

Appendix G

<p style="text-align: center;"><b>NUCLEAR WASTE MANAGEMENT PROGRAM</b></p> <p>Sandia National Laboratories</p>	<h2 style="margin: 0;">User's Manual Criteria Form</h2>	<p><b>Form Number: NP 19-1-6</b></p> <p><b>Page 1 of 1</b></p>
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**Does the user's manual contain as appropriate:**

1. <b>Software Name:</b>	EPA UNI		
2. <b>Software Version:</b>	1.15		
3. <b>Document Version:</b>	1.15		
4. <b>ERMS #:</b>	529570		
5. A statement(s) of functional requirements (consistent with those in the RD) and system limitations?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A <input type="checkbox"/> N/R
6. An explanation of the mathematical model and numerical models?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A <input type="checkbox"/> N/R
7. Physical and mathematical assumptions?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A <input type="checkbox"/> N/R
8. The capabilities and limitations inherent in the software?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A <input type="checkbox"/> N/R
9. Instructions that describe the user's interaction with the software?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A <input type="checkbox"/> N/R
10. The identification of input parameters, formats, and valid ranges?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A <input type="checkbox"/> N/R
11. Messages initiated as a result of improper input and how the user can respond?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A <input type="checkbox"/> N/R
12. The identification and description of output specifications and formats?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A <input type="checkbox"/> N/R
13. A description of any required training necessary to use the software?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A <input type="checkbox"/> N/R
14. The identification of components of the code that were not tested?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input checked="" type="checkbox"/> N/A <input type="checkbox"/> N/R

<p>15. <u>Christi Leigh</u> Code Team/Sponsor (print)</p>	<p><u>[Signature]</u> Signature</p>	<p><u>5/21/03</u> Date</p>
<p>16. <u>Sean Dunagan</u> Technical Reviewer (print)</p>	<p><u>[Signature]</u> Signature</p>	<p><u>5/29/03</u> Date</p>
<p>17. <u>David Kessel</u> Responsible Manager (print)</p>	<p><u>[Signature]</u> Signature</p>	<p><u>5/29/03</u> Date</p>
<p>18. <u>Rodger Long</u> SCM Coordinator (print) 5/29/03</p>	<p><u>[Signature]</u> Signature</p>	<p><u>5/29/03</u> Date</p>

Key for check boxes above:

Check <b>Yes</b> for each item reviewed and found acceptable	Check <b>No</b> for each item which requires further work
Check <b>N/A</b> for items not applicable	Check <b>N/R</b> for items not reviewed (multiple technical reviews)

Information Only

**WIPP PA**  
**User's Manual**

**for**

**EPAUNI (Version 1.15)**

**Document Version 1.15**

**ERMS # 529570**

**MAY 21, 2003**

**Information Only**

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## 1.0 INTRODUCTION

This document serves as a User's Manual for EPAUNI, as used by the Sandia National Laboratories for the Waste Isolation Pilot Plant (WIPP). It describes the code's purpose and function, the user's interaction with the code, and the models and methods employed by the code.

EPAUNI is a FORTRAN program used to identify the distribution of EPA Units among the Contact-Handled Transuranic (CH-TRU) waste stream and for the WIPP-Scale Remote Handled-Transuranic (RH-TRU) destined for the WIPP. EPAUNI reads radionuclide activities for seven key radionuclides (for each WIPP CH-TRU waste stream) from a single input file obtained from the Transuranic Waste Baseline Inventory Report (TWBIR) and then performs the following: (1) calculates the activities as a function of time by using analytical solutions, (2) determines the EPA Units associated with the radionuclides, and (3) generates the normalized distribution associated with the volumetric EPA Units.

