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The X6XS.0 Cross Section Library for MCNP-4

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ABSTRACT

This report documents the work done by X-6, HSE-6, and CTR Technical Services to produce a comprehensive working cross-section library for MCNP-4 suitable for SUN workstations and similar environments. The resulting library consists of a total of 436 files (one file for each ZAID). The library is 152 Megabytes in Type 1 format and 32 Megabytes in Type 2 format. Type 2 can be used when porting the library from one computer to another of the same make. Otherwise, Type 1 must be used to ensure portability between different computer systems. Instructions for installing the library and adding ZAIDs to it are included here. Also included is a description of the steps necessary to install and test version 4 of MCNP. To improve readability of this report, certain commands and filenames are given in uppercase letters. The actual command or filename on the SUN workstation, however, must be specified in lowercase letters. Any questions regarding the data contained in the library should be directed to X-6 and any questions regarding the installation of the library and the testing that was performed should be directed to HSE-6.

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1. OBJECTIVE

The objective for building the X6XS.0 cross-section library was to extract a complete and useful library from all of the cross-section evaluations available from X-6. The criteria for selection of the evaluations are given below.

2. SELECTION CRITERIA

Of the 840 ZAIDs for neutron cross-sections found in the common file system (CFS) file /076997/myredstuff/xslist (described in Ref. 3), less than a third represent room temperature, continuous, recent evaluated data. The criteria used to select from this list were the following -

2.1 No high temperature evaluations (greater than 300 °K)
2.2 No "discrete" evaluations
2.3 No "multi-group" evaluations
2.4 Take most recent or most "valid" evaluation for each nuclide as determined by Bob Seamon of X-6. There were 157 of these.
2.5 Add Howerton library (ENDL85) for those nuclides not already using ENDL85 by criteria 2.4 above (for users wanting to compare evaluations). There were 50 of these.
2.6 Add "thinned" set (51C) for all nuclides in which an available thinned set was significantly smaller than the full continuous set (for users who need to reduce the memory requirements for a particular problem). There were 31 of these.
2.7 Add the room temperature evaluations for the 9 materials from the thermal library (e.g., lwtr.01t, poly.01t, etc.)
2.8 Add the 94 elements of the photon library (1000.01p, 2000.01p, etc.)
2.9 Add the 94 elements of the electron library (1000.01e, 2000.01e, etc.)
2.10 Only Type 1 data was to be transferred from X-6 to HSE-6
2.11 The name of the resulting library was chosen to be the X6XS.0 Cross-Section Library

3. ORIGIN OF THE EVALUATIONS

After applying the selection criteria described above, a total of 435 ZAIDs were identified to be included in the X6XS.0 Cross-Section Library. The origin of these evaluations is described in Refs. 3, 4, 5, and 6. In short, the data came from existing CFS cross section files maintained by X-6. All of the data were transferred in Type 1 format and came over as 7 large files on a SUN 1/4-inch tape. Also included on the tape was a new XSDIR file (called XSDIRCT1) with the information needed to extract the cross-section data from the 7 files. A 436th ZAID, 6000.50c, was left off the original list because its data is the same as for 6012.50c. It was added later, however, for the convenience of those who want to use natural carbon as a material id (see Section 4.37). Please note that 6000.50c and 6012.50c is the only case in which two ZAIDs consist of the same data. Most of the chronology given in Section 4 refers to 435 ZAIDs but there are 436 ZAIDs that ended up in the library.

4. CHRONOLOGY OF EVENTS AND TESTING PERFORMED

Following is a chronology of the sequence of events and tests that were performed on the data that was received from X-6.

4.1 The cross-section data to be used for the X6XS.0 library was gathered by X-6 into the 8 CFS standard text files described below -

/090895/yellows	52 ZAIDs identified as "most useful"
/090895/blacks	105 ZAIDs identified as "may be needed"
/090895/thins	31 "meaningful thinned" sets
/090895/endl85ts	50 additional evaluations from the Howerton library
/x6xs/stext/tmccss	9 materials from the thermal library
/x6xs/stext/mcplibs	94 photon sets
/x6xs/stext/els	94 electron sets
/090895/xsdircts	xsdir for the 435 ZAIDs

4.2 After converting to native text format on the X-6 SUN LAN and replacing the "s" at the end of each filename with a "1", X-6 prepared a SUN 1/4-inch tape containing the above files.

4.3 The tape was copied to a sub-directory on MAYNARD, the SUN computer in HSE-6 that was to be used as the test bed for the X6XS.0 Cross-Section Library. MAYNARD has 56 Megabytes of memory, over 1,000 Megabytes of disk storage, and a CPU speed about one-quarter that of a CRAY XMP.

4.4 It was decided that the cross-section evaluation for each ZAID should be stored as a separate file, with the filename being the ZAID itself appended with a 1 (for a Type 1 file) or a 2 (for a Type 2 file). The library would then consist of 435 separate files in a sub-directory. Adding and deleting ZAIDs could then be accomplished by adding and deleting files and changing the XSDIR file accordingly. The naming convention consists of a five character ZA (Z*1000 plus the nearest integer to the atomic weight), a period, 3 characters indicating the evaluation for the nuclide, and a type 1 or 2 identifier for a total of 10 characters. NOTE: This naming convention will not work under CTSS because all filenames are limited to 8 characters. If the X6XS.0 library were to be installed on CTSS, then a different naming convention would have to be used. No other operating system is known to have this limitation.

4.5 The program MAKEXSF was used to manipulate the cross-section files and was obtained from X-6. The version obtained was /x6code/auxcodes/makxsf9 on CFS. Also obtained was the pre-processor code, PRPR. The version obtained was /x6code/auxcodes/prpr9. The files were obtained as local files on a CRAY machine and then downloaded to MAYNARD using KERMIT.

4.6 To create an executable version of MAKEXSF on MAYNARD, the following procedure was used -

4.6.1 Rename prpr9 to prpr.f
4.6.2 *Compile prpr.f using the SUN Fortran Compiler, F77* to create an executable file PRPR
4.6.3 Rename makxsf9 to codef
4.6.4 Create a batch file consisting of 1 line - : *define cheap
4.6.5 *Execute PRPR to create a file called compile*
4.6.6 Rename compile to makexs.f
4.6.7 Compile makexs.f to create an executable file MAKEXS

4.7 Several tests were done using MAKEXS to check that everything was working properly. A description of the input required for MAKEXS can be *found in the file MAKXSF9. The input must be on a file called SPECS.*

4.8 A SPECS file was created for each of the 7 large files to "break up" the *cross-section information included on the file into individual files (see* Section 4.4). The SPECS files that were used can be found on MAYNARD in the directory /usr/ctr/specs. SPECS files were created to make both *Type 1 files and Type 2 files from the same original large file.*

4.9 During testing with MAKEXS, it was discovered that several of the files obtained from X-6 were corrupted in some way (MAKEXS would encounter unanticipated read errors). After checking with X-6, it was verified that the files had not gone through the NTEXT procedure cleanly. The files were then remade using CTOU (a utility to convert CRAY native text to UNIX native text) and a new SUN 1/4-inch tape was written using the X-6 LAN. The remade files were checked and found to be clean (i.e., no errors were encountered using MAKEXS on the files). Also, the sizes of the resulting files on MAYNARD were compared with the file sizes shown by CFS and they were the same (this was not the case before).

4.10 Using the remade files, individual Type 1 and individual Type 2 files were created using the appropriate SPECS input files.

4.11 It was decided that comments needed to be included for 21 of the ZAIDs since these evaluations had limitations of one kind or another. These comments would appear on the MCNP-4 output (in the header of Table 100) whenever these particular ZAIDs were requested. The comments were prepared by R. E. Seamon and R. C. Little of X-6 and are documented in Ref. 4. The comments were incorporated by modifying the second line of the Type 1 file for the ZAID of interest. The ZAIDs and the comments are given below.

21045.55c	based on nuclear model calcs in group t-2; valid up to 5 mev only
35079.55c	incomplete fiss prod eval; iso ang dists, no phot prod, no heating
35081.55c	incomplete fiss prod eval; iso ang dists, no phot prod, no heating
36082.59c	endf/b-v mat=1332 with rough phot prod from group t-2
36083.59c	endf/b-v mat=1333 with rough phot prod from group t-2
36084.59c	endf/b-v mat=1334 with rough phot prod from group t-2
36086.59c	endf/b-v mat=1336 with rough phot prod from group t-2
37085.55c	incomplete fiss prod eval; iso ang dists, no phot prod, no heating
37087.55c	incomplete fiss prod eval; iso ang dists, no phot prod, no heating
53127.55c	incomplete fiss prod eval; iso ang dists, no phot prod, no heating
55133.55c	mat=1355, endf/b-v tape 510, no phot prod
64152.55c	phot prod added to endf/b-v;not good above 1 mev;heating not good
64154.55c	phot prod added to endf/b-v;not good above 1 mev;heating not good
64155.55c	phot prod added to endf/b-v;not good above 1 mev;heating not good
64156.55c	phot prod added to endf/b-v;not good above 1 mev;heating not good
64157.55c	phot prod added to endf/b-v;not good above 1 mev;heating not good
64158.55c	phot prod added to endf/b-v;not good above 1 mev;heating not good
64160.55c	phot prod added to endf/b-v;not good above 1 mev;heating not good
69169.55c	special file created by r. c. little - use with caution
77000.55c	special file created by r. c. little - use with caution
91231.50c	special file created by r. c. little - use with caution

4.12 It turned out that the header for 20 of these 21 files contained unreadable characters and this was the source of the problem with the STEXT and NTEXT utilities. The headers for all of the other files were scanned and only one other file had unreadable characters: 96245.52c. For this file, the characters were removed and replaced with blanks.

4.13 X-6 noted that the electron cross-section set could not be converted to Type 2 because of a limitation in the MAKEXSF program (the electron data is read into MCNP-4 in double-precision format versus single precision for the neutron, photon, and thermal cross-sections). John Hendricks of X-6 removed this limitation and prepared a newer version of MAKEXSF. The new file was obtained from CFS as /x6code/auxcodes/smakxsf (standard text format). The file was converted to native text using NTEXT and then re-compiled using the procedure described above in 4.6. The electron library could then be converted to Type 2 as long as the SPECS file for electrons specified 256 entries per record instead of 512 entries per record for the neutron and photon data.

4.14 To check whether the Type 2 files created from the original Type 1 files were reproducing the original data, MAKEXS was used to create a Type 1 file from the Type 2 file. The resulting Type 1 file could then be compared to the original Type 1 file. Unfortunately, the original Type 1 data is recorded in double precision on the file (i.e., 15 decimal places) and since MAKEXS uses single precision (7 decimal places) to process the data into Type 2, the two files will always differ in the insignificant places. Therefore, a program was written to compare only a specified number of significant digits of each entry in a MAKEXS Type 1 file to the corresponding entry in the original Type 1 file. This program is called comprx2.f and can be found on MAYNARD in the sub-directory /home/maynard/ctr/bat. After compiling and running this program, it was determined that all of the Type 2 files reproduced the Type 1 data to 7 decimal places.

4.15 After all 435 ZAIDs were converted into individual Type 1 files and individual Type 2 files, a SPECS file was created to convert the individual Type 1 files into individual Type 2 files. The plan was to compare these Type 2 files to the same Type 2 files that were created from the original large files. If the comparison showed no difference, this would increase confidence that all of the Type 1 and Type 2 files were valid.

4.16 Although some of the Type 2 files described above were identical, many of the Type 2 files created from the individual Type 1 files did not match the Type 2 files created from the original large files from X-6. Since a Type 2 file is in binary format it could not be determined where the difference was. So a further test was devised. Using MAKEXS, each of the different Type 2 files was converted back to Type 1 and the resulting Type 1 files were then compared. They were exactly the same (byte for byte). This was done on several of the different Type 2 files and each time, the resulting Type 1 files were exactly the same. So whatever the difference was, it did not seem to affect the numbers.

4.17 Version 4.1e of MCNP was obtained on a SUN 1/4-inch tape from X-6 and installed on MAYNARD. Also obtained were 25 test cases that could be used to verify that MCNP-4 was working properly. The source files can be found under /home/maynard/ctr/mcnpv4/src and the standard test files under /home/maynard/ctr/mcnpv4/test.

4.18 Details regarding the installation and execution of MCNP-4 can be found in Section 7.

4.19 It was discovered that the location of the cross-section files could not be passed to MCNP-4 using the first line of the XSDIR file. Instead, local "links" to every cross-section file had to be established before MCNP-4 could find them. A change to MCNP-4 to correct this was made later and now the first line of the XSDIR file can point to the location of the cross-section files.

4.20 As a first pass, the 25 test problems that came with MCNP-4 were run using the X6XS.0 cross-section library (using the executable file that was on the tape). 9 of the 25 problems executed with no differences. 16 of the problems would not run because a ZAID or ZAIDs requested in the input for the test problem was not in the X6XS.0 cross-section library. The fact that 9 of the problems gave identical results, however, provided additional confidence that the transfer of data from CFS to MAYNARD was sound.

4.21 A cross-section library that would work for all 25 standard test problems was obtained from X-6 and copied to MAYNARD. The library was in Type 2 format and was about 45 Megabytes in size. All 25 test problems were re-run using this library and there were no differences in any of the problems. This showed that the executable copy of MCNP-4 was working properly.

4.22 Several changes were made to the MCNP-4 code to change the value of MDAS and to add a patch to read the location of the cross-section files from the XSDIR file. The code was then re-compiled on MAYNARD. After re-compilation, the 25 standard test problems were re-run and found to give the same results as before. This provided confidence that re-compilation of MCNP-4 on the SUN introduced no errors. [This is true only for version 1.2 of the SUN FORTRAN compiler. See Section 4.46]

4.23 To verify the X6XS.0 cross-section library, a series of MCNP-4 test problems was developed to exercise each ZAID in the library. Most test problems consisted of 10 concentric spheres with each layer of the sphere consisting of a different material (a single ZAID). 10 ZAIDs could then be exercised in each problem. The following numbering scheme for the test problems was used -

1 - 25	25 problems similar to the "standard" 25 (see 4.24 below)
26 - 30	reserved for future problems
31 - 54	24 problems to test each of the 238 neutron evaluations
55	a problem to test the 9 thermal evaluations
56 - 65	10 problems to test the 94 photon sets
66 - 75	10 problems to test the 94 electron sets

4.24 Problems 1-25 were patterned after the 25 "standard" MCNP-4 test problems that were provided with MCNP-4. These 25 problems were modified, however, so that the X6XS.0 cross-section library could be used. The most common change was to eliminate all requests for "discrete" evaluations since there are no discrete evaluations in the X6XS.0 library. Other changes replaced a ZAID that did not exist in the X6XS.0 library with a ZAID that did exist. For example, 7014.51c was replaced with 7014.50c.

4.25 Problems 40, 42, 43, and 44 did not run because 8 of the nuclides in the X6XS.0 library did not have a corresponding entry in the atomic weight table at the beginning of the XSDIR file.

4.26 Input for the above 4 problems were modified to include the AWTAB card for the nuclides that had missing atomic weight ratios. The atomic weight ratio was estimated by using linear interpolation between isotopes or by using the weight ratio of a neighboring nuclide that had the same A number. The problems then ran successfully. Atomic weight ratios for these 8 nuclides were provided later by X-6 (Ref. 7) and were subsequently incorporated into the atomic weight table of the XSDIR file. The 8 nuclides and the atomic weight ratios used on the AWTAB card for the test problems and the values subsequently provided by X-6 are given below -

ZA	AWTAB Card	X-6 (Ref. 7)
44103	102.020880	102.022302
45105	104.003885	104.004489
60147	145.652940	145.654023
61147	145.652830	145.653069
61148	146.644165	146.646787
61149	147.637915	147.639055
62151	149.622040	149.623460
63155	153.593870	153.592023

4.27 The atomic weight ratios in the table in the first section of the XSDIR file were compared to the ratios calculated from data in the 14th Edition of "Nuclides and Isotopes," GE Nuclear Energy (1989) (Ref. 1). Differences were found in the atomic weight ratio for several natural elements. These differences were subsequently investigated by X-6 (Ref. 8). It turns out that the values for the atomic weights of most natural elements were reported in Ref. 1 to only 5 or 6 significant digits even though the values could be calculated to many more digits using the isotopic abundances and isotopic weights from the same reference. The reporting of fewer digits was done intentionally by the authors of Ref. 1 because the isotopic abundances are not known as precisely as the atomic weights and can in fact vary from place to place on the earth. When the atomic weights for the natural elements were re-calculated using the isotopic abundances and isotopic weights reported in Ref. 1, there were essentially no differences and we can conclude that the values for the atomic weight ratios given in the XSDIR file are accurate. For those who want to calculate the number densities directly, a list of the atomic weights and ratios for the nuclides in the X6XS.0 library is given in Section 5.

4.28 The value of Avogadro's number (divided by the neutron mass) used in MCNP-4 does not agree with the most recent data. The value using data from Ref. 1 is .59704037 (.60221367 / 1.008664904) and Ref. 8 suggests a value of .59704034 (.60221367 / 1.008664967) while the value being used in MCNP-4 is .59703109 (comdeck zc.31). Using the MCNP-4 number will result in slightly inaccurate calculations of the number density whenever the user inputs mass density for the materials. An option for the user to be able to input this number should be added to MCNP-4.

4.29 The electron problems (66-75) would not run because MCNP-4 would report an invalid library (i.e., 1000.01e was declared invalid). When the "e" on the end of the ZAID was eliminated, the error was avoided (i.e., 1001.01 is "valid"). MCNP-4 accepts a "p" for the photon library but does not accept an "e" for the electron library. The input for problems 66-75 had to be revised to eliminate the trailing "e" in the material descriptions.

4.30 After making the above change, problem 66 executed (although very slowly) but problems 67-75 would not run because the particles kept getting "lost" and MCNP-4 would report a geometry error. Apparently there is a minor bug in the MCNP-4 code and it is being fixed. Meanwhile, the electron problems are being deferred. [The bug has been corrected in Version 4.2]

4.31 Examination of the XSDIRCT1 file that was provided from X-6 showed that the photon and electron entries included atomic weight ratios for a number of isotopes of each Z. This information was not present for the neutron entries. Also, after being processed by MAKEXS, the electron entries would "lose" this information on the resulting new XSDIR file. This was brought to the attention of X-6 and they said that the information was not needed. The extra information was eliminated from the XSDIR file and all of the photon problems (56-65) were re-run. The results were identical to the results obtained before and so it appears that the extra information was indeed not necessary.

4.32 After successfully running 60 test problems (1-25 and 31-65) with the X6XS.0 library in Type 2 format, the 60 problems were re-run with the X6XS.0 library in Type 1 format. All results were identical. This provides further confidence that the data is valid and that the conversion from Type 1 format to Type 2 format was accurate.

4.33 It was noted by X-6 in Refs. 5 and 6 that 68 of the 436 evaluations on the X6XS.0 cross-section library cannot be distributed indiscriminately to others. Refs. 5 and 6 provide details regarding this issue and an appropriate note has been added to the "comments" column of the lists found in Section 12. A list of the 68 ZAIDs subject to limited distribution is provided in Table 1 below. Except for these 68 evaluations, all of the cross-section evaluations included in the X6XS.0 library can be distributed without restriction.

Table 1. List of ZAIDs in X6XS.0 Subject to Limited Distribution

7014.50c	
8016.50c	
11023.50c	
12000.50c	12000.51c
14000.50c	14000.51c
15031.50c	
16032.50c	
17000.50c	
19000.50c	
20000.50c	20000.51c
22000.50c	22000.51c
23000.50c	
27059.50c	27059.51c
31000.50c	
36078.50c	
36080.50c	
40000.50c	40000.51c
41093.50c	41093.51c
42000.50c	42000.51c
43099.50c	
45103.50c	
47107.50c	
47109.50c	
54131.50c	
54135.50c	
62149.50c	
63152.50c	63152.51c
63154.50c	63154.51c
72000.50c	
73181.50c	73181.51c
83209.50c	
90232.50c	90232.51c
91233.50c	91233.51c
92233.50c	92233.51c
92234.50c	92234.51c
92236.50c	92236.51c
94238.50c	94238.51c
94240.50c	94240.51c
94241.50c	94241.51c
94242.50c	94242.51c
95241.50c	95241.51c
95242.50c	
95243.50c	95243.51c
96244.50c	96244.51c
96245.52c	

4.34 It was suggested that perhaps a sub-set of the X6XS.0 cross-section library was needed to reduce the size of the library and yet be able to handle nearly all of the problems. The criteria for eliminating ZAIDs for use in the smaller library were the following -

4.34.1 Eliminate the Howerton evaluations for nuclides that already had a valid, more recent evaluation (50 ZAIDs)

4.34.2 Eliminate all the "thinned" sets (31 ZAIDs)

4.34.3 Eliminate nuclides that are rare in nature and are otherwise not very useful (a judgement call) (30 ZAIDs)

4.35 This resulted in 111 ZAIDs that could be eliminated from the X6XS.0 cross-section library without significantly reducing its usefulness. The size of the smaller library in Type 2 format would be 22 Megabytes versus 32 Megabytes for the X6XS.0 library saving 10 Megabytes of disk space.

4.36 After some thought and much agony, it was decided that it would be very inefficient to maintain two separate libraries (the X6XS.0 library plus the smaller library). For example, whenever an evaluation was added or deleted, it would have to be done for both libraries, essentially doubling the work required. Instead, a single library would be maintained (called the X6XS.0 library) along with a list of "rarely used" ZAIDs. This list is given in Table 2 on page 13. Users who need the disk space can simply eliminate files (and ZAIDs) of their choice.

