

Complete only applicable items.

| 3. System<br>DOE and Commercial Waste Package   |                                | 4. Document Identifier<br>000-00C-DS00-01100-000-00A |                       |  |   |   |
|---|--------------------------------|--|-----------------------|--|---|---|
| 5. Title<br>Tabulation of Fundamental Assembly Heat and Radiation Source Files  |                                |  |                       |  |   |   |
| 6. Group<br>Thermal Structural Analysis   |                                |  |                       |  |   |   |
| 7. Document Status Designation<br><input type="checkbox"/> Preliminary <input checked="" type="checkbox"/> Committed <input type="checkbox"/> Confirmed <input type="checkbox"/> Cancelled/Superseded |                                |  |                       |  |   |   |
| 8. Notes/Comments<br><br>Attachment II was originated by Jeffrey C. Ryman. The remainder of the calculation was originated by Tim deBues.   |                                |  |                       |  |   |   |
| Attachments   |                                |  | Total Number of Pages |  |   |   |
| I:  | List of Files in Attachment II | 4  |                       |  |   |   |
| II:   | One Compact Disc               | N/A  |                       |  |   |   |
| <b>RECORD OF REVISIONS</b>  |                                |  |                       |  |   |   |
| 9. No.  | 10. Reason For Revision        | 11. Total # of Pgs.                                  | 12. Last Pg. #        | 13. Originator (Print/Sign/Date)   | 14. Checker (Print/Sign/Date)               | 15. Approved/Accepted (Print/Sign/Date)                 |
| 00A   | Initial issue                  | 12   | 12                    | Tim deBues<br><i>Tim deBues</i><br>10/25/06<br><br>Jeffrey C. Ryman<br><i>Jeffrey C. Ryman</i><br>10/25/06 | Matt Hinds<br><i>Matt Hinds</i><br>10/25/06 | Michael Anderson<br><i>Michael Anderson</i><br>10/26/06 |

**DISCLAIMER**

The calculations contained in this document were developed by Bechtel SAIC Company, LLC (BSC) and are intended solely for the use of BSC in its work for the Yucca Mountain Project.

## CONTENTS

|                                 | <b>Page</b> |
|---------------------------------|-------------|
| 1. PURPOSE.....                 | 5           |
| 2. REFERENCES .....             | 5           |
| 2.1 DESIGN INPUTS .....         | 5           |
| 2.2 DESIGN CONSTRAINTS.....     | 5           |
| 2.3 DESIGN OUTPUTS .....        | 6           |
| 3. ASSUMPTIONS .....            | 6           |
| 4. METHODOLOGY .....            | 6           |
| 4.1 QUALITY ASSURANCE .....     | 6           |
| 4.2 USE OF SOFTWARE.....        | 6           |
| 4.3 METHOD.....                 | 7           |
| 5. ATTACHMENTS .....            | 7           |
| 6. CALCULATION.....             | 7           |
| 7. RESULTS AND CONCLUSION ..... | 8           |
| ATTACHMENT I.....               | 9           |

**TABLES**

|                                   | <b>Page</b> |
|-----------------------------------|-------------|
| Table 1. List of Attachments..... | 7           |
| Table 2. UNIX Script Files .....  | 8           |

## 1. PURPOSE

The purpose of this calculation is to tabulate a set of computer files for use as input to the WPLOAD thermal loading software. These files contain details regarding heat and radiation from pressurized water reactor (PWR) assemblies and boiling water reactor (BWR) assemblies. The scope of this calculation is limited to rearranging and reducing the existing file information into a more streamlined set of tables for use as input to WPLOAD. The electronic source term files used as input to this calculation were generated from the output files of the SAS2H/ORIGIN-S sequence of the SCALE Version 4.3 modular code system, as documented in References 2.1.1 and 2.1.2, and are included in Attachment II.

## 2. REFERENCES

### 2.1 DESIGN INPUTS

- 2.1.1 BSC (Bechtel SAIC Company) 2003. *BWR Source Term Generation and Evaluation*. 000-00C-MGR0-00200-000-00A. Las Vegas, Nevada: Bechtel SAIC Company. ACC: [ENG.20030723.0001](#); [ENG.20050815.0024](#). [DIRS 164364]
- 2.1.2 BSC (Bechtel SAIC Company) 2004. *PWR Source Term Generation and Evaluation*. 000-00C-MGR0-00100-000-00B. Las Vegas, Nevada: Bechtel SAIC Company. ACC: [ENG.20040524.0007](#); [ENG.20050815.0020](#); [ENG.20050822.0006](#). [DIRS 169061]