### 1.1 Software Identifier

Code Name:	EPAUNI
Version:	1.15
WIPP Prefix:	EPU
CMS Library:	EPU (WP\$CMSROOT:[EPU])
CMS Class:	QB0115
Executable:	EPAUNI_QB0115.EXE
Executable Identification:	"P QB0115 1.15"
Executable Date/time:	21-MAY-2003 11:58:33.62
Executable Size:	62 blocks
Platform:	Compaq Fortran V7.5-1961-48BCD on OpenVMS V7.3-1 ES40

### 1.2 Points of Contact

Code Sponsor:	Christi Leigh Sandia National Laboratories Carlsbad, NM 88220 Voice: (505) 234-0038 Fax: (505) 234-0061
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Code Consultant:	Lawrence C. Sanchez Sandia National Laboratories Albuquerque, NM 87185-1328 Voice: (505) 848-0685 Fax: (505) 848-0705
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## **2.0 FUNCTIONAL REQUIREMENTS**

- R.1** This program reads TWBIR data for seven key CH-TRU radionuclides for each waste stream identified as being sent to the WIPP site and calculates the radioactivity of these radionuclides as a function of time (up to the regulatory limit of 10,000 years after the closure of WIPP).
- R.2** This program reads TWBIR data for ten key RH-TRU radionuclides for each waste stream identified as being sent to the WIPP site and calculates the radioactivity of these radionuclides as a function of time (up to the regulatory limit of 10,000 years after the closure of WIPP).
- R.3** EPAUNI calculates the EPA Units due to the radionuclides at select time frames and determines the volumetric EPA Units for each waste stream. WIPP-SCALE volumetric EPA Units are also calculated.

## **3.0 REQUIRED USER TRAINING**

In order to run the EPAUNI program successfully, the code user should have a basic knowledge of Open VMS and Digital Command Language, and should have access to the WIPP cluster of Alpha microcomputers or their equivalent.

To manipulate and/or interpret the results of EPAUNI, users should have the following background: (1) a basic understanding of probability, (2) a basic understanding of the WIPP PA process, including the definitions and usage of conceptual models and scenarios, and (3) an understanding of the EPA standards that address the management and disposal of the transuranic radioactive wastes listed in 40 CFR 191.

## 4.0 MODELS AND METHODS

The EPA Units will be calculated for key radionuclides only. The number of radionuclides is limited to a manageable number by noting that the Transuranic Baseline Inventory Database to be used in the WIPP PA calculations are dominated by only a few key radionuclides (that is, the top five radionuclides contribute to greater than 99.9% of the unit of waste value and 99.6% of the initial EPA Units for CH-TRU and RH-TRU, (Sanchez et al. 1997, Tables 1-2 and 1-3). The dominant CH-TRU radionuclides are the following: Am241, Pu238, Pu239, Pu240, and U234. The three parent radionuclides (Pu241, Cm244 and Pu238) are also used in the calculations. For RH-TRU, three additional key radionuclides are included: Cs137, Sr90 and U233.

## 5.0 CAPABILITIES AND LIMITATIONS OF THE SOFTWARE

The EPAUNI program performs radionuclide buildup and decay calculations on CH-TRU waste streams containing seven key radionuclides (for each WIPP CH-TRU waste stream) and at ten times after closure. The following are the key radionuclides for the CH-TRU waste stream: Am-241, Cm-244, Pu-238, Pu-239, Pu-240, Pu-241, and U-234 radionuclides. The following are the ten time periods of interest for the CH-TRU waste stream:

0, 100, 125, 175, 350, 1000, 3000, 5000, 7500, and 10,000 years.

The EPAUNI program has a limit of 970 waste streams and 10 time periods.

EPAUNI does not obtain the half-lives, and release limit values from the WIPP PA database. This makes the code machine independent. However, the values for WUF, half-lives, and release limits are hard coded in the main module of EPAUNI.

To add additional radionuclide waste stream data and to add or modify time periods, the NUWS and NUTIME parameters should be modified, respectively. If the NUTIME parameter is modified, then array TIME needs to be modified.