4.37 After running some of the test problems, it was found that the ZAID 6000.50c had not been included in the X6XS.0 library because it uses the same data as 6012.50c. Since natural carbon is frequently used as a material identifier, we decided to add it to the X6XS.0 library. This also gave us experience in adding files to the library. Based on this experience, a write-up was prepared on how to add ZAIDs to the library (see Section 6). The data for 6000.50c was obtained from the CFS files /x6xs/ctss/1/rmccs1 and /x6xs/ctss/1/xsdir1. To exercise the data, the ZAID was added to the input for test problem 54 and it was re-run with no errors.

Table 2. List of ZAIDs on the X6XS.0 Library That May Rarely Be Used

1003.35c	43099.50c	91233.35c
5011.35c	44101.50c	91233.51c
6012.35c	44103.50c	92233.35c
8016.35c	45105.50c	92233.51c
9019.35c	46105.50c	92234.35c
11023.35c	46108.50c	92234.51c
12000.35c	47107.35c	92235.51c
12000.51c	47109.35c	92236.35c
13027.35c	48000.35c	92236.51c
14000.35c	48000.51c	92237.35c
14000.51c	54131.50c	92237.51c
15031.35c	54134.35c	92238.35c
16032.35c	54135.50c	92238.51c
17000.35c	56138.50c	93237.35c
19000.35c	56138.35c	94238.35c
20000.35c	60143.50c	94238.51c
20000.51c	60145.50c	94240.51c
22000.35c	60147 50c	94241.35c
22000.51c	60148.50c	94241.51c
24000.35c	61147.50c	94242.35c
24000.51c	61148.50c	94242.51c
25055.35c	61149.50c	95241.35c
25055.51c	62147.50c	95241.51c
26000.35c	62149.50c	95242.35c
27059.35c	62150.50c	95243.35c
27059.51c	62151.50c	95243.51c
28000.51c	62152.50c	96242.35c
28058.35c	63152.50c	96242.51c
29000.35c	63152.51c	96244.35c
31000.35c	63154.50c	96244.51c
33074.35c	63154.51c	96245.35c
39088.35c	63155.50c	
40000.35c	72000.35c	
40000.51c	73181.35c	
40093.50c	73181.51c	
41093.35c	79197.35c	
41093.51c	82000.35c	
42000.35c	83209.35c	
42000.51c	90232.35c	
42095.50c	90232.51c	

4.38 The value of MDAS u[illegible]e compilation of MCNP-4 determines how large a problem car[illegible]n and how many simultaneous MCNP-4 processes can be run[illegible]e. For MAYNARD, with 56 Megabytes of main memory, if we wanted to have two MCNP-4 processes running in main memory at once, how large could MDAS be? Several tests were performed and it was found that the amount of memory required to load and run MCNP-4 was 8.9 Megabytes plus 4 times the value of MDAS. For example, with MDAS set to 1 million words, the memory requirement was 12.9 Megabytes. For 5 million words, the requirement was 28.9 Megabytes. Since two 5 million word MCNP-4 sessions would exceed the 56 Megabytes of main memory in MAYNARD, it was decided that a value of 4 million words should be used for MAYNARD. For a problem with ten ZAIDs having very large file sizes, an MDAS value of 4 million words allows at least 80,000 particles per cycle to be stored in memory before having to write information to the disk.

4.39 Several members in HSE-6 have machines that have only 8 Megabytes of memory (versus the 56 Megabytes in MAYNARD). With disk swapping, however, large programs such as MCNP-4 can still be run. For the smaller machines, an MDAS value of 1 million words was tried (requiring 12.9 Megabytes) but it was found that 11 of the test problems would not run because MDAS was too small. MDAS was then changed to 2 million words (requiring 16.9 Megabytes) and all problems ran successfully. It is noteworthy that there was little or no degradation of performance in using the larger MDAS. The SUN operating system is intelligent enough to "swap" only when absolutely necessary and it appeared that all of the major calculations were being performed without any disk swapping at all.

4.40 During some of the testing, it was noted that MAYNARD became very slow. Investigation showed that several processes (identified by the letters NFSD, network file server daemon) were using over 50% of the CPU time. Don Shirk was called in to see if he remembered seeing that before. He suggested that the remote terminal, JOSIE, be powered down and then powered up again. This fixed the problem. Apparently, JOSIE had undergone an ungraceful exit at some point and the file server was repeatedly trying to send data packets to JOSIE.

4.41 After the above tests were carried out on the SUN workstations in HSE-6, the Type 1 cross sections were written to a 1/4-inch tape and the tape was read by Bob Ryan in C-9 onto his SUN computer. The files were then converted to standard text format (using STEXT) and transferred to the common file system (CFS). The files are currently stored there under the node /ctr/type1. The files are named SZZAAA.EVL1 where S stands for "standard text" file, ZZAAA is the ZA for the nuclide, EVL is the three letter evaluation (50c, [illegible]p, etc.) and 1 stands for Type 1 file.

4.42 The test files used for the SUN were also transferred to CFS in standard text format and are located in the node /ctr/testmcnp. The source files used can be found in the node /ctr/mcnpsrc.

4.43 The original CFS files that were used to create the X6XS.0 library (see Section 4.1) were copied to a temporary disk on the CRAY UNICOS machine. The files were converted to native text format using NTEXT and MAKEXS was used to create individual Type 1 files for each ZAID. Problems were encountered similar to that described in Section 4.9. The CFS files /090895/black1 and /090895/yellow1 were then obtained and the utility CTOU was used to convert from CRAY native text to UNICOS native text. MAKEXS was then able to create individual Type 1 files for each ZAID.

4.44 All of the Type 1 files stored under the node /ctr/type1 were then transferred to the CRAY UNICOS machine and converted to native text format using NTEXT. The files were then compared to the files created in step 4.43. All but 22 of the files were identical. The 22 files that were different were the ones whose header had been altered (see Sections 4.11 and 4.12). Although the headers were different, the data was the same in these 22 files. This final comparison has demonstrated conclusively that the cross-section data sets in the X6XS.0 library on the SUN workstation are identical to those in the original CFS files from X-6.

4.45 A write-up was prepared on how to install MCNP-4 and the X6XS.0 cross-section library on a SUN workstation and the procedure was improved after testing it on two of the workstations in HSE-6. This write-up can be found in Section 7.

4.46 The MCNP-4 source was transferred to the SUN computer maintained by Stuart Vessard of HSE-6. After re-compilation with version 1.3.1 of the SUN Fortran compiler, execution errors (segmentation faults) were encountered. Stuart then implemented a SUN patch for 1.3.1 and re-compiled the code. All of the test problems ran successfully except problem 25. An unexpected end of record was encountered in reading the restart file (unit 42). Other test problems using a restart file had run successfully. Since problem 25 ran successfully when the code was compiled with version 1.2 on MAYNARD, there appears to be a problem in the newer compiler. This requires further investigation.

4.47 After the Type 1 cross-sections were transferred to CFS in standard text format, they were ported to the P-15 VAX computer by Bob Horning. Bob also obtained Version 4.2 of MCNP and the most recent versions of the PRPR and MAKEXSF programs.

4.48 PRPR was compiled on the VAX and then run on the MCNP Version 4.2 source code. The MCNP compile file was then compiled. An unreadable character was encountered at the end of the compile file. When this character was removed, MCNP compiled with no errors. The unreadable character also appeared after running PRPR on MAKEXSF. Apparently, something is wrong when PRPR writes the compile file under VMS.

4.49 After compiling, MCNP-4 could not find the location of the cross-section files because MCNP-4 appends a slash (/) at the end of the user-defined directory before appending the filename (statements cor4-2.124, 127, 164, and 166). Unfortunately, VAX VMS uses a right bracket (]) to delimit the directory from the filename instead of a slash. MCNP-4 needs a define directive that removes the appended slash when compiling under VMS.

4.50 After re-compiling with the above correction, the first test case ran successfully and provided confidence that the transfer of files from CFS to the VAX was valid. The remaining test problems have yet to be run because the command line options would not work correctly (see below).

4.51 For the command line options to work under VMS (such as setting the input and output filenames), the code must be compiled in uppercase and the data files must be in uppercase. Otherwise, a complicated command line processor must be developed to properly interpret everything. If the whole source is converted to uppercase, however, the following must be included in the PATCH file so that MCNP-4 can read lower-case exponents as regular numbers -

```
*D COR4-2.250  LINE 31397
*/
*/  CONVERT UPPER-CASE E AND D BACK TO LOWER CASE (VMS)
*/
 IH=INDEX('0123456789. +-edED',HD(IP:IP))
```

4.52 A write-up was prepared on how to modify the source code for MCNP-4 and to re-compile it on a SUN workstation. See Section 8.

4.53 A write-up was prepared on how to install MCNP-4 and load the X6XS.0 cross-section library in Type 1 format on a non-SUN computer system. Included in the write-up are instructions for converting the Type 1 files to Type 2 files to save disk space. This write-up can be found in Section 9.

4.54 Based on our experience in running MCNP-4 and installing the X6XS.0 cross-section library, we have prepared a list of potential improvements to MCNP-4 that could be made in a future release. See Section 10.

This completes the chronology of events as of March 27, 1991 in preparing and testing the X6XS.0 library and MCNP-4 on the SUN and VAX platforms.

5. ATOMIC WEIGHTS AND ATOMIC WEIGHT RATIOS

Table 3 below gives the atomic weights and atomic weight ratios for the 158 nuclides for which there exists a neutron evaluation in the X6XS.0 library. The atomic weight was obtained by multiplying the atomic weight ratio given on the X6DIR file by the mass of the neutron = 1.008664967 (see Ref. 2 for a discussion of the source of the atomic weight ratios). Using this table and Avogadro's number = $6.02204345 \times 10^{23}$, the user should be able to reproduce the number densities that would be calculated by MCNP-4. Please note that this value of Avogadro's number is not the most recent recommended value but is the value being used in MCNP 4 (see Section 4.28). The atomic weight is reported to 8 places past the decimal point only to ensure numerical reproducibility of the number densities and atomic weight ratios that are given to 6 places past the decimal point. The extra places do not have any physical significance.

Table 3. Atomic Weights and Atomic Weight Ratios for the X6XS.0 Library

Element	Symbol	ZA	Atomic Weight	Weight Ratio
Hydrogen	H	1001	1. 0078 2475	0. 9991 67
		1002	2. 0141 0221	1. 9968 00
		1003	3. 0160 4946	2. 9901 40
Helium	He	2003	3. 0160 2929	2. 9901 20
		2004	4. 0026 0349	3. 9632 19
Lithium	Li	3006	6. 0151 2310	5. 9634 50
		3007	7. 0160 0420	6. 9557 33
Beryllium	Be	4009	9. 0121 8243	8. 9347 63
Boron	B	5010	10. 0129 3845	9. 9269 22
		5011	11. 0093 0578	10. 9147 30
Carbon	C	6000	12. 0110 3718	11. 9078 56
		6012	12. 0000 0037	11. 8969 14
		6013	13. 0033 5471	12. 8916 49
Nitrogen	N	7014	14. 0030 7383	13. 8827 80
		7015	15. 0001 0889	14. 8712 50
Oxygen	O	8016	15. 9949 1480	15. 8575 10
Fluorine	F	9019	18. 9984 0336	18. 8351 97
Sodium	Na	11023	22. 9897 6931	22. 7922 75

Element	Symbol	ZA	Atomic Weight	Weight Ratio
Magnesium	Mg	12000	24. 3050 5431	24. 0962 61
Aluminum	Al	13027	26. 9815 4175	26. 7497 56
Silicon	Si	14000	28. 0855 1043	27. 8442 41
Phosphorus	P	15031	30. 9737 6305	30. 7076 82
Sulfur	S	16032	31. 9720 7205	31. 6974 15
Chlorine	Cl	17000	35. 4527 3782	35. 1481 80
Argon	Ar	18000	39. 9476 6059	39. 6044 89
Potassium	K	19000	39. 0983 0215	38. 7624 27
Calcium	Ca	20000	40. 0780 2247	39. 7337 31
Scandium	Sc	21045	44. 9559 1314	44. 5697 18
Titanium	Ti	22000	47. 8784 2506	47. 4671 24
Vanadium	V	23000	50. 9414 7025	50. 5038 56
Chromium	Cr	24000	51. 9959 2558	51. 5492 53
Manganese	Mn	25055	54. 9380 4595	54. 4660 99
Iron	Fe	26000	55. 8454 1574	55. 3656 74
Cobalt	Co	27059	58. 9331 9742	58. 4269 30
Nickel	Ni	28000 28058	58. 6878 9010 57. 9353 4736	58. 1837 30 57. 4376 52
Copper	Cu	29000	63. 5456 4176	62. 9997 51
Gallium	Ga	31000	69. 7230 2980	69. 1240 72
Arsenic	As	33074 33075	73. 9239 2976 74. 9215 9524	73. 2888 84 74. 2779 79
Bromine	Br	35079 35081	78. 9183 3636 80. 9162 8984	78. 2403 86 80. 2211 76

Element	Symbol	ZA	Atomic Weight	Weight Ratio
Krypton	Kr	36078	77. 9203 9653	77. 2510 19
		36080	79. 9163 7504	79. 2293 51
		36082	81. 9134 8326	81. 2098 05
		36083	82. 9141 3439	82. 2013 58
		36084	83. 9115 0634	83. 1906 62
		36086	85. 9106 1373	85. 1725 96
Rubidium	Rb	37085	84. 9117 9939	84. 1823 62
		37087	86. 9091 8398	86. 1625 88
Yttrium	Y	39088	87. 9095 0325	87. 1543 14
		39089	88. 9058 5646	88. 1421 08
Zirconium	Zr	40000	91. 2236 4953	90. 4399 90
		40093	92. 9064 7691	92. 1083 61
Niobium	Nb	41093	92. 9063 7806	92. 1082 63
Molybdenum	Mo	42000	95. 9312 8865	95. 1071 88
		42095	94. 9058 3748	94. 0905 46
Technetium	Tc	43099	98. 9062 5216	98. 0565 95
Ruthenium	Ru	44101	100. 9055 8045	100. 0387 48
		44103	102. 9063 2188	102. 0223 02
Rhodium	Rh	45103	102. 9055 0284	102. 0214 90
		45105	104. 9056 8447	104. 0044 89
Palladium	Pd	46105	104. 9050 7523	104. 0038 85
		46108	107. 9038 9367	106. 9769 42
Silver	Ag	47000	107. 8681 3045	106. 9414 86
		47107	106. 9050 9547	105. 9867 24
		47109	108. 9047 5359	107. 9692 04
Cadmium	Cd	48000	112. 4115 5487	111. 4458 80
Tin	Sn	50000	118. 7102 1167	117. 6904 28
Iodine	I	53127	126. 9044 7676	125. 8143 00
Xenon	Xe	54000	131. 2930 7918	130. 1652 02
		54131	130. 9050 7603	129. 7805 32
		54134	133. 9053 9536	132. 7550 77
		54135	134. 9071 3181	133. 7482 08

Element	Symbol	ZA	Atomic Weight	Weight Ratio
Cesium	Cs	55133	132. 9054 3316	131. 7637 05
Barium	Ba	56138	137. 9052 3611	136. 7205 57
Praseodymium	Pr	59141	140. 9076 5650	139. 6971 85
Neodymium	Nd	60143	142. 9098 2317	141. 6821 52
		60145	144. 9125 8193	143. 6677 06
		60147	146. 9161 1030	145. 6540 23
		60148	147. 9169 0062	146. 6462 16
Promethium	Pm	61147	146. 9151 4804	145. 6530 69
		61148	147. 9174 7657	146. 6467 87
		61149	148. 9183 4254	147. 6390 55
Samarium	Sm	62147	146. 9149 0697	145. 6528 30
		62149	148. 9171 9266	147. 6379 15
		62150	149. 9172 8498	148. 6294 16
		62151	150. 9199 4234	149. 6234 60
		62152	151. 9197 4115	150. 6146 70
Europium	Eu	63000	151. 9645 8236	150. 6591 26
		63151	150. 9198 5963	149. 6233 78
		63152	151. 9217 5646	150. 6166 68
		63153	152. 9212 4257	151. 6075 68
		63154	153. 9229 9919	152. 6007 19
		63155	154. 9228 9281	153. 5920 23
Gadolinium	Gd	64000	157. 2521 2919	155. 9012 50
		64152	151. 9198 0267	150. 6147 31
		64154	153. 9208 7595	152. 5986 14
		64155	154. 9226 2854	153. 5917 61
		64156	155. 9221 2979	154. 5826 76
		64157	156. 9239 6710	155. 5759 07
		64158	157. 9241 1087	156. 5674 59
		64160	159. 9270 6127	158. 5532 03
Holmium	Ho	67165	164. 9303 3202	163. 5134 93
Thulium	Tm	69169	168. 9342 2458	167. 4829 90
Hafnium	Hf	72000	178. 4864 8557	176. 9531 92
Tantalum	Ta	73181	180. 9480 1441	179. 3935 75

Element	Symbol	ZA	Atomic Weight	Weight Ratio
Tungsten	W	74000	183. 8495 0878	182. 2701 44
		74182	181. 9482 2474	180. 3851 93
		74183	182. 9502 4463	181. 3786 05
		74184	183. 9509 5324	182. 3707 17
		74186	185. 9543 7671	184. 3569 30
Rhenium	Re	75185	184. 9529 7716	183. 3641 33
		75187	186. 9557 6517	185. 3497 16
Iridium	Ir	77000	192. 2160 6998	190. 5648 32
Platinum	Pt	78000	195. 0801 2574	193. 4042 84
Gold	Au	79197	196. 9665 0021	195. 2745 13
Lead	Pb	82000	207. 2168 9704	205. 4367 94
Bismuth	Bi	83209	208. 9803 8837	207. 1851 36
Thorium	Th	90231	231. 0362 9833	229. 0515 74
		90232	232. 0380 5394	230. 0447 24
		90233	233. 0415 8077	231. 0396 30
Protactinium	Pa	91231	231. 0358 8074	229. 0511 60
		91233	233. 0402 4328	231. 0383 04
Uranium	U	92233	233. 0396 2900	231. 0376 95
		92234	234. 0409 4786	232. 0304 12
		92235	235. 0439 2497	233. 0247 73
		92236	236. 0455 6257	234. 0178 06
		92237	237. 0487 2627	235. 0123 52
		92238	238. 0507 8549	236. 0058 03
		92239	239. 0542 9114	237. 0006 88
		92240	240. 0565 6841	237. 9943 75
Neptunium	Np	93235	235. 0440 5710	233. 0249 04
		93236	236. 0466 1965	234. 0188 54
		93237	237. 0481 6848	235. 0117 99
		93238	238. 0509 4184	236. 0059 58
Plutonium	Pu	94237	237. 0484 0249	235. 0120 31
		94238	238. 0495 5492	236. 0045 83
		94239	239. 0521 5781	236. 9985 73
		94240	240. 0538 0852	237. 9916 19
		94241	241. 0568 4716	238. 9860 41
		94242	242. 0587 3894	239. 9793 26
		94243	243. 0619 9948	240. 9739 68

Element	Symbol	ZA	Atomic Weight	Weight Ratio
Americium	Am	95241	241. 0568 2497	238. 9860 19
		95242	242. 0595 4083	239. 9801 21
		95243	243. 0613 7411	240. 9733 48
Curium	Cm	96242	242. 0588 3174	239. 9794 18
		96243	243. 0613 8218	240. 9733 56
		96244	244. 0627 4744	241. 9661 19
		96245	245. 0654 8751	242. 9602 45
		96246	246. 0672 2093	243. 9533 73
		96247	247. 0703 4933	244. 9478 84
		96248	248. 0723 4501	245. 9412 72
Berkelium	Bk	97249	249. 0749 8421	246. 9352 98
Californium	Cf	98249	249. 0748 4905	246. 9351 64
		98250	250. 0764 0293	247. 9281 14
		98251	251. 0795 8076	248. 9226 74
		98252	252. 0816 2182	249. 9161 07

6. HOW TO ADD AND DELETE ZAIDS IN THE CROSS-SECTION LIBRARY

If you want to delete evaluations from the library, simply delete the files from the cross-section directory. The corresponding XSDIR file does not need to be altered. If you wish, however, the lines referring to the deleted files can be removed from the file.

If you want to add evaluations (new ZAIDs) to the X6XS.0 cross-section library, the following steps should be performed. It is assumed that the cross-section data for the ZAIDs of interest are contained in one or more Type 1 file(s). In addition, a corresponding XSDIR-type file must exist that describes the Type 1 file for each ZAID of interest. This information is needed by the MAKEXS program so that the new files can be properly created. Also needed would be the atomic weight ratio of any nuclide that did not have a previous evaluation. If you already have an executable version of the MAKEXS program in a MAKEXS sub-directory, skip to step 6.11. Otherwise, proceed with steps 6.1 to 6.10.

6.1 Make a sub-directory called MAKEXS and copy into it the PATCH.MXS, PRPRF, and MAKEXSF files from the MCNP-4 source directory.

6.2 Delete any local files called the following:

CODEF PATCH MAKEXS COMPILE PRPR COMPILE.F NEWID

TPRINT SPECS XSDIR2.0

6.3 Copy PRPRF to PRPR.F

6.4 Copy MAKEXSF to CODEF

6.5 Using the Fortran compiler, compile the PRPR.F source file to create an executable file called PRPR.

6.6 Copy PATCH.MXS to PATCH

6.7 If you are aware of any directives that need to be made to the PATCH file for your computer system, edit the PATCH file now. The PATCH file provided contains only one line (*define cheap) and it should be sufficient for most 32-bit computers.

