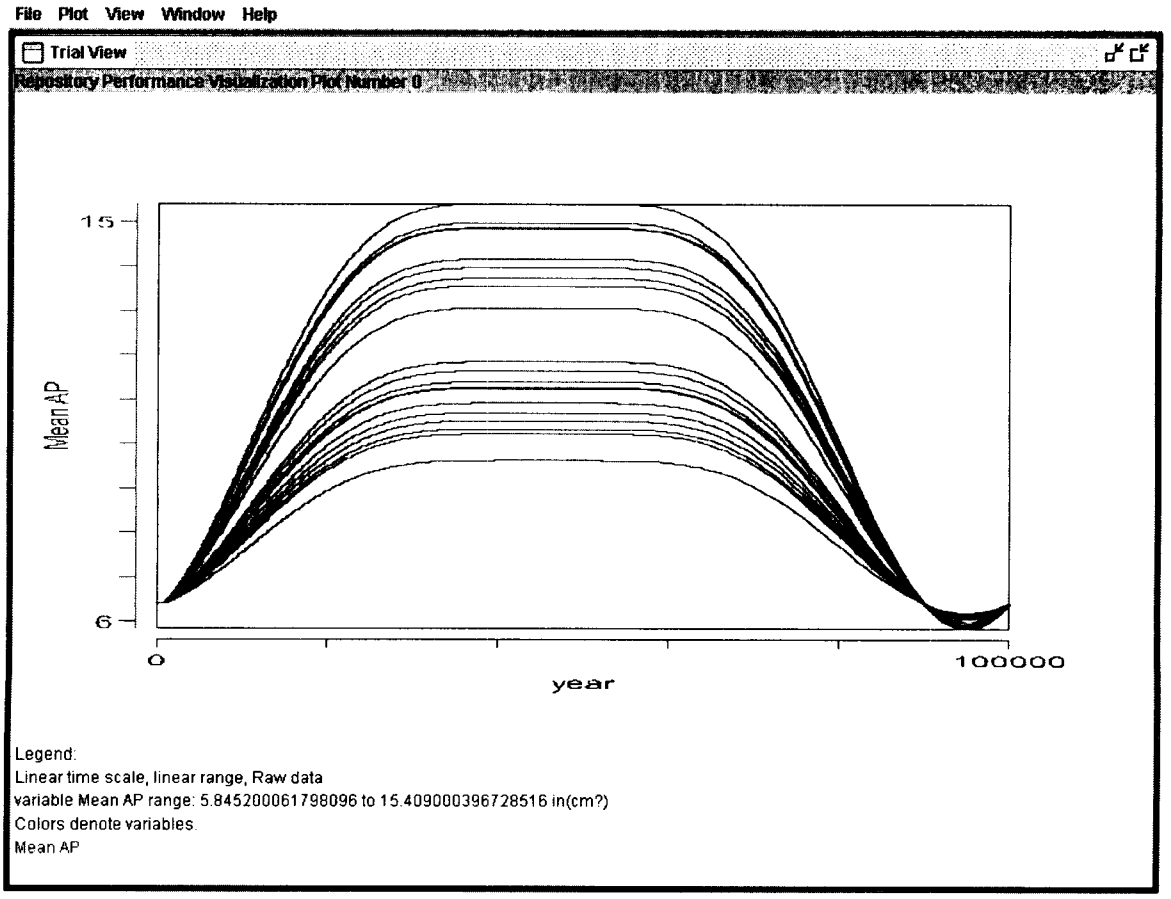
Temperature at the drift



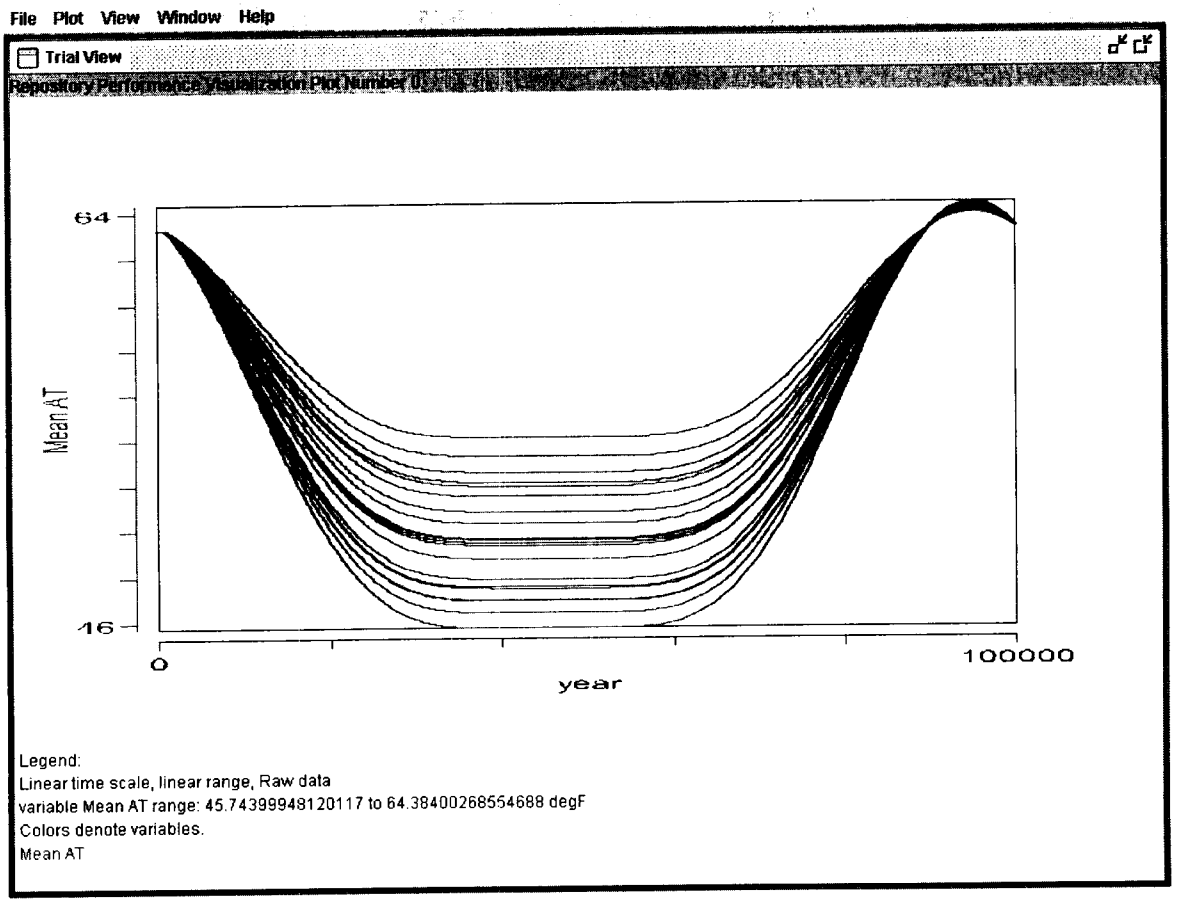
Fraction of WPs failed



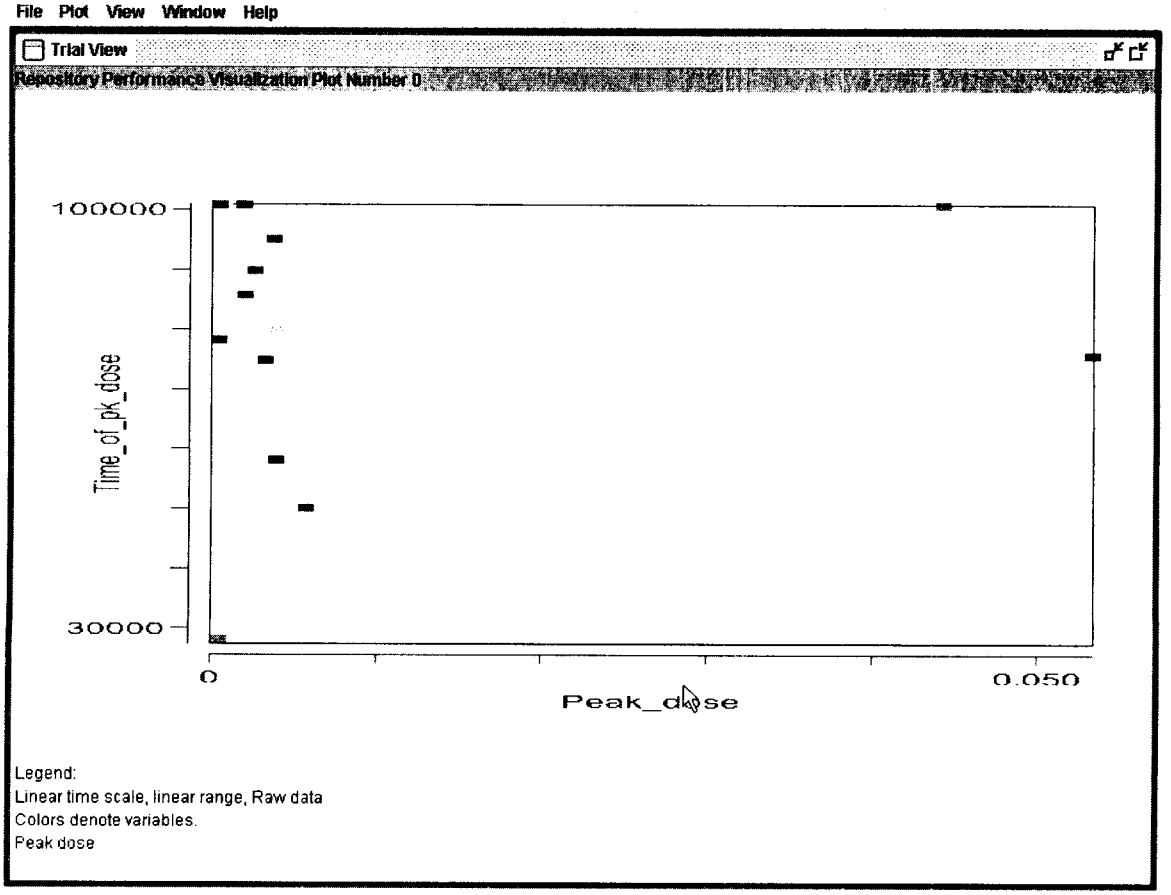
Infiltration per subarea



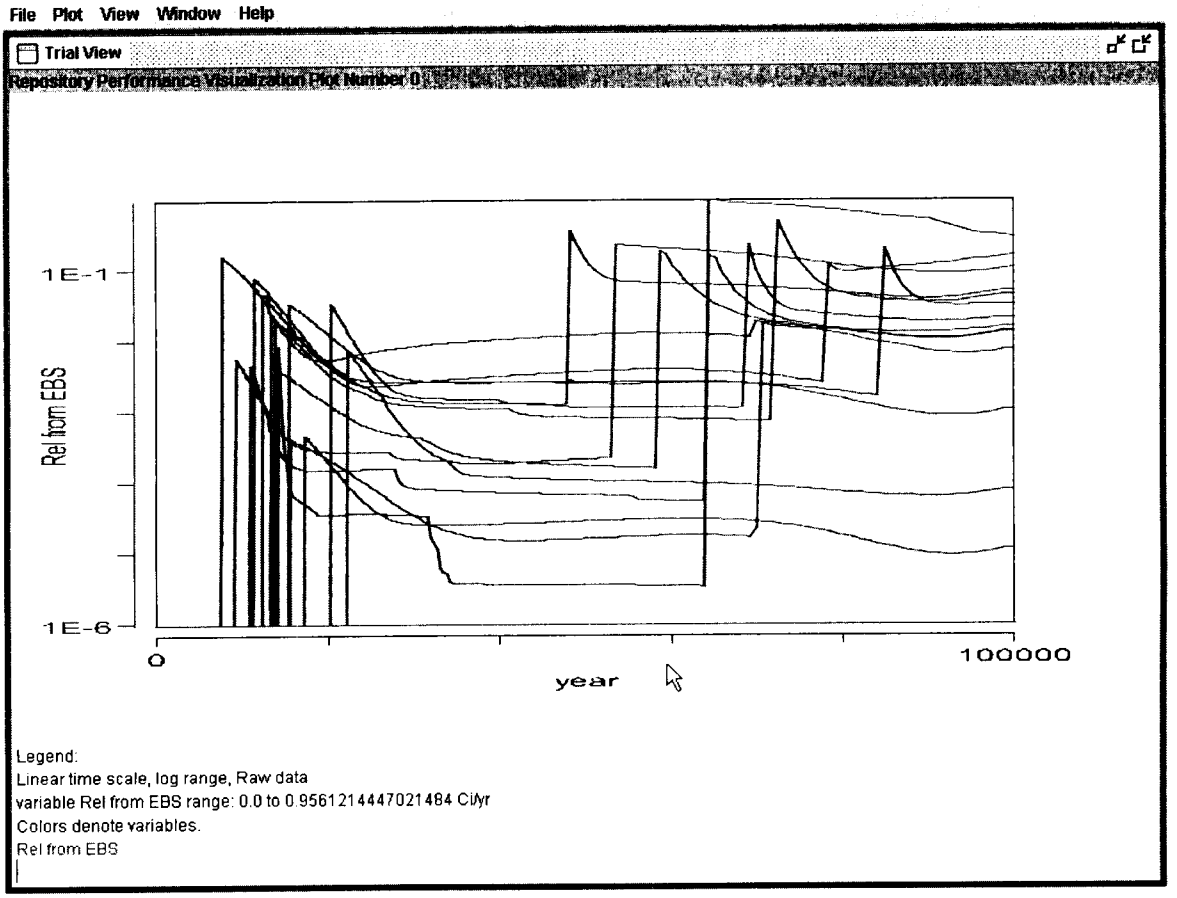
Mean annual precipitation



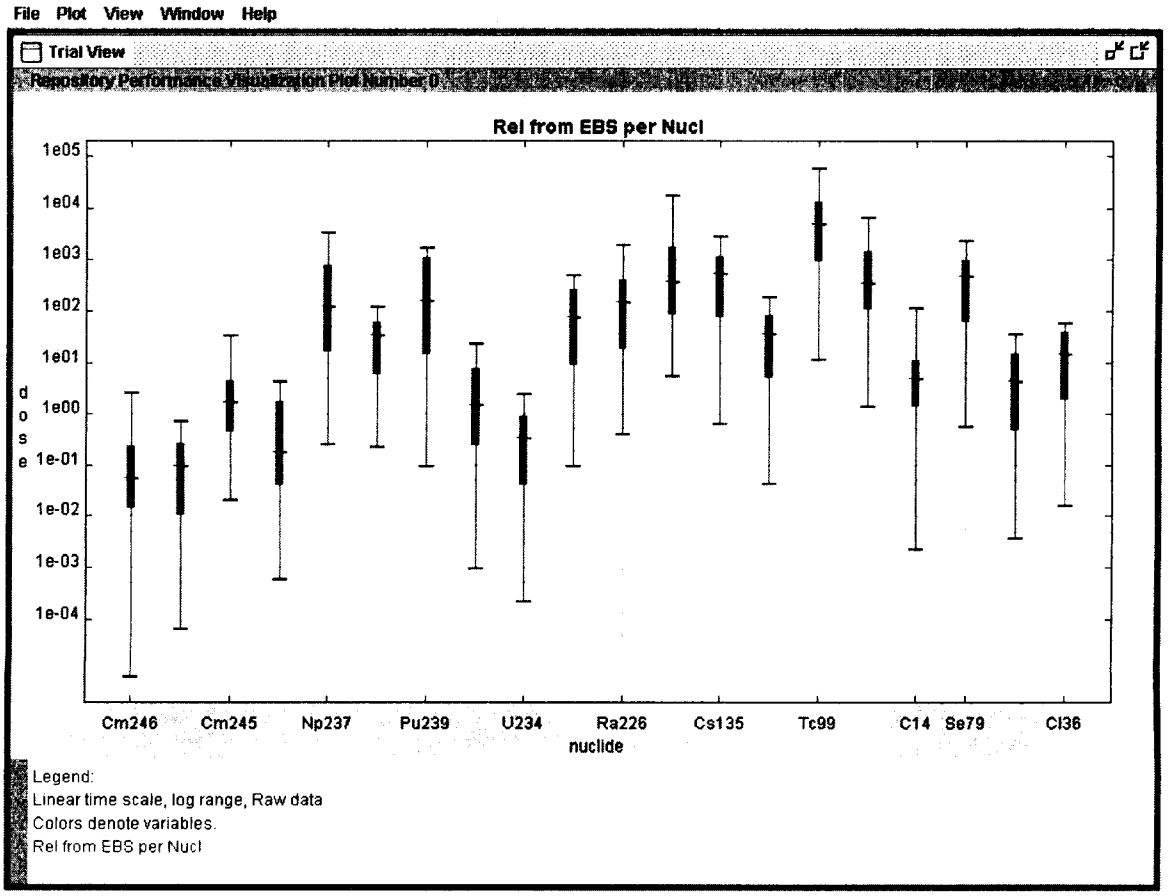
Mean annual temperature



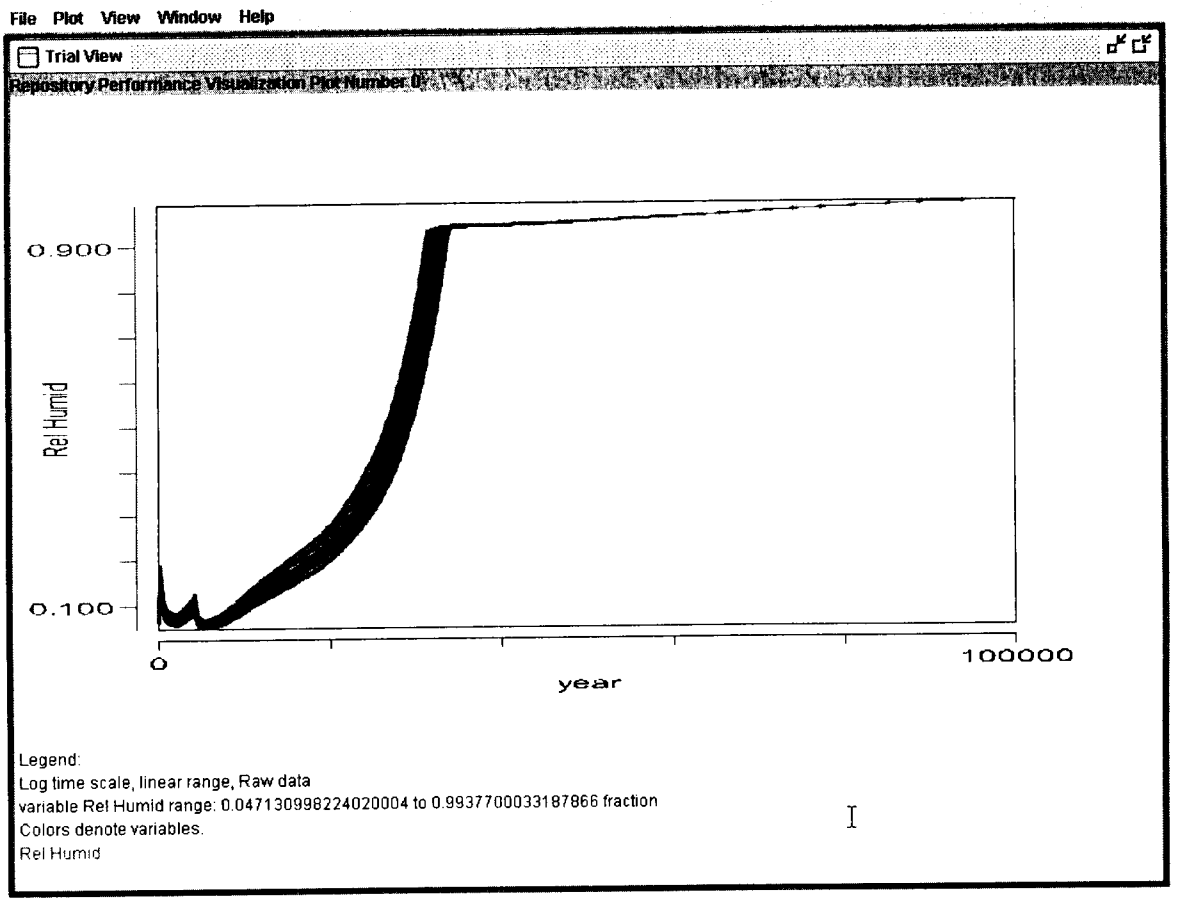
Scatter plot of time of peak dose versus peak dose