## 6.0 USER INTERACTIONS WITH THE SOFTWARE

EPAUNI executes on a DEC Alpha under OpenVMS. The output files generated by EPAUNI are as follows: EPU\_DIAG\$OUT (optional diagnostics file), EPU\$DIA, EPU\_ACTIVITY\$DIA (Diagnostic files), EPU\$OUT, EPU2\$OUT (Supplementary output files), and EPU\$DAT (standard output file). The EPAUNI code displays the following output on the terminal:

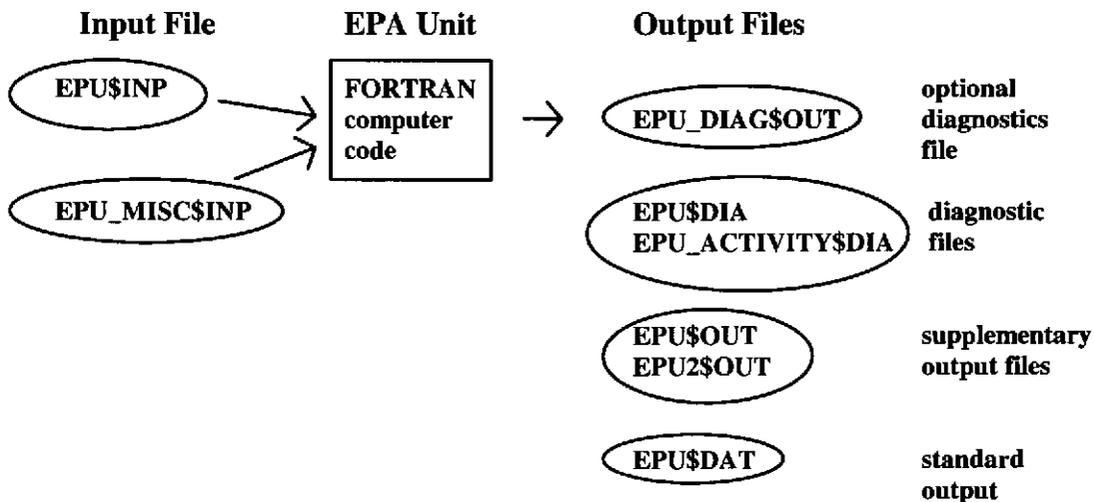
```
Version - 1.15
E P A   U N I T
This code was generated for the repository work.
The code will perform the following:

1) Read a datafile generated from the TWBIR.
2) Calculate the activity of key radionuclides.
3) Using decayed data, calculate the EPA unit.
4) Determine the EPA Unit per unit volume along with
the associated weighting (volume) for each
CH-TRU waste stream destined for the WIPP facility.
(RH-TRU is all grouped into one item.)
```

```
Stage #1 Completed -- TWBID read, Output files opened.
Stage #2 Completed -- Analysis done, Output written.
Stage #3 Completed -- Alternate Output written.
Stage #4 Completed -- Output files closed.
```

Figure 1 describes the associated input and output files for EPAUNI:

Figure 1: EPAUNI Input and Output File Flowchart



The current code settings for reading input and producing outputs are as follows:

- IFLAGD=0 Do not invoke diagnostic print statements,
  - 1 Print out extra format statements to screen and to file – EPU\_DIAG\$OUT,
  - 2 Level 2 diagnostics are in greater detail than level 1.
- IFLAGO=0 Silent mode (create no output files),
  - 1 Printout EPU\$DAT file only,
  - 2 Printout all files.
- IFLAGI=0 Read EPU\$INP file with free format (i.e., tabs, commas, or blanks are used as delimiters),
  - 1 Read EPU\$INP file with fixed format (i.e., use FORMAT 9903 -- LCS format) 9903 FORMAT(A14,1x,F8.2,7(1X,E8.2)),
  - 2 Read EPU\$INP file with fixed format (i.e., use FORMAT 9904 -- LCS format) 9904 FORMAT(A14,1x,F11.0,7(2X,E9.2)),
  - 3 Read EPU\$INP file with a character string (i.e., parsing is used for second read).
- IFLAGR=0 Data that are read in are for CH-TRU,
  - 1 Data that are read in are for RH-TRU (the code that can be automatically tripped to set this flag to 1 is the identifier "StreamRH" used in the input file, see analyses).
- IFLAGC=0 Perform calculations assuming that start time is 0 years. (This assumes 2033 Baseline Inventory Report (BIR) data to be used.)
  - 1 Perform calculations assuming that start time is -38 years. (This allows 1995 BIR data to be used).