6.8 Execute PRPR. This will create a file called COMPILE.

6.9 Rename COMPILE to MAKEXS.F

6.10 Compile the MAKEXS.F file to create an executable file called MAKEXS.

6.11 Obtain the Type 1 file(s) and the corresponding XSDIR file for the ZAIDs to be added. Copy these files into the MAKEXS sub-directory. For the following example, assume that the XSDIR file is called XSDIRCT and that the ZAIDs to be added are called 99250.60c and 99251.60c

6.12 Create a SPECS1 file consisting of the following lines -

```
xsdirct  xsdir1.0a
99250.60c1  1
[blank line]
99250.60c
[blank line]
99251.60c1  1
[blank line]
99251.60c
[blank line]
```

6.13 Copy SPECS1 to SPECS

6.14 Execute MAKEXS. This will read the SPECS file as input, extract the cross-section data for the ZAIDs of interest from the Type 1 file(s) and create individual Type 1 files for each ZAID (named 99250.60c1, etc.).

6.15 Create a SPECS2 file consisting of the following lines

```
xsdir1.0a  xsdir2.0a
99250.60c1  99250.60c2  2
[blank line]
99251.60c1  99251.60c2  2
[blank line]
```

6.16 Copy SPECS2 to SPECS

6.17 Execute MAKEXS. This will read the SPECS file as input, extract the cross-section data for the ZAIDs of interest from the Type 1 files and create individual Type 2 files for each ZAID (named 99250.60c2, etc.).

6.18 Copy the newly created Type 2 files to the same directory containing all of the other Type 2 files. Edit the XSDIR2.0 file in this directory to add entries for the ZAIDs that were added. These entries can be found on the XSDIR2.0A file in the MAKEXS directory (one line for each ZAID). If necessary, add any new atomic weight ratios.

6.19 If desired, an MCNP-4 test case can be created to exercise the new ZAIDs that were added. Use one of the existing test cases (e.g., INP31.CT) as a pattern. If no errors are encountered, then the data is valid.

7. HOW TO INSTALL MCNP-4 AND THE X6XS.0 LIBRARY ON A SUN COMPUTER

The following steps are contained in a file called INSTRUCTIONS (in the DOCUMENT sub-directory) that is included on the transmittal tape. This description is meant to provide a detailed explanation of the steps required to install and test MCNP-4 and the X6XS.0 cross-section library on a SUN workstation. If MCNP-4 is to be installed on a different kind of computer, see Section 9.

7.1 The purpose of these instructions is to guide you in installing and testing MCNP-4 and the X6XS.0 cross-section library on a SUN workstation. Everything you need should be on the tape (including these instructions). For a step-by-step example of what UNIX commands to enter to implement the following procedure, see number 7.12 below. The executable for MCNP-4 was compiled with MDAS set to 2 million words (requiring 16.9 Megabytes of memory) using version 1.2 of the SUN FORTRAN compiler. The MCNP-4 source files are provided in a sub-directory called SRC as a contingency but you should not have to re-compile the code under normal circumstances. [Note: Only version 1.2 of the compiler has been found to give good results. Other versions may give unexpected errors.]

7.2 Locate a copy of the 1/4-inch magnetic tape labeled "MCNP-4 and X6XS.0 Cross-Sections". Verify that this tape contains the proper files by listing a table of contents (e.g., tar tvf /dev/rst0). A partial list of the files on the tape is given in Section 7.16.

7.3 Copy the contents of the tape media to a working sub-directory. You will need about 50 Megabytes of free disk space. (e.g., tar xvf /dev/rst0)

7.4 This will create five sub-directories under the working directory called DOCUMENT, EXE, TESTMCNP, TYPE2, and SRC.

7.5 The TYPE2 sub-directory will contain all of the cross-section files in Type 2 (binary) format. The set contains neutron cross-sections for 239 ZAIDs, thermal cross-sections for 9 materials, and photon and electron cross-sections for 94 elements (a total of 436 files). The first 5 characters of the filename is Z*1000 plus the nearest integer of the atomic weight. The first 3 characters of the extension (that part following the decimal point) indicates the evaluation for the nuclide. The filenames are then appended with a 2 to denote a type 2 file (e.g., 74000.55c2 is the file for ZAID 74000.55c).

7.6 The EXE sub-directory will contain the executable file MCNPX4.2M2 The 4.2M2 designates that this is version 4.2 that was compiled with MDAS set to 2 million words. As presently implemented on SUN workstations, this means that 16.9 Megabytes of memory will be required to load and run MCNP-4. The dynamic allocation feature of MCNP-4 is currently not operational for the SUN workstation. Most machines, however, will be able to handle this memory requirement by swapping to disk when needed. For a machine with 8 Megabytes of memory, it is recommended that at least 32 Megabytes of disk space be reserved for disk swapping.

7.7 The DOCUMENT sub-directory will contain these instructions and other documents that you may find useful.

7.8 To set up MCNP-4, link the XSDIR2.0 file in the TYPE2 sub-directory to a file called XSDIR in the directory from which you want to run MCNP-4. Then change the first line of the XSDIR2.0 file to reflect the full pathname of the TYPE2 sub-directory on your system. Also create an alias in your .cshrc file for MCNP-4. For example, if the files were copied into a sub-directory called /usr/local/mcnp, then the first line of the XSDIR2.0 file would be

```
datapath = /usr/local/mcnp/type2
```

the alias for MCNP-4 would be

```
alias mcnp '/usr/local/mcnp/exe/mcnpx4.2m2'
```

and the link for the XSDIR file would be

```
ln -s /usr/local/mcnp/type2/xsdir2.0 xsdir
```

All of the above actions should be done under your regular user id.

7.9 The TESTMCNP sub-directory will contain input and output files for 70 test problems that can be run to verify that the transfer of MCNP-4 and the cross-section set was successful. 25 of the test problems are patterned after the 25 "standard" test problems for MCNP-4 except that some of the material descriptions were changed to use ZAIDs that are available in the X6XS.0 library. Successful completion of all 70 test problems will verify that the code and the cross-section data are valid. A UNIX script called TESTMCNP will automatically run through the 70 test problems, compare to the expected output file, and write the differences on 70 files called diffnn where nn is the problem number (1-25 and 31-75). This may take several hours. After the test problems are complete, there should be 70 files called mctalnn and 70 files called diffnn. The lengths of all the diffnn files should be zero (indicating no difference) and there should exist 70 mctalnn files that have non-zero length (indicating that the job was completed).

7.10 To run the test problems, go to the TESTMCNP sub-directory, and type testmcnp to execute the script. After completion, examine the results as described above. Important: The test problems should be run under your normal user id so that the environment will be the same as when you run MCNP-4 under your working directory. Therefore, your normal user id will have to have write permission for the TESTMCNP sub-directory.

7.11 You can always move and/or rename these files as you see fit as long as you change the datapath in XSDIR2.0 and the MCNP-4 alias accordingly.

7.12 The following is a step-by-step example of the commands to be entered to implement the above procedure. This example assumes that MCNP-4 will be installed in a directory called /usr/local/mcnp, that superuser privileges are required to write to this directory, that your username is xyz and that the working directory for running MCNP-4 will be mcnp.wrk under your home directory. The example was prepared by Stuart Vessard of HSE-6.

```
su root                                              (become superuser)
cd /usr/local                                        (switch to /usr/local)
mkdir mcnp                                           (make directory mcnp)
cd mcnp                                              (go to mcnp directory)
[load the tape on your tape drive]
tar tvf /dev/rst0                                    (display tape contents)
mt -f /dev/rst0 rew                                  (rewind the tape)
tar xvf /dev/rst0                                    (copy the tape contents)
ls -la                                               (list contents of mcnp directory)
[verify that 5 sub-directories were created]
cd type2                                             (go to type2 sub-directory)
vi xsdir2.0                                          (enter the visual editor)
dd                                                   (delete the first line)
O                                                    (enter insert mode before the first line)
datapath = /usr/local/mcnp/type2                     (enter correct datapath)
ESC (the escape key)                                 (exit insert mode)
ZZ                                                   (save and exit vi)
cd ..                                                (go to mcnp directory)
chown xyz test                                       (change owner of test to your username)
exit                                                 (exit superuser mode)
cd                                                   (go to your home directory)
mkdir mcnp.wrk                                       (make mcnp working directory)
cd mcnp.wrk                                          (go to mcnp working directory)
ln -s /usr/local/mcnp/type2/xsdir2.0 xsdir           (set up link)
cd ..                                                (change to home directory)
vi .cshrc                                            (edit your .cshrc file)
[use arrow keys to go to section on aliases]
o                                                    (enter insert mode)
alias mcnp '/usr/local/mcnp/exe/mcnpx4.2m2'          (set up alias)
ESC (the escape key)                                 (exit insert mode)
ZZ                                                   (save and exit)
[close sunview and all open windows]                 (exit environment)
logout                                               (log off)
login xyz                                            (log back in)
cd /usr/local/mcnp/test                              (go to test sub-directory)
testmcnp                                             (run the test problems)
[wait several hours]
ls -l mctal* | more                                  (list output files)
[verify that all 70 problems executed (1-25, 31-75)]
ls -l diff* | more                                   (list difference files)
[verify that all differences (1-25, 31-75) are zero]
```

7.13 To run MCNP-4, go to mcnp.wrk in your home directory, create an input file, yyy, and enter mcnp inp=yyy. Done!

7.14 If you should need to re-compile the MCNP-4 code, the source is located in a sub-directory called SRC. Instructions for re-compiling can be found in Section 8.

7.15 If you are cramped for disk space after installing and testing MCNP-4 you may want to delete the output files created in the TESTMCNP sub-directory. This will free about 10 megabytes. Also, remove any CORE files created during abnormal execution of any of the test problems. If you are still cramped for space, you may want to delete some of the cross-section files from the TYPE2 sub-directory. Norm Pruvost, of HSE-6, has examined each of the 239 ZAIDs for neutron cross-sections and has come up with a list of 111 ZAIDs that he feels would rarely be used (see Sections 4.34 thru 4.36). The list is given in Table 2 on page 13. If you think you will not need these ZAIDs, feel free to delete the files from the TYPE2 sub-directory. The filename is of the form zzaaa.nnc2 where zzaaa is the ZA, nn is the evaluation number (like 35 or 51), c is for continuous neutron evaluation, and 2 is for type 2 file. Deleting all 111 files will free up about 10 Megabytes of disk space.

7.16 Partial List of Files on Tape "MCNP-4 and X6XS.0 Cross-Sections"

(The tape includes files needed to install version 4 of MCNP and the associated X6XS.0 cross-section library. There are 436 ZAIDs in the X6XS.0 cross-section library.)

```
rwxr-xr-x104/0        0 Apr 11 16:16 1991 document/
rw-r--r--104/20  215385 Apr  7 13:10 1991 document/x6xs0.txt
rw-r--r--104/20   79583 Apr 11 16:16 1991 document/xsdoc
rw-r--r--104/20   50186 Apr  7 13:11 1991 document/list
rw-r--r--104/20   32674 Apr 12 09:06 1991 document/instructions
rw-r--r--104/20   60208 Apr 11 16:16 1991 document/xslist.z
rw-r--r--104/20  122632 Apr 11 16:16 1991 document/xslistal

rwxr-xr-x104/0        0 Feb 27 11:04 1991 type2/
rw-r--r--104/20    6144 Feb  5 16:53 1991 type2/1000.01e2
rw-r--r--104/20    4096 Feb  5 16:52 1991 type2/1000.01p2
rw-r--r--104/20    6144 Feb  5 16:53 1991 type2/10000.01e2
rw-r--r--104/20    4096 Feb  5 16:52 1991 type2/10000.01p2
rw-r--r--104/20   14336 Feb  5 15:18 1991 type2/1001.50c2
rw-r--r--104/20   26624 Feb  5 15:18 1991 type2/1002.55c2
rw-r--r--104/20    8192 Feb  5 15:18 1991 type2/1003.35c2
rw-r--r--104/20   12288 Feb  5 15:18 1991 type2/1003.50c2
rw-r--r--104/20    6144 Feb  5 16:53 1991 type2/11000.01e2

            etc.              etc.              etc.

rw-r--r--104/20  100352 Feb  5 16:48 1991 type2/96245.35c2
rw-r--r--104/20   88064 Feb  5 16:48 1991 type2/96245.52c2
rw-r--r--104/20   53248 Feb  5 16:49 1991 type2/96246.35c2
rw-r--r--104/20   83968 Feb  5 16:49 1991 type2/96247.35c2
rw-r--r--104/20   75776 Feb  5 16:49 1991 type2/96248.35c2
rw-r--r--104/20   51200 Feb  5 16:49 1991 type2/97249.35c2
rw-r--r--104/20  114688 Feb  5 16:50 1991 type2/98249.35c2
rw-r--r--104/20   45056 Feb  5 16:50 1991 type2/98250.35c2
rw-r--r--104/20   47104 Feb  5 16:50 1991 type2/98251.35c2
rw-r--r--104/20   73728 Feb  5 16:50 1991 type2/98252.35c2
rw-r--r--104/20   43008 Feb  5 16:51 1991 type2/be.01t2
rw-r--r--104/20   67584 Feb  5 16:51 1991 type2/benz.01t2
rw-r--r--104/20   67584 Feb  5 16:51 1991 type2/beo.01t2
rw-r--r--104/20   69632 Feb  5 16:51 1991 type2/grph.01t2
rw-r--r--104/20   43008 Feb  5 16:51 1991 type2/hwtr.01t2
rw-r--r--104/20   49152 Feb  5 16:50 1991 type2/hzr.01t2
rw-r--r--104/20   43008 Feb  5 16:50 1991 type2/lwtr.01t2
rw-r--r--104/20   49152 Feb  5 16:50 1991 type2/poly.01t2
rw-rw-rw-104/20 39448 Apr  7 13:17 1991 type2/xsdir2.0
rw-r--r--104/20   71680 Feb  5 16:52 1991 type2/zrh.01t2
rw-r--r--104/20   96256 Feb 24 15:31 1991 type2/6000.50c2
```

7.16 Partial List of Files on Tape "MCNP-4 and X6XS.0 Cross-Sections" (continued)

```
rwxrwxrwx104/0        0 Feb 26 07:31 1991 testmcnp/
rw-r--r--104/20   49622 Feb 25 10:25 1991 testmcnp/xsdir
rwxr-xr-x104/20   2756 Feb 25 19:03 1991 testmcnp/testmcnp
rw-r--r--104/20   1274 Feb 25 18:34 1991 testmcnp/inp01.ct
rw-r--r--104/20   1909 Feb 25 18:34 1991 testmcnp/inp02.ct

            etc              etc            etc.

rw-r--r--104/20   1069 Feb 25 18:34 1991 testmcnp/inp74.ct
rw-r--r--104/20   1069 Feb 25 18:34 1991 testmcnp/inp75.ct
rw-r--r--104/20   6017 Feb 25 18:35 1991 testmcnp/mctl01.c
rw-r--r--104/20   8336 Feb 25 18:35 1991 testmcnp/mctl02.c

            etc.             etc.           etc.

rw-r--r--104/20    647 Feb 25 19:04 1991 testmcnp/mctl74.c
rw-r--r--104/20    647 Feb 25 19:04 1991 testmcnp/mctl75.c
rw-r--r--104/201362797 Feb 26 07:18 1991 testmcnp/w184xs
rw-r--r--104/20    106 Feb 26 07:17 1991 testmcnp/mgdir

rwxr-xr-x104/202162688 Apr 10 14:35 1991 exe/mcnpx4.2
rwxr-xr-x104/202162688 Apr 10 14:37 1991 exe/mcnpx4.2pt
rwxr-xr-x104/202162688 Apr 10 14:36 1991 exe/mcnpx4.1m2
rw-rw-rw-104/20 39448 Apr 10 14:44 1991 exe/xsdir2.0
rw-r--r--104/20 621911 Apr 10 14:57 1991 exe/wssa09
rwxr-xr-x104/202162688 Apr 11 16:30 1991 exe/mcnpx4.2p2
rwxr-xr-x104/20   98304 Apr 11 16:40 1991 exe/prpr
rwxr-xr-x104/20  131072 Apr 11 16:49 1991 exe/makexs
rwxr-xr-x104/202162688 Apr  8 17:53 1991 exe/mcnpx4.1pt
rwxr-xr-x104/202162688 Apr 11 08:51 1991 exe/mcnpx4.1
rwxr-xr-x104/202162688 Apr 11 10:19 1991 exe/mcnpx4.2m2

rwxr-xr-x104/0        0 Apr 12 08:21 1991 src/
rw-r--r--104/20     364 Apr 11 16:39 1991 src/patch
rw-r--r--104/20  343222 Apr  7 15:44 1991 src/libcgs.a
rw-r--r--104/20    3723 Apr 10 14:06 1991 src/makefile
rwxr-xr-x104/20     424 Apr  7 15:35 1991 src/makemcnp
rw-r--r--104/20   15873 Apr  7 13:13 1991 src/makexsf
rw-r--r--104/20     364 Apr 11 16:39 1991 src/patch4.2
rw-r--r--104/20    7270 Feb 25 09:09 1991 src/prprf
rw-r--r--104/20     669 Apr  7 13:13 1991 src/patch.vax
rw-r--r--104/203030466 Apr  7 13:15 1991 src/mcnp4.2
rw-r--r--104/20      19 Apr 10 14:23 1991 src/patch.mxs
rw-r--r--104/20   39448 Apr  7 13:17 1991 src/xsdir2.0
rw-r--r--104/20   36480 Apr  7 13:17 1991 src/xsdir1.0
```

8. HOW TO MODIFY MCNP-4 ON SUN COMPUTERS

The following steps describe how to re-compile MCNP-4 and make an executable file called MCNPX.

8.1 To re-compile MCNP-4, make any changes by using the PATCH file. This file directs the deletion and insertion of lines using the ID numbers found on the CODEF file. For example, to change MDAS to a different value, edit the PATCH file accordingly.

8.2 After changes to the PATCH file have been made (the original patch file is saved as PATCH4.2), run the shell script called MAKEMCNP. This will read the directives found on the PATCH file, create a modified fortran source called COMPILE, then split the COMPILE file into individual files, run the random library (RANLIB) routine on the graphics library, and finally create an executable file called MCNPX using MAKE. A listing of this script is given below. Ignore warning messages concerning deleting files that do not exist but pay attention to other errors or messages. Important: It is assumed that the SUN FORTRAN utilities F77, FSPLIT, RANLIB, and MAKE are accessible in your path and that you will have write permission for the directory since many files will be created. [The path must be set in the .CSHRC file for the user doing the compilation.]

8.3 The compilation may take a long time, so be patient. Also be sure to have about five Megabytes of free disk space available.

8.4 The UNIX script, MAKEMCNP, is reproduced below -

```
#
#  shell script to make MCNP-4 on SUN Workstations
#  it will create an executable file called MCNPX
#
set  echo
rm  *.f  *.o  newid  compile
cp  prprf  prpr.f
f77  prpr.f  -o  prpr
prpr
fsplit  compile
ranlib  libcgs.a
make
```

9. HOW TO INSTALL MCNP-4 AND THE LIBRARY ON A NON-SUN COMPUTER

The following gives a simplified step-by-step procedure for installing MCNP-4 and the X6XS.0 cross-section library on a non-SUN computer. For more detailed information, see Appendix C of Ref. 9.

9.1 Create 3 sub-directories on your computer for the MCNP-4 code and the cross-section files. For the purpose of illustration, assume that a directory called MCNP is created under directory XYZ and that the sub-directories are called MCNPSRC, XSECT, and TESTXS, respectively. You will need about 170 Megabytes of free disk space.

9.2 Copy the MCNP-4 source files to the sub-directory MCNPSRC. On a VAX computer, all the source files should be converted to upper-case. Change to the MCNPSRC directory.

9.3 Compile the graphics library (such as CGS) or if you already have a compatible graphics library, copy it to the MCNPSRC directory.

9.4 Copy or assign the source code PRPRF to a file called PRPR.F

9.5 Using your computer's Fortran compiler, compile PRPR.F to create an executable file called PRPR.

9.6 Edit the PATCH file to define the appropriate directives for your particular computer system. For example, if you have a 32-bit computer with the CGS graphics library, the first line of the PATCH file should read -

```
*define cheap,plot,cgs,mcplot,gkssim
```

If you want to run MCNP-4 with no graphics capabilities, the line would be

```
*define cheap
```

On a VAX computer, the line should read

```
*DEFINE CHEAP,VMS
```

9.7 The PATCH file directs the insertion and deletion of lines using the ID numbers found on a file called CODEF. If you are aware of any changes required for your particular computer system, edit the PATCH file accordingly. For example, on a VAX computer, the following should be included in the PATCH file

```
*D COR4-1E.164
*/
*/  CONVERT UPPER-CASE E AND D BACK TO LOWER CASE (VMS)
*/
 IH=INDEX('0123456789. +-edED',HD(IP:IP))
```

9.8 Copy or assign the file MCNP.SRC to CODEF.

9.9 Delete any local files called COMPILE or NEWID

9.10 Execute PRPR. This will read the PATCH file for directives, make the appropriate changes to the CODEF file and create a file called COMPILE. The CODEF file will not be altered.