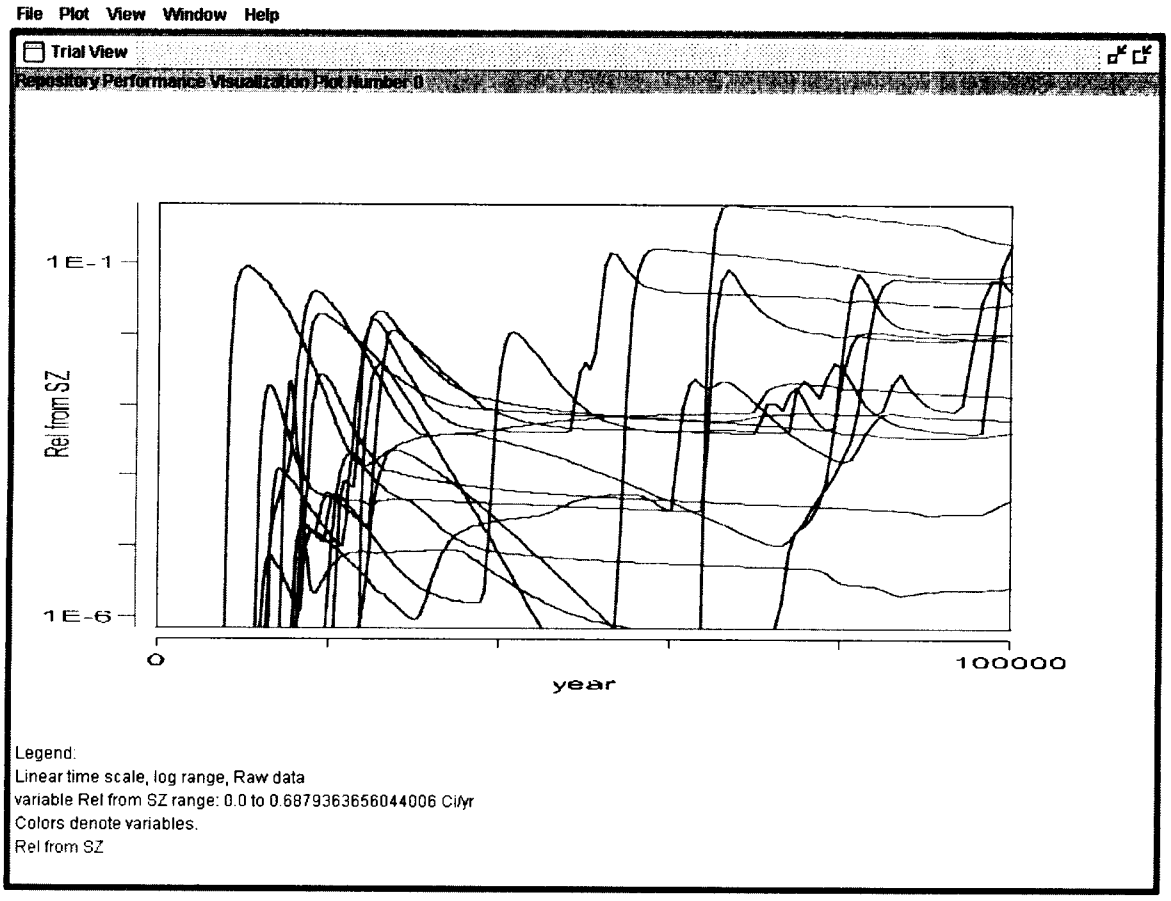
Release rate at the engineer barrier system



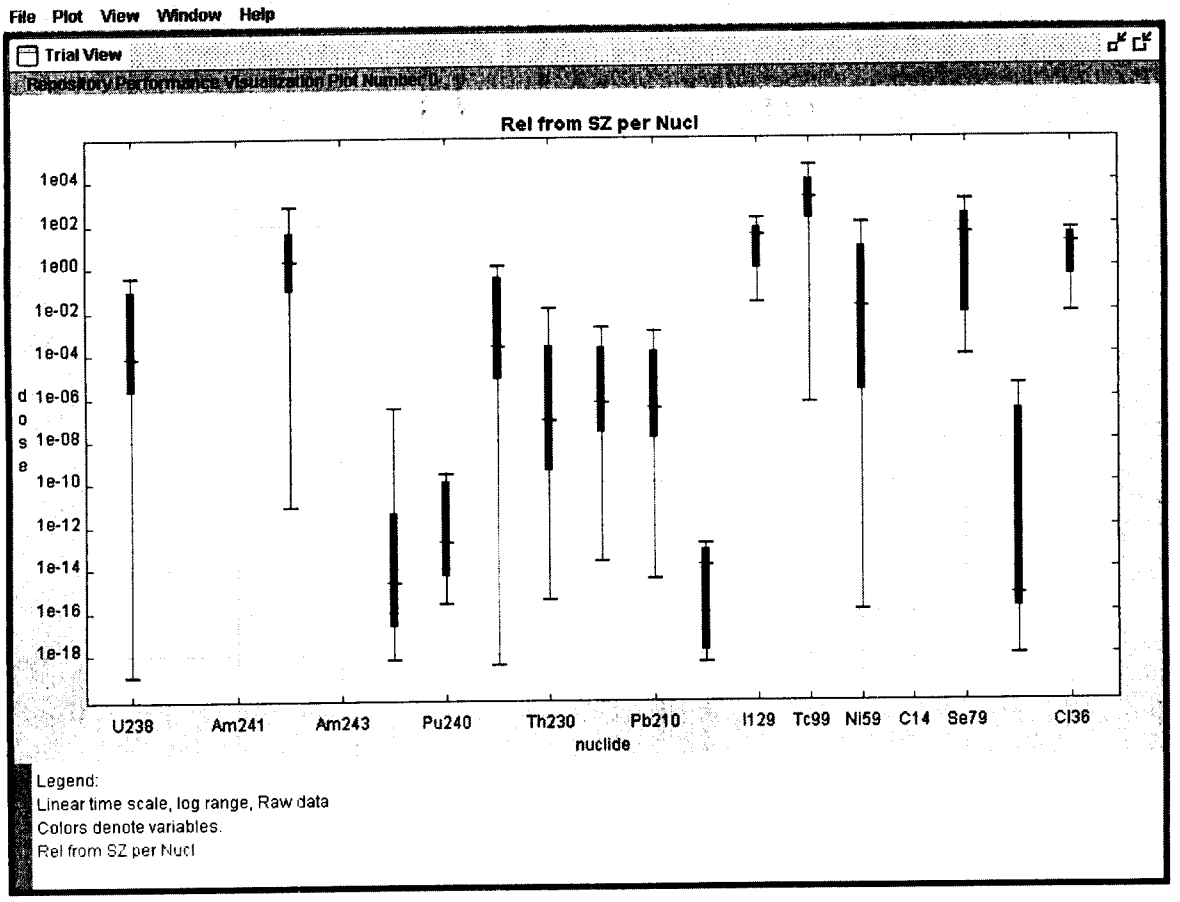
Cumulative release at the EBS per nuclide



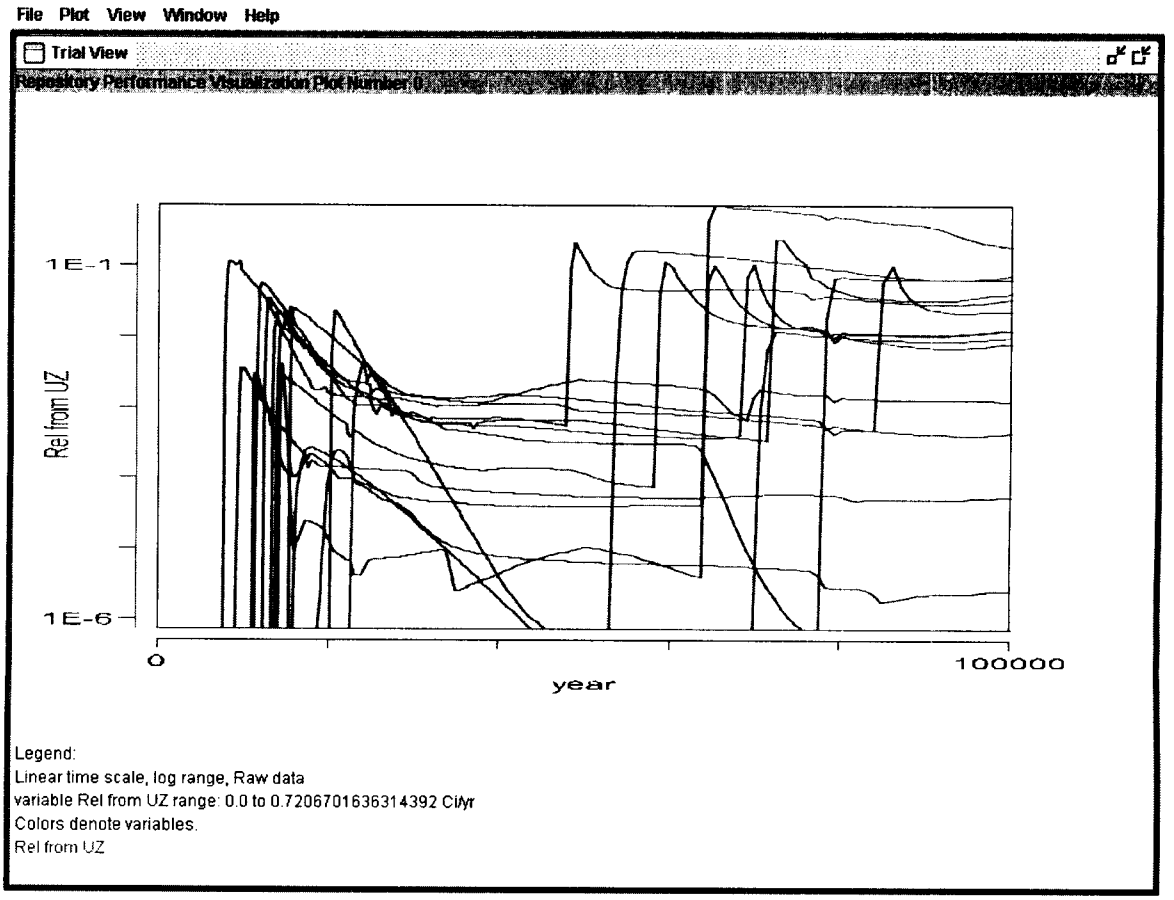
Relative humidity



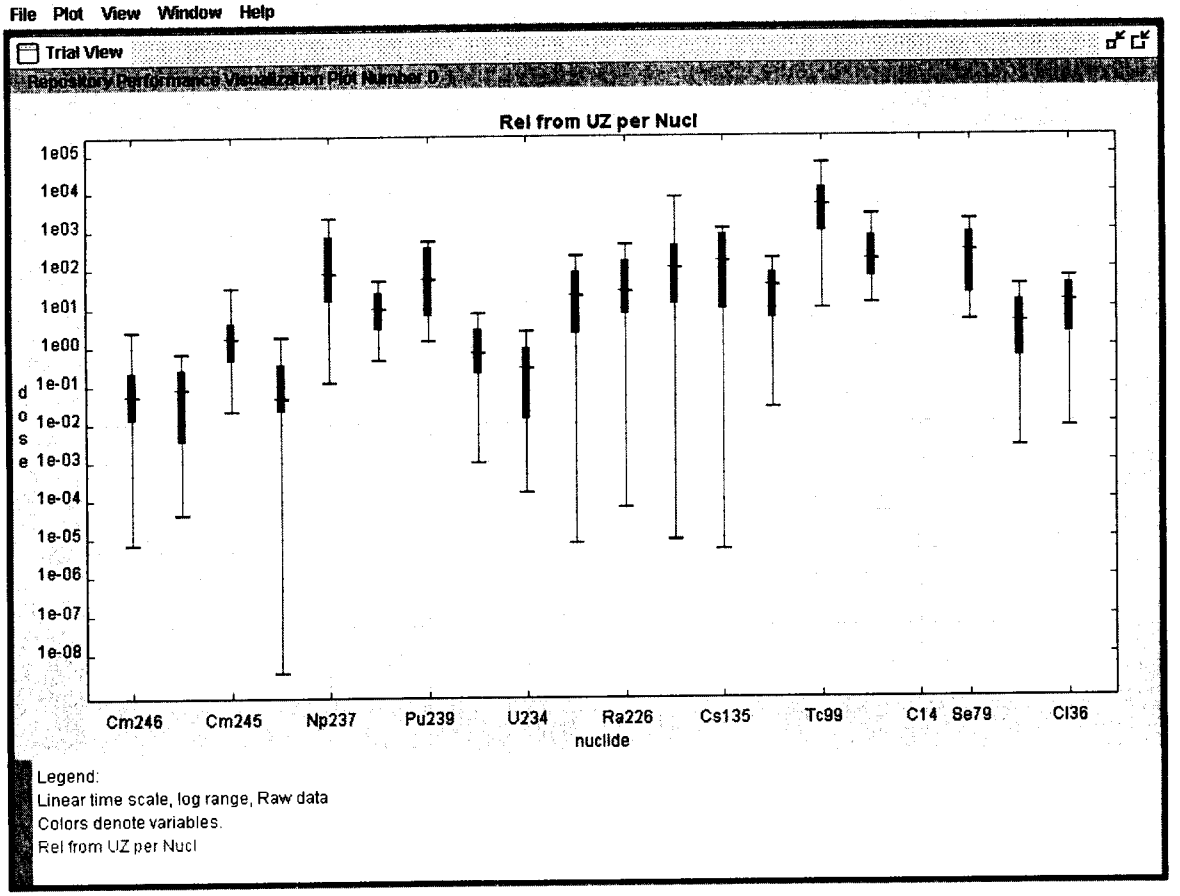
Release rate from saturated zone



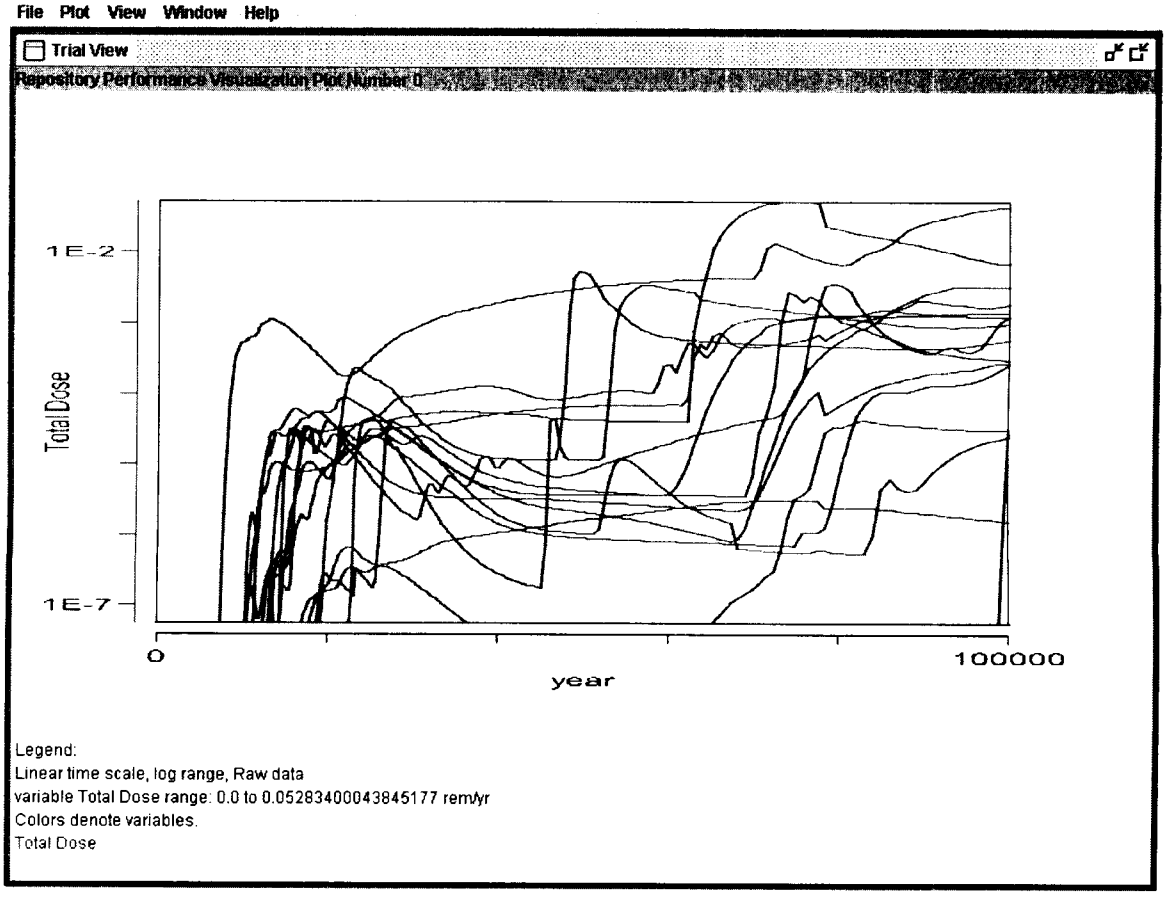
Cumulative release from saturated zone per nuclide



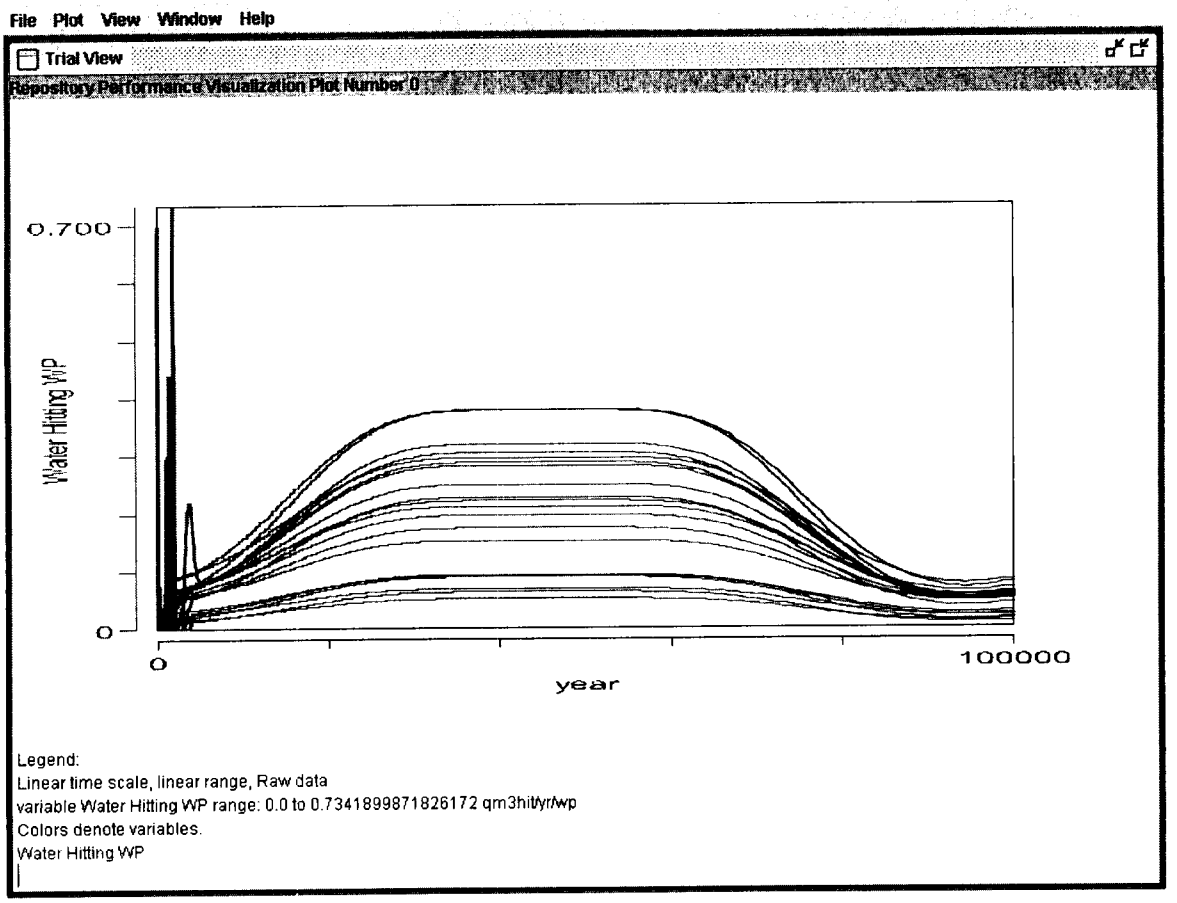
Release rate from unsaturated zone



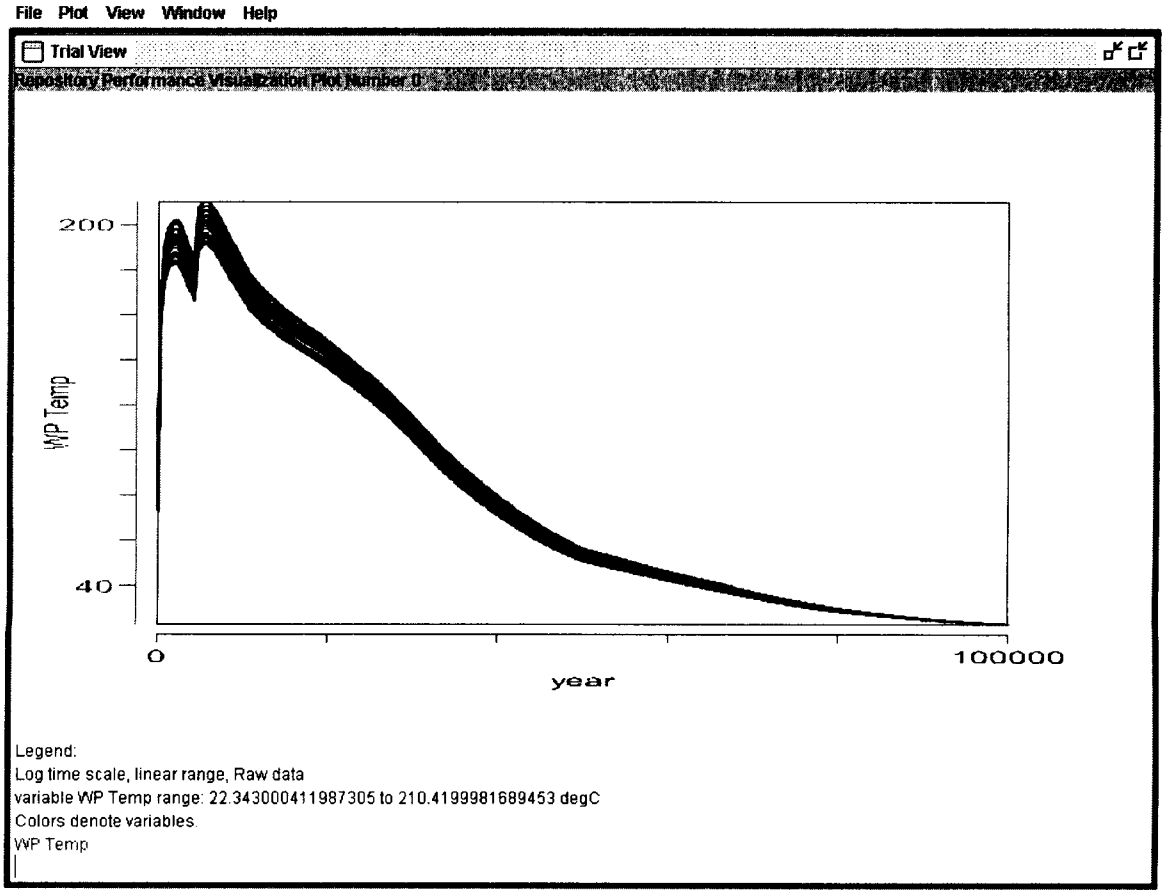
Cumulative release from unsaturated zone per nuclide



Total dose rate



Amount of water hitting waste packages



Waste package temperature

Requirement 2:

The software will be able to plot for any set of realizations and any of the mentioned variables, either (i) the bundle of trajectories showing for each realization the value of the variable during time, (ii) a single curve summarizing the bundle by representing the median (50th percentile) value of the variable for each time, or (iii) a family of curves containing not only the median curve described previously, but also the curve for any other percentile.