## 7.0 DESCRIPTION OF INPUT FILES

EPAUNI requires two input files assigned to the logicals EPU\$INP and EPU\_DIAG\$INP.

### 7.1 EPU\$INP Input File

This input file should contain the seven key CH-TRU radionuclides data or the ten key RH-TRU data. CH-TRU radionuclides data cannot be combined with RH-TRU radionuclides data in the same input file.

The required content and structure of the input file are as follows: for CH-TRU data, the first line in the input file must be character data beginning in column one with the keyword "**Stream.**" This line must be followed by one or more lines of waste stream data that include the following: waste stream ID, volume ( $m^3$ ), and total activity (in curies) for the appropriate radionuclides. For CH-TRU, the appropriate radionuclides are the following: Am-241, Cm-244, Pu-238, Pu-239, Pu-240, Pu-241, and U-234. These activities must be entered in the order shown here. Data

values are delimited by spaces or tabs. An example of an input file for one CH-TRU waste stream is shown in Figure 2.

**Figure 2: Sample EPAUNI Input File for WIPP-Scale CH TRU**

Stream ID#	Volume (m <sup>3</sup> )	Am-241	Cm-244	Pu-238	Pu-239	Pu-240	Pu-241	U-234
CH-Total	168500.00	4.42E+05	0.00E+00	0.00E+00	7.85E+05	2.10E+05	0.00E+00	4.65E+02

Similarly, for RH-TRU, the first two lines in the input file must be character data, with the first line beginning in column one with the keyword "*StreamRH.*" The first two lines must be followed by one or more sets of two lines of waste stream data that include the following: waste stream ID, volume (m<sup>3</sup>), and total activity (in curies) for the appropriate radionuclides. For RH-TRU, the appropriate radionuclides are the following: Am-241, Cm-244, Pu-238, Pu-239, Pu-240, Pu-241, U-234, Cs-137, Sr-90, and U-233. These activities must be entered in the order shown here. Also, for each two-line set of waste stream data, the first seven activities must be on the first line, and the other three must be on the second line. Data values are delimited by spaces or tabs. An example of an input file for one RH-TRU waste stream is shown in Figure 3.

**Figure 3: Sample EPAUNI Input File for WIPP-Scale RH TRU**

Stream ID#	Volume (m <sup>3</sup> )	Am-241	Cm-244	Pu-238	Pu-239	Pu-240	Pu-241	U-234
RH-Total	7080.00	Cs-137	Sr-90	U-233	1.03E+04	5.07E+03	0.00E+00	4.27E+01
		5.96E+03	0.00E+00	0.00E+00				

## 7.2 EPU\_MISC\$INP Input File

EPAUNI reads the control files and WUF from the file assigned the logical EPU\_MISC\$INP. The first five integers are IFLAGD, IFLAGO, IFLAGI, IFLAGR, and IFLAGC; while the second line is the WUF value. An example of an input file for the control files and WUF is shown in Figure 4.

**Figure 4: Sample EPAUNI Input File for WUF Value and Control Input**

```

0           2           3           0           1
3.44

```

## 8.0 ERROR MESSAGES

The EPAUNI program does not generate error messages.

## 9.0 DESCRIPTION OF OUTPUT FILES

EPAUNI can generate six output files. Many of these files are generated for diagnostic purposes. The output file EPU\$DAT contains the following information: waste stream number (ICH), normalized volume (PCH(ICH)), and volumetric EPA Units for nine time periods of interest (that is, 100, 125, 175, 350, 1000, 3000, 5000, 7500, and 10,000 years after closure, CCH(ICH,1)..CCH(ICH,ITMCH)). The NCH in the output defines the number of waste streams and NTMCH defines the number of time periods. For examples of the other output files, refer to Sanchez et al. 1997.