9.11 Rename COMPILE to MCNP.F and compile it with the Fortran compiler to create an object file called MCNP.OBJ. If there are any compilation errors, modify the source using the PATCH file and repeat steps 9.6 thru 9.11.

9.12 Link MCNP.OBJ with the graphics library to create an executable file called MCNPX.

9.13 Copy the MCNP-4 test files (input and output files) to the directory TESTXS. On a VAX computer, convert these files to upper-case.

9.14 Copy the X6XS.0 cross-section files (plus the XSDIR1.0 file and the cross-section manipulation files) to the sub-directory XSECT. All of the cross-section files will be regular ASCII files (Type 1).

9.15 Edit the XSDIR1.0 file so that MCNP-4 can use the Type 1 cross-section files. Modify the first line of the XSDIR1.0 file to point to the sub-directory that contains all of these files (i.e., change the datapath to the appropriate full directory name). For example, if the full pathname to the cross-section directory is /XYZ/MCNP/XSECT, then the first line of the XSDIR1.0 file should read -

datapath = /xyz/mcnp/xsect

9.16 Change to the TESTXS directory to run the test problems.

9.17 Copy the XSDIR1.0 file that was modified in step 9.15 above to a file called XSDIR in the TESTXS directory.

9.18 Create an alias or use some other system function so that the command MCNP will execute the file MCNPX in the MCNPSRC directory. For example, under UNIX, the command would be -

```
alias mcnp '/xyz/mcnp/mcnpsrc/mcnpx'
```

9.19 Enter the following command to run the first test problem -

```
mcnp inp=inp01.ct
```

9.20 If the problem runs, compare the file MCTAL to MCTL01.C. There should be no differences.

9.21 If the first problem ran successfully, modify the UNIX script called TESTMCNP to be compatible with your operating system. This script will run test problems 1-25 and 31-75 and compare the results to the expected results found on the MCTLnn.C files.

9.22 Execute TESTMCNP to run the 70 test problems.

9.23 Verify that all 70 problems executed with no errors and that the answers were the same as given on the MCTLnn.C files.

9.24 MCNP-4 and the cross-section library are then verified.

9.25 To run MCNP-4 using the Type 1 cross-sections in another directory, go to that directory and copy the XSDIR1.0 file to a local file called XSDIR. Create an MCNP-4 input file YYY and enter the command -

```
mcnp inp=yyy
```

9.26 To reduce the size of the cross-section library by a factor of 4 to 5, you will need to convert the Type 1 cross sections into Type 2 format (direct access instead of ASCII). After the cross sections have been converted and tested, you can then delete the Type 1 files from the disk and recover the space. To convert to Type 2 format, perform the following steps.

9.27 Go to the XSECT directory.

9.28 Delete any local files called the following:

CODEF PATCH MAKEXS COMPILE PRPR COMPILE.F NEWID

TPRINT SPECS XSDIR2.0

9.29 Copy PRPRF to PRPR.F

9.30 Copy MAKEXSF to CODEF

9.31 Using the Fortran compiler, compile the PRPR.F source file to create an executable file called PRPR.

9.32 Copy PATCH.MXS to PATCH

9.33 If you are aware of any directives that need to be made to the PATCH file for your computer system, edit the PATCH file now. The PATCH file provided contains only one line (*define cheap) and it should be sufficient for most 32-bit computers. For VAX computers, try *DEFINE CHEAP,VMS

9.34 Execute PRPR. This will create a file called COMPILE.

9.35 Rename COMPILE to MAKEXS.F

9.36 Compile the MAKEXS.F file to create an executable file called MAKEXS.

9.37 Copy SPECS.1to2 to SPECS

9.38 Edit the SPECS file and remove all but the first 5 lines.

9.39 Execute MAKEXS. This will read the SPECS file as input and convert the first two Type 1 files into Type 2 files. Verify that the Type 2 files are much smaller than the Type 1 files.

9.40 After verifying that MAKEXS is working properly, remove the following files

1001.50C2 1002.55C2 TPRINT SPECS XSDIR2.0

9.41 Copy SPECS.1to2 to SPECS

9.42 Execute MAKEXS. This will read the SPECS file as input and convert all of the Type 1 files into Type 2 files. It will also create a file called XSDIR2.0

9.43 To test the Type 2 files, go to the TESTXS directory and copy the XSDIR2.0 file to a local file called XSDIR.

9.44 Repeat steps 9.22 to 9.23 to verify the Type 2 cross-sections.

9.45 To run MCNP-4 using the Type 2 cross-sections in another directory, go to that directory and copy the XSDIR2.0 file to a local file called XSDIR. Create an MCNP-4 input file YYY and enter the command -

mcnp inp=yyy

9.46 After you are convinced that everything is working, the Type 1 files can be deleted, but be careful!

9.47 A UNIX script file that performs steps 9.28 thru 9.42 is included and is called MAKETYPE2. If you wish, it can be edited to fit your operating system.

9.48 Finis!

10. MCNP-4 CODE IMPROVEMENTS

Based on our experience with installing and testing the X6XS.0 cross-section library, the following is a list of suggested improvements to the MCNP-4 code.

10.1 As noted in Section 4.13, the electron cross-section data must be read in double precision format versus single precision format for the neutron, photon, and thermal cross-section types. This complicates the MAKEXS procedure and can lead to errors in converting the electron library from Type 1 format to Type 2 format. MCNP-4 should be changed so that the electron data is consistent with all of the other data.

10.2 The input for the current 25 "standard" test problems use many materials that are not included in the X6XS.0 cross-section library (see Section 4.20). In order to reproduce the "official" X-6 results, a special set of cross-sections from X-6 must be installed that consumes about 45 Megabytes of disk space in Type 2 format. To streamline the testing of MCNP-4 when it is installed on a different computer, a special cross-section library (in Type 1 format) should be created that contains only those materials needed to run the 25 test problems. This would make porting and testing the code much less cumbersome.

10.3 An alternative to 10.2 above is to revise the materials for the 25 problems so that they are all available in the X6XS.0 cross-section library. That way, both the code and the cross-section data could be ported, installed, and tested in one step.

10.4 Since the installation of graphics routines to be used with MCNP-4 can be complicated, there should be one or more test problems to test the graphics features of MCNP-4.

10.5 The default Avogadro's number should be output by the code so that the user is aware of what was used.

10.6 An option should be added that would allow the user to input Avogadro's number divided by the mass of the neutron. As the number changes slightly in the years ahead, the code would then be able to calculate the most accurate data without having to be re-compiled (see Section 4.27).

10.7 MCNP-4 will not allow a material specification of the form zzaaa.01e because the trailing "e" is not recognized as a valid library. This should be changed (see Section 4.29).

10.8 A 26th standard test problem should be devised to test the pure mode "e" electron transport capability of MCNP-4 (see Section 4.30).

10.9 The header for the "dynamic allocation" table that is output by MCNP-4 should state that this is the amount of memory being allocated in decimal words.

10.10 As noted in Section 4.49, the location of the cross-section directory using the datapath statement on the XSDIR file will not work under VMS because VMS directories are not separated with a slash (/). For portability, these statements should be revised with a VMS directive.

10.11 The MCNP-4 code was compiled on a 386 PC using the Lahey 32-bit Fortran compiler. Two compilation errors resulted. The Lahey compiler will allow only numbers greater than 2^{-126} (which is 1.18×10^{-38}). There are two instances in the MCNP-4 source in which a value of 1×10^{-38} is used and therefore results in a compilation error. These are lines qu.12 and qu.28 in subroutine QUAD. Changing the two lines to use 1×10^{-37} instead of 1×10^{-38} solved the problem. To make MCNP-4 even more portable, perhaps these changes should be made in a future release.

10.12 Compiling MCNP-4 with Version 1.3 and higher of the SUN FORTRAN compiler will result in an error for test problem 25. This needs to be investigated.

11. LISTING OF XSDIR2.0 FILE

Table 4 below is a listing of the XSDIR2.0 file that is used in conjunction with the 436 Type 2 files that make up the X6XS.0 cross-section library. The XSDIR1.0 file, used with the Type 1 files, is very similar but is not reproduced here. The first part of the file consists of atomic weight ratios for nearly all of the elements and their isotopes. The source of these numbers is described in Ref. 2. Following the atomic weight ratios, there is a directory that consists of one line for each ZAID in the library. The first entry is the identifier for the evaluation (ZAID), the second entry is the atomic weight ratio that was used in the evaluation, the third entry is the filename that contains the cross-section data, the fourth entry is the path to the filename (denoted by a zero), the fifth entry is the format of the data (type 1 or 2), the sixth entry is the record that begins the data (always a 1 in this case), the seventh entry is the length of the data block indicating how many words of data there are, the eighth entry is the number of bytes per record (Type 2 format), the ninth entry is the number of words per record (Type 2 format), and the tenth entry is the temperature at which the evaluation was processed (in units of Mev).

Table 4. Listing of XSDIR2.0 File

```
datapath /usr/ctr/type2
atomic weight ratios
    1    1.000000
 1000    0.999317   1001    0.999167   1002    1.996800   1003    2.990140
 2000    3.968217   2003    2.990120   2004    3.968219
 3000    6.881312   3006    5.963450   3007    6.955733
 4000    8.934763   4007    6.956451   4009    8.934763
 5000   10.718156   5010    9.926922   5011   10.914730
 6000   11.907856   6012   11.896914   6013   12.891649   6014   13.882947
 7000   13.886438   7014   13.882780   7015   14.871250
 8000   15.861882   8016   15.857510   8017   16.853099   8018   17.844537
 9000   18.835197   9019   18.835197
10000   20.006688  10020   19.820693  10021   20.813497  10022   21.802466
11000   22.792275  11023   22.792275
12000   24.096261  12023   22.796595  12024   23.779001  12025   24.771198
                   12026   25.759391  12027   26.752533
13000   26.749756  13026   25.763654  13027   26.749756
14000   27.844241  14027   26.754874  14028   27.736592  14029   28.727573
                   14030   29.716281  14031   30.709269
15000   30.707682  15031   30.707682
16000   31.788939  16031   30.713425  16032   31.697415  16033   32.688217
                   16034   33.676066  16035   34.668630  16036   35.658103
                   16037   36.653512
17000   35.148180  17034   33.681912  17035   34.668452  17036   35.659320
                   17037   36.648346  17038   37.641845
18000   39.604489  18036   35.658565  18037   36.649212  18038   37.636612
                   18039   38.629591  18040   39.619085  18041   40.612594
                   18042   41.602565  18043   42.596572
19000   38.762427  19038   37.642906  19039   38.628989  19040   39.620687
                   19041   40.609942  19042   41.601923  19043   42.591666
                   19044   43.583907  19045   44.574461  19046   45.567137
20000   39.733731  20039   38.635912  20040   39.619291  20041   40.610390
                   20042   41.598175  20043   42.589732  20044   43.577884
                   20045   44.569992  20046   45.558922  20047   46.551179
                   20048   47.540594  20049   48.535122
21000   44.569718  21044   43.581774  21045   44.569718  21046   45.560395
                   21047   46.549064  21048   47.540295
22000   47.467124  22045   44.571914  22046   45.557875  22047   46.548424
                   22048   47.536048  22049   48.527382  22050   49.515734
                   22051   50.508951
23000   50.503856  23047   46.551543  23048   47.540322  23049   48.528023
                   23050   49.518089  23051   50.506327  23052   51.498545
```

Table 4. Listing of XSDIR2.0 File

24000	51.549253	24049	48.530820	24050	49.516983	24051	50.507126
		24052	51.494313	24053	52.485863	24054	53.475519
		24055	54.468871	24056	55.460111		
25000	54.466099	25051	50.510541	25052	51.499327	25053	52.486497
		25054	53.476984	25055	54.466099	25056	55.458362
		25057	56.449155	25058	57.441918		
26000	55.365674	26053	52.490481	26054	53.476242	26055	54.466346
		26056	55.454429	26057	56.446290	26058	57.435600
		26059	58.428596	26060	59.419180		
27000	58.426930	27057	56.447181	27058	57.438056	27059	58.426930
		27060	59.418957	27061	60.409036	27062	61.401927
		27063	62.392968	27064	63.386569		
28000	58.183730	28057	56.450632	28058	57.437652	28059	58.428073
		28060	59.415952	28061	60.407628	28062	61.396349
		28063	62.389071	28064	63.378793	28065	64.372303
29000	62.999751	29062	61.400552	29063	62.389001	29064	63.380576
		29065	64.370028	29066	65.362507		
30000	64.834574	30064	63.379960	30066	65.359696	30067	66.352189
		30068	67.341335	30070	69.324629		
31000	69.124072	31069	68.333474	31071	70.315420		
32000	72.008301	32070	69.323563	32072	71.304231	32073	72.297013
		32074	73.286157	32076	75.269198		
33000	74.277979	33072	71.308862	33073	72.297380	33074	73.288884
		33075	74.277979				
34000	78.290893	34074	73.287444	34076	75.267020	34077	76.259125
		34078	77.247953	34080	79.229995	34082	81.213001
35000	79.217113	35079	78.240386	35081	80.221176		
36000	83.080137	36078	77.251019	36080	79.229851	36082	81.209803
		36083	82.201858	36084	83.190662	36086	85.172596
37000	84.733459	37085	84.182362	37087	86.162588		
38000	86.863983	38084	83.192567	38086	85.171267	38087	86.162297
		38088	87.150469				
39000	88.142108	39086	85.176879	39087	86.164278	39088	87.154314
		39089	88.142108	39090	89.134810	39091	90.126359
		39092	91.119394	39093	92.111437		
40000	90.439990	40088	87.155035	40089	88.145126	40090	89.132379
		40091	90.124717	40092	91.115526	40093	92.108361
		40094	93.099614	40095	94.092727	40096	95.084369
		40097	96.078429				
41000	92.108263	41091	90.126053	41092	91.117663	41093	92.108263
		41094	93.100569	41095	94.091532	41096	95.084196
		41097	96.075601	41098	97.069225	41100	99.055844
42000	95.107188	42090	89.141530	42091	90.130777	42092	91.117281
		42093	92.108695	42094	93.098392	42095	94.090546
		42096	95.080803	42097	96.073544	42098	97.064346
		42099	98.058039	42100	99.049215	42101	100.043469
43000	97.066136	43097	96.073885	43098	97.066136	43099	98.056595
44000	100.198326	44096	95.083699	44098	97.064229	44099	98.056283
		44100	99.045987	44101	100.038748	44102	101.028935
		44103	102.022302	44104	103.012819		
45000	102.021490	45103	102.021490	45105	104.004489	45117	115.544640
46000	105.501161	46102	101.030186	46104	103.011435	46105	104.003885
		46106	104.993708	46108	106.976942	46110	108.961025
		46119	117.525510				
47000	106.941486	47106	104.996883	47107	105.986724	47108	106.978987
		47109	107.969204	47110	108.961961		
48000	111.445880	48106	104.996668	48108	106.977232	48110	108.958882
		48111	109.951456	48112	110.941457	48113	111.934493
		48114	112.924870	48116	114.909075		
49000	113.831536	49113	111.934150	49115	113.916790		
50000	117.690428	50112	110.943501	50114	112.924296	50115	113.916263
		50116	114.906086	50117	115.898695	50118	116.888769
		50119	117.881868	50120	118.872176	50122	120.856225
		50124	122.840859				
51000	120.712028	51121	119.865196	51123	121.848410		
52000	126.500901	52120	118.873982	52122	120.855843	52123	121.848465
		52124	122.838434	52125	123.831440	52126	124.821734
		52128	126.805697	52130	128.790266		

Table 4. Listing of XSDIR2.0 File

53000	125.814300	53127	125.814300				
54000	130.165202	54124	122.841701	54126	124.822696	54128	126.804772
		54129	127.797420	54130	128.787569	54131	129.780532
		54132	130.771021	54134	132.755077	54135	133.748208
		54136	134.739704				
55000	131.763705	55133	131.763705				
56000	136.146950	56130	128.790313	56132	130.771908	56134	132.754179
		56135	133.746757	56136	134.737064	56137	135.729722
		56138	136.720557				
57000	137.712184	57138	136.722419	57139	137.713076		
58000	138.911207	58136	134.739626	58138	136.721310	58140	138.703580
		58142	140.690173				
59000	139.697185	59141	139.697185				
60000	143.003231	60142	140.688668	60143	141.682152	60144	142.673832
		60145	143.667706	60146	144.659655	60147	145.654023
		60148	146.646216	60150	148.633000		
61000	143.667877	61145	143.667877	61147	145.653069	61148	146.646787
		61149	147.639055				
62000	149.068576	62144	142.675729	62147	145.652830	62148	146.644165
		62149	147.637915	62150	148.629416	62151	149.623460
		62152	150.614670	62154	152.599945		
63000	150.659126	63151	149.623378	63152	150.616668	63153	151.607568
		63154	152.600719	63155	153.592023		
64000	155.901250	64150	148.630782	64151	149.623892	64152	150.614731
		64154	152.598614	64155	153.591761	64156	154.582676
		64157	155.575907	64158	156.567459	64160	158.553203
65000	157.560097	65159	157.560097				
66000	161.101601	66156	154.584815	66158	156.567758	66160	158.551361
		66161	159.544491	66162	160.535768	66163	161.529093
		66164	162.520944				
67000	163.513493	67163	161.529095	67164	162.522030	67165	163.513493
		67166	164.506850				
68000	165.818900	68162	160.537733	68164	162.520772	68166	164.504876
		68167	165.498026	68168	166.489755	68170	168.475640
69000	167.482990	69166	164.508119	69167	165.498823	69168	166.491542
		69169	167.482990	69170	168.475974	69171	169.468007
		69172	170.461358	69173	171.453996		
70000	171.547746	70168	166.491267	70170	168.474944	70171	169.467904
		70172	170.459368	70173	171.452591	70174	172.444646
		70176	174.431136				
71000	173.463677	71173	171.453310	71174	172.446113	71175	173.437951
		71176	174.431253	71177	175.423725		
72000	176.953192	72174	172.445828	72175	173.438601	72176	174.429990
		72177	175.423197	72178	176.415079	72179	177.408587
		72180	178.400725	72181	179.394662	72183	181.381881
73000	179.393456	73179	177.408710	73180	178.401645	73181	179.393575
		73182	180.387122	73183	181.379742	73184	182.373767
		73186	184.361077				
74000	182.270144	74179	177.409843	74180	178.400889	74181	179.393774
		74182	180.385193	74183	181.378605	74184	182.370717
		74185	183.364593	74186	184.356930	74187	185.351113
		74188	186.343838				
75000	184.607108	75184	182.372309	75185	183.364133	75186	184.357556
		75187	185.349716	75188	186.343466		
76000	188.605526	76184	182.372264	76186	184.356410	76187	185.349713
		76188	186.341210	76189	187.334905	76190	188.326611
		76192	190.312436				
77000	190.564832	77188	186.344193	77189	187.335435	77190	188.328738
		77191	189.320150	77192	190.313552	77193	191.305288
		77194	192.298832	77195	193.291116		
78000	193.404284	78190	188.328080	78192	190.312002	78193	191.305353
		78194	192.296437	78195	193.289934	78196	194.281504
		78197	195.275278	78198	196.267230	78199	197.261301
79000	195.274513	79193	191.306525	79194	192.299107	79195	193.290179
		79196	194.283089	79197	195.274513	79198	196.267581
		79199	197.259509	79200	198.252836		