Evaluation of Requirement 2:

Point (i) has been checked in the set of plots for Requirement 1. Points (ii) and (iii) are verified in the next set of plots. It is concluded that Requirement 2 is fulfilled. The GPP allows display of **regularized** data. At each time step, a defined percentile of the quantity is computed. The percentile curve is plotted as a single continuous curve as a function of time. If multiple percentiles are plotted, the outcome is a collection of curves that do not intersect. The GPP allows for selection of the percentiles to be plotted, in the Plot Control window and in the Percentiles frame.

The following observations apply:

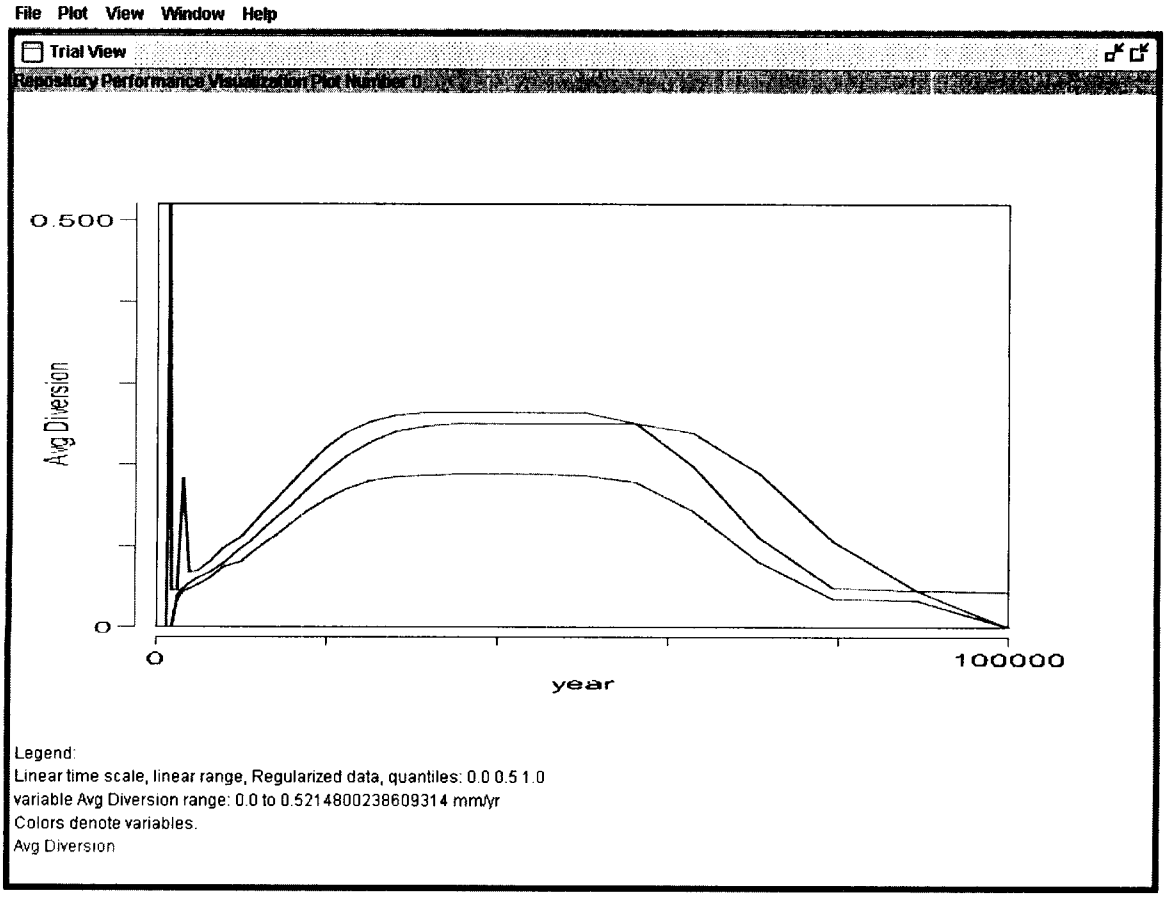
- The scatter plot for the peak dose cannot be controlled from the Percentiles frame in the Plot Control Window. This is acceptable as it lacks meaning the computation of percentiles for the peak dose and the time of the peak dose. For example, the 10^{th} percentile of the peak dose can be computed, but at what time does it occur?

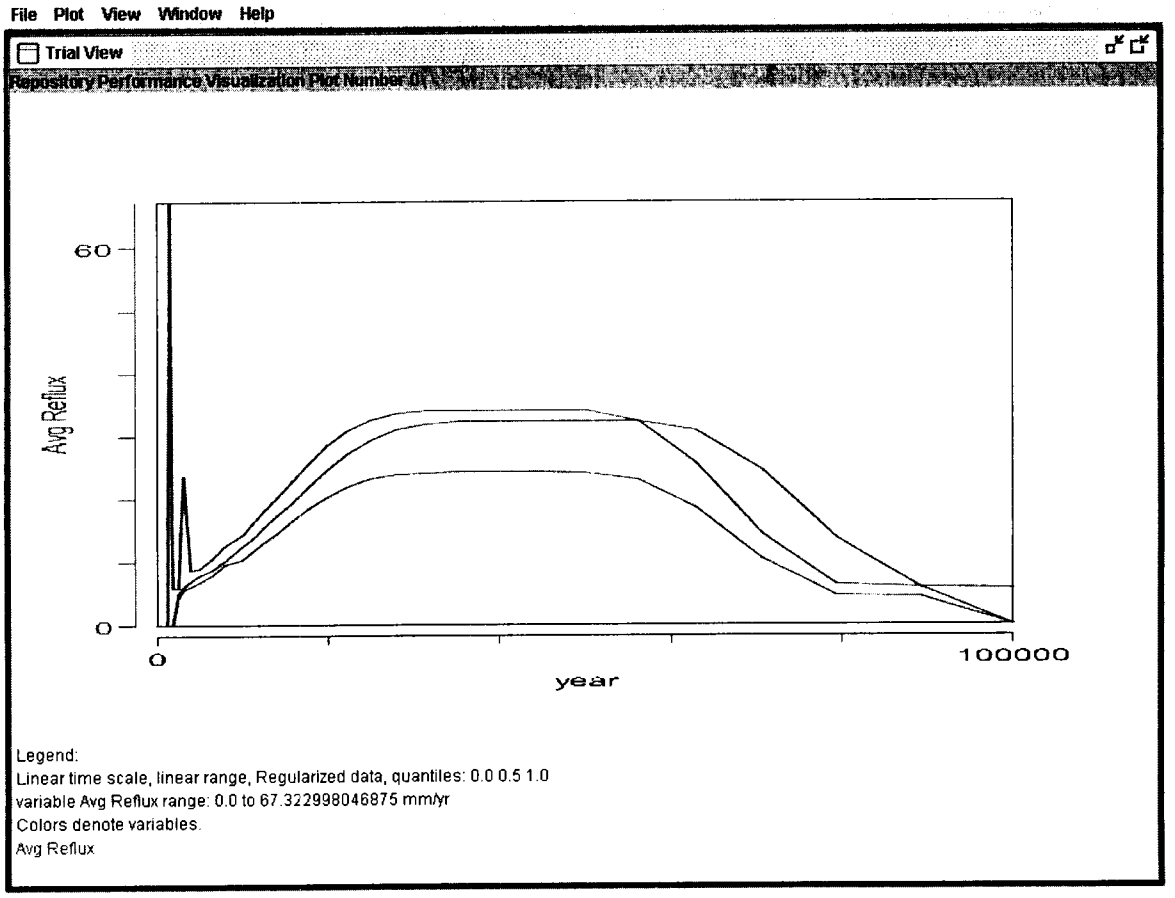
- Box and whisker plots cannot be controlled from the Percentiles frame in the Plot Control Window. This is acceptable as the box and whisker plots already contain information on percentiles.

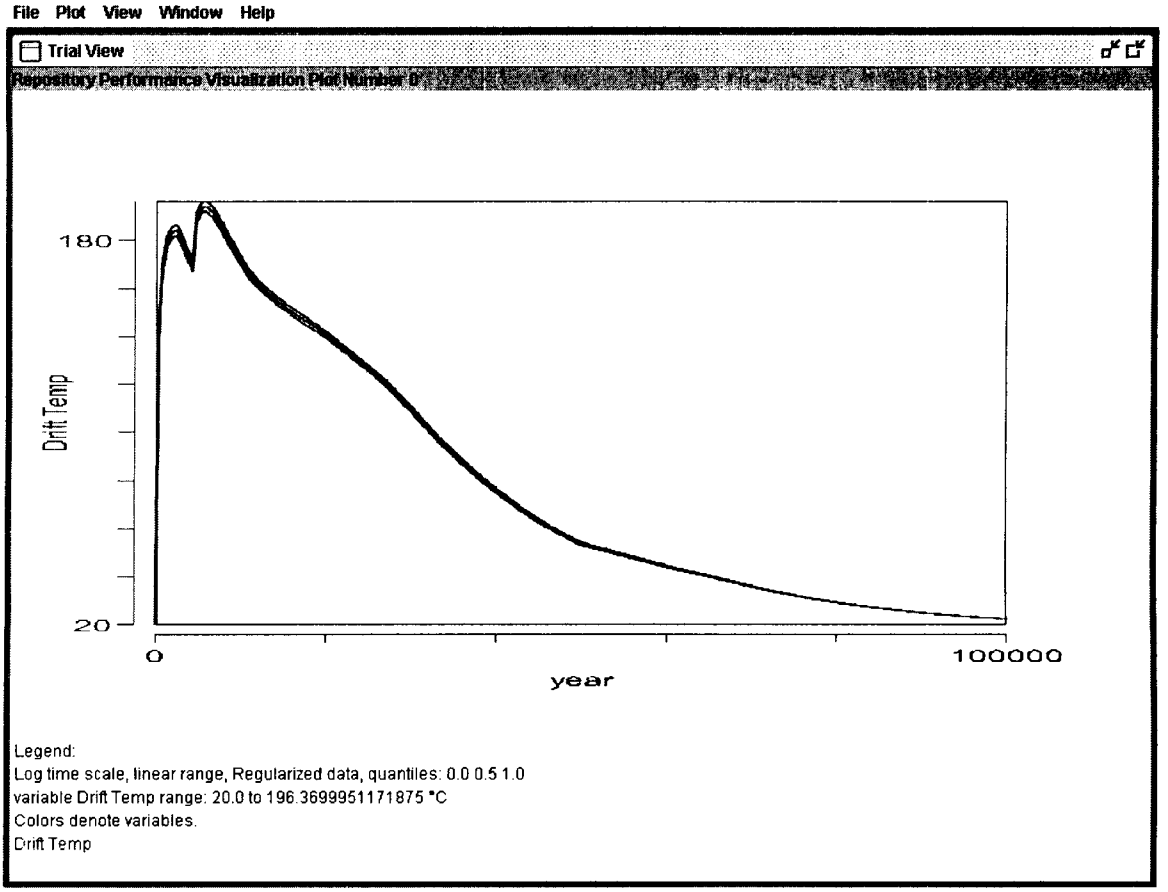
Notes:

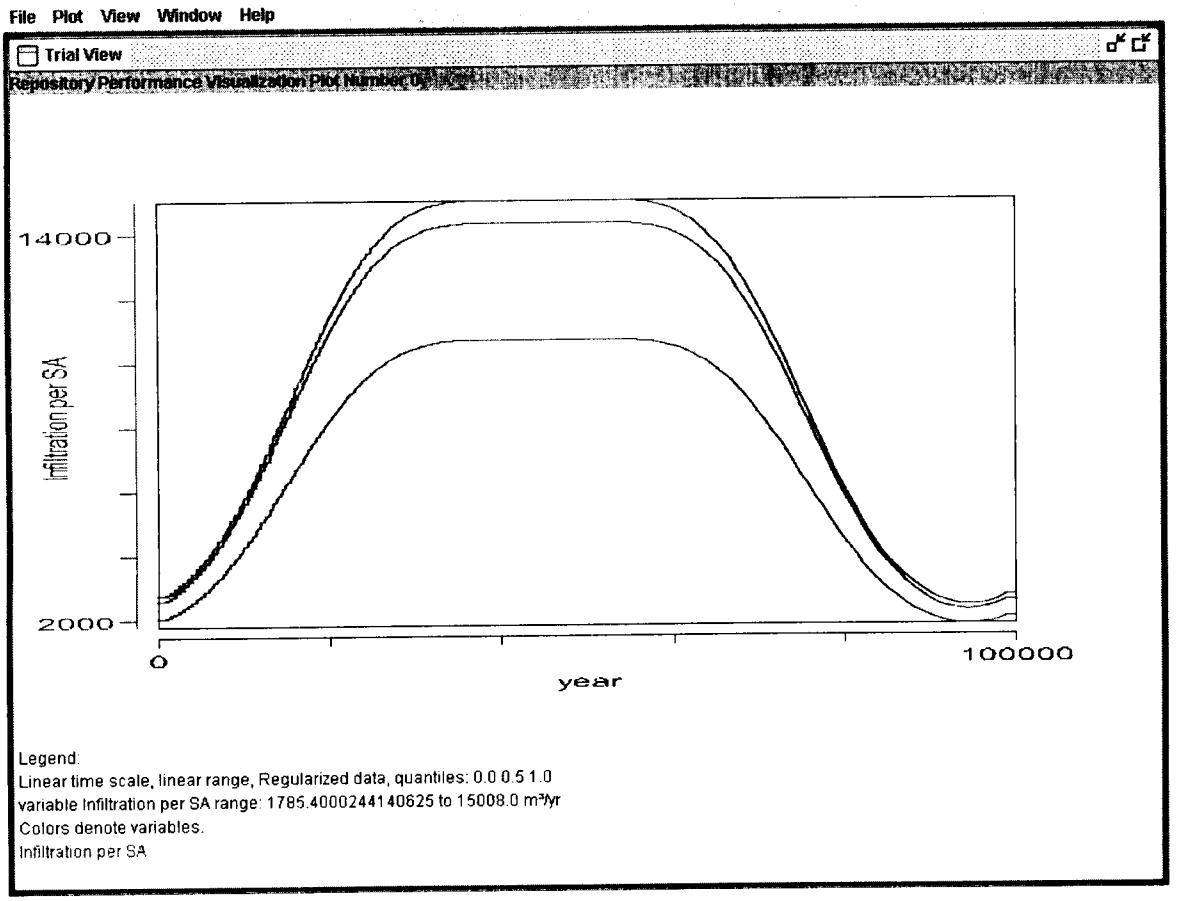
The following plots were computed by selecting 0, 50^{th}, and 100^{th} percentiles in the plot control window. The 0 and 100^{th} percentiles correspond to the minimum and maximum of the variable of interest. The x and y scales were adjusted to be linear or logarithmic so that an adequate display of the data would be achieved.

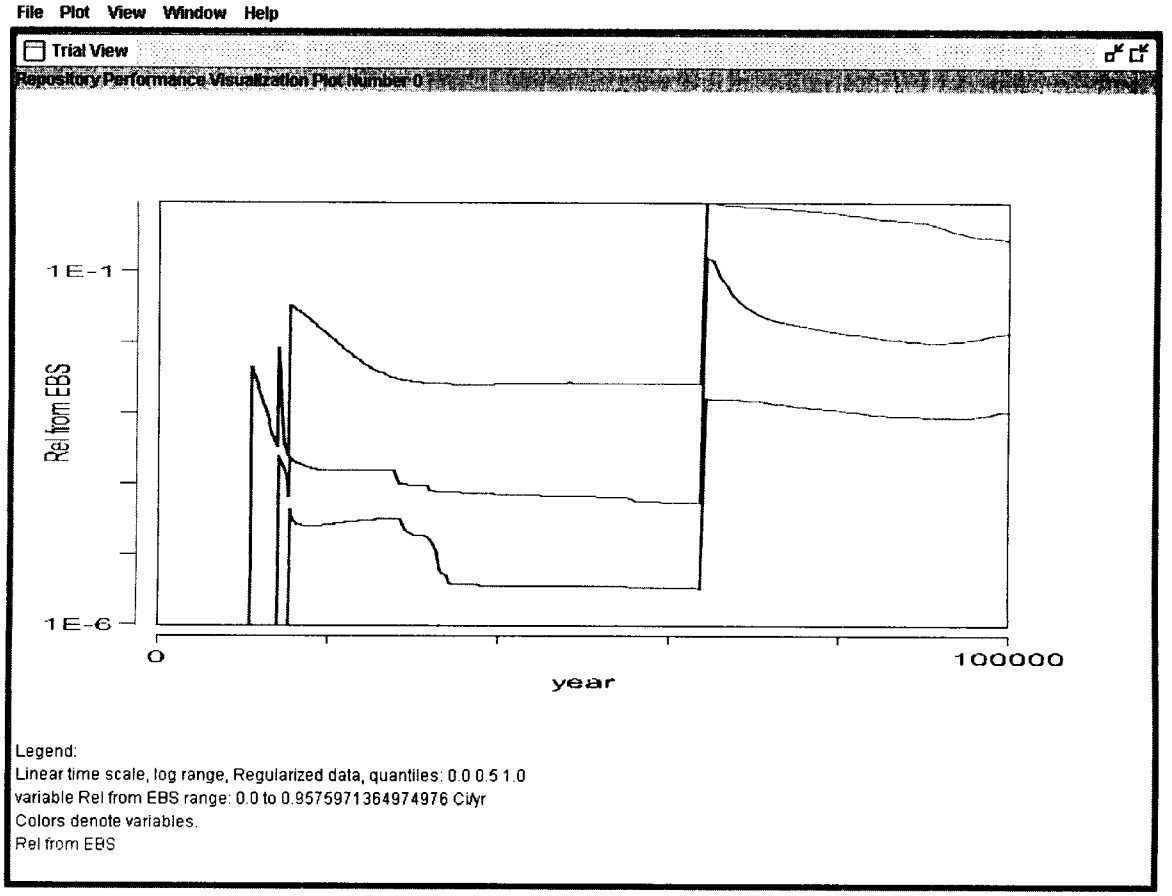
Plots:

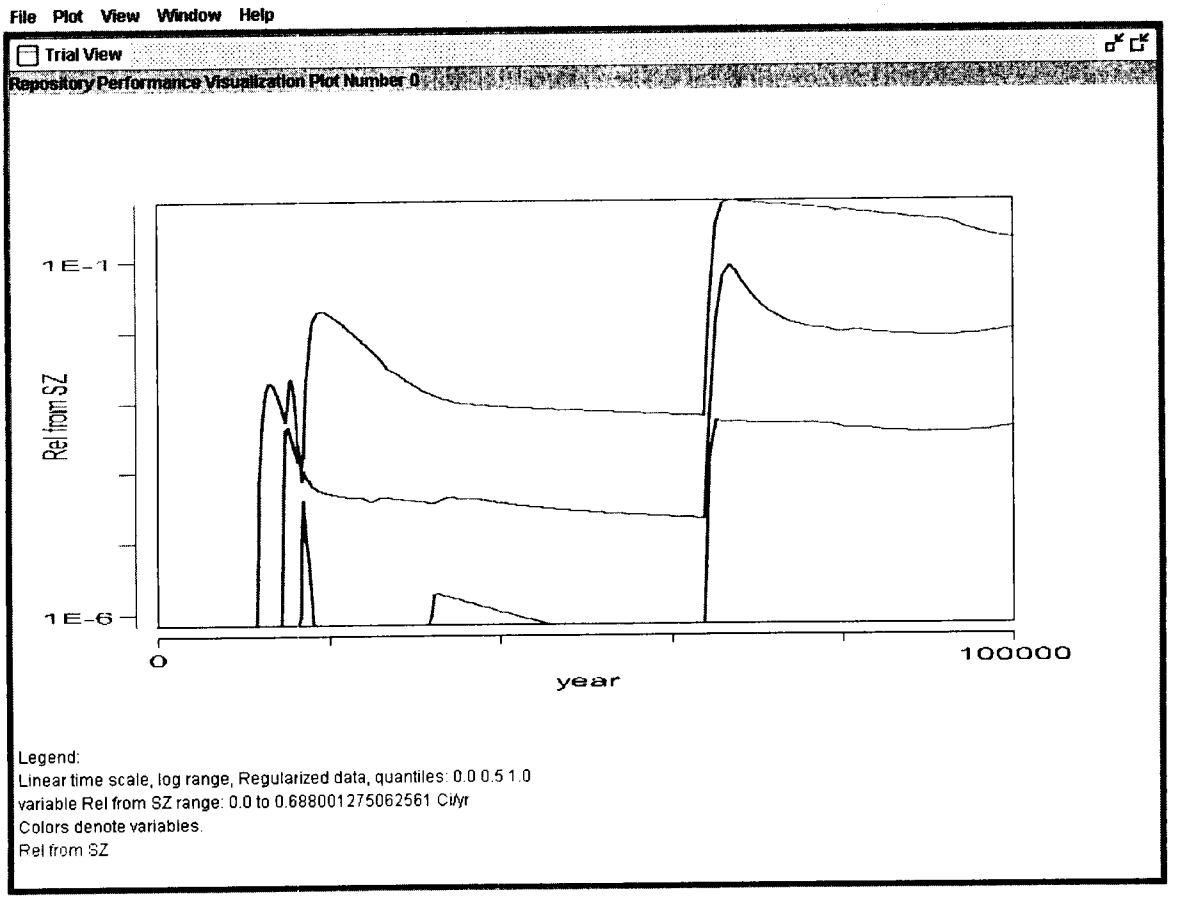

File Plot View Window Help
Trial View
Repository Performance Visualization Plot Number 0
0.500
0
Avg Diversion
0
100000
year
Legend:
Linear time scale, linear range, Regularized data, quantiles: 0.0 0.5 1.0
variable Avg Diversion range: 0.0 to 0.5214800238609314 mm/yr
Colors denote variables.
Avg Diversion