### 2.2 DESIGN CONSTRAINTS

- 2.2.1 BSC (Bechtel SAIC Company) 2005. *Q-List*. 000-30R-MGR0-00500-000-003. Las Vegas, Nevada: Bechtel SAIC Company. ACC: [ENG.20050929.0008](#). [DIRS 175539]
- 2.2.2 BSC (Bechtel SAIC Company) 2006. *Quality Management Directive*. QA-DIR-10, Rev. 0. Las Vegas, Nevada: Bechtel SAIC Company. ACC: [DOC.20060906.0001](#). [DIRS 177655]
- 2.2.3 EG-PRO-3DP-G04B-00037, Rev. 4. *Calculations and Analyses*. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20060927.0010.
- 2.2.4 IT-PRO-0011, Rev. 1. *Software Management*. Las Vegas, Nevada: Bechtel SAIC Company. ACC: DOC.20060929.0002.
- 2.2.5 ORD (Office of Repository Development) 2006. *Repository Project Management Automation Plan*. 000-PLN-MGR0-00200-000, Rev. 00D. Las Vegas, Nevada: U.S. Department of Energy, Office of Repository Development. ACC: ENG.20060703.0001.

## 2.3 DESIGN OUTPUTS

None.

## 3. ASSUMPTIONS

This calculation does not use assumptions.

## 4. METHODOLOGY

### 4.1 QUALITY ASSURANCE

This calculation was prepared in accordance with EG-PRO-3DP-G04B-00037, *Calculations and Analyses* (Reference 2.2.3). The uncanistered spent nuclear fuel (i.e., the waste form) is classified as a Safety Category item (important to safety and important to waste isolation) on the *Q-list* (Reference 2.2.1 [DIRS 175539], Table A-1, p. A-7). Therefore, this document is subject to the requirements of the *Quality Management Directive* (Reference 2.2.2 [DIRS 177655], Sections 2.1.C.1.1.a.i and 17.E), and the approval version is designated as QA: QA.

### 4.2 USE OF SOFTWARE

This calculation was performed by using the commercially available HP-UX 10.20 (UNIX) operating system. This calculation consists solely of editing text files using the UNIX scripts described in Section 6. Usage of the HP-UX 10.20 operating system in this calculation constitutes Level 2 software usage, as defined in IT-PRO-0011 (Reference 2.2.4, Section 1.2). The HP-UX 10.20 operating system is listed in the current *Software Report*, as well as the *Repository Project Management Automation Plan* (Reference 2.2.5, Table 6-1). The files can be verified by visual inspection.

The calculation using the basic UNIX commands was executed on the following Hewlett-Packard (HP) 9000 Series workstation running operating system HP-UX 10.20:

Central Processing Unit (CPU) Name: Outland, Civilian Radioactive Waste Management  
System Management and Operating Contractor (CRWMS M&O) Tag Number: 117161.

WinZip version 9.0 SR-1 is used for the creation of the “.zip” files in Attachment II. Usage of WinZip version 9.0 SR-1 in this calculation constitutes Level 2 software usage, as defined in IT-PRO-0011 (Reference 2.2.4, Section 1.2). WinZip version 9.0 SR-1 is listed in the current *Software Report*, as well as the *Repository Project Management Automation Plan* (Reference 2.2.5, Table 6-1). The files can be verified by visual inspection.

WinZip version 9.0 SR-1 was executed on a PC running the Microsoft Windows 2000 SP-4 operating system.

All inputs and outputs are located in Attachment II.

### 4.3 METHOD

This calculation consists solely of editing text files using the UNIX scripts described in Section 6. The results of this calculation are provided in electronic file format in Attachment II.

## 5. ATTACHMENTS

Table 1. List of Attachments

| Attachment | Description                    | Number of Pages |
|------------|--------------------------------|-----------------|
| I          | List of files in Attachment II | 4               |
| II         | One Compact Disc               | N/A             |

## 6. CALCULATION

The solutions to this calculation were written using the Posix shell script “orgsrc”. The input files (identified by “.cut” file extensions), are taken from *BWR Source Term Generation and Evaluation* (Reference 2.1.1, Attachment VII, Discs 1 through 3) and *PWR Source Term Generation and Evaluation* (Reference 2.1.2, Attachment X, Discs 1 through 4) and are included in Attachment II of this calculation.