Table 4. Listing of XSDIR2.0 File

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80000   198.865285   80196   194.282362   80198   196.266121   80199   197.259026
                     80200   198.250482   80201   199.243852   80202   200.235597
                     80203   201.229219   80204   202.221241
81000   202.627636   81202   200.237054   81203   201.228696   81204   202.221612
                     81205   203.213571
82000   205.436794   82203   201.229733   82204   202.220800   82205   203.213636
                     82206   204.205025   82207   205.197852   82208   206.190011
                     82209   207.185822   82210   208.180303
83000   207.185136   83208   206.193077   83209   207.185136   83210   208.180235
84000   207.187152   84209   207.187152   84210   208.179000
85000   208.183242   85210   208.183242
86000   220.110325   86222   220.110325
87000   221.103876   87223   221.103876
88000   224.083728   88226   224.083728
89000   225.077462   89227   225.077462
90000   230.044724   90230   228.057024   90231   229.0515 ,   90232   230.044724
                     90233   231.039630   90234   232.033(.39
91000   229.051160   91231   229.051160   91233   231.038304
92000   235.984121   92233   231.037695   92234   232.030412   92235   233.024773
                     92236   234.017806   92237   235.012352   92238   236.005803
                     92239   237.000688   92240   237.994375
93000   235.011799   93235   233.024904   93236   234.018854   93237   235.011799
                     93238   236.005958
94000   241.967559   94237   235.012031   94238   236.004583   94239   236.998573
                     94240   237.991619   94241   238.986041   94242   239.979326
                     94243   240.973968   94244   241.967559
95000   240.973348   95241   238.986019   95242   239.980121   95243   240.973348
96000   244.947884   96242   239.979418   96243   240.973356   96244   241.966119
                     96245   242.960245   96246   243.953373   96247   244.947884
                     96248   245.941272
97000   244.947835   97245   242.961106   97246   243.954859   97247   244.947835
                     97248   245.941911   97249   246.935298
98000   248.922674   98249   246.935164   98250   247.928114   98251   248.922674
                     98252   249.916107
directory
 type 2 files      3/27/91          (C. T. Rombough)
 1001.50c 0.999170 1001.50c2 0 2 1 2766 2048 512 2.5300E-08
 1002.55c 1.996800 1002.55c2 0 2 1 5981 2048 512 2.5300E-08
 1003.50c 2.990140 1003.50c2 0 2 1 2428 2048 512 2.5300E-08
 1003.35c 2.990140 1003.35c2 0 2 1 1269 2048 512 0.0000E+00
 2003.50c 2.990100 2003.50c2 0 2 1 2320 2048 512 2.5300E-08
 2004.50c 4.001500 2004.50c2 0 2 1 3061 2048 512 2.5300E-08
 3006.50c 5.963400 3006.50c2 0 2 1 9932 2048 512 2.5300E-08
 3007.55c 6.955700 3007.55c2 0 2 1 13171 2048 512 2.5300E-08
 4009.50c 8.934800 4009.50c2 0 2 1 8886 2048 512 2.5300E-08
 5010.50c 9.926900 5010.50c2 0 2 1 20200 2048 512 2.5300E-08
 5011.56c 10.914700 5011.56c2 0 2 1 56929 2048 512 2.5300E-08
 5011.35c 10.914730 5011.35c2 0 2 1 4289 2048 512 0.0000E+00
 6000.50c 11.896900 6000.50c2 0 2 1 23326 2048 512 2.5300E-08
 6012.50c 11.896900 6012.50c2 0 2 1 23326 2048 512 2.5300E-08
 6012.35c 11.896913 6012.35c2 0 2 1 5154 2048 512 0.0000E+00
 6013.35c 12.891649 6013.35c2 0 2 1 4886 2048 512 0.0000E+00
 7014.50c 13.883000 7014.50c2 0 2 1 45457 2048 512 2.5300E-08
 7015.55c 14.871000 7015.55c2 0 2 1 20920 2048 512 2.5300E-08
 8016.50c 15.858000 8016.50c2 0 2 1 37942 2048 512 2.5300E-08
 8016.35c 15.857510 8016.35c2 0 2 1 10357 2048 512 0.0000E+00
 9019.50c 18.835000 9019.50c2 0 2 1 34130 2048 512 2.5300E-08
 9019.35c 18.835196 9019.35c2 0 2 1 31547 2048 512 0.0000E+00
 11023.50c 22.792000 11023.50c2 0 2 1 52252 2048 512 2.5300E-08
 11023.35c 22.792274 11023.35c2 0 2 1 22777 2048 512 0.0000E+00
 12000.50c 24.096300 12000.50c2 0 2 1 56334 2048 512 2.5300E-08
 12000.35c 24.096206 12000.35c2 0 2 1 9686 2048 512 0.0000E+00
 12000.51c 24.096300 12000.51c2 0 2 1 48917 2048 512 2.5300E-08
 13027.50c 26.750000 13027.50c2 0 2 1 54162 2048 512 2.5300E-08
 13027.35c 26.749754 13027.35c2 0 2 1 36895 2048 512 0.0000E+00
 14000.50c 27.844000 14000.50c2 0 2 1 98609 2048 512 2.5300E-08
 14000.35c 27.844230 14000.35c2 0 2 1 19016 2048 512 0.0000E+00
 14000.51c 27.844000 14000.51c2 0 2 1 88129 2048 512 2.5300E-08
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Table 4. Listing of XSDIR2.0 File

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15031.50c 30.708000 15031.50c2 0 2 1 5733 2048 512 2.5300E-08
15031.35c 30.707681 15031.35c2 0 2 1 5875 2048 512 0.0000E+00
16032.50c 31.697000 16032.50c2 0 2 1 6789 2048 512 2.5300E-08
16032.35c 31.697413 16032.35c2 0 2 1 7054 2048 512 0.0000E+00
17000.50c 35.148000 17000.50c2 0 2 1 23313 2048 512 2.5300E-08
17000.35c 35.148439 17000.35c2 0 2 1 12903 2048 512 0.0000E+00
18000.35c 39.604824 18000.35c2 0 2 1 5585 2048 512 0.0000E+00
19000.50c 38.766000 19000.50c2 0 2 1 22051 2048 512 2.5300E-08
19000.35c 38.762424 19000.35c2 0 2 1 11130 2048 512 0.0000E+00
20000.50c 39.736000 20000.50c2 0 2 1 62624 2048 512 2.5300E-08
20000.35c 39.735690 20000.35c2 0 2 1 12933 2048 512 0.0000E+00
20000.51c 39.736000 20000.51c2 0 2 1 53372 2048 512 2.5300E-08
21045.55c 44.569700 21045.55c2 0 2 1 6070 2048 512 2.5300E-08
22000.50c 47.467600 22000.50c2 0 2 1 54801 2048 512 2.5300E-08
22000.35c 47.488512 22000.35c2 0 2 1 13421 2048 512 0.0000E+00
22000.51c 47.467600 22000.51c2 0 2 1 31832 2048 512 2.5300E-08
23000.50c 50.504000 23000.50c2 0 2 1 38312 2048 512 2.5300E-08
24000.50c 51.549000 24000.50c2 0 2 1 134454 2048 512 2.5300E-08
24000.35c 51.549325 24000.35c2 0 2 1 9218 2048 512 0.0000E+00
24000.51c 51.549000 24000.51c2 0 2 1 55616 2048 512 2.5300E-08
25055.50c 54.466100 25055.50c2 0 2 1 105093 2048 512 2.5300E-08
25055.35c 54.466096 25055.35c2 0 2 1 7493 2048 512 0.0000E+00
25055.51c 54.466100 25055.51c2 0 2 1 25727 2048 512 2.5300E-08
26000.55c 55.365000 26000.55c2 0 2 1 178392 2048 512 2.5300E-08
26000.35c 55.367243 26000.35c2 0 2 1 30983 2048 512 0.0000E+00
27059.50c 58.426900 27059.50c2 0 2 1 117075 2048 512 2.5300E-08
27059.35c 58.426927 27059.35c2 0 2 1 38958 2048 512 0.0000E+00
27059.51c 58.426900 27059.51c2 0 2 1 28355 2048 512 2.5300E-08
28000.50c 58.182600 28000.50c2 0 2 1 129913 2048 512 2.5300E-08
28000.51c 58.182600 28000.51c2 0 2 1 93575 2048 512 2.5300E-08
28058.35c 57.437649 28058.35c2 0 2 1 42744 2048 512 0.0000E+00
29000.50c 63.546000 29000.50c2 0 2 1 51850 2048 512 2.5300E-08
29000.35c 63.000104 29000.35c2 0 2 1 7039 2048 512 0.0000E+00
31000.50c 69.121100 31000.50c2 0 2 1 7928 2048 512 2.5300E-08
31000.35c 69.121066 31000.35c2 0 2 1 7509 2048 512 0.0000E+00
33074.35c 73.288880 33074.35c2 0 2 1 50881 2048 512 0.0000E+00
33075.35c 74.277975 33075.35c2 0 2 1 50931 2048 512 0.0000E+00
35079.55c 78.240400 35079.55c2 0 2 1 10431 2048 512 2.5300E-08
35081.55c 80.221200 35081.55c2 0 2 1 5342 2048 512 2.5300E-08
36078.50c 77.251000 36078.50c2 0 2 1 9057 2048 512 2.5300E-08
36080.50c 79.229800 36080.50c2 0 2 1 10165 2048 512 2.5300E-08
36082.59c 81.209800 36082.59c2 0 2 1 7010 2048 512 2.5300E-08
36083.59c 82.201800 36083.59c2 0 2 1 8069 2048 512 2.5300E-08
36084.59c 83.190600 36084.59c2 0 2 1 10370 2048 512 2.5300E-08
36086.59c 85.172600 36086.59c2 0 2 1 8740 2048 512 2.5300E-08
37085.55c 84.182400 37085.55c2 0 2 1 27304 2048 512 2.5300E-08
37087.55c 86.162600 37087.55c2 0 2 1 8409 2048 512 2.5300E-08
39088.35c 87.154309 39088.35c2 0 2 1 11299 2048 512 0.0000E+00
39089.35c 88.142103 39089.35c2 0 2 1 49885 2048 512 0.0000E+00
40000.50c 90.436000 40000.50c2 0 2 1 52064 2048 512 2.5300E-08
40000.35c 90.436369 40000.35c2 0 2 1 14738 2048 512 0.0000E+00
40000.51c 90.436000 40000.51c2 0 2 1 16816 2048 512 2.5300E-08
40093.50c 92.108300 40093.50c2 0 2 1 2579 2048 512 2.5300E-08
41093.50c 92.105100 41093.50c2 0 2 1 128960 2048 512 2.5300E-08
41093.35c 92.108258 41093.35c2 0 2 1 50441 2048 512 0.0000E+00
41093.51c 92.105100 41093.51c2 0 2 1 14675 2048 512 2.5300E-08
42000.50c 95.116000 42000.50c2 0 2 1 35634 2048 512 2.5300E-08
42000.35c 95.115821 42000.35c2 0 2 1 8628 2048 512 0.0000E+00
42000.51c 95.116000 42000.51c2 0 2 1 10139 2048 512 2.5300E-08
42095.50c 94.090600 42095.50c2 0 2 1 15411 2048 512 2.5300E-08
43099.50c 98.150000 43099.50c2 0 2 1 12152 2048 512 2.5300E-08
44101.50c 100.039000 44101.50c2 0 2 1 5299 2048 512 2.5300E-08
44103.50c 102.022000 44103.50c2 0 2 1 3052 2048 512 2.5300E-08
45103.50c 102.021000 45103.50c2 0 2 1 18870 2048 512 2.5300E-08
45105.50c 104.005000 45105.50c2 0 2 1 1591 2048 512 2.5300E-08
46105.50c 104.004000 46105.50c2 0 2 1 4647 2048 512 2.5300E-08
46108.5uc 106.977000 46108.50c2 0 2 1 4549 2048 512 2.5300E-08
47000.55c 106.942000 47000.55c2 0 2 1 29092 2048 512 2.5300E-08
```

Table 4. Listing of XSDIR2.0 File

```
47107.50c 105.987000 47107.50c2 0 2 1 12111 2048 512 2.5300E-08
47107.35c 105.986718 47107.35c2 0 2 1 13134 2048 512 0.0000E+00
47109.50c 107.969000 47109.50c2 0 2 1 14585 2048 512 2.5300E-08
47109.35c 107.969199 47109.35c2 0 2 1 13452 2048 512 0.0000E+00
48000.50c 111.460000 48000.50c2 0 2 1 19714 2048 512 2.5300E-08
48000.35c 111.444335 48000.35c2 0 2 1 12283 2048 512 0.0000E+00
48000.51c 111.460000 48000.51c2 0 2 1 6734 2048 512 2.5300E-08
50000.35c 117.670386 50000.35c2 0 2 1 5970 2048 512 0.0000E+00
53127.55c 125.814000 53127.55c2 0 2 1 59725 2048 512 2.5300E-08
54000.35c 130.172059 54000.35c2 0 2 1 41432 2048 512 0.0000E+00
54131.50c 129.781000 54131.50c2 0 2 1 22572 2048 512 2.5300E-08
54134.35c 132.755070 54134.35c2 0 2 1 7463 2048 512 0.0000E+00
54135.50c 133.748000 54135.50c2 0 2 1 5529 2048 512 2.5300E-08
55133.55c 131.764000 55133.55c2 0 2 1 67893 2048 512 2.5300E-08
56138.50c 136.715000 56138.50c2 0 2 1 6018 2048 512 2.5300E-08
56138.35c 136.720550 56138.35c2 0 2 1 5985 2048 512 0.0000E+00
59141.50c 139.697000 59141.50c2 0 2 1 15620 2048 512 2.5300E-08
60143.50c 141.682000 60143.50c2 0 2 1 17216 2048 512 2.5300E-08
60145.50c 143.668000 60145.50c2 0 2 1 38473 2048 512 2.5300E-08
60147.50c 145.654000 60147.50c2 0 2 1 1816 2048 512 2.5300E-08
60148.50c 146.646000 60148.50c2 0 2 1 10867 2048 512 2.5300E-08
61147.50c 145.653000 61147.50c2 0 2 1 9152 2048 512 2.5300E-08
61148.50c 146.647000 61148.50c2 0 2 1 1643 2048 512 2.5300E-08
61149.50c 147.639000 61149.50c2 0 2 1 2069 2048 512 2.5300E-08
62147.50c 145.653000 62147.50c2 0 2 1 33773 2048 512 2.5300E-08
62149.50c 147.638000 62149.50c2 0 2 1 15662 2048 512 2.5300E-08
62150.50c 148.629000 62150.50c2 0 2 1 9345 2048 512 2.5300E-08
62151.50c 149.623000 62151.50c2 0 2 1 7303 2048 512 2.5300E-08
62152.50c 150.615000 62152.50c2 0 2 1 41252 2048 512 2.5300E-08
63000.35c 150.454578 63000.35c2 0 2 1 6926 2048 512 0.0000E+00
63151.55c 149.623000 63151.55c2 0 2 1 86575 2048 512 2.5300E-08
63152.50c 150.620000 63152.50c2 0 2 1 49313 2048 512 2.5300E-08
63152.51c 150.620000 63152.51c2 0 2 1 10852 2048 512 2.5300E-08
63153.55c 151.608000 63153.55c2 0 2 1 72971 2048 512 2.5300E-08
63154.50c 152.600000 63154.50c2 0 2 1 37008 2048 512 2.5300E-08
63154.51c 152.600000 63154.51c2 0 2 1 10366 2048 512 2.5300E-08
63155.50c 153.592000 63155.50c2 0 2 1 4532 2048 512 2.5300E-08
64000.35c 155.899134 64000.35c2 0 2 1 7878 2048 512 0.0000E+00
64152.55c 150.615000 64152.55c2 0 2 1 32590 2048 512 2.5300E-08
64154.55c 152.599000 64154.55c2 0 2 1 59814 2048 512 2.5300E-08
64155.55c 153.592000 64155.55c2 0 2 1 54346 2048 512 2.5300E-08
64156.55c 154.583000 64156.55c2 0 2 1 44391 2048 512 2.5300E-08
64157.55c 155.576000 64157.55c2 0 2 1 47271 2048 512 2.5300E-08
64158.55c 156.567000 64158.55c2 0 2 1 113916 2048 512 2.5300E-08
64160.55c 158.553000 64160.55c2 0 2 1 65261 2048 512 2.5300E-08
67165.55c 163.513000 67165.55c2 0 2 1 56605 2048 512 2.5300E-08
69169.55c 167.483000 69169.55c2 0 2 1 47941 2048 512 2.5300E-08
72000.50c 176.954000 72000.50c2 0 2 1 52231 2048 512 2.5300E-08
72000.35c 176.956670 72000.35c2 0 2 1 75862 2048 512 0.0000E+00
73181.50c 179.400000 73181.50c2 0 2 1 60740 2048 512 2.5300E-08
73181.35c 179.393568 73181.35c2 0 2 1 33547 2048 512 0.0000E+00
73181.51c 179.400000 73181.51c2 0 2 1 21527 2048 512 2.5300E-08
74000.55c 182.277000 74000.55c2 0 2 1 50639 2048 512 2.5300E-08
74182.55c 180.390000 74182.55c2 0 2 1 122290 2048 512 2.5300E-08
74183.55c 181.380000 74183.55c2 0 2 1 79534 2048 512 2.5300E-08
74184.55c 182.370000 74184.55c2 0 2 1 80006 2048 512 2.5300E-08
74186.55c 184.360000 74186.55c2 0 2 1 83618 2048 512 2.5300E-08
75185.35c 183.364126 75185.35c2 0 2 1 16038 2048 512 0.0000E+00
75187.35c 185.349709 75187.35c2 0 2 1 14769 2048 512 0.0000E+00
77000.55c 190.563000 77000.55c2 0 2 1 43071 2048 512 2.5300E-08
78000.35c 193.414067 78000.35c2 0 2 1 15371 2048 512 0.0000E+00
79197.56c 195.274000 79197.56c2 0 2 1 122482 2048 512 2.5300E-08
79197.35c 195.274505 79197.35c2 0 2 1 31871 2048 512 0.0000E+00
82000.50c 205.430000 82000.50c2 0 2 1 37633 2048 512 2.5300E-08
82000.35c 205.420035 82000.35c2 0 2 1 6639 2048 512 0.0000E+00
83209.50c 207.185000 83209.50c2 0 2 1 14939 2048 512 2.5300E-08
83209.35c 207.185129 83209.35c2 0 2 1 18316 2048 512 0.0000E+00
90231.35c 229.051567 90231.35c2 0 2 1 9157 2048 512 0.0000E+00
```

Table 4. Listing of XSDIR2.0 File

```
90232.50c 230.040000 90232.50c2 0 2 1 152782 2048 512 2.5300E-08
90232.35c 230.044718 90232.35c2 0 2 1 56091 2048 512 0.0000E+00
90232.51c 230.040000 90232.51c2 0 2 1 17925 2048 512 2.5300E-08
90233.35c 231.039623 90233.35c2 0 2 1 9352 2048 512 0.0000E+00
91231.50c 229.050000 91231.50c2 0 2 1 7025 2048 512 2.5300E-08
91233.50c 231.038000 91233.50c2 0 2 1 19519 2048 512 2.5300E-08
91233.35c 231.038298 91233.35c2 0 2 1 19170 2048 512 0.0000E+00
91233.51c 231.038000 91233.51c2 0 2 1 5641 2048 512 2.5300E-08
92233.50c 231.043000 92233.50c2 0 2 1 18815 2048 512 2.5300E-08
92233.35c 231.037688 92233.35c2 0 2 1 29674 2048 512 0.0000E+00
92233.51c 231.043000 92233.51c2 0 2 1 7713 2048 512 2.5300E-08
92234.50c 232.030000 92234.50c2 0 2 1 89433 2048 512 2.5300E-08
92234.35c 232.030405 92234.35c2 0 2 1 8557 2048 512 0.0000E+00
92234.51c 232.030000 92234.51c2 0 2 1 6426 2048 512 2.5300E-08
92235.50c 233.025000 92235.50c2 0 2 1 60489 2048 512 2.5300E-08
92235.51c 233.025000 92235.51c2 0 2 1 25801 2048 512 2.5300E-08
92236.50c 234.018000 92236.50c2 0 2 1 138715 2048 512 2.5300E-08
92236.35c 234.017800 92236.35c2 0 2 1 8699 2048 512 0.0000E+00
92236.51c 234.018000 92236.51c2 0 2 1 7302 2048 512 2.5300E-08
92237.50c 235.012000 92237.50c2 0 2 1 32445 2048 512 2.5300E-08
92237.35c 235.012345 92237.35c2 0 2 1 9364 2048 512 0.0000E+00
92237.51c 235.012000 92237.51c2 0 2 1 10317 2048 512 2.5300E-08
92238.50c 236.006000 92238.50c2 0 2 1 88998 2048 512 2.5300E-08
92238.35c 236.005797 92238.35c2 0 2 1 27168 2048 512 0.0000E+00
92238.51c 236.006000 92238.51c2 0 2 1 23860 2048 512 2.5300E-08
92239.35c 237.000681 92239.35c2 0 2 1 9809 2048 512 0.0000E+00
92240.35c 237.994368 92240.35c2 0 2 1 8495 2048 512 0.0000E+00
93235.35c 233.024897 93235.35c2 0 2 1 9490 2048 512 0.0000E+00
93236.35c 234.018847 93236.35c2 0 2 1 8821 2048 512 0.0000E+00
93237.55c 235.012000 93237.55c2 0 2 1 32558 2048 512 2.5300E-08
93237.35c 235.011793 93237.35c2 0 2 1 20225 2048 512 0.0000E+00
93238.35c 236.005951 93238.35c2 0 2 1 8878 2048 512 0.0000E+00
94237.35c 235.012025 94237.35c2 0 2 1 11300 2048 512 0.0000E+00
94238.50c 236.167000 94238.50c2 0 2 1 18763 2048 512 2.5300E-08
94238.35c 236.004576 94238.35c2 0 2 1 15619 2048 512 0.0000E+00
94238.51c 236.167000 94238.51c2 0 2 1 6067 2048 512 2.5300E-08
94239.55c 236.999000 94239.55c2 0 2 1 102099 2048 512 2.5300E-08
94240.50c 237.992000 94240.50c2 0 2 1 58917 2048 512 2.5300E-08
94240.51c 237.992000 94240.51c2 0 2 1 15134 2048 512 2.5300E-08
94241.50c 238.978000 94241.50c2 0 2 1 38601 2048 512 2.5300E-08
94241.35c 238.986034 94241.35c2 0 2 1 8844 2048 512 0.0000E+00
94241.51c 238.978000 94241.51c2 0 2 1 13403 2048 512 2.5300E-08
94242.50c 239.979000 94242.50c2 0 2 1 71429 2048 512 2.5300E-08
94242.35c 239.979319 94242.35c2 0 2 1 21159 2048 512 0.0000E+00
94242.51c 239.979000 94242.51c2 0 2 1 15702 2048 512 2.5300E-08
94243.35c 240.973962 94243.35c2 0 2 1 10763 2048 512 0.0000E+00
95241.50c 238.986000 95241.50c2 0 2 1 42084 2048 512 2.5300E-08
95241.35c 238.986012 95241.35c2 0 2 1 25290 2048 512 0.0000E+00
95241.51c 238.986000 95241.51c2 0 2 1 12374 2048 512 2.5300E-08
95242.50c 239.980000 95242.50c2 0 2 1 8593 2048 512 2.5300E-08
95242.35c 239.980114 95242.35c2 0 2 1 20908 2048 512 0.0000E+00
95243.50c 240.973000 95243.50c2 0 2 1 92015 2048 512 2.5300E-08
95243.35c 240.973341 95243.35c2 0 2 1 39400 2048 512 0.0000E+00
95243.51c 240.973000 95243.51c2 0 2 1 13684 2048 512 2.5300E-08
96242.50c 239.979000 96242.50c2 0 2 1 30897 2048 512 2.5300E-08
96242.35c 239.979411 96242.35c2 0 2 1 21653 2048 512 0.0000E+00
96242.51c 239.979000 96242.51c2 0 2 1 9767 2048 512 2.5300E-08
96243.35c 240.973349 96243.35c2 0 2 1 21577 2048 512 0.0000E+00
96244.50c 241.966000 96244.50c2 0 2 1 45991 2048 512 2.5300E-08
96244.35c 241.966113 96244.35c2 0 2 1 21196 2048 512 0.0000E+00
96244.51c 241.966000 96244.51c2 0 2 1 10847 2048 512 2.5300E-08
96245.52c 242.960000 96245.52c2 0 2 1 21253 2048 512 2.5300E-08
96245.35c 242.960238 96245.35c2 0 2 1 24128 2048 512 0.0000E+00
96246.35c 243.953366 96246.35c2 0 2 1 12489 2048 512 0.0000E+00
96247.35c 244.947877 96247.35c2 0 2 1 20265 2048 512 0.0000E+00
96248.35c 245.941265 96248.35c2 0 2 1 18178 2048 512 0.0000E+00
97249.35c 246.935292 97249.35c2 0 2 1 11783 2048 512 0.0000E+00
98249.35c 246.935157 98249.35c2 0 2 1 28055 2048 512 0.0000E+00
```

Table 4. Listing of XSDIR2.0 File