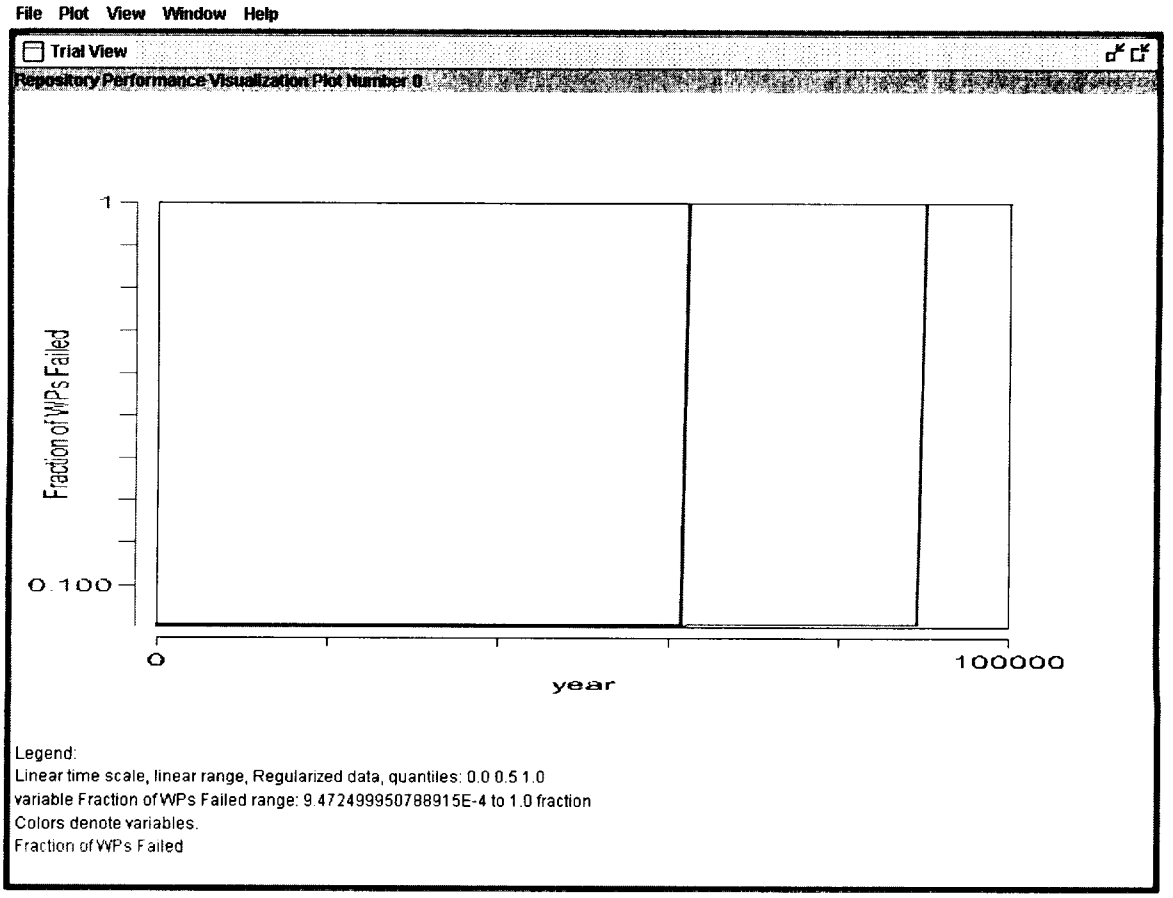

File Plot View Window Help
Trial View
Repository Performance Visualization Plot Number 01
60
0
Avg Reflux
0
100000
year
Legend:
Linear time scale, linear range, Regularized data, quantiles: 0.0 0.5 1.0
variable Avg Reflux range: 0.0 to 67.322998046875 mm/yr
Colors denote variables.
Avg Reflux

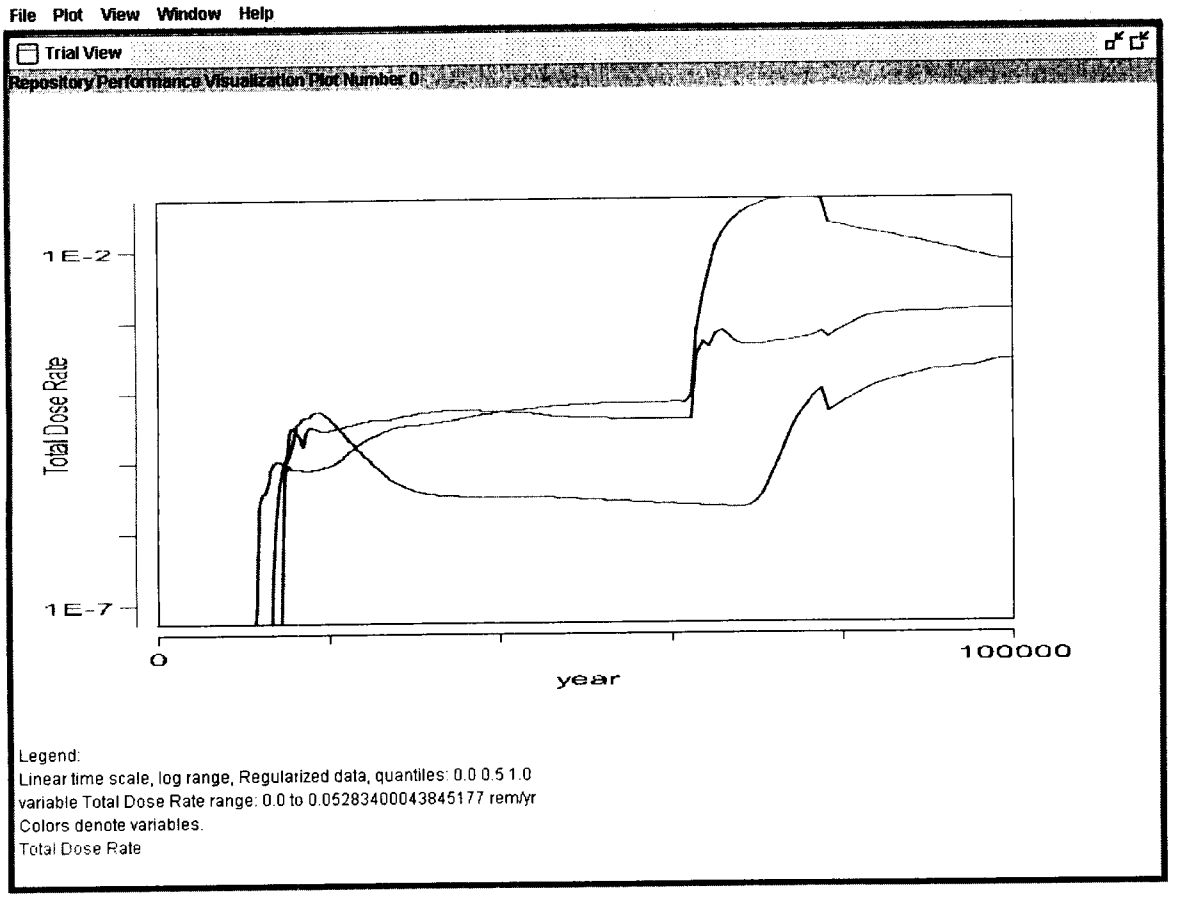

File Plot View Window Help
Trial View
Repository Performance Visualization Plot Number 0
180
20
Drift Temp
0
100000
year
Legend:
Log time scale, linear range, Regularized data, quantiles: 0.0 0.5 1.0
variable Drift Temp range: 20.0 to 196.3699951171875 °C
Colors denote variables.
Drift Temp


File Plot View Window Help
Trial View
Repository Performance Visualization Plot Number 0
14000
2000
Infiltration per SA
0
100000
year
Legend:
Linear time scale, linear range, Regularized data, quantiles: 0.0 0.5 1.0
variable Infiltration per SA range: 1785.4000244140625 to 15008.0 m³/yr
Colors denote variables.
Infiltration per SA


File Plot View Window Help
Trial View
Repository Performance Visualization Plot Number 0
1E-1
1E-6
Rel from EBS
0
100000
year
Legend:
Linear time scale, log range, Regularized data, quantiles: 0.0 0.5 1.0
variable Rel from EBS range: 0.0 to 0.9575971364974976 Ci/yr
Colors denote variables.
Rel from EBS


File Plot View Window Help
Trial View
Repository Performance Visualization Plot Number 0
1E-1
1E-6
Rel from SZ
0
100000
year
Legend:
Linear time scale, log range, Regularized data, quantiles: 0.0 0.5 1.0
variable Rel from SZ range: 0.0 to 0.688001275062561 Ci/yr
Colors denote variables.
Rel from SZ


File Plot View Window Help
Trial View
Repository Performance Visualization Plot Number 0
1
0.100
Fraction of WPs Failed
0
100000
year
Legend:
Linear time scale, linear range, Regularized data, quantiles: 0.0 0.5 1.0
variable Fraction of WPs Failed range: 9.472499950788915E-4 to 1.0 fraction
Colors denote variables.
Fraction of WPs Failed


File Plot View Window Help
Trial View
Repository Performance Visualization Plot Number 0
1E-2
1E-7
Total Dose Rate
0
100000
year
Legend:
Linear time scale, log range, Regularized data, quantiles: 0.0 0.5 1.0
variable Total Dose Rate range: 0.0 to 0.05283400043845177 rem/yr
Colors denote variables.
Total Dose Rate

Requirement 3:

The software will graphically depict the degree to which any given TPA input parameter or output variable affects a TPA output variable by

3.1 Enabling the user to select for any TPA output variable, a parameter or variable whose influence the user wants to explore

3.2 Partitioning any set of realizations into subsets based on the range of values for the parameter or variable, and plotting for each subset either the median curve or the family of percentile curves

3.3 As a special case of the previous bulleted item, for any TPA input parameter specified as a distribution, enabling the user to restrict the range of values for that parameter.

3.4 The software will be able to account for the values of any variable, calculated by the TPA code on a per subarea or per nuclide basis.

Evaluation of Requirement 3:

Definition:

Variable – TPA output as a function of time
Parameter – TPA input parameter whose values are obtained by Hypercube sampling

3.1
In the Plot Control window, the GPP allows the user to select the *influencing* variables or parameters, in the Influences frame, and the *influenced* variable in the Variable frame.

At the moment, it is not possible display influences on Scatter Plots or on Box and Whisker plots. This is acceptable, as the requirement was to display influences on those variables that are functions of time. Dose conversion factors derive from independent sampling; thus, these quantities do not correlate to input parameters or other variables.

It would be convenient to design visualizations of the effect of a parameter or variable on the peak dose and cumulative releases. These strategies have to differ from the generic strategy currently available in the GPP. This could be proposed as a future enhancement to the GPP. At this stage, this enhancement is not a requirement.

At the moment, selecting the Peak Dose or Time of Pk Dose in the Influences frame causes an error. This will be notified to the software developers to be fixed.

3.2

A

The GPP allows visualizing the influence of parameters on variables by the following scheme.

The *influenced* variable is selected in the Variable frame, in the Plot Control window

The *influencing* parameter is selected in the Influences frame, in the Plot Control window

Parameter values are split into several bins. The number of bins is defined in the properties file, gpp.properties, by the line

param_percentiles=10,50,100

The above line tells that 3 bins are used, the first bin encloses from the [0,10 th) percentile values of the influencing parameter, the second bin encloses from the [10th, 50 th) values, and the third bin, from the [50th,100th] percentile values of the influencing parameter.

Up to five bins can be defined. For example, the line

param_percentiles=10,25,50,75,100

indicates that five bins will be formed: [0,10), [10,25), [25,50), [50,75), [75,100]

Realizations are classified into the several bins, according to the value of the influencing parameter.

The influenced variable is plotted by the GPP, by displaying in a single color those realizations belonging in a single bin. Up to five different colors in the influence diagrams, depending on the number of bins defined in the file gpp.properties. Examples of influence diagrams are later presented.

B

The GPP allows visualizing the influence of variables on variables by the following scheme.

The *influenced* variable is selected in the Variable frame, in the Plot Control window

The *influencing* variable is selected in the Influences frame, in the Plot Control window

For the *influencing* variable, for each realization, the values of the variable are averaged over all time steps. Thus, a unique average is abstracted for each realization. Realizations are classified into bins, with respect to the value of this average.

The bins are defined as described in **A**. The same approach as the one described in **A** is used to display the *influenced* variable.

3.3
This requirement is a particular instance of 3.2. As previously explained, the percentile range is defined in the file gpp.properties by the line param_percentiles.

3.4
The property file gpp.properties allows definition of the subarea and nuclide of interest. The file gpp.properties contains the following lines:

```
which_subarea=3
num_realizations=20
param_percentiles=10,50,100
nuclide_of_interest=none
```

The file gpp.properties is editable with a text editor. The application must be launched only after modification of the file gpp.properties.

Conclusion:

The set of Requirements 3 is available in the GPP. A bug has been identified that is expected to be fixed. It is my appreciation that the GPP is acceptable, provided the above mentioned bug is fixed.

Recommendation:

It would be convenient to modify the file gpp.properties within the application, so that the GPP does not have to be re-launched every time this file is modified. Adding a Properties menu to the Repository Performance Visualization window to perform this task would be desirable. This feature was not a requirement, but can be proposed as an enhancement to the application.

Test plots:

The following parameters are know to be influential on the dose:

Preexponential_SFDissolutionModel2
AlluviumMatrixRD_SAV_Np
SubAreaWetFraction
AA_1_1[C/m2/yr]

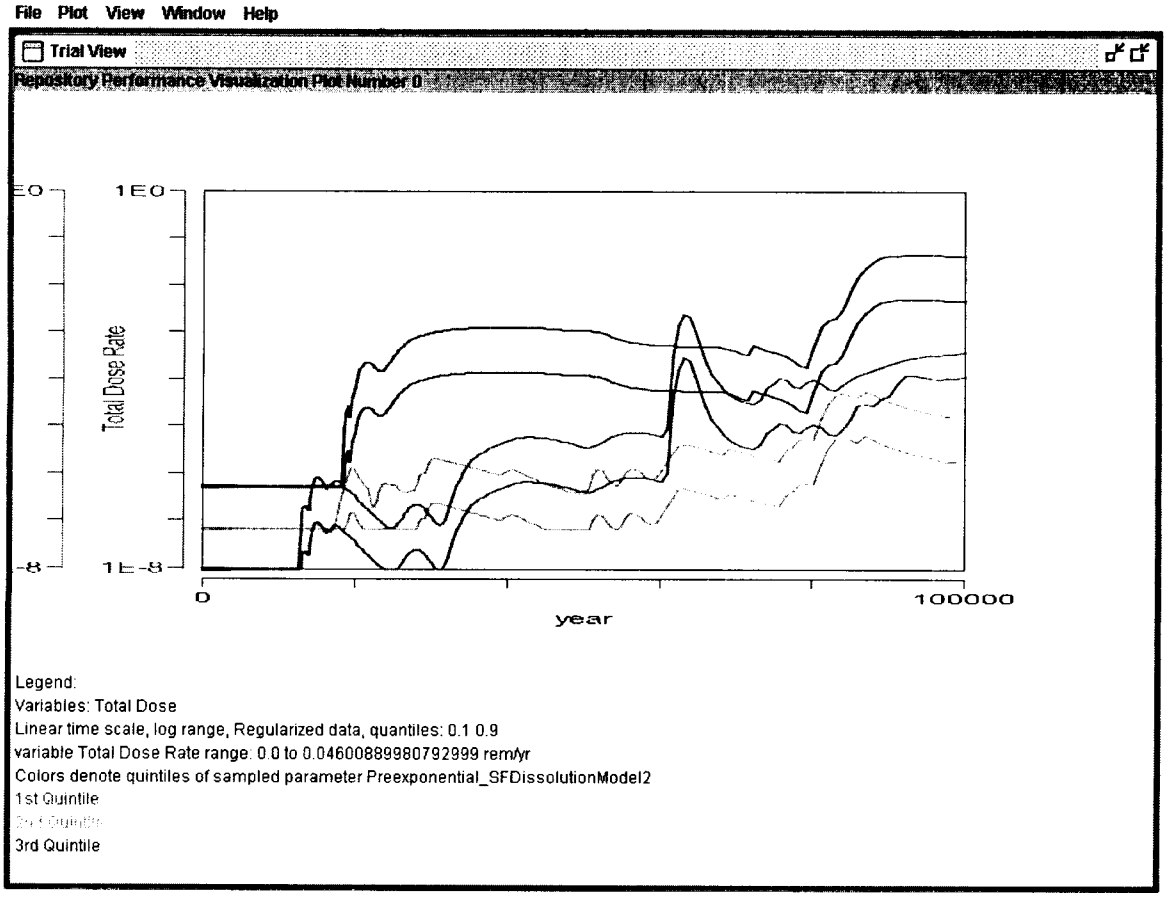
ArealAverageMeanAnnualInfiltrationAtStart[mm/yr]

The file gpp.properties was adjusted to contain the following entries:

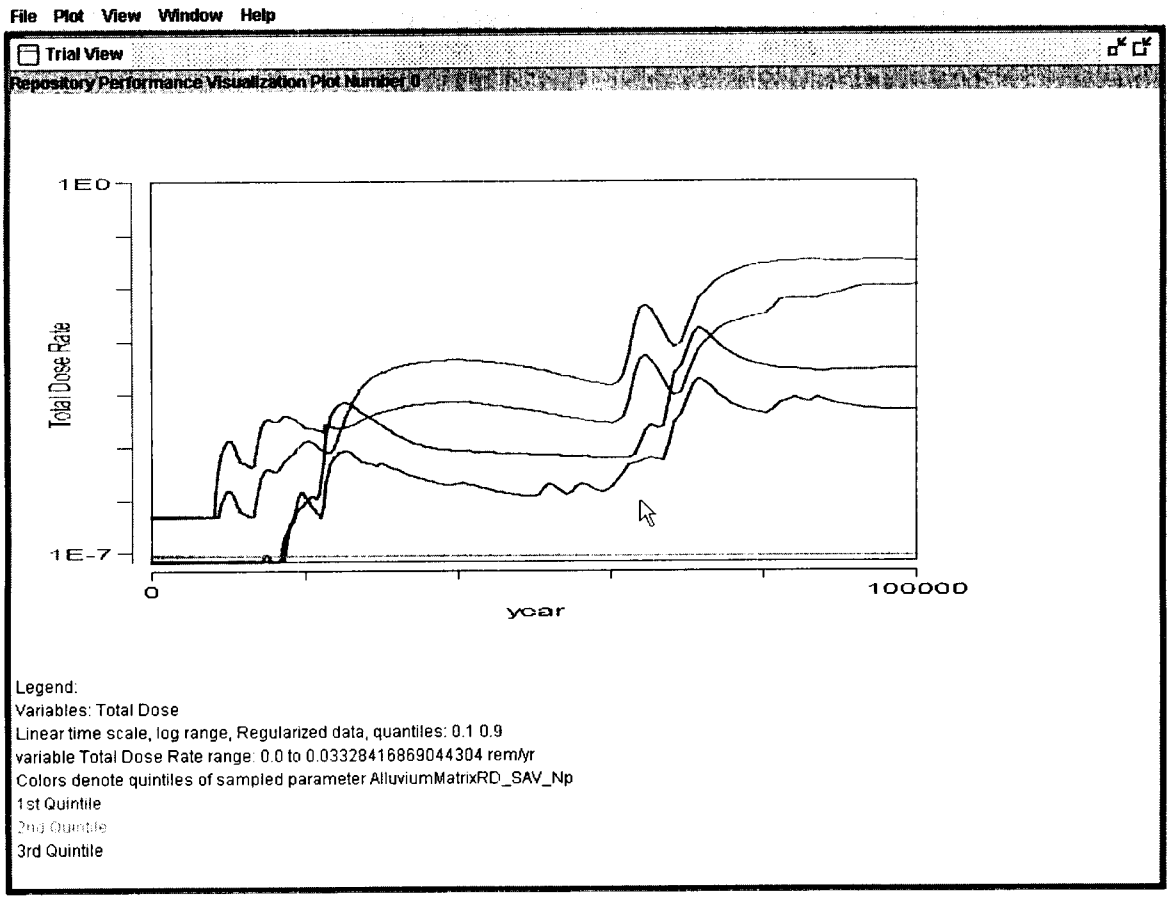
which_subarea=3
num_realizations=100
param_percentiles=10,50,100
nuclide_of_interest=none

For the following plots, two percentiles were selected in the Percentiles frame in the Plot Control window: 10th and 90^{th} percentiles.