The “orgsrc” script was used to extract thermal, activity, neutron, and gamma source information from SAS2H/ORIGEN-S “.cut” files that reside in the same directory as this script. A SAS2H/ORIGEN-S “.cut” file is that portion of a SCALE code system SAS2H/ORIGEN-S output file containing only the echoed input for SAS2H and ORIGEN-S and the output from a final ORIGEN-S run for multiple decay times. Intermediate calculations by other functional modules called by SAS2H and other information generated by SAS2H, itself, included in the output files, have been removed.

The “orgsrc” script calls four other UNIX script files (“neutrons”, “gammas”, “watts”, and “curies”) to extract separate output files from each “.cut” file. These four files perform simple editorial tasks that extract lines of information from a single “.cut” file. The specific task of each script file is noted in Table 2. Individually, the four files can be executed by typing the command “awk -f (*script file*) (*input '.cut' file name*) > (*output file name*)”. The output files are identified by “.curies”, “.gammas”, “.neutrons”, or “.watts” file extensions.

Table 2. UNIX Script Files

| File Name | Function  |
|-----------|---|
| orgsrc    | Repetitively calls the four "awk -f ( <i>script file</i> )" commands for all the ".cut" files and organizes the placement of output files |
| neutrons  | Extracts the total (alpha-n plus spontaneous fission) neutron source table from a ".cut" file   |
| gammas    | Extracts the gamma source from the light element, actinide, and fission product contributions from a ".cut" file                          |
| watts     | Extracts the total thermal output from the light element, actinide, and fission product contributions from a ".cut" file                  |
| curies    | Extracts the tables of nuclide curies from a ".cut" file for the light element, actinide, and fission product contributions               |

These script files are intended for use only with the SAS2H/ORIGEN-S ".cut" files for the waste stream, stainless steel (SS) clad and South Texas assemblies from Reference 2.1.1 and Reference 2.1.2 that are stored in Attachment II.

The input files and output files are provided in Attachment II. Note that both input and output files are compressed in ".zip" format. A list of files in the ".zip" file can be found in the text file with the same name with the ".lis" file extension.

In *BWR Source Term Generation and Evaluation* (Reference 2.1.1, Section 6.6) the actual values of burnup used in the SAS2H/ORIGEN-S computer runs were about 1.7% less than the nominal values of burnup for which the runs were planned. The runs were valid, but the computed source terms contained in the ".cut" files should be taken to correspond to the actual burnups as specified in the SAS2H/ORIGEN-S cases rather than the stated, or nominal burnups. Table 48 of Reference 2.1.1 gives the actual burnups that correspond to the stated, or nominal burnups, that one might take from the ".cut" file names.

## 7. RESULTS AND CONCLUSION

The resulting text files can be found in compressed ".zip" format in Attachment II. The results of the tabulations have been verified by visual inspection and are reasonable compared to the inputs. The results are suitable for the intended use of this calculation.



## ATTACHMENT I

### LIST OF FILES IN ATTACHMENT II

Notes: File sizes and times may vary with operating system.

Volume in drive D is 060727\_1051  
Volume Serial Number is 70A7-B24A

Directory of D:\

|            |        |           |         |
|------------|--------|-----------|---------|
| 07/26/2006 | 09:10a | <DIR>     | BWR     |
| 07/26/2006 | 09:03a | <DIR>     | PWR     |
| 07/26/2006 | 09:11a | <DIR>     | scripts |
|            |        | 0 File(s) | 0 bytes |

Directory of D:\BWR

|            |        |           |              |
|------------|--------|-----------|--------------|
| 07/26/2006 | 09:10a | <DIR>     | .            |
| 07/26/2006 | 09:10a | <DIR>     | ..           |
| 07/26/2006 | 09:11a | <DIR>     | SS_Clad      |
| 07/26/2006 | 09:09a | <DIR>     | Waste_Stream |
|            |        | 0 File(s) | 0 bytes      |

Directory of D:\BWR\SS\_Clad

|            |        |           |          |
|------------|--------|-----------|----------|
| 07/26/2006 | 09:11a | <DIR>     | .        |
| 07/26/2006 | 09:11a | <DIR>     | ..       |
| 07/27/2006 | 10:16a | <DIR>     | cutfiles |
| 07/27/2006 | 10:26a | <DIR>     | srcfiles |
|            |        | 0 File(s) | 0 bytes  |