### 9.1 EPU\$OUT Output File

An example of an output file corresponding to a test case with a single CH-TRU waste stream is presented in Figure 5.

**Figure 5: Sample EPAUNI Output File for WIPP-Scale CH TRU**

```
-----+-----+
|          |          |
| NCH  =   1 |          |
| NTMCH =   9 |          |
|          |          |
|-----+-----+
ITMCH   TMCH(ITMCH)
-----
1       100.0
2       125.0
3       175.0
4       350.0
5      1000.0
6      3000.0
7      5000.0
8      7500.0
9     10000.0

ICH   PCH(ICH)  CCH(ICH,1)  ...  CCH(ICH,ITMCH)  ....  CCH(ICH,NTMCH)
-----
1     1.000D+00 2.318D-02 2.292D-02 2.243D-02 2.097D-02 1.784D-02 1.510D-02 1.385D-02 1.254D-02 1.140D-02
-----
SUM = 1.000D+00
```

## 9.2 Other EPAUNI Output Files

EPAUNI can generate five other files for diagnostic purposes, for further details see the *Design Document for EPAUNI (Version 1.15)*.

## 10.0 REFERENCES

EPA (Environmental Protection Agency). 1985a.:40 CFR Part 191: "Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Waste: Final Rule", Federal Register, Vol. 50, No. 182, 38066-38089 (1985).

Sanchez, L.C., Liscum-Powell, J., Rath, J.S., and Trellue, H.R. 1997. *WIPP PA Analysis Report for EPAUNI: Estimating Probability Distribution of EPA Unit Loading in the WIPP Repository for Performance Assessment Calculations*, Version 1.01. WMS 1.2.07.1.1. Sandia National Laboratories. Albuquerque, NM.

PA (Performance Assessment). *Design Document for EPAUNI (Version 1.15)*. Sandia National Laboratories. Carlsbad, NM. WIPP Central Files. ERMS # 529567.

Long, Jennifer J

*Jennifer Long* 5/29/03

---

**From:** Coman, Rodger Edward  
**Sent:** Thursday, May 29, 2003 11:36 AM  
**To:** Long, Jennifer J  
**Cc:** Byle, Kathleen A  
**Subject:** EPAUNI 1.15

Jennifer,

You have my permission to sign EPAUNI documentation for the new 1.15 release and submit the documentation to the Records Center. Insure the documentation is complete and that the required signatures are completed prior to submission.

Rodger Coman  
SCM Coordinator

530203



**Sandia National Laboratories**

Operated for the U.S. Department of Energy by

**Sandia Corporation**

Albuquerque, New Mexico 87185-1395

*date:* July 3, 2003

*to:* Sandia WIPP Records Center

*from:*   
Janis R. Trone

*subject:* User's Manual for EPAUNI, Version 1.15A (Single Page Changes)

The attached changes to page 3 and 7 of the User's Manual for EPAUNI Version 1.15 (ERMS# 529570) incorporate the updated information for the Patch of the EPAUNI code from Version 1.15 to Version 1.15A (see Change Control Form for EPAUNI Version 1.15 to 1.15A, ERMS #530199). The single page change is documented under ERMS# 530203 and when replaced, the Version 1.15 User's Manual will provide sufficient documentation for EPAUNI Version 1.15A.

WIPP: 1.3.5.1.5.1:SFT:QA-L:PKG 530200

**Information Only**

## 1.0 INTRODUCTION

This document serves as a User's Manual for EPAUNI, as used by the Sandia National Laboratories for the Waste Isolation Pilot Plant (WIPP). It describes the code's purpose and function, the user's interaction with the code, and the models and methods employed by the code.