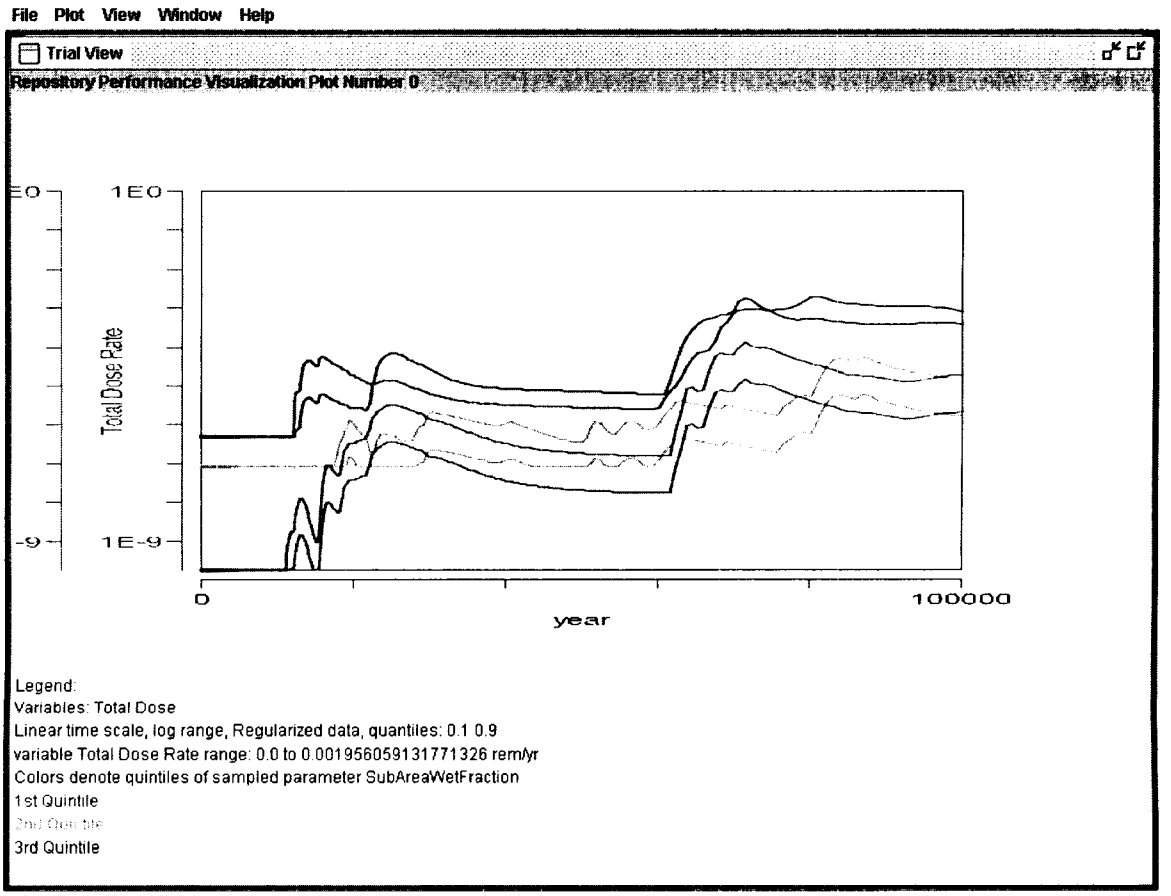
Influence of Parameters on Variables



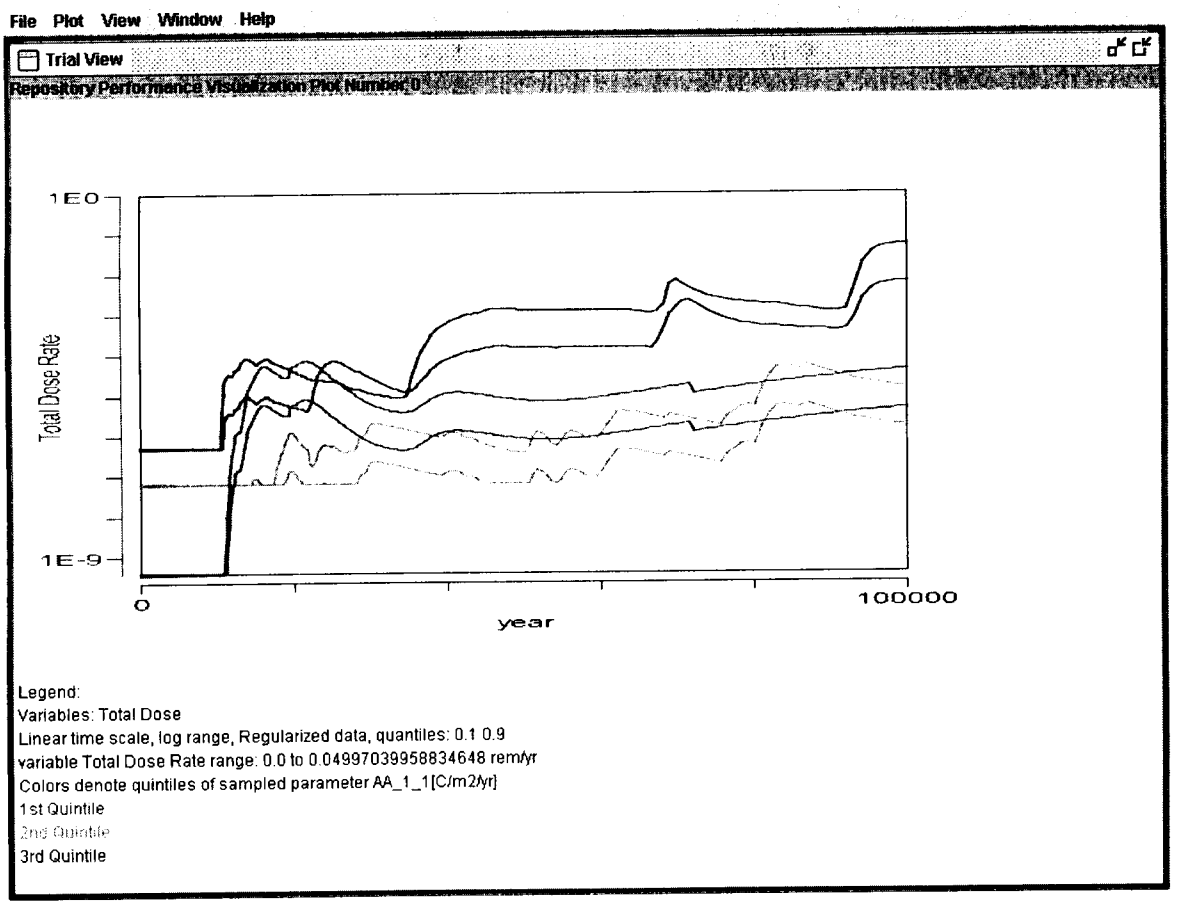
Preexponential_SFDissolutionModel2.
The plot shows that the higher the spent fuel dissolution rates the higher the dose rate.



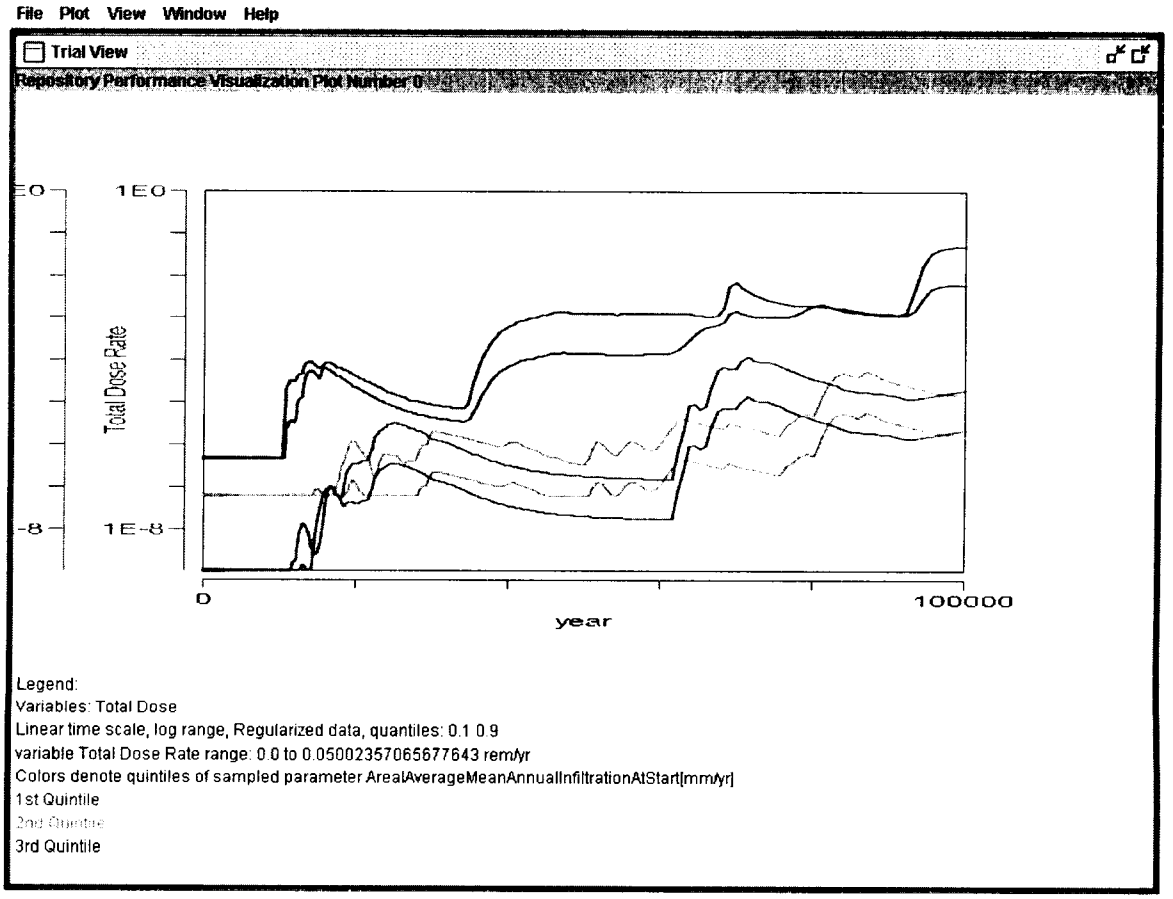
AlluviumMatrixRD_SAV_Np
The plot suggests that the higher the sorption coefficient, the lower the dose. This result is intuitively correct.



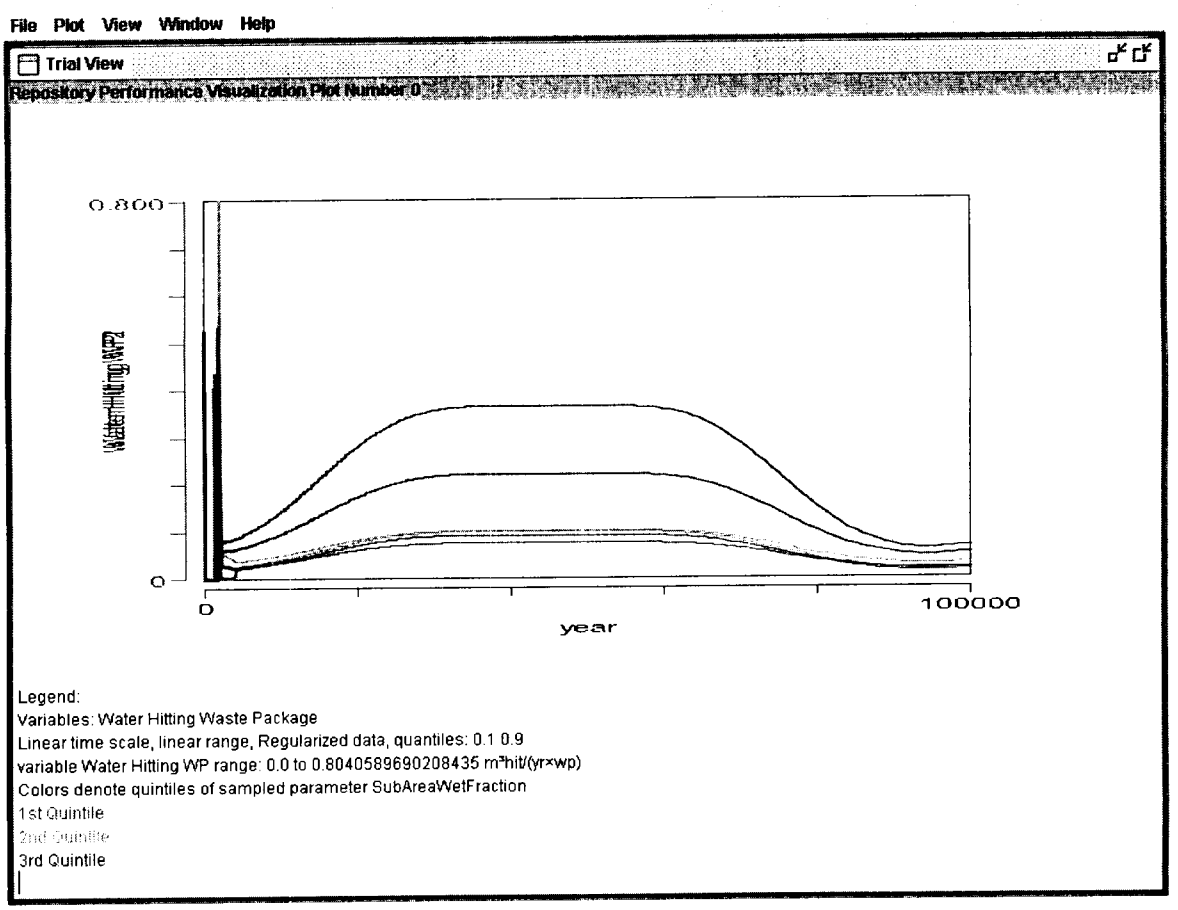
SubAreaWetFraction
The more water is available for release, the higher the dose is.



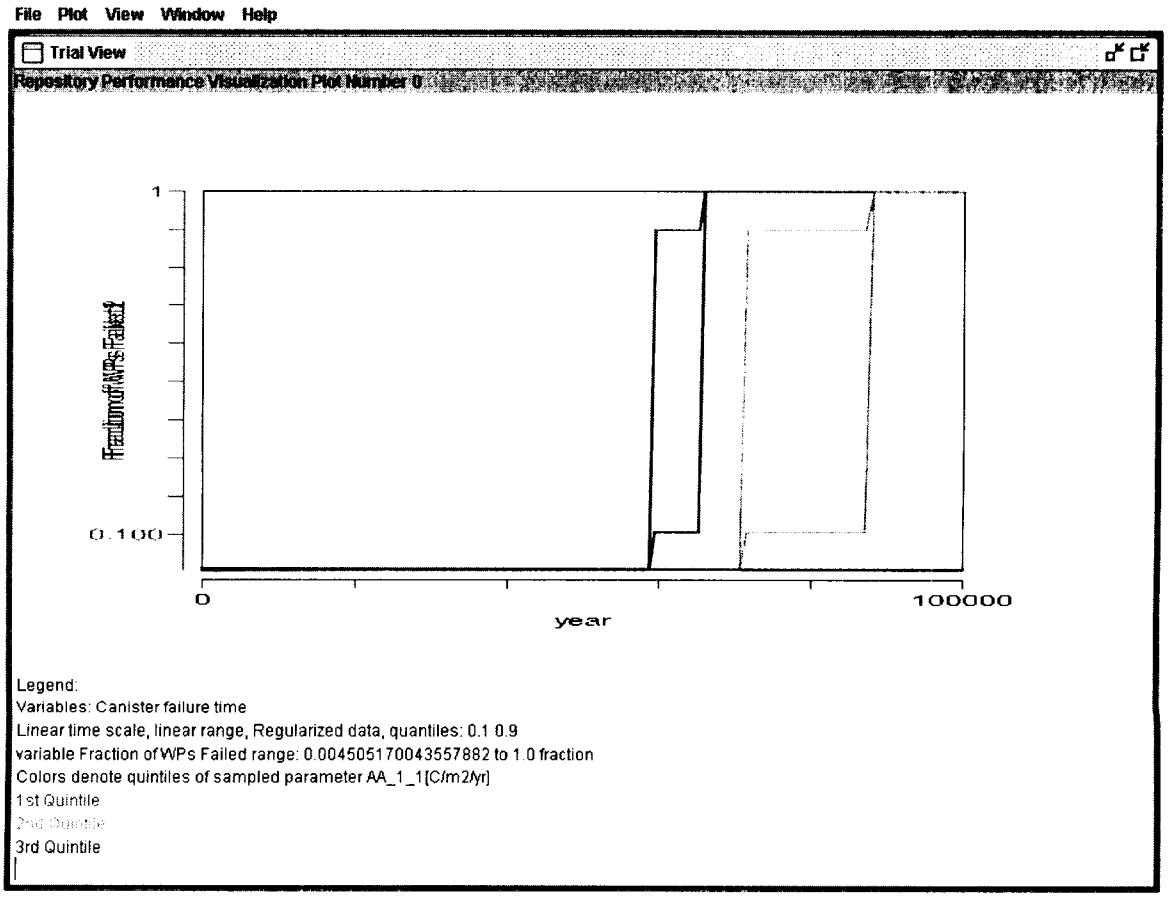
AA_1_1[C/m2/yr]
The higher the alloy 22 corrosion rate, the higher the dose



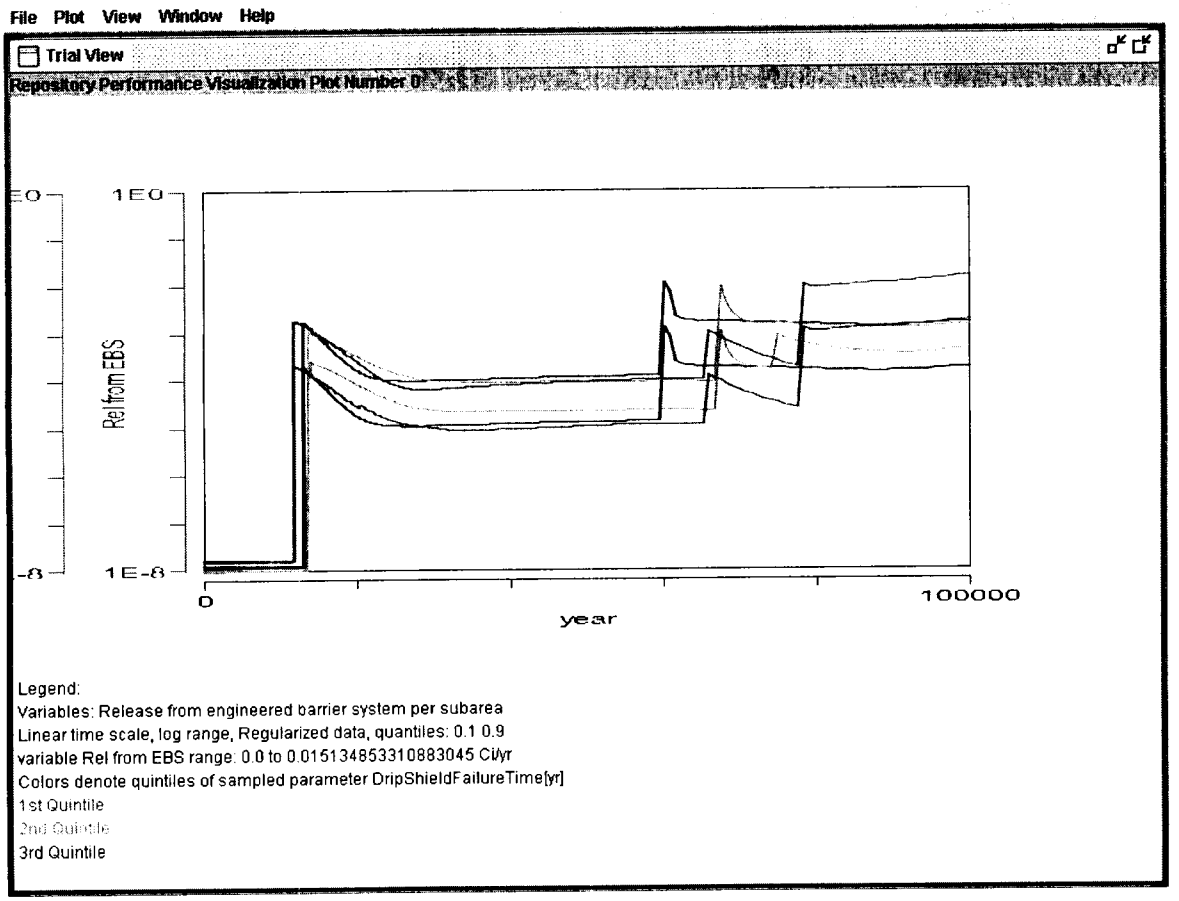
ArealAverageMeanAnnualInfiltrationAtStart[mm/yr]
The more water available for release, the higher the dose.



Influence of SubareaWetFraction on the amount of water hitting waste packages. The higher the wet fraction, the more water hits waste packages.