```
98250.35c 247.928108 98250.35c2 0 2 1 10487 2048 512 0.0000E+00
98251.35c 248.922668 98251.35c2 0 2 1 10969 2048 512 0.0000E+00
98252.35c 249.916101 98252.35c2 0 2 1 17908 2048 512 0.0000E+00
lwtr.01t 0.000000 lwtr.01t2 0 2 1 10193 2048 512
poly.01t 0.000000 poly.01t2 0 2 1 11544 2048 512
h/zr.01t 0.000000 hzr.01t2 0 2 1 11544 2048 512
benz.01t 0.000000 benz.01t2 0 2 1 16241 2048 512
hwtr.01t 0.000000 hwtr.01t2 0 2 1 10193 2048 512
be.01t 0.000000 be.01t2 0 2 1 10224 2048 512
beo.01t 0.000000 beo.01t2 0 2 1 16262 2048 512
grph.01t 0.000000 grph.01t2 0 2 1 16572 2048 512
zr/h.01t 0.000000 zrh.01t2 0 2 1 17302 2048 512
1000.01p 0.999317 1000.01p2 0 2 1 389 2048 512
2000.01p 3.968217 2000.01p2 0 2 1 389 2048 512
3000.01p 6.881312 3000.01p2 0 2 1 389 2048 512
4000.01p 8.934763 4000.01p2 0 2 1 389 2048 512
5000.01p 10.717168 5000.01p2 0 2 1 389 2048 512
6000.01p 11.907955 6000.01p2 0 2 1 389 2048 512
7000.01p 13.886438 7000.01p2 0 2 1 389 2048 512
8000.01p 15.861942 8000.01p2 0 2 1 389 2048 512
9000.01p 18.835197 9000.01p2 0 2 1 389 2048 512
10000.01p 20.006093 10000.01p2 0 2 1 389 2048 512
11000.01p 22.792275 11000.01p2 0 2 1 401 2048 512
12000.01p 24.096261 12000.01p2 0 2 1 409 2048 512
13000.01p 26.749756 13000.01p2 0 2 1 409 2048 512
14000.01p 27.844241 14000.01p2 0 2 1 409 2048 512
15000.01p 30.707682 15000.01p2 0 2 1 409 2048 512
16000.01p 31.788823 16000.01p2 0 2 1 409 2048 512
17000.01p 35.148180 17000.01p2 0 2 1 409 2048 512
18000.01p 39.604489 18000.01p2 0 2 1 409 2048 512
19000.01p 38.762423 19000.01p2 0 2 1 409 2048 512
20000.01p 39.733857 20000.01p2 0 2 1 417 2048 512
21000.01p 44.569718 21000.01p2 0 2 1 417 2048 512
22000.01p 47.455747 22000.01p2 0 2 1 417 2048 512
23000.01p 50.503856 23000.01p2 0 2 1 417 2048 512
24000.01p 51.549253 24000.01p2 0 2 1 417 2048 512
25000.01p 54.466099 25000.01p2 0 2 1 417 2048 512
26000.01p 55.366466 26000.01p2 0 2 1 417 2048 512
27000.01p 58.426930 27000.01p2 0 2 1 417 2048 512
28000.01p 58.182641 28000.01p2 0 2 1 429 2048 512
29000.01p 62.999157 29000.01p2 0 2 1 429 2048 512
30000.01p 64.835472 30000.01p2 0 2 1 453 2048 512
31000.01p 69.124270 31000.01p2 0 2 1 457 2048 512
32000.01p 72.008301 32000.01p2 0 2 1 457 2048 512
33000.01p 74.277979 33000.01p2 0 2 1 457 2048 512
34000.01p 78.310715 34000.01p2 0 2 1 457 2048 512
35000.01p 79.217113 35000.01p2 0 2 1 457 2048 512
36000.01p 83.080137 36000.01p2 0 2 1 457 2048 512
37000.01p 84.733459 37000.01p2 0 2 1 461 2048 512
38000.01p 86.864379 38000.01p2 0 2 1 461 2048 512
39000.01p 88.142108 39000.01p2 0 2 1 461 2048 512
40000.01p 90.439594 40000.01p2 0 2 1 461 2048 512
41000.01p 92.108263 41000.01p2 0 2 1 461 2048 512
42000.01p 95.106691 42000.01p2 0 2 1 461 2048 512
43000.01p 96.073885 43000.01p2 0 2 1 461 2048 512
44000.01p 100.201894 44000.01p2 0 2 1 461 2048 512
45000.01p 102.021490 45000.01p2 0 2 1 461 2048 512
46000.01p 105.513949 46000.01p2 0 2 1 461 2048 512
47000.01p 106.941685 47000.01p2 0 2 1 461 2048 512
48000.01p 111.442363 48000.01p2 0 2 1 461 2048 512
49000.01p 113.831536 49000.01p2 0 2 1 461 2048 512
50000.01p 117.667336 50000.01p2 0 2 1 461 2048 512
51000.01p 120.712028 51000.01p2 0 2 1 461 2048 512
52000.01p 126.527819 52000.01p2 0 2 1 473 2048 512
53000.01p 125.814300 53000.01p2 0 2 1 473 2048 512
54000.01p 130.165202 54000.01p2 0 2 1 473 2048 512
55000.01p 131.763705 55000.01p2 0 2 1 497 2048 512
56000.01p 136.146809 56000.01p2 0 2 1 497 2048 512
```

Table 4. Listing of XSDIR2.0 File

```
57000.01p 137.712194 57000.01p2 0 2 1 497 2048 512
58000.01p 138.911207 58000.01p2 0 2 1 497 2048 512
59000.01p 139.697185 59000.01p2 0 2 1 497 2048 512
60000.01p 142.997075 60000.01p2 0 2 1 509 2048 512
61000.01p 143.667877 61000.01p2 0 2 1 521 2048 512
62000.01p 149.060207 62000.01p2 0 2 1 521 2048 512
63000.01p 150.657141 63000.01p2 0 2 1 521 2048 512
64000.01p 155.900158 64000.01p2 0 2 1 521 2048 512
65000.01p 157.560097 65000.01p2 0 2 1 521 2048 512
66000.01p 161.098819 66000.01p2 0 2 1 521 2048 512
67000.01p 163.512493 67000.01p2 0 2 1 521 2048 512
68000.01p 165.825350 68000.01p2 0 2 1 521 2048 512
69000.01p 167.482990 69000.01p2 0 2 1 521 2048 512
70000.01p 171.537027 70000.01p2 0 2 1 521 2048 512
71000.01p 173.463777 71000.01p2 0 2 1 521 2048 512
72000.01p 176.956288 72000.01p2 0 2 1 521 2048 512
73000.01p 179.393456 73000.01p2 0 2 1 521 2048 512
74000.01p 182.269548 74000.01p2 0 2 1 521 2048 512
75000.01p 184.607108 75000.01p2 0 2 1 521 2048 512
76000.01p 188.605651 76000.01p2 0 2 1 521 2048 512
77000.01p 190.564832 77000.01p2 0 2 1 521 2048 512
78000.01p 193.404225 78000.01p2 0 2 1 521 2048 512
79000.01p 195.274513 79000.01p2 0 2 1 521 2048 512
80000.01p 198.875705 80000.01p2 0 2 1 521 2048 512
81000.01p 202.628033 81000.01p2 0 2 1 521 2048 512
82000.01p 205.436151 82000.01p2 0 2 1 521 2048 512
83000.01p 207.185136 83000.01p2 0 2 1 521 2048 512
84000.01p 207.187152 84000.01p2 0 2 1 467 2048 512
85000.01p 208.183242 85000.01p2 0 2 1 479 2048 512
86000.01p 220.110325 86000.01p2 0 2 1 533 2048 512
87000.01p 221.103876 87000.01p2 0 2 1 479 2048 512
88000.01p 224.083728 88000.01p2 0 2 1 479 2048 512
89000.01p 225.077462 89000.01p2 0 2 1 479 2048 512
90000.01p 230.044724 90000.01p2 0 2 1 533 2048 512
91000.01p 229.051160 91000.01p2 0 2 1 479 2048 512
92000.01p 235.984125 92000.01p2 0 2 1 533 2048 512
93000.01p 235.011799 93000.01p2 0 2 1 479 2048 512
94000.01p 241.967559 94000.01p2 0 2 1 533 2048 512
1000.01e 0.999317 1000.01e2 0 2 1 478 2048 256
2000.01e 3.968217 2000.01e2 0 2 1 478 2048 256
3000.01e 6.881312 3000.01e2 0 2 1 478 2048 256
4000.01e 8.934763 4000.01e2 0 2 1 478 2048 256
5000.01e 10.717168 5000.01e2 0 2 1 478 2048 256
6000.01e 11.907955 6000.01e2 0 2 1 478 2048 256
7000.01e 13.886438 7000.01e2 0 2 1 478 2048 256
8000.01e 15.861942 8000.01e2 0 2 1 478 2048 256
9000.01e 18.835197 9000.01e2 0 2 1 478 2048 256
10000.01e 20.006093 10000.01e2 0 2 1 478 2048 256
11000.01e 22.792275 11000.01e2 0 2 1 478 2048 256
12000.01e 24.096261 12000.01e2 0 2 1 478 2048 256
13000.01e 26.749756 13000.01e2 0 2 1 478 2048 256
14000.01e 27.844241 14000.01e2 0 2 1 478 2048 256
15000.01e 30.707682 15000.01e2 0 2 1 478 2048 256
16000.01e 31.788823 16000.01e2 0 2 1 478 2048 256
17000.01e 35.148180 17000.01e2 0 2 1 478 2048 256
18000.01e 39.604489 18000.01e2 0 2 1 478 2048 256
19000.01e 38.762423 19000.01e2 0 2 1 478 2048 256
20000.01e 39.733857 20000.01e2 0 2 1 478 2048 256
21000.01e 44.569718 21000.01e2 0 2 1 478 2048 256
22000.01e 47.455747 22000.01e2 0 2 1 478 2048 256
23000.01e 50.503856 23000.01e2 0 2 1 478 2048 256
24000.01e 51.549253 24000.01e2 0 2 1 478 2048 256
25000.01e 54.466099 25000.01e2 0 2 1 478 2048 256
26000.01e 55.366466 26000.01e2 0 2 1 478 2048 256
27000.01e 58.426930 27000.01e2 0 2 1 478 2048 256
28000.01e 58.182641 28000.01e2 0 2 1 478 2048 256
29000.01e 62.999157 29000.01e2 0 2 1 478 2048 256
30000.01e 64.835472 30000.01e2 0 2 1 478 2048 256
```

Table 4. Listing of XSDIR2.0 File