EPAUNI is a FORTRAN program used to identify the distribution of EPA Units among the Contact-Handled Transuranic (CH-TRU) waste stream and for the WIPP-Scale Remote Handled-Transuranic (RH-TRU) destined for the WIPP. EPAUNI reads radionuclide activities for seven key radionuclides (for each WIPP CH-TRU waste stream) from a single input file obtained from the Transuranic Waste Baseline Inventory Report (TWBIR) and then performs the following: (1) calculates the activities as a function of time by using analytical solutions, (2) determines the EPA Units associated with the radionuclides, and (3) generates the normalized distribution associated with the volumetric EPA Units.

### 1.1 Software Identifier

Code Name:	EPAUNI
Version:	1.15A <i>gr 7/3/03</i>
WIPP Prefix:	EPU
CMS Library:	EPU (WP\$CMSROOT:[EPU])
CMS Class:	<u>QB0115QA0115A</u> <i>gr 7/3/03</i>
Executable:	<u>EPAUNI_QB0115QA0115A.EXE</u> <i>gr 7/3/03</i>
Executable Identification:	"P <u>QB0115QA0115A 1.15A</u> " <i>gr 7/3/03</i>
Executable Date/time:	<u>3-JUL-2003 10:33:50.6321</u> <del>MAY 2003 11:58:33.62</del> <i>gr 7/3/03</i>
Executable Size:	62 blocks
Platform:	Compaq Fortran V7.5-1961-48BCD on OpenVMS V7.3-1 ES40

### 1.2 Points of Contact

Code Sponsor:	Christi Leigh Sandia National Laboratories Carlsbad, NM 88220 Voice: (505) 234-0038 Fax: (505) 234-0061
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Code Consultant:	Lawrence C. Sanchez Sandia National Laboratories Albuquerque, NM 87185-1328 Voice: (505) 848-0685 Fax: (505) 848-0705
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The current code settings for reading input and producing outputs are as follows:

IFLAGD=0	Do not invoke diagnostic print statements,
1	Print out extra format statements to screen and to file – EPU_DIAG\$OUT,
2	Level 2 diagnostics are in greater detail than level 1.
IFLAGO=0	Silent mode (create no output files),
1	Printout EPU\$DAT file only,
2	Printout all files.
IFLAGI=0	Read EPU\$INP file with free format (i.e., tabs, commas, or blanks are used as delimiters),
1	Read EPU\$INP file with fixed format (i.e., use FORMAT 9903 -- LCS format) 9903 FORMAT(A14,1x,F8.2,7(1X,E8.2)),
2	Read EPU\$INP file with fixed format (i.e., use FORMAT 9904 -- LCS format) 9904 FORMAT(A14,1x,F11.0,7(2X,E9.2)),
3	Read EPU\$INP file with a character string (i.e., parsing is used for second read).
IFLAGR=0	Data that are read in are for CH-TRU,
1	Data that are read in are for RH-TRU (the code that can be automatically tripped to set this flag to 1 is the identifier "StreamRH" used in the input file, see analyses).
IFLAGC=0	Perform calculations assuming that start time is 0 years. (This assumes 2033 Baseline Inventory Report (BIR) data to be used.)
1	Perform calculations assuming that start time is -38 years. (This allows 1995 BIR data to be used).
<u>n</u>	<u>Use n as the base year for the radionuclide inventory</u>

*JP 7/3/03*

## 7.0 DESCRIPTION OF INPUT FILES

EPAUNI requires two input files assigned to the logicals EPU\$INP and EPU\_DIAG\$INP.

### 7.1 EPU\$INP Input File

This input file should contain the seven key CH-TRU radionuclides data or the ten key RH-TRU data. CH-TRU radionuclides data cannot be combined with RH-TRU radionuclides data in the same input file.

The required content and structure of the input file are as follows: for CH-TRU data, the first line in the input file must be character data beginning in column one with the keyword "Stream." This line must be followed by one or more lines of waste stream data that include the following: waste stream ID, volume (m<sup>3</sup>), and total activity (in curies) for the appropriate radionuclides. For CH-TRU, the appropriate radionuclides are the following: Am-241, Cm-244, Pu-238, Pu-239, Pu-240, Pu-241, and U-234. These activities must be entered in the order shown here. Data