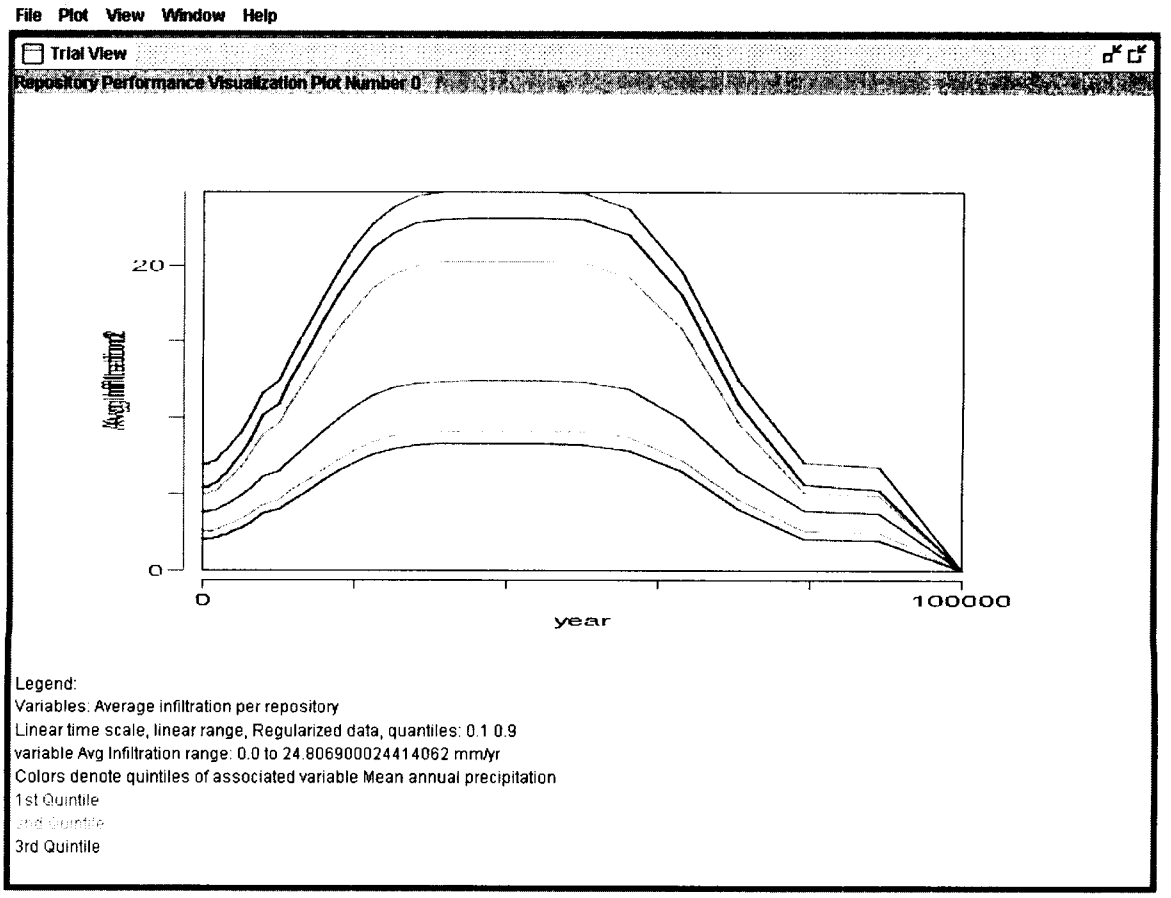


Influence of corrosion rates on the fraction of waste packages failed. The higher the corrosion rates, the more WPs failing.

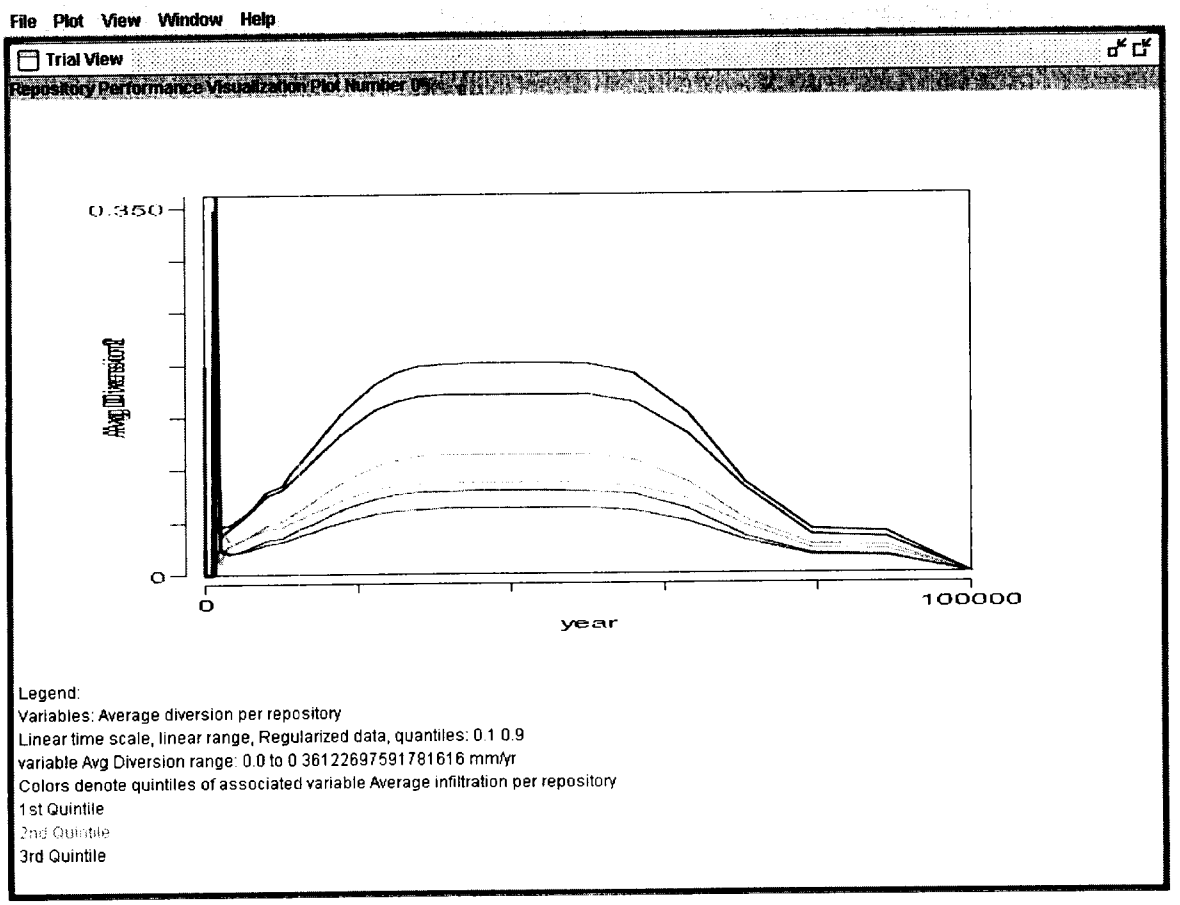


Influence of DripShieldFailureTime on the release rate from the EBS. These quantities do not seem to be correlated.

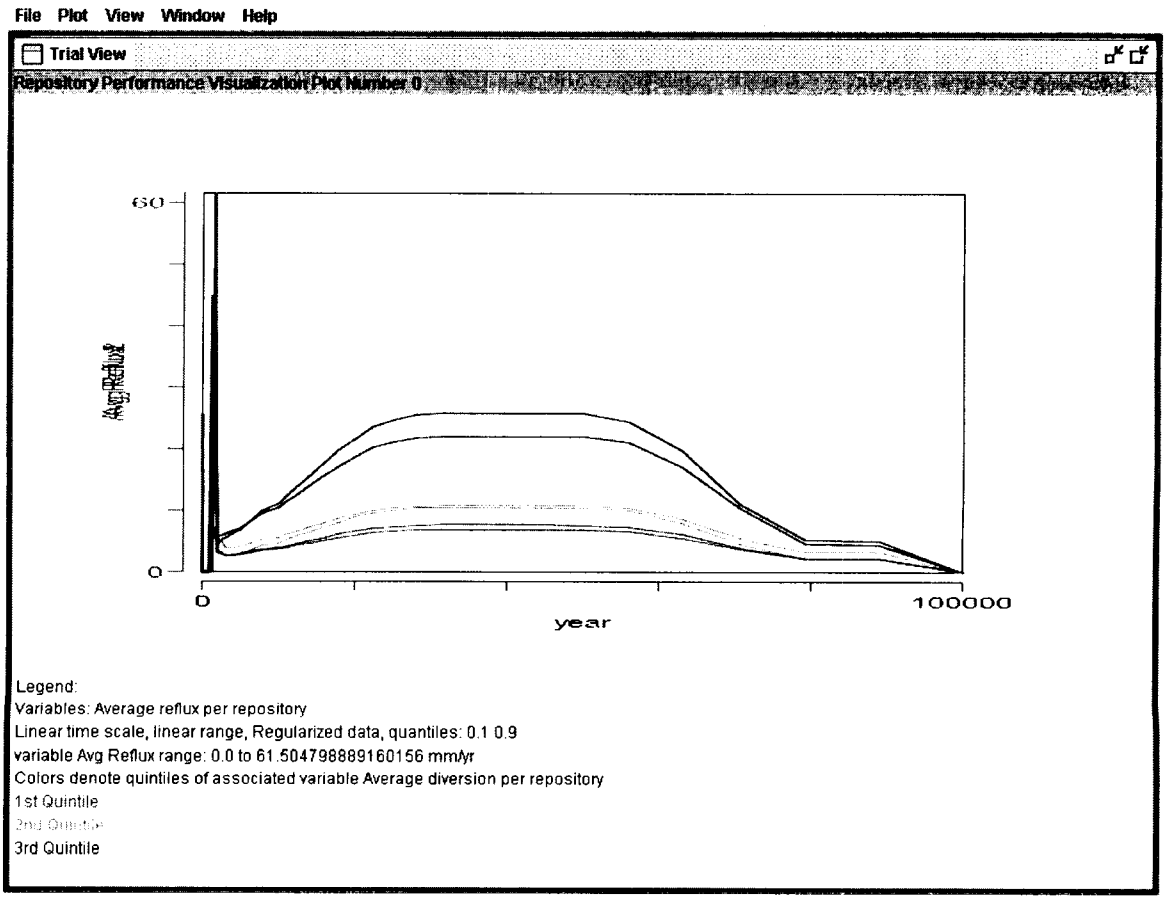
Influence of variables on variables



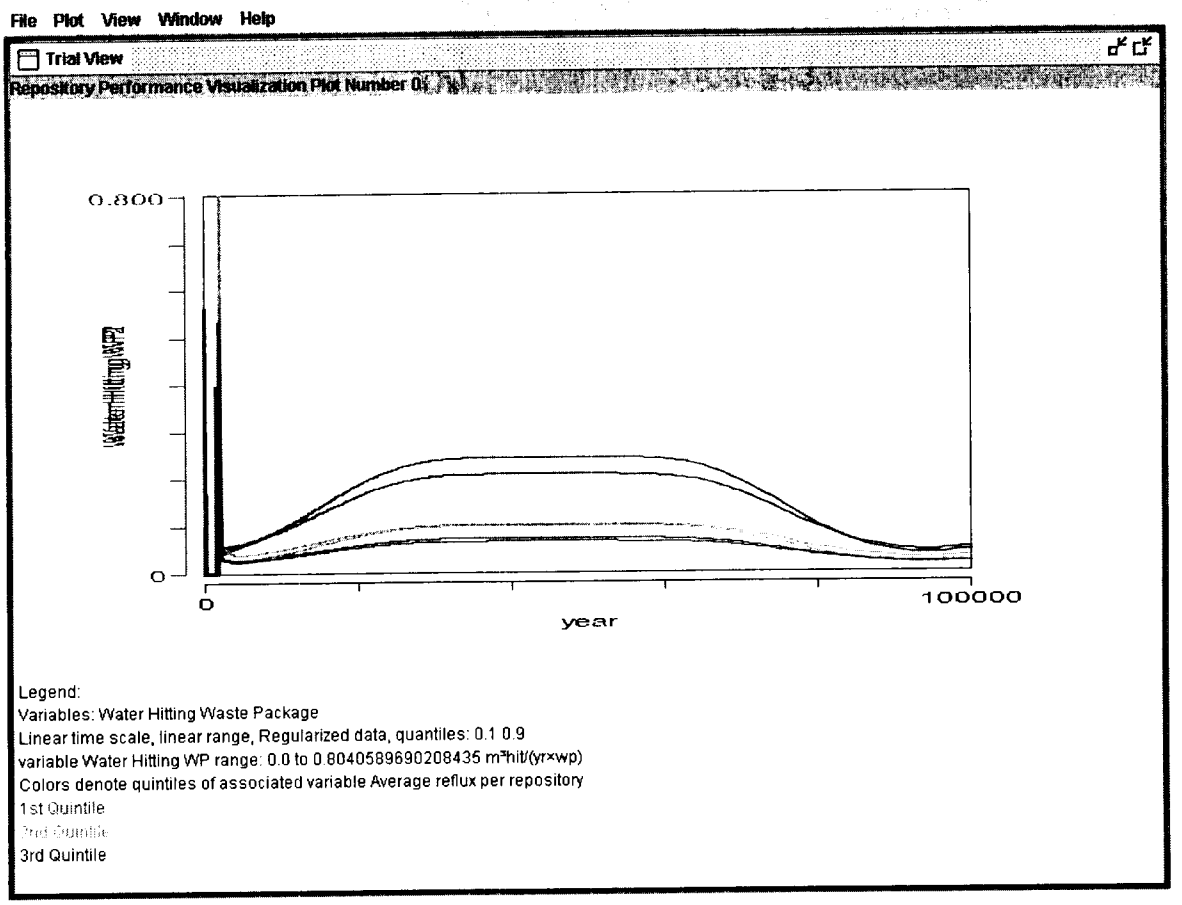
Influence of Mean Annual Precipitation on the Average Infiltration.



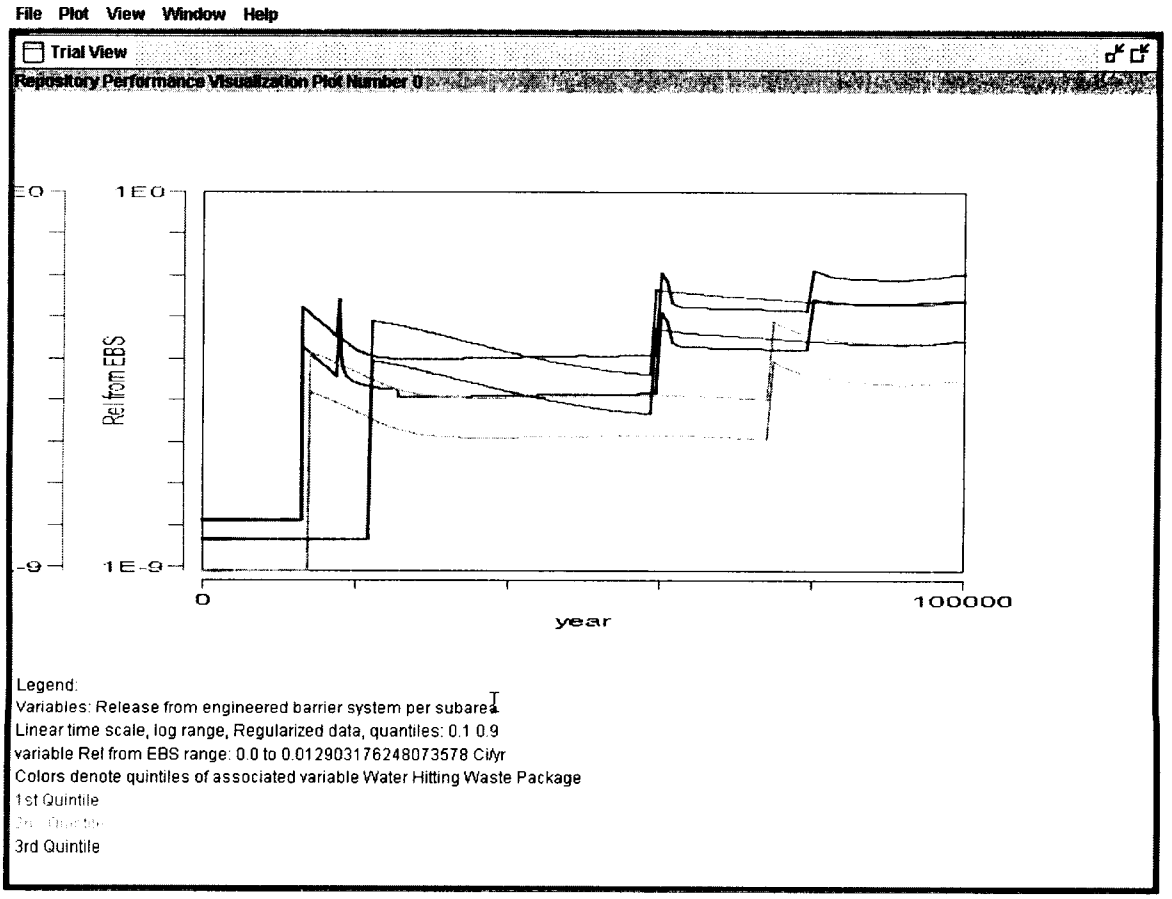
Influence of the Average Infiltration on the Average diversion.



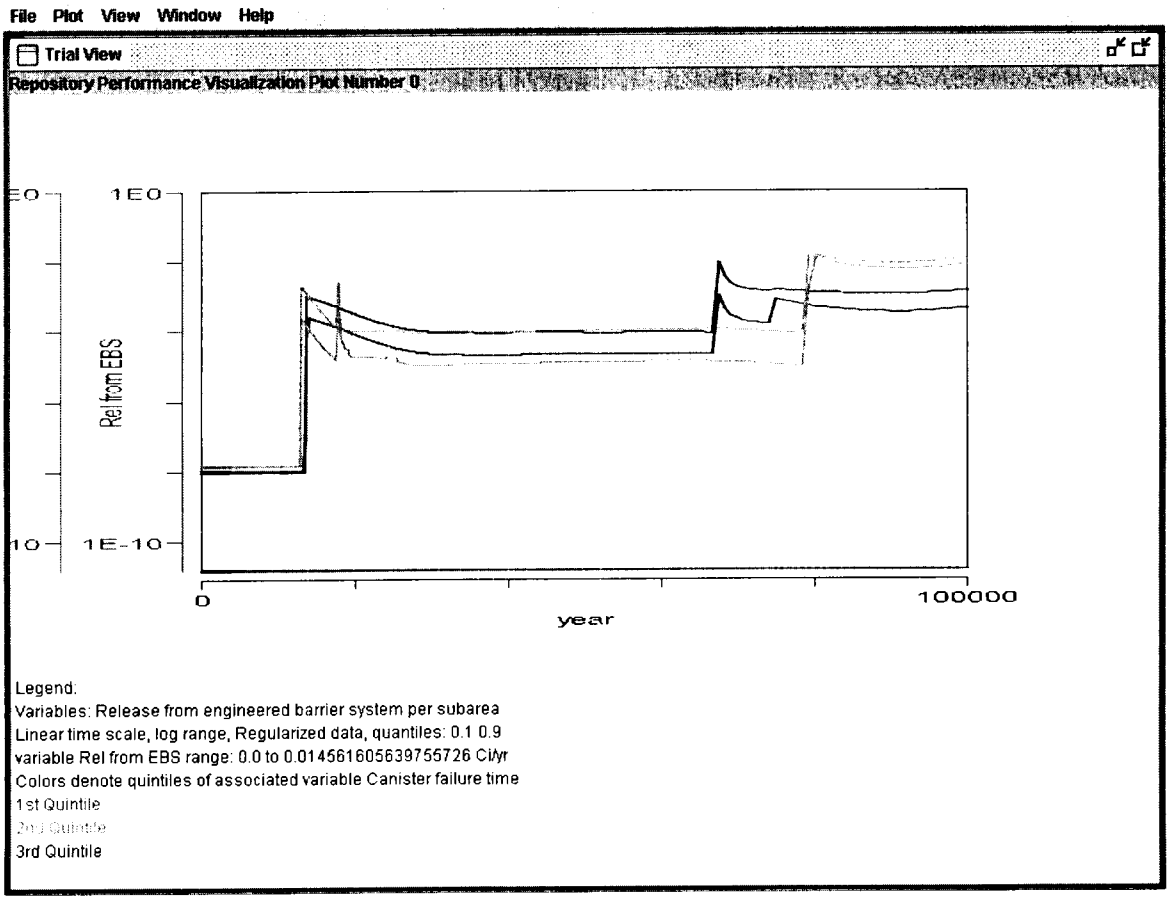
Influence of Average Diversion on the Average Reflux



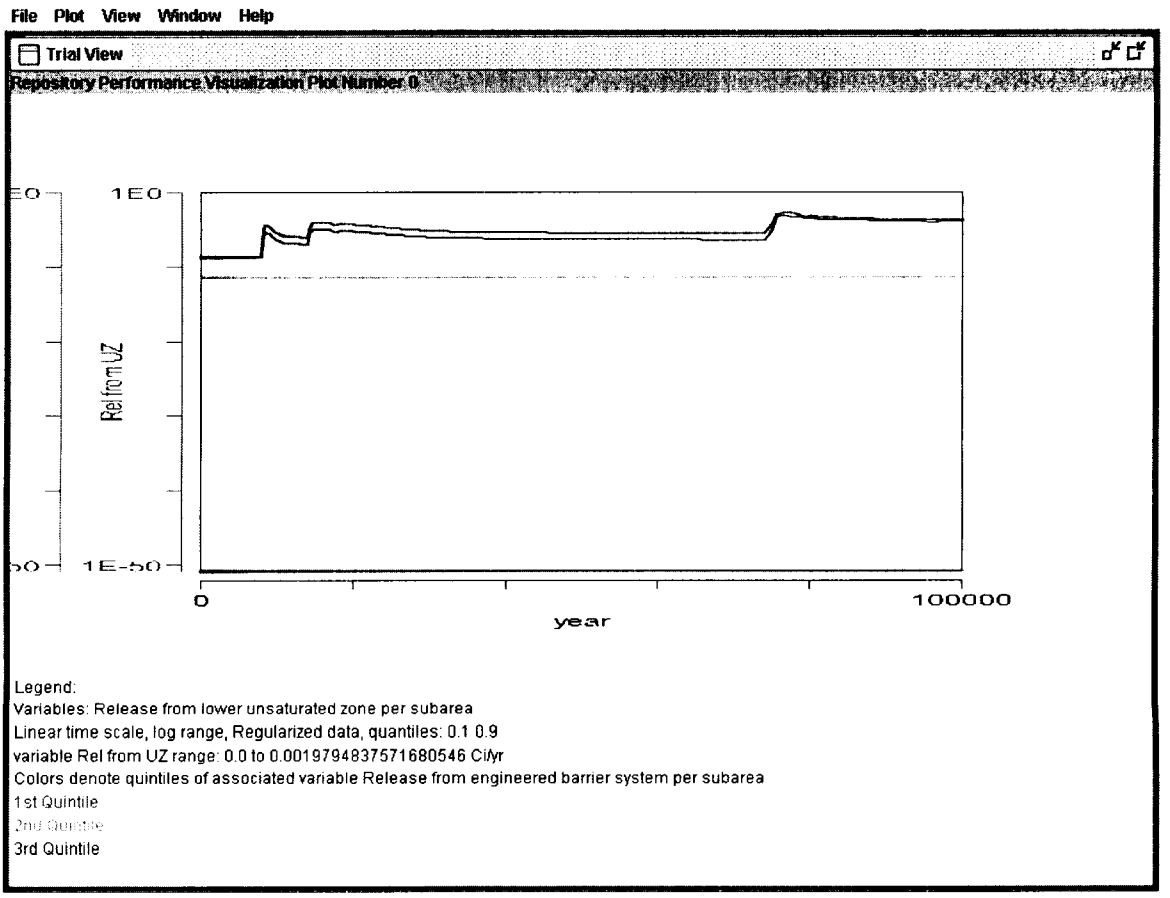
Influence of reflux on the amount of water hitting waste packages.