Directory of D:\BWR\SS\_Clad\cutfiles

|            |        |           |                           |
|------------|--------|-----------|---------------------------|
| 07/27/2006 | 10:16a | <DIR>     | .                         |
| 07/27/2006 | 10:16a | <DIR>     | ..                        |
| 07/27/2006 | 10:16a |           | 1,042 BWR_SS_cut.lis      |
| 03/08/2005 | 11:08a |           | 6,763,974 BWR_SS_cut.zip  |
| 03/08/2005 | 12:12p |           | 322 Readme_BWR_SS_cut.txt |
|            |        | 3 File(s) | 6,765,338 bytes           |

Directory of D:\BWR\SS\_Clad\srcfiles

|            |        |       |                             |
|------------|--------|-------|-----------------------------|
| 07/27/2006 | 10:26a | <DIR> | .                           |
| 07/27/2006 | 10:26a | <DIR> | ..                          |
| 07/27/2006 | 09:47a |       | 1,173 BWR_SS_watts.lis      |
| 03/08/2005 | 11:09a |       | 608,763 BWR_SS_curies.zip   |
| 07/27/2006 | 09:46a |       | 1,191 BWR_SS_gammas.lis     |
| 03/08/2005 | 11:10a |       | 618,614 BWR_SS_gammas.zip   |
| 07/27/2006 | 09:47a |       | 1,233 BWR_SS_neutrons.lis   |
| 03/08/2005 | 11:10a |       | 121,647 BWR_SS_neutrons.zip |
| 07/27/2006 | 09:46a |       | 1,198 BWR_SS_curies.lis     |

03/08/2005 11:11a 458,861 BWR\_SS\_watts.zip  
8 File(s) 1,812,680 bytes

Directory of D:\BWR\Waste\_Stream

07/26/2006 09:09a <DIR> .  
07/26/2006 09:09a <DIR> ..  
07/27/2006 10:27a <DIR> cutfiles  
07/27/2006 10:30a <DIR> srcfiles  
0 File(s) 0 bytes

Directory of D:\BWR\Waste\_Stream\cutfiles

07/27/2006 10:27a <DIR> .  
07/27/2006 10:27a <DIR> ..  
03/08/2005 11:22a 29,350 BWR\_WS\_cut.lis.bak  
07/27/2006 10:27a 25,654 BWR\_WS\_cut.lis  
03/08/2005 11:33a 168,741,096 BWR\_WS\_cut.zip  
03/08/2005 12:30p 412 Readme\_BWR\_WS\_cut.txt  
4 File(s) 168,796,512 bytes

Directory of D:\BWR\Waste\_Stream\srcfiles

07/27/2006 10:30a <DIR> .  
07/27/2006 10:30a <DIR> ..  
03/08/2005 11:21a 29,366 BWR\_WS\_curies.lis  
03/08/2005 11:38a 14,557,933 BWR\_WS\_curies.zip  
03/08/2005 11:21a 29,359 BWR\_WS\_gammas.lis  
03/08/2005 11:41a 16,244,602 BWR\_WS\_gammas.zip  
03/08/2005 11:21a 30,417 BWR\_WS\_neutrons.lis  
03/08/2005 11:43a 2,921,302 BWR\_WS\_neutrons.zip  
03/08/2005 11:22a 28,833 BWR\_WS\_watts.lis  
03/08/2005 11:45a 10,974,742 BWR\_WS\_watts.zip  
8 File(s) 44,816,554 bytes

Directory of D:\PWR

07/26/2006 09:03a <DIR> .  
07/26/2006 09:03a <DIR> ..  
07/26/2006 09:04a <DIR> South\_Texas  
07/26/2006 09:03a <DIR> SS\_Clad  
07/26/2006 09:00a <DIR> Waste\_Stream  
0 File(s) 0 bytes

Directory of D:\PWR\South\_Texas

07/26/2006 09:04a <DIR> .  
07/26/2006 09:04a <DIR> ..  
07/26/2006 10:34a <DIR> cutfiles  
07/26/2006 10:36a <DIR> srcfiles  
0 File(s) 0 bytes

Directory of D:\PWR\South\_Texas\cutfiles

07/26/2006 10:34a <DIR> .

```
07/26/2006 10:34a <DIR> ..
03/08/2005 12:12p          290 Readme_South_Texas_cut.txt
07/26/2006 10:05a          7,071 South_Texas_cut.lis
03/08/2005 03:33p        54,081,738 South_Texas_cut.zip
07/26/2006 10:31a          8,163 South_Texas_cut_mod.lis
          4 File(s)          54,097,262 bytes
```