```
31000.01e 69.124270 31000.01e2 0 2 1 478 2048 256
32000.01e 72.008301 32000.01e2 0 2 1 478 2048 256
33000.01e 74.277979 33000.01e2 0 2 1 478 2048 256
34000.01e 78.310715 34000.01e2 0 2 1 478 2048 256
35000.01e 79.217113 35000.01e2 0 2 1 478 2048 256
36000.01e 83.080137 36000.01e2 0 2 1 478 2048 256
37000.01e 84.733459 37000.01e2 0 2 1 478 2048 256
38000.01e 86.864379 38000.01e2 0 2 1 478 2048 256
39000.01e 88.142108 39000.01e2 0 2 1 478 2048 256
40000.01e 90.439594 40000.01e2 0 2 1 478 2048 256
41000.01e 92.108263 41000.01e2 0 2 1 478 2048 256
42000.01e 95.106691 42000.01e2 0 2 1 478 2048 256
43000.01e 96.073885 43000.01e2 0 2 1 478 2048 256
44000.01e 100.201894 44000.01e2 0 2 1 478 2048 256
45000.01e 102.021490 45000.01e2 0 2 1 478 2048 256
46000.01e 105.513949 46000.01e2 0 2 1 478 2048 256
47000.01e 106.941685 47000.01e2 0 2 1 478 2048 256
48000.01e 111.442363 48000.01e2 0 2 1 478 2048 256
49000.01e 113.831536 49000.01e2 0 2 1 478 2048 256
50000.01e 117.667336 50000.01e2 0 2 1 478 2048 256
51000.01e 120.712028 51000.01e2 0 2 1 478 2048 256
52000.01e 126.527819 52000.01e2 0 2 1 478 2048 256
53000.01e 125.814300 53000.01e2 0 2 1 478 2048 256
54000.01e 130.165202 54000.01e2 0 2 1 478 2048 256
55000.01e 131.763705 55000.01e2 0 2 1 478 2048 256
56000.01e 136.146809 56000.01e2 0 2 1 478 2048 256
57000.01e 137.712194 57000.01e2 0 2 1 478 2048 256
58000.01e 138.911207 58000.01e2 0 2 1 478 2048 256
59000.01e 139.697185 59000.01e2 0 2 1 478 2048 256
60000.01e 142.997075 60000.01e2 0 2 1 478 2048 256
61000.01e 143.667877 61000.01e2 0 2 1 478 2048 256
62000.01e 149.060207 62000.01e2 0 2 1 478 2048 256
63000.01e 150.657141 63000.01e2 0 2 1 478 2048 256
64000.01e 155.900158 64000.01e2 0 2 1 478 2048 256
65000.01e 157.560097 65000.01e2 0 2 1 478 2048 256
66000.01e 161.098819 66000.01e2 0 2 1 478 2048 256
67000.01e 163.513493 67000.01e2 0 2 1 478 2048 256
68000.01e 165.825350 68000.01e2 0 2 1 478 2048 256
69000.01e 167.482990 69000.01e2 0 2 1 478 2048 256
70000.01e 171.537027 70000.01e2 0 2 1 478 2048 256
71000.01e 173.463777 71000.01e2 0 2 1 478 2048 256
72000.01e 176.956288 72000.01e2 0 2 1 478 2048 256
73000.01e 179.393456 73000.01e2 0 2 1 478 2048 256
74000.01e 182.269548 74000.01e2 0 2 1 478 2048 256
75000.01e 184.607108 75000.01e2 0 2 1 478 2048 256
76000.01e 188.605651 76000.01e2 0 2 1 478 2048 256
77000.01e 190.564832 77000.01e2 0 2 1 478 2048 256
78000.01e 193.404225 78000.01e2 0 2 1 478 2048 256
79000.01e 195.274513 79000.01e2 0 2 1 478 2048 256
80000.01e 198.875705 80000.01e2 0 2 1 478 2048 256
81000.01e 202.628033 81000.01e2 0 2 1 478 2048 256
82000.01e 205.436151 82000.01e2 0 2 1 478 2048 256
83000.01e 207.185136 83000.01e2 0 2 1 478 2048 256
84000.01e 207.187152 84000.01e2 0 2 1 478 2048 256
85000.01e 208.183242 85000.01e2 0 2 1 478 2048 256
86000.01e 220.110325 86000.01e2 0 2 1 478 2048 256
87000.01e 221.103876 87000.01e2 0 2 1 478 2048 256
88000.01e 224.083728 88000.01e2 0 2 1 478 2048 256
89000.01e 225.077462 89000.01e2 0 2 1 478 2048 256
90000.01e 230.044724 90000.01e2 0 2 1 478 2048 256
91000.01e 229.051160 91000.01e2 0 2 1 478 2048 256
92000.01e 235.984125 92000.01e2 0 2 1 478 2048 256
93000.01e 235.011799 93000.01e2 0 2 1 478 2048 256
94000.01e 241.967559 94000.01e2 0 2 1 478 2048 256
```

12. LIST OF ZAIDS IN THE X6XS.0 CROSS-SECTION LIBRARY

The following tables give abbreviated information regarding the cross-section data for each ZAID in the X6XS.0 cross-section library. There are a total of 3 tables. Table 5 gives information regarding each evaluation sorted by ZAID. Table 6 is similar to Table 5 but is sorted by source, and Table 7 is sorted inversely by file length. Tables 6 and 7 do not repeat the thermal, photon, and electron libraries that are given in Table 5. Tables 5, 6, and 7 consist of 8 columns. These columns are described below -

12.1 ZAID Identifier. The first 5 characters represent the ZA. This is Z*1000 plus the nearest integer to the atomic weight. The natural form of a particular Z is represented by Z*1000 plus zero. The ZA is followed by a period. Then there are 3 characters to represent a particular evaluation for the ZA. These 3 characters consist of a 2 digit number and a letter. The letter can be "c" for continuous neutron evaluation, "t" for special thermal evaluation, "p" for photon evaluation, or "e" for electron evaluation. Usually, the larger the 2 digit number, the more recent the evaluation (50c is more recent than 10c). All 51c evaluations stand for "thinned" representations of the corresponding 50c evaluations.

12.2 Source of the Data. This is a brief descriptor to identify the source of the original data from which a particular evaluation was performed. Examples are ENDF/B-V, ENDL-85, etc.

12.3 Temperature. This column indicates the temperature (in degrees Kelvin) for which the evaluation was performed. All of the evaluations in the X6XS.0 library are either 0 or 300 degrees Kelvin. 0 degrees Kelvin means that no Doppler broadening was performed.

12.4 Photon Production. This column indicates with a yes or no whether the evaluation includes the production of photons resulting from the various neutron interactions.

12.5 Type 1 Length. This is the length of the file in bytes (8 bits per byte) on a SUN workstation when the file is in Type 1 (ASCII) format.

12.6 Type 2 Length. This is the length of the file in bytes on a SUN workstation when the file is in Type 2 (binary) format.

12.7 Nubar. For elements having a fission cross-section, this column defines the meaning of nubar in the data file. "prompt" means that nubar is the number of prompt neutrons produced per fission. "total" means that nubar is the number of prompt plus delayed neutrons produced per fission. "both" means that nubar-prompt and nubar-total are both available in the data file.

12.8 Comments. Additional information regarding a particular ZAID is included as note letters in this column. The notes are given on the next page.

a. These ZAIDs cannot be distributed indiscriminately. See Refs. 5 and 6.

b. The data for ZAIDs 6000.50c and 6012.50c are identical.

c. Photon production added to ENDF/B-V neutron files by R. E. Macfarlane, T-2, with intent to estimate photon heating roughly. Reference: R. C. Little, "Argon and Krypton Cross-Section Files," Los Alamos National Laboratory memo to P. D. Soran (June 30, 1982).

d. These data are valid to 5 Mev; they were extended to 20 Mev for completeness only. Reference: R. C. Little, "SC-45 Cross Sections for MCNP," Los Alamos National Laboratory memo X-6:RCL-85-430 to C. D. Bowman (August 27, 1985).

e. These data were taken from incomplete fission-product evaluations. Reference: R. C. Little, "Cross Sections in ACE Format for Various IP Target Materials," Los Alamos National Laboratory memo to D. Davidson (August 19, 1982).

f. Photon-production data were added to ENDF/B-V neutron cross sections by P. G. Young, T-2. These data are valid to 1 Mev only, heating not good. Reference: R. C. Little and R. E. Seamon, "ENDF/B-V GD Cross Sections with Photon Production," Los Alamos National Laboratory memo X-6:RCL/RES-86-30 to A. R. Larson (January 22, 1986).

g. This has to do with file TM1693. File created by R. C. Little. Use with caution. The file was first written on 09/29/86.

h. This has to do with file IRNAT3. File created by R. C. Little. Use with caution. The file was first written on 09/19/86.

i. This has to do with file PA2313. File created by R. C. Little. Use with caution. The file was first written on 01/25/88.

j. Very little detail was given in the original ENDF/B-V evaluation for CM-245. The updated evaluation available under ENDF/B-V Revision 2 is very complete. The two sets are compared in Little's memo X-6:RCL-86-220. Reference: R. C. Little, "Monte Carlo Cross Sections for CM-245," Los Alamos National Laboratory memo X-6:RCL-86-220 to J. T. West (June 3, 1986).

k. The user may wish to delete these ZAIDs from the library because they would probably never be needed (see Section 4.37).

Table 5. X6XS.0 Cross-Section Library (Sorted by ZAID)

Continuous Neutron Evaluations:

ZAID	SOURCE	TEMP (K)	PHOTON PROD.	TYPE 1 LENGTH	TYPE 2 LENGTH	NUBAR	COMMENTS
1001.50c	endf/b-v	300	yes	56909	14336		
1002.55c	grp./t-2	300	yes	122033	26624		
1003.35c	endl-85	0	no	26615	8192		note k
1003.50c	endf/b-v	300	no	50024	12288		
2003.50c	endf/b-v	300	no	47837	12288		
2004.50c	endf/b-v	300	no	62903	14336		
3006.50c	endf/b-v	300	yes	201980	43008		
3007.55c	grp./t-2	300	yes	267590	55296		
4009.50c	endf/b-v	300	yes	180839	38912		
5010.50c	endf/b-v	300	yes	409907	83968		
5011.35c	endl-85	0	yes	87770	20480		note k
5011.56c	grp./t-2	300	yes	1153730	231424		
6000.50c	endf/b-v	300	yes	473249	96256		note b
6012.35c	endl-85	0	yes	105266	24576		note k
6012.50c	endf/b-v	300	yes	473249	96256		note b
6013.35c	endl-85	0	yes	99839	22528		
7014.50c	endf/b-v	300	yes	921422	184320		note a
7015.55c	grp./t-2	300	yes	424487	86016		
8016.35c	endl-85	0	yes	210647	45056		note k
8016.50c	endf/b-v	300	yes	769223	155648		note a
9019.35c	endl-85	0	yes	639704	129024		note k
9019.50c	endf/b-v	300	yes	894530	180224		
11023.35c	endl-85	0	yes	462152	94208		note k
11023.50c	endf/b-v	300	yes	1058960	212992		note a
12000.35c	endl-85	0	yes	197039	40960		note k
12000.50c	endf/b-v	300	yes	1141661	229376		note a
12000.51c	endf/b-v	300	yes	991487	198656		note a k
13027.35c	endl-85	0	yes	748001	151552		note k
13027.50c	endf/b-v	300	yes	1097678	219136		
14000.35c	endl-85	0	yes	385931	77872		note k
14000.50c	endf/b-v	300	yes	1997750	397312		note a
14000.51c	endf/b-v	300	yes	1785530	356352		note a k
15031.35c	endl-85	0	yes	119846	26624		note k
15031.50c	endf/b-v	300	yes	117011	26624		note a
16032.35c	endl-85	0	yes	143741	30720		note k
16032.50c	endf/b-v	300	yes	138395	30720		note a
17000.35c	endl-85	0	yes	262163	55296		note k
17000.50c	endf/b-v	300	yes	473006	96256		note a
18000.35c	endl-85	0	yes	114014	24576		
19000.35c	endl-85	0	yes	226280	47104		note k
19000.50c	endf/b-v	300	yes	447410	92160		note a
20000.35c	endl-85	0	yes	262811	55296		note k
20000.50c	endf/b-v	300	yes	1268993	253952		note a
20000.51c	endf/b-v	300	yes	1081640	217088		note a k
21045.55c	grp./t-2	300	no	123800	26624		note d
22000.35c	endl-85	0	yes	272693	57344		note k
22000.50c	endf/b-v	300	yes	1110638	223232		note a
22000.51c	endf/b-v	300	yes	645455	131072		note a k
23000.50c	endf/b-v	300	yes	776675	155648		note a
24000.35c	endl-85	0	yes	187562	40960		note k
24000.50c	endf/b-v	300	yes	2723591	540672		
24000.51c	endf/b-v	300	yes	1127081	225280		note k
25055.35c	endl-85	0	yes	152651	32768		note k
25055.50c	endf/b-v	300	yes	2129051	423936		
25055.51c	endf/b-v	300	yes	521849	106496		note k
26000.35c	endl-85	0	yes	628283	126976		note k
26000.55c	grp./t-2	300	yes	3613295	716800		
27059.35c	endl-85	0	yes	789797	159744		note k
27059.50c	endf/b-v	300	yes	2371646	471040		note a
27059.51c	endf/b-v	300	yes	575066	116736		note a k
28000.50c	endf/b-v	300	yes	2834156	563200		
28000.51c	endf/b-v	300	yes	1895771	376832		note k
28058.35c	endl-85	0	yes	866423	174080		note k
29000.35c	endl-85	0	yes	143417	30720		note k

Table 5. X6XSA Cross-Section Library (Sorted by ZAID)

ZAID	SOURCE	TEMP (K)	PHOTON PROD.	TYPE 1 LENGTH	TYPE 2 LENGTH	NUBAR	COMMENTS
29000.50c	endf/b-v	300	yes	1050860	210944		
31000.35c	endl-85	0	yes	152975	32768		note k
31000.50c	endf/b-v	300	yes	161399	34816		note a
33074.35c	endl-85	0	yes	1031258	20 948		note k
33075.35c	endl-85	0	yes	1032230	206848		
35079.55c	grp./t-2	300	no	212089	45056		note e
35081.55c	grp./t-2	300	no	109049	24576		note e
36078.50c	endf/b-v	300	no	184322	38912		note a
36080.50c	endf/b-v	300	no	206759	43008		note a
36082.59c	grp./t-2	300	yes	142813	30720		note c
36083.59c	grp./t-2	300	yes	164278	34816		note c
36084.59c	grp./t-2	300	yes	210853	45056		note c
36086.59c	grp./t-2	300	yes	177805	38912		note c
37085.55c	grp./t-2	300	no	553739	112640		note e
37087.55c	grp./t-2	300	no	171176	36864		note e
39088.35c	endl-85	0	yes	229682	49152		note k
39089.35c	endl-85	0	yes	1011089	202752		
40000.35c	endl-85	0	yes	299342	61440		note k
40000.50c	endf/b-v	300	no	1055153	210944		note a
40000.51c	endf/b-v	300	no	341381	69632		note a k
40093.50c	endf/b-v	300	no	53102	14336		note k
41093.35c	endl-85	0	yes	1022348	204800		note k
41093.50c	endf/b-v	300	yes	2612297	518144		note a
41093.51c	endf/b-v	300	yes	298046	61440		note a k
42000.35c	endl-85	0	yes	175574	36864		note k
42000.50c	endf/b-v	300	yes	722486	145408		note a
42000.51c	endf/b-v	300	yes	206192	43008		note a k
42095.50c	endf/b-v	300	no	312950	65536		note k
43099.50c	endf/b-v	300	no	244935	51200		note a k
44101.50c	endf/b-v	300	no	108182	24576		note k
44103.50c	endf/b-v	300	no	62660	14336		note k
45103.50c	endf/b-v	300	no	383015	77824		note a
45105.50c	endf/b-v	300	no	33095	10240		note k
46105.50c	endf/b-v	300	no	94979	2.528		note k
46108.50c	endf/b-v	300	no	93035	20480		note k
47000.55c	grp./t-2	300	yes	589970	118784		
47107.35c	endl-85	0	yes	266861	55296		note k
47107.50c	endf/b-v	300	no	246125	51200		note a
47109.35c	endl-85	0	yes	273260	57344		note k
47109.50c	endf/b-v	300	no	296264	61440		note a
48000.35c	endl-85	0	yes	249608	51200		note k
48000.50c	endf/b-v	300	no	400106	81920		
48000.51c	endf/b-v	300	no	137261	30720		note k
50000.35c	endl-85	0	yes	121790	26624		
53127.55c	grp./t-2	300	no	1210325	241664		note e
54000.35c	endl-85	0	yes	839855	167936		
54131.50c	endf/b-v	300	no	457940	94208		note a k
54134.35c	endl-85	0	yes	152003	32768		note k
54135.50c	endf/b-v	300	no	112880	26576		note a k
55133.55c	grp./t-2	300	no	1375702	274432		note e
56138.35c	endl-85	0	yes	122114	26624		note k
56138.50c	endf/b-v	300	yes	122762	26624		note k
59141.50c	endf/b-v	300	no	317162	65536		
60143.50c	endf/b-v	300	no	349481	71680		note k
60145.50c	endf/b-v	300	no	779996	157696		note k
60147.50c	endf/b-v	300	no	37631	10240		note k
60148.50c	endf/b-v	300	no	220934	47104		note k
61147.50c	endf/b-v	300	no	186185	38912		note k
61148.50c	endf/b-v	300	no	34148	10240		note k
61149.50c	endf/b-v	300	no	42815	12288		note k
62147.50c	endf/b-v	300	no	684821	137216		note k
62149.50c	endf/b-v	300	no	318053	65536		note a k
62150.50c	endf/b-v	300	no	190154	40960		note k
62151.50c	endf/b-v	300	no	148763	32768		note k
62152.50c	endf/b-v	300	no	836210	167936		note k

79197.35c	endl-85	0	yes	646265	131072		note k
79197.56c	grp./t-2	300	yes	2481158	493568		
82000.35c	endl-85	0	yes	135317	28672		note k
82000.50c	endf/b-v	300	yes	762986	153600		
83209.35c	endl-85	0	yes	371756	75776		note k
83209.50c	endf/b-v	300	yes	303392	63488		note a
90231.35c	endl-85	0	yes	186347	38912	prompt	
90232.35c	endl-85	0	yes	1136720	227328	prompt	note k
90232.50c	endf/b-v	300	yes	3094733	614400	both	note a
90232.51c	endf/b-v	300	yes	363899	75776	both	note a k
90233.35c	endl-85	0	yes	190235	40960	prompt	
91231.50c	endf/b-v	300	no	143174	30720	total	note i
91233.35c	endl-85	0	yes	389090	79872	prompt	note k
91233.50c	endf/b-v	300	no	396137	81920	total	note a
91233.51c	endf/b-v	300	no	115148	26624	total	note a k
92233.35c	endl-85	0	yes	601796	120832	prompt	note k
92233.50c	endf/b-v	300	no	381881	77824	both	note a
92233.51c	endf/b-v	300	no	157106	34816	both	note a k
92234.35c	endl-85	0	yes	174197	36864	prompt	note k
92234.50c	endf/b-v	300	no	1811936	360448	total	note a
92234.51c	endf/b-v	300	no	131024	28672	total	note a k
92235.50c	endf/b-v	300	yes	1225820	245760	both	
92235.51c	endf/b-v	300	yes	523388	106496	both	note k
92236.35c	endl-85	0	yes	177032	36864	prompt	note k
92236.50c	endf/b-v	300	no	2809856	557056	total	note a
92236.51c	endf/b-v	300	no	148763	32768	total	note a k
92237.35c	endl-85	0	yes	190478	40960	prompt	note k
92237.50c	endf/b-v	300	yes	657929	133120	total	
92237.51c	endf/b-v	300	yes	209837	45056	total	note k
92238.35c	endl-85	0	yes	551009	112640	prompt	note k
92238.50c	endf/b-v	300	yes	1803107	358400	both	
92238.51c	endf/b-v	300	yes	484022	98304	both	note k
92239.35c	endl-85	0	yes	199550	43008	prompt	

Table 5. X6XSA Cross-Section Library (Sorted by ZAID)

ZAID	SOURCE	TEMP (K)	PHOTON PROD.	TYPE 1 LENGTH	TYPE 2 LENGTH	NUBAR	COMMENTS
92240.35c	endl-85	0	yes	172901	36864	prompt	
93235.35c	endl-85	0	yes	193070	40960	prompt	
93236.35c	endl-85	0	yes	179543	38912	prompt	
93237.35c	endl-85	0	yes	410474	83968	prompt	note k
93237.55c	grp./t-2	300	no	660197	133120	both	
93238.35c	endl-85	0	yes	180677	38912	prompt	
94237.35c	endl-85	0	yes	229682	49152	prompt	
94238.35c	endl-85	0	yes	317162	65536	prompt	note k
94238.50c	endf/b-v	300	no	380828	77824	total	note a
94238.51c	endf/b-v	300	no	123734	26624	total	note a k
94239.55c	grp./t-2	300	yes	2068382	411648	both	
94240.50c	endf/b-v	300	yes	1193987	239616	both	note a
94240.51c	endf/b-v	300	yes	307361	63488	both	note a k
94241.35c	endl-85	0	yes	179948	38912	prompt	note k
94241.50c	endf/b-v	300	yes	782588	157696	both	note a
94241.51c	endf/b-v	300	yes	272288	57344	both	note a k
94242.35c	endl-85	0	yes	429347	88064	prompt	note k
94242.50c	endf/b-v	300	yes	1447355	288768	both	note a
94242.51c	endf/b-v	300	yes	318863	65536	both	note a k
94243.35c	endl-85	0	yes	218828	47104	prompt	
95241.35c	endl-85	0	yes	513020	104448	prompt	note k
95241.50c	endf/b-v	300	yes	853058	172032	total	note a
95241.51c	endf/b-v	300	yes	251471	53248	total	note a k
95242.35c	endl-85	0	yes	424244	86016	prompt	note k
95242.50c	endf/b-v	300	yes	174926	36864	total	note a
95243.35c	endl-85	0	yes	798707	159744	prompt	note k
95243.50c	endf/b-v	300	yes	1864181	370688	total	note a
95243.51c	endf/b-v	300	yes	277958	57344	total	note a k
96242.35c	endl-85	0	yes	439391	90112	prompt	note k
96242.50c	endf/b-v	300	yes	626582	126976	total	
96242.51c	endf/b-v	300	yes	198659	43008	total	note k
96243.35c	endl-85	0	yes	437852	90112	prompt	
96244.35c	endl-85	0	yes	430076	88064	prompt	note k
96244.50c	endf/b-v	300	yes	932195	186368	total	note a
96244.51c	endf/b-v	300	yes	220529	47104	total	note a k
96245.35c	endl-85	0	yes	489449	100352	prompt	note k
96245.52c	ndfb-v.2	300	yes	431203	88064	both	note a j
96246.35c	endl-85	0	yes	253820	53248	prompt	
96247.35c	endl-85	0	yes	411284	83968	prompt	
96248.35c	endl-85	0	yes	369002	75776	prompt	
97249.35c	endl-85	0	yes	239483	51200	prompt	
98249.35c	endl-85	0	yes	568991	114688	prompt	
98250.35c	endl-85	0	yes	213239	45056	prompt	
98251.35c	endl-85	0	yes	223040	47104	prompt	
98252.35c	endl-85	0	yes	363494	73728	prompt	
Thermal Library (See Ref. 6 for the source of these data):							
be.01t	-	300	no	207893	43008		
benz.01t	-	300	no	329798	67584		
beo.01t	-	300	no	330203	67584		
grph.01t	-	300	no	336440	69632		
hwtr.01t	-	300	no	207326	43008		
hzr.01t	-	300	no	234623	49152		
lwtr.01t	-	300	no	207326	43008		
poly.01t	-	300	no	234623	49152		
zrh.01t	-	300	no	351263	71680		

Table 5. X6XSA Cross-Section Library (Sorted by ZAID)

ZAID	SOURCE	TEMP (K)	PHOTON PROD.	TYPE 1 LENGTH	TYPE 2 LENGTH	NUBAR	COMMENTS
Photon Library (See Ref. 6 for the source of these data):							
1000.01p	-	-	-	8795	4096		
2000.01p	-	-	-	8795	4096		
3000.01p	-	-	-	8795	4096		
4000.01p	-	-	-	8795	4096		