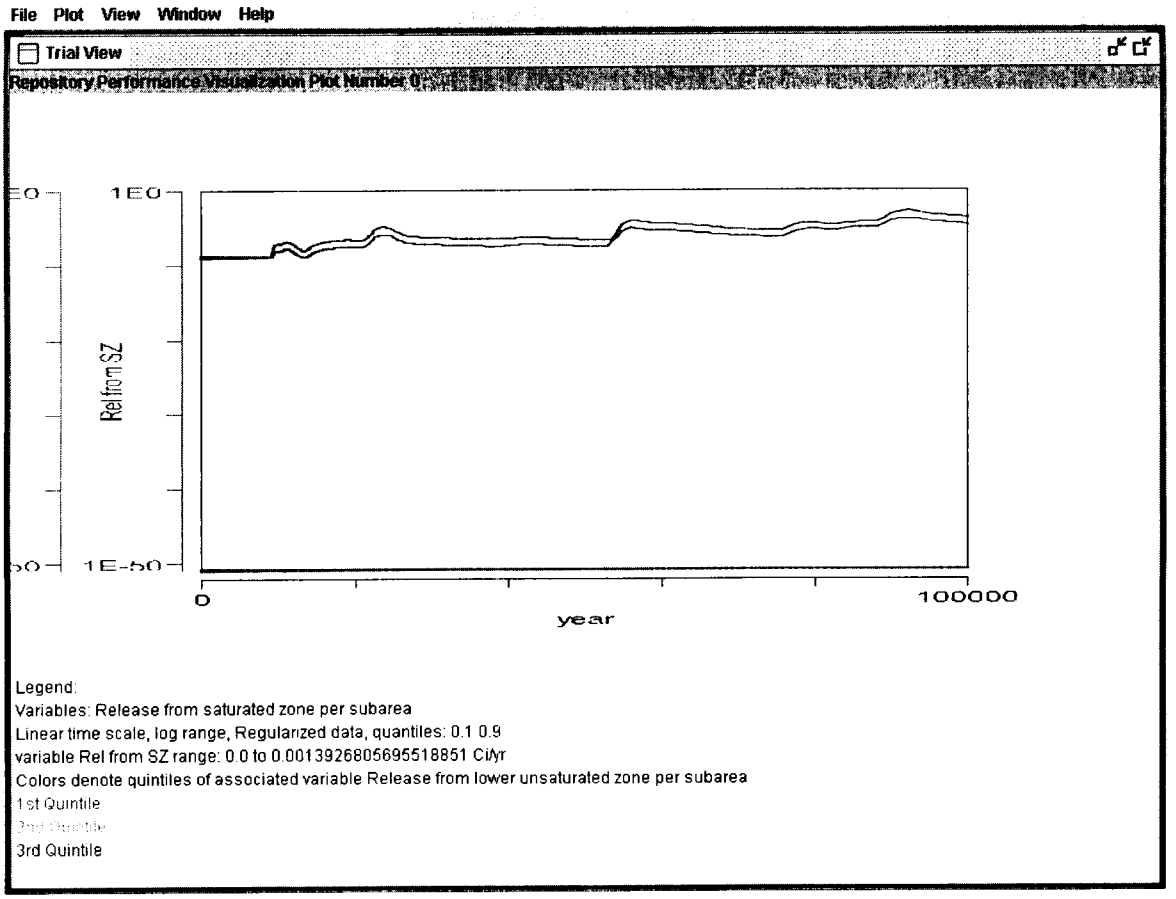
Influence of Water Hitting WPs on the Release rate at the EBS.



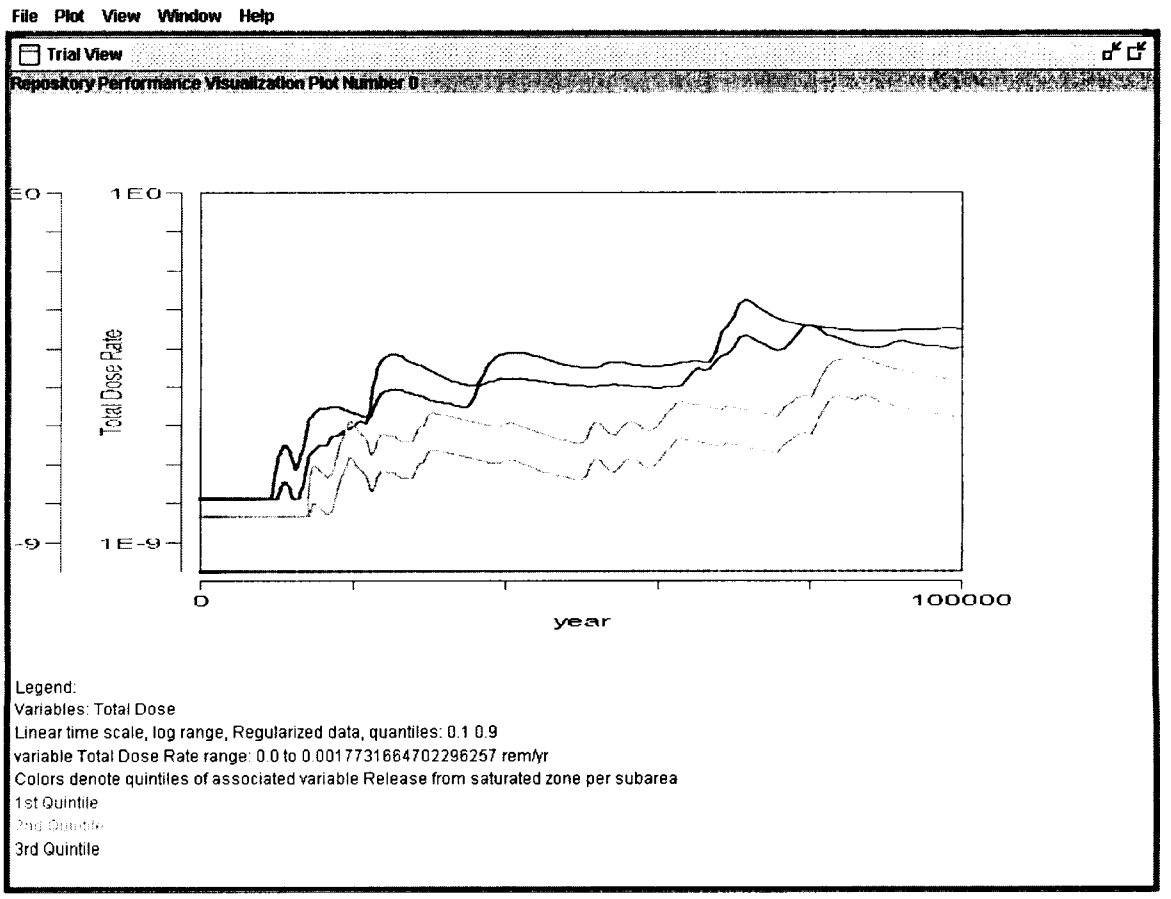
Influence of the Fraction of WPs failed on the Release rate at the EBS.



Influence of Release from the EBS on the Release rate from the UZ



Influence of Release from the UZ on the Release from the SZ.



Influence of Release from the SZ on the Dose Rate

Requirement 4:

The software will enable the user to

4.1 Control the windows in which plots are displayed

4.2 Control for any plot the appearance of the following visual components
- Background color
- Box
- Legend
- Title

4.2 Control for any axes of a plot
- What is the range and kind of scale (linear or logarithmic) used
- How the axis is labeled
- What color is used or what variable is mapped to the color
- What range of values to include
- Which field is mapped to that axis

4.3 "Snap" or capture, from any plot currently open, an image file that may be stored in "JPEG" or "PNG" format

4.4 Write values for any data being plotted to a disk file in a tabular format

4.5 Select parameters or variables whose influence on the displayed variable the user wants to explore

4.6 Perform side-by-side visual comparisons of different plots

Evaluation of Requirement 4

4.1
The GPP allows naming the plots in the View Control window. Plots with specific names can be retrieved from the Repository Performance Visualization window.

4.2
Background color:
The background color can be controlled from the Plot Control window. The background color of the plot changes accordingly.

Box:
It was agreed on a Memorandum on January 15, 2001, that the capability to allow the user to draw a box around a plot was not a requirement. Having this capability does not add any value to the application.

Legend:
Labels are defined in the file variable_abbrevs.properties. Units of variables are defined in the file variables.properties. Both files can be modified using a text editor.

The GPP must be launched after modification to the property files in order for changes to these files to be recognized by the GPP. It would be desirable to include a menu where these files could be modified within the application, without re-launching of the application. At this stage, however, such enhancement is not a requirement.

Title:
Titles of plots are defined in the Plot Control window.

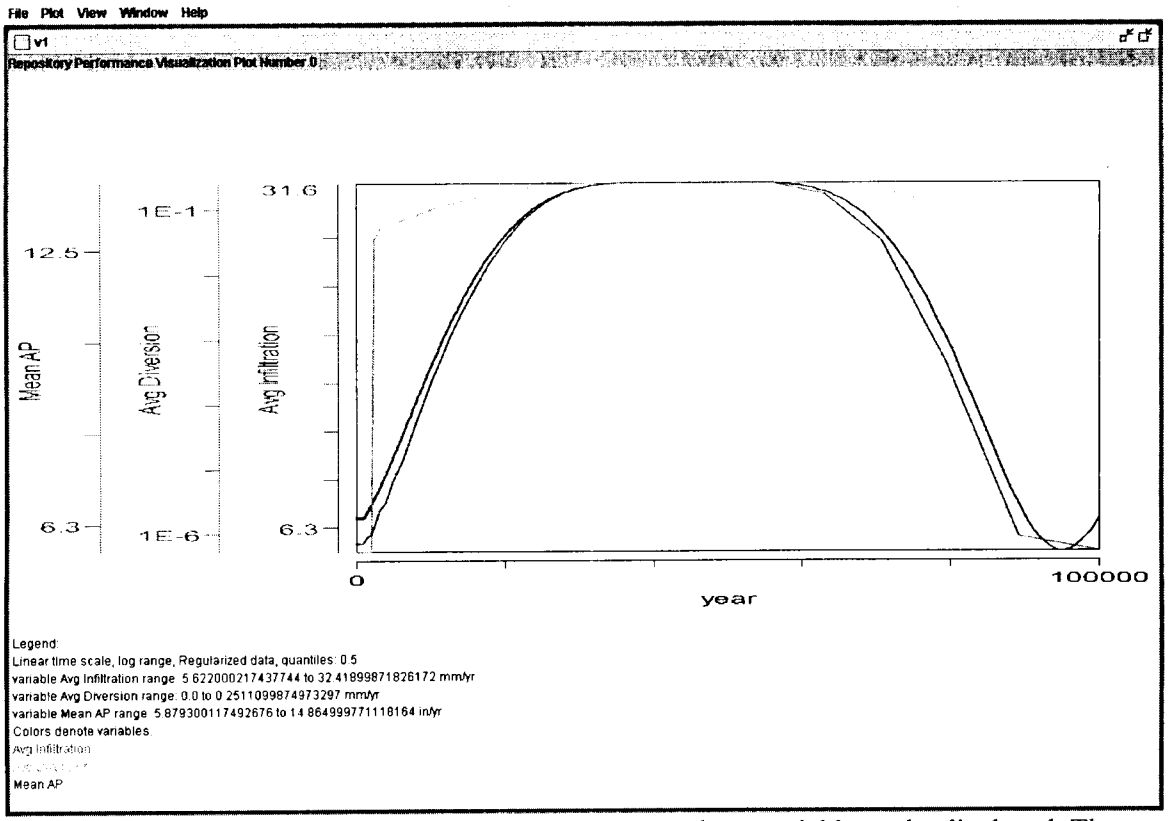
4.2
Kind of scale:
The user can control the scale for the x and y axes. There is a radio button available in the Plot Control window. The range is automatically selected by the application.

Axis Label:
It has been discussed that labels are defined in property files, which can be modified by the user with a text editor.

Color:
The GPP selects colors automatically to allow visualization of different variables or of influences. The meaning of the colors is explained as caption text at the bottom of the plots. Such approach is considered adequate and user friendly.

Range of values:
The range is defined automatically by the application, without user intervention. Given the complexity of the application, it was considered that automatic selection of the range would be more appropriate. It would be desirable to include a field where the range of the x and y axis could be defined. At this stage, however, such enhancement is not considered a requirement.

Names of field mapped to axes:
Multiple variables can be displayed in a plot. The variables can be selected in the Plot Control window. Colors and ranges are selected automatically. The figure caption explains which line(s) correspond to which variables. Aside from the selection of the variables to be displayed, labels and figure captions are generated automatically. Such approach is considered to be adequate. An example of a plot with multiple variables is presented in the next figure.



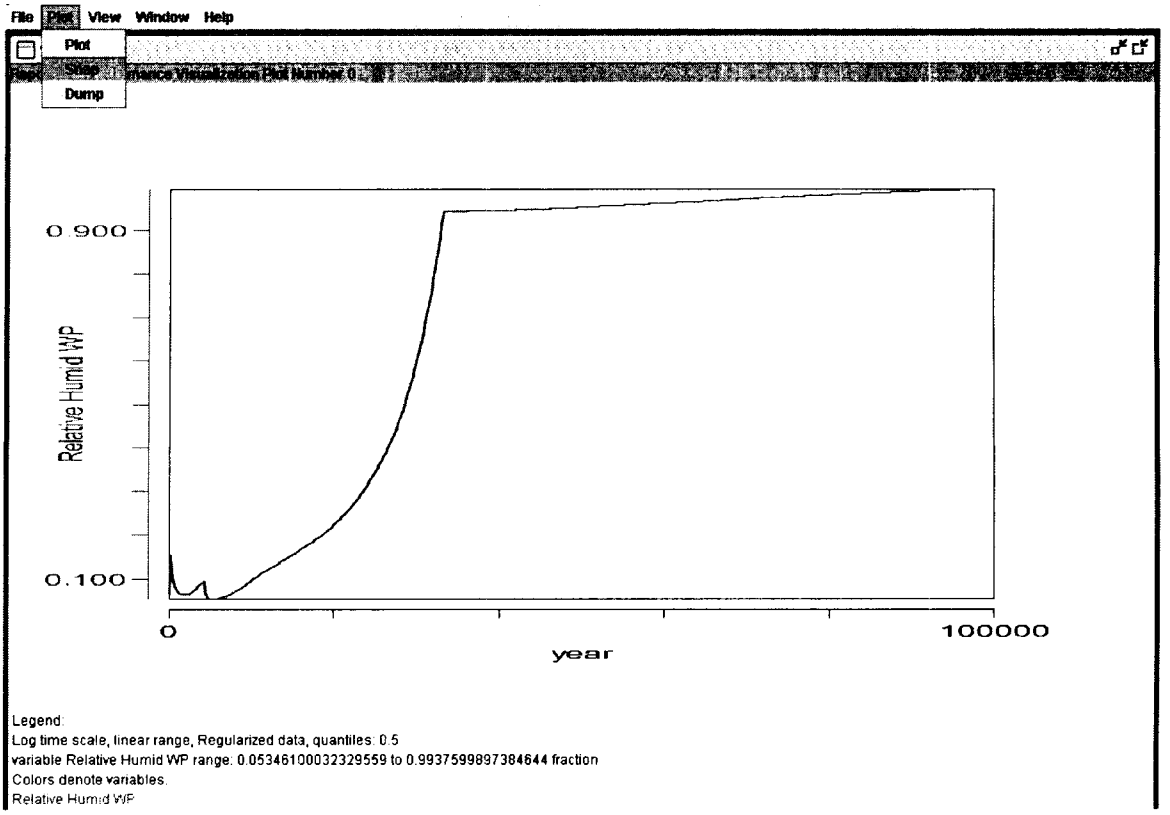
Example of multiple variables in a single plot. The user selects variables to be displayed. The GPP selects ranges and colors automatically.

A bug was detected while running the application, linear scale is selected, all of the vertical axes overlap. This problem has been communicated to software developers on 12-03-2001. This problem should be fixed before software release.

Aside from that problem, all items listed under 4.2 are considered adequate.

4.3 Capture figures in JPG format

The Repository Performance Visualization window features a menu, from which a figure can be "snapped" into a JPG file. In order to "snap" a plot; click on Snap under the Plot menu. A sample plot is reproduced in the following figure:



Note that the Snap selection is highlighted in the menu in the output JPG file. It would be desirable not to include the menu of the Repository Performance Visualization (RPV) window in the output JPG file. Deleting the menu of the RPV window the Snap selection from the JPG file can easily be accomplished with any graphics software, such as the Microsoft Paint. Generating a clean JPG file can be proposed as an enhancement, but it is not a requirement at this time.

The directory where the JPG file is created is the same directory where the GPP is located in the host PC. The user cannot select the output directory. It would be convenient to allow the user selection of an output directory. This feature can be proposed as an enhancement. It is not a requirement at this time.

It would also be desirable to allow the user selection of the name of the output file, rather than generating the name automatically. This feature can be proposed as an enhancement. It is not a requirement at this time.

4.4 Write values for any data being plotted to a disk file in a tabular format

The Repository Performance Visualization (RPV) window features a menu, from which a plot can be "dumped" into a comma-separated value (CSV) file. The Dump choice appears under the Plot menu.

CSV files can be modified within a text editor and loaded into excel. They can be easily loaded from Matlab and Mathematica.

I browsed a CSV file and it is my impression that it is correct. CSV files should be checked for accuracy during model validation testing.

Observations:

CSV files are not available for the scatter plot for the peak dose and also for box and whisker plots. Scatter plot data for the peak dose is readily available at the file gwpkdos.res; thus, it is not necessary to generate these data again.

It would be convenient to copy the data for box and whisker plots into a CSV file. At this stage, however, we have not discussed this item with software developers, and it is considered not to be a requirement. This item should be considered as an enhancement to the application.

Currently, rows in CSV files contain information on the lines included in the GPP plots. It would be convenient to transpose the matrix of numbers in CSV files, so that information on the lines is represented along columns. Excel cannot display all of the numbers in the CSV files (there are more columns than what Excel can deal with) in the current format. I can still load the data into Excel using a combination of straightforward manipulation of the CSV file with a common text editor, and a simple script in Mathematica or Matlab. Producing adequate CSV files that can be easily loaded into Excel can be proposed as an enhancement. Full compatibility of the CSV files with Excel was not proposed as a requirement; however, it can be proposed as an enhancement to the application.

4.5 Select parameters or variables whose influence on the displayed variable the user wants to explore

The GPP features a couple of pull down menus in the Plot Control window, under the Variable and Influences frames, where the user can select the *influencing* variable or parameter, and also the *influenced* variable.

4.6 Perform side-by-side visual comparisons of different plots

Plots can be assigned names in the View Control window. All the produced plots are tracked in the Repository Performance Visualization window, and can be displayed by selecting the appropriate name under the Window menu.

Joanne Damours discussed with me the difficulty of displaying plots side by side. She told me that the library of functions that they used to construct the application is quite limited, and that they would need to design a complex strategy to make automatic the side-by-side display. I judged that 4.6 was a minor requirement, which function could still be accomplished by saving plots as JPG files, and then performing the wanted side by side comparison. At this stage, I consider that the GPP functionality is adequate.

CONCLUSIONS:

I consider that requirements agreed upon have been adequately addressed.

Two bugs have been identified which have been communicated to software developers to be fixed.

A number of enhancements would be appropriate to improve the application. These enhancements are not considered requirements at this time.