Directory of D:\PWR\South\_Texas\srcfiles

```
07/26/2006 10:36a <DIR> .
07/26/2006 10:36a <DIR> ..
07/26/2006 10:36a          8,018 South_Texas_watts.lis
03/08/2005 04:03p        5,011,206 South_Texas_curies.zip
07/26/2006 10:33a          8,172 South_Texas_gammas.lis
03/08/2005 04:04p        871,196 South_Texas_neutrons.zip
07/26/2006 10:35a          8,486 South_Texas_neutrons.lis
03/08/2005 04:04p       4,834,302 South_Texas_gammas.zip
07/26/2006 10:19a          8,181 South_Texas_curies.lis
03/08/2005 04:05p        3,861,356 South_Texas_watts.zip
          8 File(s)       14,610,917 bytes
```

Directory of D:\PWR\SS\_Clad

```
07/26/2006 09:03a <DIR> .
07/26/2006 09:03a <DIR> ..
07/26/2006 09:03a <DIR> cutfiles
07/26/2006 12:48p <DIR> srcfiles
          0 File(s)          0 bytes
```

Directory of D:\PWR\SS\_Clad\cutfiles

```
07/26/2006 09:03a <DIR> .
07/26/2006 09:03a <DIR> ..
03/08/2005 10:32a          4,920 PWR_SS_cut.lis
03/08/2005 04:11p       36,926,857 PWR_SS_cut.zip
03/08/2005 12:12p          303 Readme_PWR_SS_cut.txt
          3 File(s)       36,932,080 bytes
```

Directory of D:\PWR\SS\_Clad\srcfiles

```
07/26/2006 12:48p <DIR> .
07/26/2006 12:48p <DIR> ..
03/08/2005 10:32a          5,591 PWR_SS_watts.lis
03/08/2005 04:23p       3,383,486 PWR_SS_curies.zip
07/20/2006 04:17p          5,701 PWR_SS_gammas.lis
03/08/2005 04:25p       3,115,351 PWR_SS_gammas.zip
03/08/2005 10:32a          5,921 PWR_SS_neutrons.lis
03/08/2005 04:25p        674,653 PWR_SS_neutrons.zip
03/08/2005 10:32a          5,706 PWR_SS_curies.lis
03/08/2005 04:26p       2,663,530 PWR_SS_watts.zip
          8 File(s)       9,859,939 bytes
```

Directory of D:\PWR\Waste\_Stream

```
07/26/2006 09:00a <DIR> .
```

```
07/26/2006 09:00a <DIR> ..
07/26/2006 09:02a <DIR> cutfiles
07/27/2006 10:51a <DIR> srcfiles
                0 File(s)                0 bytes
```

Directory of D:\PWR\Waste\_Stream\cutfiles

```
07/26/2006 09:02a <DIR> .
07/26/2006 09:02a <DIR> ..
07/20/2006 03:54p          37,978 PWR_WS_cut.lis
03/08/2005 10:21a      233,927,327 PWR_WS_cut.zip
03/08/2005 12:26p          535 Readme_PWR_WS_cut.txt
                3 File(s)      233,965,840 bytes
```

Directory of D:\PWR\Waste\_Stream\srcfiles

```
07/27/2006 10:51a <DIR> .
07/27/2006 10:51a <DIR> ..
07/25/2006 11:26a          42,311 PWR_WS_watts.lis
03/08/2005 10:37a      21,439,953 PWR_WS_curies.zip
07/27/2006 09:38a          43,029 PWR_WS_gammas.lis
03/08/2005 10:40a      18,776,909 PWR_WS_gammas.zip
07/27/2006 09:40a          44,471 PWR_WS_neutrons.lis
03/08/2005 10:43a      4,121,107 PWR_WS_neutrons.zip
07/20/2006 04:47p          43,036 PWR_WS_curies.lis
03/08/2005 10:46a      16,990,203 PWR_WS_watts.zip
                8 File(s)      61,501,019 bytes
```

Directory of D:\scripts

```
07/26/2006 09:11a <DIR> .
07/26/2006 09:11a <DIR> ..
10/12/1999 03:08a          261 curies
10/12/1999 03:08a          177 gammas
10/12/1999 03:08a          158 neutrons
01/14/2005 02:01p          6,073 orgsrc
03/08/2005 12:16p          678 Readme_scripts.txt
10/12/1999 03:08a          268 watts
                6 File(s)          7,615 bytes
```

Total Files Listed:

```
63 File(s)      633,165,756 bytes
54 Dir(s)              0 bytes free
```