Date: December 4, 2001

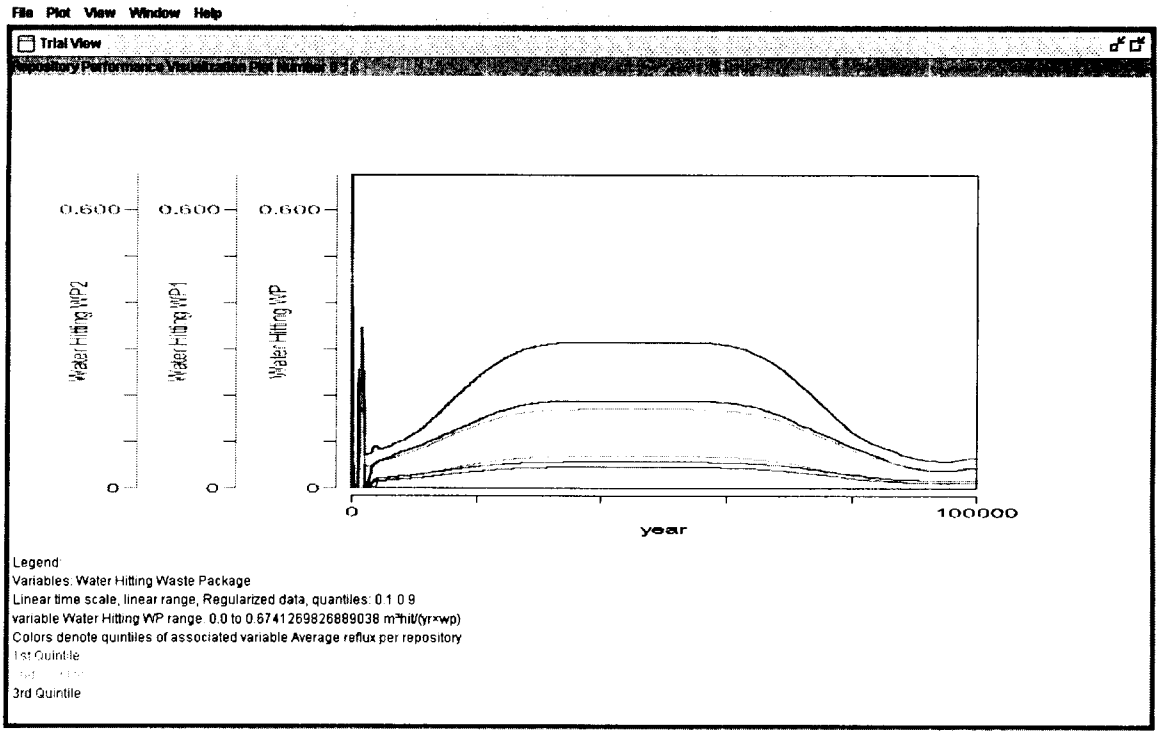
1/14/2002

The bugs documented above were discussed with software developers.

Version 02-01-08 has cleaned the bug related to the difficulty of selecting the Peak Dose or Time of Pk Dose in the Influences frame. No error is produced now, and influences are well displayed.

The variables have been renamed: Peak_Dose changed in Version 02-01-08 to Peak_Dose[rem/yr], and Time_of_Pk_Dose changed to Time_of_Pk_Dose[yr].

In the second bug, selection of linear scale caused all of the vertical axes to overlap. That problem has been fixed for Version 02-01-08. The next figure shows that the bug has been fixed.



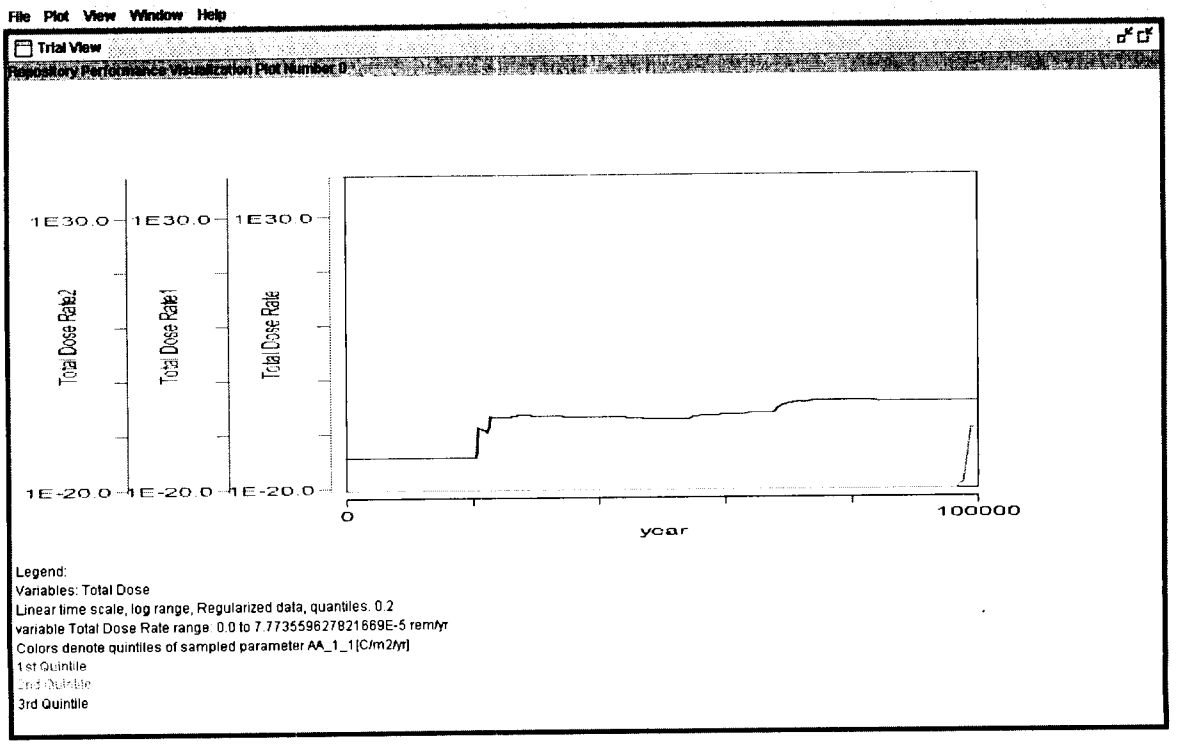
Note that the vertical axes above do not overlap.

Note:
During regular testing of the GPP, other bugs were discovered and documented in the following files
Problems011119.txt
Bugs011119.doc
Problems011222.txt
Bugs011222.doc
Problems020108.txt

Versions 01-12-22, 02-01-05, and 02-01-08 have been produced by Bayesian Systems, Inc. to fix the reported bugs.

Some of these fixes change the appearance of plots generated with the GPP version 01-11-19. However, the conclusion of the acceptance testing remains the same; i.e., I consider that requirements have been adequately addressed.

Date: January 11, 2002
A new bug for version 02-01-08 was discovered, which is presented in the following figure.



Data for base case 4.0 was used.

Value of Parameter: AA_1_1[C/m2/yr]
Variable: Total Dose Rate
Percentiles: 20
x : linear
y : logarithmic

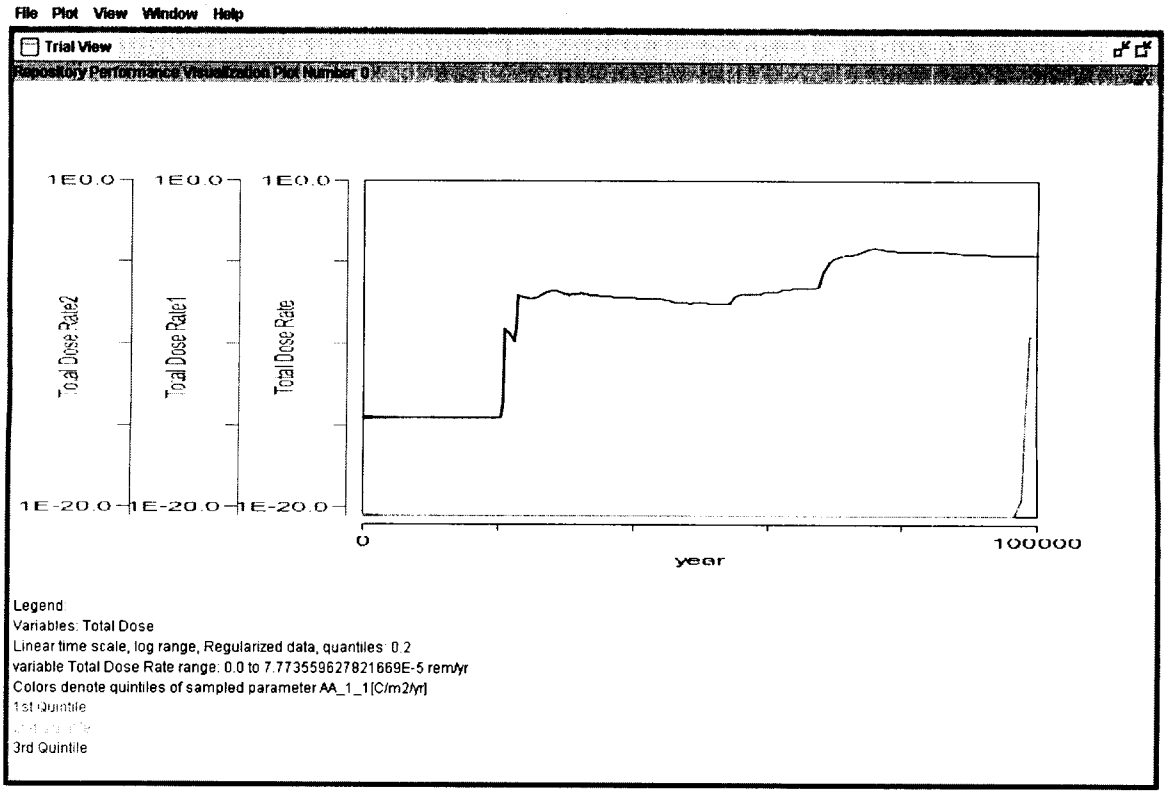
The gpp.properties file contained

#which_subarea=2
num_realizations=100
param_percentiles=10,50,100

nuclide_of_interest=none

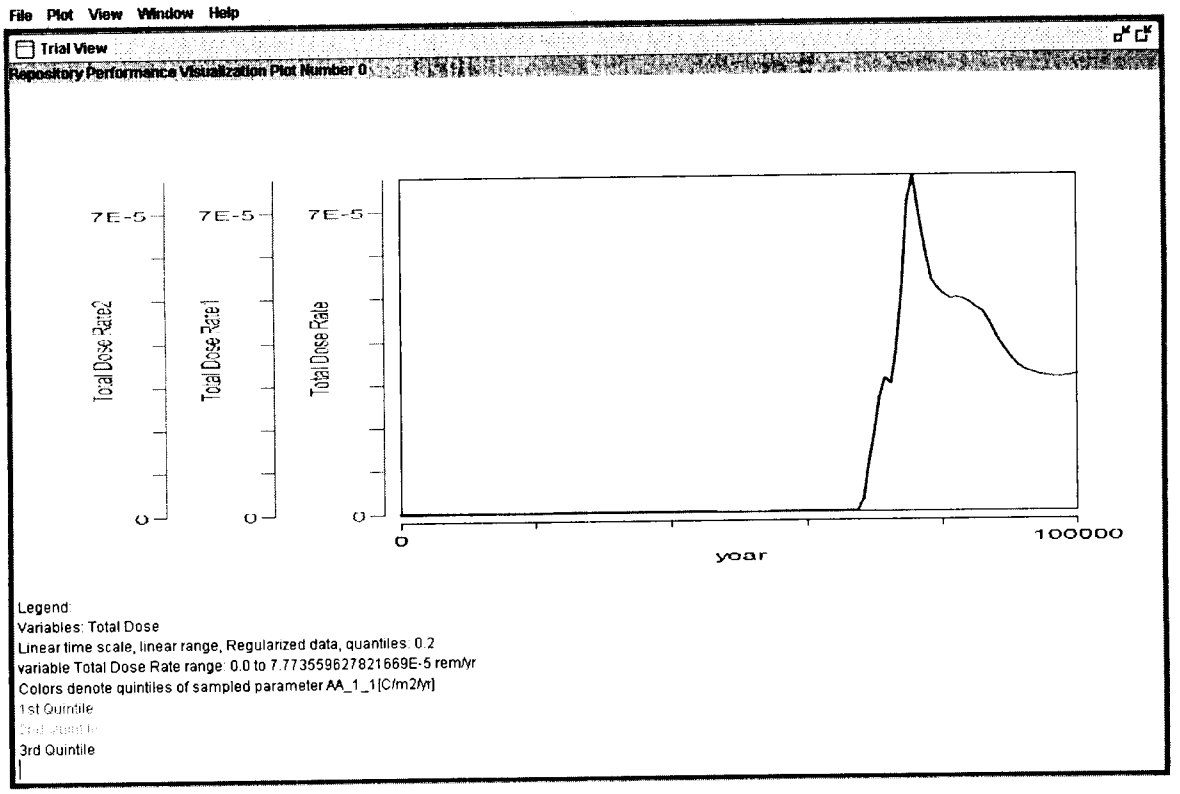
A line appears at 1E+30 that it is not right.

The above bug was fixed on Version 02-01-13. This version produces the following plot:



The reason for the bug, is that a data containing only 0's was attempted to be plotted on a log scale. Software developers decided not to plot such data. Such a solution is adequate.

Note that the y-linear scale does show the zero-data:



The solution offered by software developers is adequate.

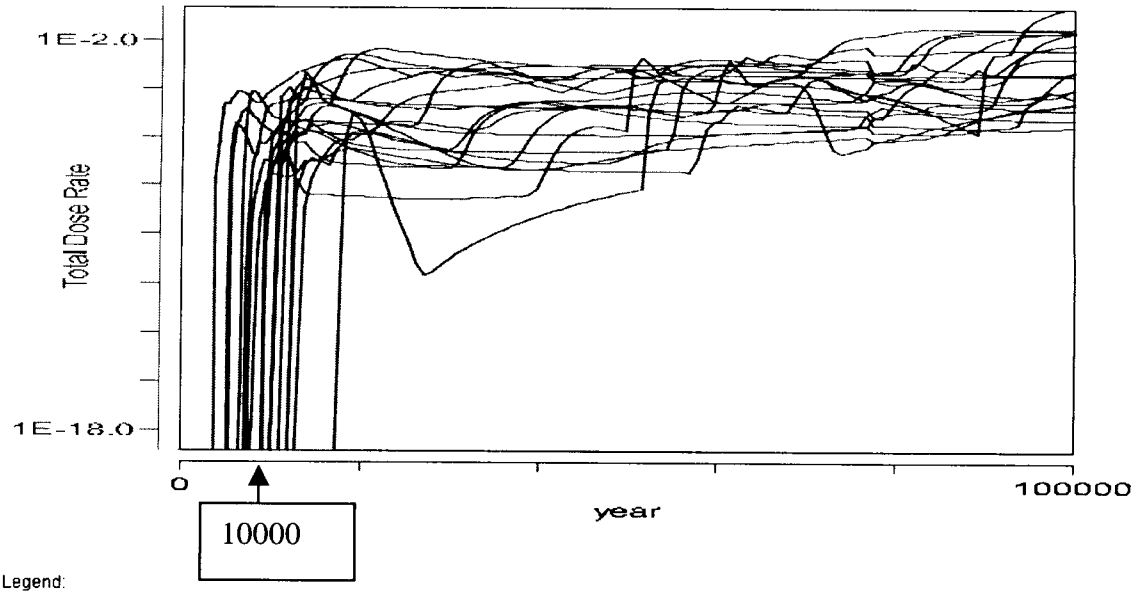
Current version: 02-01-13

February 8, 2002

During testing, bugs related to the handling of the log scale for the horizontal axis were discovered. The bugs are documented in the file Problems020113.txt, bugs020113.doc, bugs020113.xls, and bugs020113.zip.

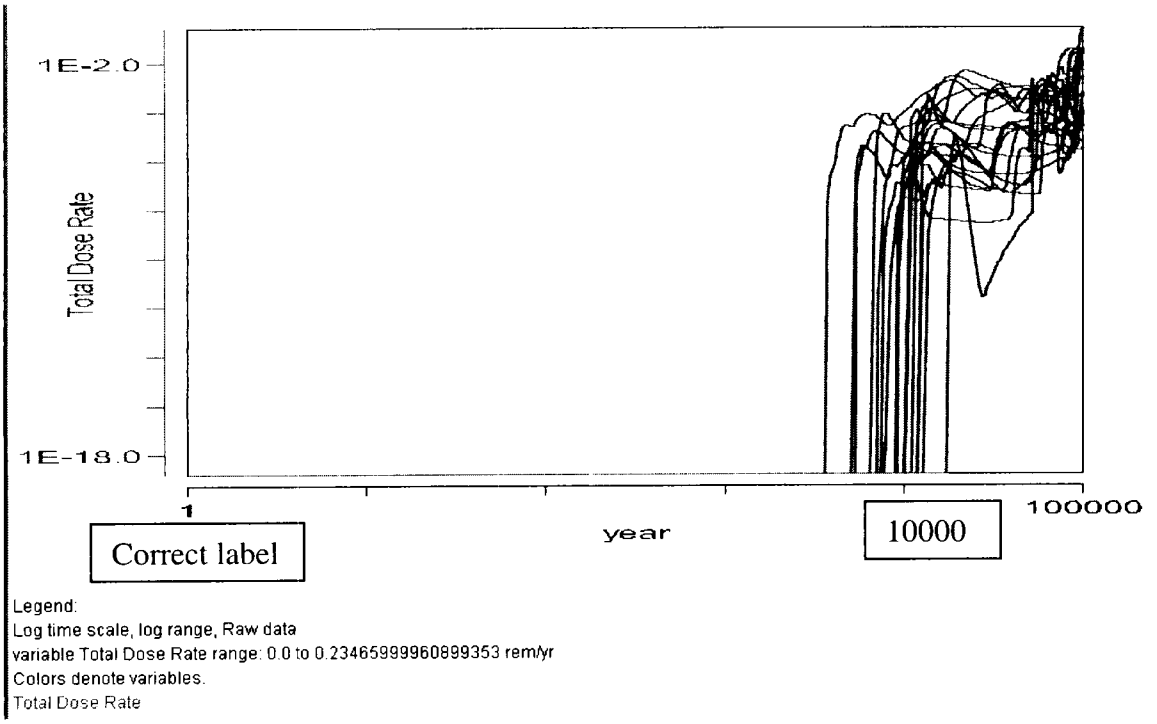
Summary of problem:
Linear-time scale is correctly plotted. Log-time scale is incorrectly plotted.
Time-step data for linear(X)-log(Y) and log(x)-log(y) are incorrectly exported to CSV files. Time steps that do not correspond to the TPA time steps are displayed.

The above bugs were corrected in Version 02-02-07. The following plots are presented to show that the bugs have been fixed.



Legend:
Linear time scale, log range, Raw data
variable Total Dose Rate range: 0.0 to 0.23465999960899353 rem/yr
Colors denote variables.
Total Dose Rate

Linear(x)-Log(y) plot. Correct plot.



Plot correctly displayed.

Note that the first tick label is **1**, and the plot is consistent with the linear(x) plot on page 70. The solution offered by software developers is adequate.

The solution to the bug in the CSV files is documented in the file bugs020113.xls and bugs020113.zip.

Current Version: 02-02-07
Version 02-02-07 was submitted to QA records on February 8, 2002.
The Graphical Post-Processor Version 1.0 is the same as Version 02-02-07

Bugs in version 02-02-07:

Plotting the time axis in log scale will produce an error for the following variables:

Avg_Infiltration [mm/yr]
Avg_Reflux [mm/yr]
Avg_Diversion [mm/yr]

Data for these variables come from the TPA output file infilper.res.

The error message is the following:

```
==========================================
      at javax.swing.AbstractButton.fireActionPerformed(Unknown Source)
      at javax.swing.AbstractButton$ForwardActionEvents.actionPerformed(Unknow
n Source)
      at javax.swing.DefaultButtonModel.fireActionPerformed(Unknown Source)
      at javax.swing.DefaultButtonModel.setPressed(Unknown Source)
      at javax.swing.plaf.basic.BasicButtonListener.mouseReleased(Unknown Sour
ce)
      at java.awt.Component.processMouseEvent(Unknown Source)
      at java.awt.Component.processEvent(Unknown Source)
      at java.awt.Container.processEvent(Unknown Source)
      at java.awt.Component.dispatchEventImpl(Unknown Source)
      at java.awt.Container.dispatchEventImpl(Unknown Source)
      at java.awt.Component.dispatchEvent(Unknown Source)
      at java.awt.LightweightDispatcher.retargetMouseEvent(Unknown Source)
      at java.awt.LightweightDispatcher.processMouseEvent(Unknown Source)
      at java.awt.LightweightDispatcher.dispatchEvent(Unknown Source)
      at java.awt.Container.dispatchEventImpl(Unknown Source)
      at java.awt.Window.dispatchEventImpl(Unknown Source)
      at java.awt.Component.dispatchEvent(Unknown Source)
      at java.awt.EventQueue.dispatchEvent(Unknown Source)
      at java.awt.EventDispatchThread.pumpOneEvent(Unknown Source)
      at java.awt.EventDispatchThread.pumpEvents(Unknown Source)
      at java.awt.EventDispatchThread.run(Unknown Source)
```

Version 02-02-11 addresses the above problem.

Current Version : 02-02-11

This Version of the GPP (Version 02-02-11) was delivered to the NRC on February 13, 2002. It was distributed to David Esh, James Firth, Tim McCartin, Chris Grossman, Robert K. Johnson, and Bill Dam.

Bugs of Version 02-02-11:

Three bugs were discovered and documented in the files Problems020211.txt and Bugs020211.xls.

The bugs were corrected by Version 02-02-28.

The fixes to the bugs are documented also in the file Bugs020211.xls

The fixes offered by software developers are satisfactory.

Software Change Report GPP001 was filled, reporting the bugs of Versions 02-02-07 and 02-02-11.

The current version, 02-02-28, is officially adopted as the Graphical Post-Processor Version 1.01.

Summary:
GPP Version 1.0 : same as 02-02-07
GPP Version 1.01 : same as 02-02-28

Entries into Scientific Notebook No. 376E for the period November 28, 2001 to March 21, 2002 have been made by

OP 3/21/2002

Osvaldo Pensado Date

Entries into Scientific Notebook No. 376-2E for pages 1 to 74 have been made by

OP 3/21/2002

Osvaldo Pensado Date

No original text entered into this Scientific Notebook has been removed.

OP 3/21/2002

Osvaldo Pensado Date

This SN is closed. It served a journal of the programmer who developed and tested the GPP for the TMA code. By itself this SN is insufficient to allow a competent programmer to replicate the development of the GPP.

Gordon Wittmeyer
3/26/2002

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