5000.01p	-	-	-	8795	4096		
6000.01p	-	-	-	8795	4096		
7000.01p	-	-	-	8795	4096		
8000.01p	-	-	-	8795	4096		
9000.01p	-	-	-	8795	4096		
10000.01p	-	-	-	8795	4096		
11000.01p	-	-	-	9038	4096		
12000.01p	-	-	-	9200	4096		
13000.01p	-	-	-	9200	4096		
14000.01p	-	-	-	9200	4096		
15000.01p	-	-	-	9200	4096		
16000.01p	-	-	-	9200	4096		
17000.01p	-	-	-	9200	4096		
18000.01p	-	-	-	9200	4096		
19000.01p	-	-	-	9200	4096		
20000.01p	-	-	-	9362	4096		
21000.01p	-	-	-	9362	4096		
22000.01p	-	-	-	9362	4096		
23000.01p	-	-	-	9362	4096		
24000.01p	-	-	-	9362	4096		
25000.01p	-	-	-	9362	4096		
26000.01p	-	-	-	9362	4096		
27000.01p	-	-	-	9362	4096		
28000.01p	-	-	-	9605	4096		
29000.01p	-	-	-	9605	4096		
30000.01p	-	-	-	10091	4096		
31000.01p	-	-	-	10172	4096		
32000.01p	-	-	-	10172	4096		
33000.01p	-	-	-	10172	4096		
34000.01p	-	-	-	10172	4096		
35000.01p	-	-	-	10172	4096		
36000.01p	-	-	-	10172	4096		
37000.01p	-	-	-	10253	4096		
38000.01p	-	-	-	10253	4096		
39000.01p	-	-	-	10253	4096		
40000.01p	-	-	-	10253	4096		
41000.01p	-	-	-	10253	4096		
42000.01p	-	-	-	10253	4096		
43000.01p	-	-	-	10253	4096		
44000.01p	-	-	-	10253	4096		
45000.01p	-	-	-	10253	4096		
46000.01p	-	-	-	10253	4096		
47000.01p	-	-	-	10253	4096		
48000.01p	-	-	-	10253	4096		
49000.01p	-	-	-	10253	4096		
50000.01p	-	-	-	10253	4096		
51000.01p	-	-	-	10253	4096		
52000.01p	-	-	-	10496	4096		
53000.01p	-	-	-	10496	4096		
54000.01p	-	-	-	10496	4096		
55000.01p	-	-	-	10982	4096		
56000.01p	-	-	-	10982	4096		
57000.01p	-	-	-	10982	4096		
58000.01p	-	-	-	10982	4096		
59000.01p	-	-	-	10982	4096		
60000.01p	-	-	-	11225	4096		
61000.01p	-	-	-	11468	6144		
62000.01p	-	-	-	11468	6144		
63000.01p	-	-	-	11468	6144		

Table 5. X6XSA Cross-Section Library (Sorted by ZAID)

ZAID	SOURCE	TEMP (K)	PHOTON PROD.	TYPE 1 LENGTH	TYPE 2 LENGTH	NUBAR	COMMENTS
64000.01p	-	-	-	11468	6144		
65000.01p	-	-	-	11468	6144		
66000.01p	-	-	-	11468	6144		
67000.01p	-	-	-	11468	6144		
68000.01p	-	-	-	11468	6144		
69000.01p	-	-	-	11468	6144		
70000.01p	-	-	-	11468	6144		
71000.01p	-	-	-	11468	6144		
72000.01p	-	-	-	11468	6144		
73000.01p	-	-	-	11468	6144		
74000.01p	-	-	-	11468	6144		
75000.01p	-	-	-	11468	6144		
76000.01p	-	-	-	11468	6144		
77000.01p	-	-	-	11468	6144		
78000.01p	-	-	-	11468	6144		
79000.01p	-	-	-	11468	6144		
80000.01p	-	-	-	11468	6144		
81000.01p	-	-	-	11468	6144		
82000.01p	-	-	-	11468	6144		
83000.01p	-	-	-	11468	6144		
84000.01p	-	-	-	10334	4096		
85000.01p	-	-	-	10577	4096		
86000.01p	-	-	-	11711	6144		
87000.01p	-	-	-	10577	4096		
88000.01p	-	-	-	10577	4096		
89000.01p	-	-	-	10577	4096		
90000.01p	-	-	-	11711	6144		
91000.01p	-	-	-	10577	4096		
92000.01p	-	-	-	11711	6144		
93000.01p	-	-	-	10577	4096		
94000.01p	-	-	-	11711	6144		
Electron Library (See Ref. 6 for the source of these data):							
1000.01e	-	-	-	10577	6144		
2000.01e	-	-	-	10577	6144		
3000.01e	-	-	-	10577	6144		
4000.01e	-	-	-	10577	6144		
5000.01e	-	-	-	10577	6144		
6000.01e	-	-	-	10577	6144		
7000.01e	-	-	-	10577	6144		
8000.01e	-	-	-	10577	6144		
9000.01e	-	-	-	10577	6144		
10000.01e	-	-	-	10577	6144		
11000.01e	-	-	-	10577	6144		
12000.01e	-	-	-	10577	6144		
13000.01e	-	-	-	10577	6144		
14000.01e	-	-	-	10577	6144		
15000.01e	-	-	-	10577	6144		
16000.01e	-	-	-	10577	6144		
17000.01e	-	-	-	10577	6144		
18000.01e	-	-	-	10577	6144		
19000.01e	-	-	-	10577	6144		
20000.01e	-	-	-	10577	6144		
21000.01e	-	-	-	10577	6144		
22000.01e	-	-	-	10577	6144		
23000.01e	-	-	-	10577	6144		
24000.01e	-	-	-	10577	6144		
25000.01e	-	-	-	10577	6144		
26000.01e	-	-	-	10577	6144		
27000.01e	-	-	-	10577	6144		
28000.01e	-	-	-	10577	6144		
29000.01e	-	-	-	10577	6144		
30000.01e	-	-	-	10577	6144		
31000.01e	-	-	-	10577	6144		

Table 5. X6XSA Cross-Section Library (Sorted by ZAID)

ZAID	SOURCE	TEMP (K)	PHOTON PROD.	TYPE 1 LENGTH	TYPE 2 LENGTH	NUBAR	COMMENTS
32000.01e	-	-	-	10577	6144		
33000.01e	-	-	-	10577	6144		
34000.01e	-	-	-	10577	6144		
35000.01e	-	-	-	10577	6144		
36000.01e	-	-	-	10577	6144		
37000.01e	-	-	-	10577	6144		
38000.01e	-	-	-	10577	6144		
39000.01e	-	-	-	10577	6144		
40000.01e	-	-	-	10577	6144		
41000.01e	-	-	-	10577	6144		
42000.01e	-	-	-	10577	6144		
43000.01e	-	-	-	10577	6144		
44000.01e	-	-	-	10577	6144		
45000.01e	-	-	-	10577	6144		
46000.01e	-	-	-	10577	6144		
47000.01e	-	-	-	10577	6144		
48000.01e	-	-	-	10577	6144		
49000.01e	-	-	-	10577	6144		
50000.01e	-	-	-	10577	6144		
51000.01e	-	-	-	10577	6144		
52000.01e	-	-	-	10577	6144		
53000.01e	-	-	-	10577	6144		
54000.01e	-	-	-	10577	6144		
55000.01e	-	-	-	10577	6144		
56000.01e	-	-	-	10577	6144		
57000.01e	-	-	-	10577	6144		
58000.01e	-	-	-	10577	6144		
59000.01e	-	-	-	10577	6144		
60000.01e	-	-	-	10577	6144		
61000.01e	-	-	-	10577	6144		
62000.01e	-	-	-	10577	6144		
63000.01e	-	-	-	10577	6144		
64000.01e	-	-	-	10577	6144		
65000.01e	-	-	-	10577	6144		
66000.01e	-	-	-	10577	6144		
67000.01e	-	-	-	10577	6144		
68000.01e	-	-	-	10577	6144		
69000.01e	-	-	-	10577	6144		
70000.01e	-	-	-	10577	6144		
71000.01e	-	-	-	10577	6144		
72000.01e	-	-	-	10577	6144		
73000.01e	-	-	-	10577	6144		
74000.01e	-	-	-	10577	6144		
75000.01e	-	-	-	10577	6144		
76000.01e	-	-	-	10577	6144		
77000.01e	-	-	-	10577	6144		
78000.01e	-	-	-	10577	6144		
79000.01e	-	-	-	10577	6144		
80000.01e	-	-	-	10577	6144		
81000.01e	-	-	-	10577	6144		
82000.01e	-	-	-	10577	6144		
83000.01e	-	-	-	10577	6144		
84000.01e	-	-	-	10577	6144		
85000.01e	-	-	-	10577	6144		
86000.01e	-	-	-	10577	6144		
87000.01e	-	-	-	10577	6144		
88000.01e	-	-	-	10577	6144		
89000.01e	-	-	-	10577	6144		
90000.01e	-	-	-	10577	6144		
91000.01e	-	-	-	10577	6144		
92000.01e	-	-	-	10577	6144		
93000.01e	-	-	-	10577	6144		
94000.01e	-	-	-	10577	6144		

Table 6. X6XS.0 Neutron Cross-Sections (Sorted by Source)

Continuous Neutron Evaluations:

ZAID	SOURCE	TEMP (K)	PHOTON PROD.	TYPE 1 LENGTH	TYPE 2 LENGTH	NUBAR	COMMENTS
1003.35c	endl-85	0	no	26615	8192		note k
5011.35c	endl-85	0	yes	87770	20480		note k
6012.35c	endl-85	0	yes	105266	24576		note k
6013.35c	endl-85	0	yes	99839	22528		
8016.35c	endl-85	0	yes	210647	45056		note k
9019.35c	endl-85	0	yes	639704	129024		note k
11023.35c	endl-85	0	yes	462152	94208		note k
12000.35c	endl-85	0	yes	197039	40960		note k
13027.35c	endl-85	0	yes	748001	151552		note k
14000.35c	endl-85	0	yes	385931	79872		note k
15031.35c	endl-85	0	yes	119846	26624		note k
16032.35c	endl-85	0	yes	143741	30720		note k
17000.35c	endl-85	0	yes	262163	55296		note k
18000.35c	endl-85	0	yes	114014	24576		
19000.35c	endl-85	0	yes	226280	47104		note k
20000.35c	endl-85	0	yes	262811	55296		note k
22000.35c	endl-85	0	yes	272693	57344		note k
24000.35c	endl-85	0	yes	187562	40960		note k
25055.35c	endl-85	0	yes	152651	32768		note k
26000.35c	endl-85	0	yes	628283	126976		note k
27059.35c	endl-85	0	yes	789797	159744		note k
28058.35c	endl-85	0	yes	866423	174080		note k
29000.35c	endl-85	0	yes	143417	30720		note k
31000.35c	endl-85	0	yes	152975	32768		note k
33074.35c	endl-85	0	yes	1031258	206848		note k
33075.35c	endl-85	0	yes	1032230	206848		
39088.35c	endl-85	0	yes	229682	49152		note k
39089.35c	endl-85	0	yes	1011089	202752		
40000.35c	endl-85	0	yes	299342	61440		note k
41093.35c	endl-85	0	yes	1022348	204800		note k
42000.35c	endl-85	0	yes	175574	36864		note k
47107.35c	endl-85	0	yes	266861	55296		note k
47109.35c	endl-85	0	yes	273260	57344		note k
48000.35c	endl-85	0	yes	249608	51200		note k
50000.35c	endl-85	0	yes	121790	26624		
54000.35c	endl-85	0	yes	839855	167936		
54134.35c	endl-85	0	yes	152003	32768		note k
56138.35c	endl-85	0	yes	122114	26624		note k
63000.35c	endl-85	0	yes	141149	30720		
64000.35c	endl-85	0	yes	160427	34816		
72000.35c	endl-85	0	yes	1537103	307200		note k
73181.35c	endl-85	0	yes	680204	137216		note k
75185.35c	endl-85	0	yes	325667	67584		
75187.35c	endl-85	0	yes	299990	61440		
78000.35c	endl-85	0	yes	312140	65536		
79197.35c	endl-85	0	yes	646265	131072		note k
82000.35c	endl-85	0	yes	135317	28672		note k
83209.35c	endl-85	0	yes	371756	75776		note k
90231.35c	endl-85	0	yes	186347	38912	prompt	
90232.35c	endl-85	0	yes	1136720	227328	prompt	note k
90233.35c	endl-85	0	yes	190235	40960	prompt	
91233.35c	endl-85	0	yes	389090	79872	prompt	note k
92233.35c	endl-85	0	yes	601796	120832	prompt	note k
92234.35c	endl-85	0	yes	174197	36864	prompt	note k
92236.35c	endl-85	0	yes	177032	36864	prompt	note k
92237.35c	endl-85	0	yes	190478	40960	prompt	note k
92238.35c	endl-85	0	yes	551009	112640	prompt	note k
92239.35c	endl-85	0	yes	199550	43008	prompt	
92240.35c	endl-85	0	yes	172901	36864	prompt	
93235.35c	endl-85	0	yes	193070	40960	prompt	
93236.35c	endl-85	0	yes	179543	38912	prompt	
93237.35c	endl-85	0	yes	410474	83968	prompt	note k
93238.35c	endl-85	0	yes	180677	38912	prompt	
94237.35c	endl-85	0	yes	229682	49152	prompt	

Table 6. X6XSA Neutron Cross-Sections (Sorted by Source)

ZAID	SOURCE	TEMP (K)	PHOTON PROD.	TYPE 1 LENGTH	TYPE 2 LENGTH	NUBAR	COMMENTS
94238.35c	endl-85	0	yes	317162	65536	prompt	note k
94241.35c	endl-85	0	yes	179948	38912	prompt	note k
94242.35c	endl-85	0	yes	429347	88064	prompt	note k
94243.35c	endl-85	0	yes	218828	47104	prompt	
95241.35c	endl-85	0	yes	513020	104448	prompt	note k
95242.35c	endl-85	0	yes	424244	86016	prompt	note k
95243.35c	endl-85	0	yes	798707	159744	prompt	note k
96242.35c	endl-85	0	yes	439391	90112	prompt	note k
96243.35c	endl-85	0	yes	437852	90112	prompt	
96244.35c	endl-85	0	yes	430076	88064	prompt	note k
96245.35c	endl-85	0	yes	489449	100352	prompt	note k
96246.35c	endl-85	0	yes	253820	53248	prompt	
96247.35c	endl-85	0	yes	411284	83968	prompt	
96248.35c	endl-85	0	yes	369002	75776	prompt	
97249.35c	endl-85	0	yes	239483	51200	prompt	
98249.35c	endl-85	0	yes	568991	114688	prompt	
98250.35c	endl-85	0	yes	213239	45056	prompt	
98251.35c	endl-85	0	yes	223040	47104	prompt	
98252.35c	endl-85	0	yes	363494	73728	prompt	
1001.50c	endf/b-v	300	yes	56909	14336		
1003.50c	endf/b-v	300	no	50024	12288		
2003.50c	endf/b-v	300	no	47837	12288		
2004.50c	endf/b-v	300	no	62903	14336		
3006.50c	endf/b-v	300	yes	201980	43008		
4009.50c	endf/b-v	300	yes	180839	38912		
5010.50c	endf/b-v	300	yes	409907	83968		
6000.50c	endf/b-v	300	yes	473249	96256		note b
6012.50c	endf/b-v	300	yes	473249	96256		note b
7014.50c	endf/b-v	300	yes	921422	184320		note a
8016.50c	endf/b-v	300	yes	769223	155648		note a
9019.50c	endf/b-v	300	yes	894530	180224		
11023.50c	endf/b-v	300	yes	1058960	212992		note a
12000.50c	endf/b-v	300	yes	1141661	229376		note a
13027.50c	endf/b-v	300	yes	1097678	219136		
14000.50c	endf/b-v	300	yes	1997750	397312		note a
15031.50c	endf/b-v	300	yes	117011	26624		note a
16032.50c	endf/b-v	300	yes	138395	30720		note a
17000.50c	endf/b-v	300	yes	473006	96256		note a
19000.50c	endf/b-v	300	yes	447410	92160		note a
20000.50c	endf/b-v	300	yes	1268993	253952		note a
22000.50c	endf/b-v	300	yes	1110638	223232		note a
23000.50c	endf/b-v	300	yes	776675	155648		note a
24000.50c	endf/b-v	300	yes	2723591	540672		
25055.50c	endf/b-v	300	yes	2129051	423936		
27059.50c	endf/b-v	300	yes	2371646	471040		note a
28000.50c	endf/b-v	300	yes	2834156	563200		
29000.50c	endf/b-v	300	yes	1050860	210944		
31000.50c	endf/b-v	300	yes	161399	34816		note a
36078.50c	endf/b-v	300	no	184322	38912		note a
36080.50c	endf/b-v	300	no	206759	43008		note a
40000.50c	endf/b-v	300	no	1055153	210944		note a
40093.50c	endf/b-v	300	no	53102	14336		note k
41093.50c	endf/b-v	300	yes	2612297	518144		note a
42000.50c	endf/b-v	300	yes	722486	145408		note a
42095.50c	endf/b-v	300	no	312950	65536		note k
43099.50c	endf/b-v	300	no	246935	51200		note a k
44101.50c	endf/b-v	300	no	108182	24576		note k
44103.50c	endf/b-v	300	no	62660	14336		note k
45103.50c	endf/b-v	300	no	383015	77824		note a
45105.50c	endf/b-v	300	no	33095	10240		note k
46105.50c	endf/b-v	300	no	94979	22528		note k
46108.50c	endf/b-v	300	no	93035	20480		note k
47107.50c	endf/b-v	300	no	246125	51200		note a
47109.50c	endf/b-v	300	no	296264	61440		note a

Table 6. X6XSA Neutron Cross-Sections (Sorted by Source)

ZAID	SOURCE	TEMP (K)	PHOTON PROD.	TYPE 1 LENGTH	TYPE 2 LENGTH	NUBAR	COMMENTS
48000.50c	endf/b-v	300	no	400106	81920		
54131.50c	endf/b-v	300	no	457940	94208		note a k
54135.50c	endf/b-v	300	no	112880	24576		note a k
56138.50c	endf/b-v	300	yes	122762	26624		note k
59141.50c	endf/b-v	300	no	317162	65536		
60143.50c	endf/b-v	300	no	349481	71680		note k
60145.50c	endf/b-v	300	no	779996	157696		note k
60147.50c	endf/b-v	300	no	37631	10240		note k
60148.50c	endf/b-v	300	no	220934	47104		note k
61147.50c	endf/b-v	300	no	186185	38912		note k
61148.50c	endf/b-v	300	no	34148	10240		note k
61149.50c	endf/b-v	300	no	42815	12288		note k
62147.50c	endf/b-v	300	no	684821	137216		note k
62149.50c	endf/b-v	300	no	318053	65536		note a k
62150.50c	endf/b-v	300	no	190154	40960		note k
62151.50c	endf/b-v	300	no	148763	32768		note k
62152.50c	endf/b-v	300	no	836210	167936		note k
63152.50c	endf/b-v	300	no	999506	200704		note a k
63154.50c	endf/b-v	300	no	750269	151552		note a k
63155.50c	endf/b-v	300	no	92630	20480		note k
72000.50c	endf/b-v	300	no	1058555	212992		note a
73181.50c	endf/b-v	300	yes	1230842	245760		note a
82000.50c	endf/b-v	300	yes	762986	153600		
83209.50c	endf/b-v	300	yes	303392	63488		note a
90232.50c	endf/b-v	300	yes	3094733	614400	both	note a
91231.50c	endf/b-v	300	no	143174	30720	total	note i
91233.50c	endf/b-v	300	no	396137	81920	total	note a
92233.50c	endf/b-v	300	no	381881	77824	both	note a
92234.50c	endf/b-v	300	no	1811936	360448	total	note a
92235.50c	endf/b-v	300	yes	1225820	245760	both	
92236.50c	endf/b-v	300	no	2809856	557056	total	note a
92237.50c	endf/b-v	300	yes	657929	133120	total	
92238.50c	endf/b-v	300	yes	1803107	358400	both	
94238.50c	endf/b-v	300	no	380828	77824	total	note a
94240.50c	endf/b-v	300	yes	1193987	239616	both	note a
94241.50c	endf/b-v	300	yes	782588	157696	both	note a
94242.50c	endf/b-v	300	yes	1447355	288768	both	note a
95241.50c	endf/b-v	300	yes	853058	172032	total	note a
95242.50c	endf/b-v	300	yes	174926	36864	total	note a
95243.50c	endf/b-v	300	yes	1864181	370688	total	note a
96242.50c	endf/b-v	300	yes	626582	126976	total	
96244.50c	endf/b-v	300	yes	932195	186368	total	note a
12000.51c	endf/b-v	300	yes	991487	198656		note a k
14000.51c	endf/b-v	300	yes	1785530	356352		note a k
20000.51c	endf/b-v	300	yes	1081640	217088		note a k
22000.51c	endf/b-v	300	yes	645455	131072		note a k
24000.51c	endf/b-v	300	yes	1127081	225280		note k
25055.51c	endf/b-v	300	yes	521849	106496		note k
27059.51c	endf/b-v	300	yes	575066	116736		note a k
28000.51c	endf/b-v	300	yes	1895771	376832		note k
40000.51c	endf/b-v	300	no	341381	69632		note a k
41093.51c	endf/b-v	300	yes	298046	61440		note a k
42000.51c	endf/b-v	300	yes	206192	43008		note a k
48000.51c	endf/b-v	300	no	137261	30720		note k
63152.51c	endf/b-v	300	no	220610	47104		note a k
63154.51c	endf/b-v	300	no	210809	45056		note a k
73181.51c	endf/b-v	300	yes	436799	90112		note a k
90232.51c	endf/b-v	300	yes	363899	75776	both	note a k
91233.51c	endf/b-v	300	no	115148	26624	total	note a k
92233.51c	endf/b-v	300	no	157106	34816	both	note a k
92234.51c	endf/b-v	300	no	131024	28672	total	note a k
92235.51c	endf/b-v	300	yes	523388	106496	both	note k
92236.51c	endf/b-v	300	no	148763	32768	total	note a k
92237.51c	endf/b-v	300	yes	209837	45056	total	note k

Table 6. X6XSA Neutron Cross-Sections (Sorted by Source)

ZAID	SOURCE	TEMP (K)	PHOTON PROD.	TYPE 1 LENGTH	TYPE 2 LENGTH	NUBAR	COMMENTS
92238.51c	endf/b-v	300	yes	484022	98304	both	note k
94238.51c	endf/b-v	300	no	123734	26624	total	note a k
94240.51c	endf/b-v	300	yes	307361	63488	both	note a k
94241.51c	endf/b-v	300	yes	272288	57344	both	note a k
94242.51c	endf/b-v	300	yes	318863	65536	both	note a k
95241.51c	endf/b-v	300	yes	251471	53248	total	note a k
95243.51c	endf/b-v	300	yes	277958	57344	total	note a k
96242.51c	endf/b-v	300	yes	198659	43008	total	note k
96244.51c	endf/b-v	300	yes	220529	47104	total	note a k
1002.55c	grp./t-2	300	yes	122033	26624		
3007.55c	grp./t-2	300	yes	267590	55296		
5011.56c	grp./t-2	300	yes	1153730	231424		
7015.55c	grp./t-2	300	yes	424487	86016		
21045.55c	grp./t-2	300	no	123800	26624		note d
26000.55c	grp./t-2	300	yes	3613295	716800		
35079.55c	grp./t-2	300	no	212089	45056		note e
35081.55c	grp./t-2	300	no	109049	24576		note e
36082.59c	grp./t-2	300	yes	142813	30720		note c
36083.59c	grp./t-2	300	yes	164278	34816		note c
36084.59c	grp./t-2	300	yes	210853	45056		note c
36086.59c	grp./t-2	300	yes	177805	38912		note c
37085.55c	grp./t-2	300	no	553739	112640		note e
37087.55c	grp./t-2	300	no	171176	36864		note e
47000.55c	grp./t-2	300	yes	589970	118784		
53127.55c	grp./t-2	300	no	1210325	241664		note e
55133.55c	grp./t-2	300	no	1375702	274432		note e
63151.55c	grp./t-2	300	yes	1754021	350208		
63153.55c	grp./t-2	300	yes	1478540	294912		
64152.55c	grp./t-2	300	yes	660822	133120		note f
64154.55c	grp./t-2	300	yes	1212108	241664		note f
64155.55c	grp./t-2	300	yes	1101381	221184		note f
64156.55c	grp./t-2	300	yes	899772	180224		note f
64157.55c	grp./t-2	300	yes	958092	192512		note f
64158.55c	grp./t-2	300	yes	2307633	458752		note f
64160.55c	grp./t-2	300	yes	1322430	264192		note f
67165.55c	grp./t-2	300	yes	1147169	229376		
69169.55c	grp./t-2	300	no	971688	194560		note g
74000.55c	grp./t-2	300	yes	1026317	204800		
74182.55c	grp./t-2	300	yes	2477270	491520		
74183.55c	grp./t-2	300	yes	1611461	321536		
74184.55c	grp./t-2	300	yes	1621019	323584		
74186.55c	grp./t-2	300	yes	1694162	337920		
77000.55c	grp./t-2	300	no	873030	176128		note h
79197.56c	grp./t-2	300	yes	2481158	493568		
93237.55c	grp./t-2	300	no	660197	133120	both	
94239.55c	grp./t-2	300	yes	2068382	411648	both	
96245.52c	ndfb-v.2	300	yes	431203	88064	both	note a j

Table 7. X6XS.0 Neutron Cross-Sections (Sorted by File Size)

Continuous Neutron Evaluations:

ZAID	SOURCE	TEMP (K)	PHOTON PROD.	TYPE 1 LENGTH	TYPE 2 LENGTH	NUBAR	COMMENTS
26000.55c	grp./t-2	300	yes	3613295	716800		
90232.50c	endf/b-v	300	yes	3094733	614400	both	note a
28000.50c	endf/b-v	300	yes	2834156	563200		
92236.50c	endf/b-v	300	no	2809856	557056	total	note a
24000.50c	endf/b-v	300	yes	2723591	540672		
41093.50c	endf/b-v	300	yes	2612297	518144		note a
79197.56c	grp./t-2	300	yes	2481158	493568		
74182.55c	grp./t-2	300	yes	2477270	491520		
27059.50c	endf/b-v	300	yes	2371646	471040		note a
64158.55c	grp./t-2	300	yes	2307633	458752		note f
25055.50c	endf/b-v	300	yes	2129051	423936		
94239.55c	grp./t-2	300	yes	2068382	411648	both	
14000.50c	endf/b-v	300	yes	1997750	397312		note a
28000.51c	endf/b-v	300	yes	1895771	376832		note k
95243.50c	endf/b-v	300	yes	1864181	370688	total	note a
92234.50c	endf/b-v	300	no	1811936	360448	total	note a
92238.50c	endf/b-v	300	yes	1803107	358400	both	
14000.51c	endf/b-v	300	yes	1785530	356352		note a k
63151.55c	grp./t-2	300	yes	1754021	350208		
74186.55c	grp./t-2	300	yes	1694162	337920		
74184.55c	grp./t-2	300	yes	1621019	323584		
74183.55c	grp./t-2	300	yes	1611461	321536		
72000.35c	endl-85	0	yes	1537103	307200		note k
63153.55c	grp./t-2	300	yes	1478540	294912		
94242.50c	endf/b-v	300	yes	1447355	288768	both	note a
55133.55c	grp./t-2	300	no	1375702	274432		note e
64160.55c	grp./t-2	300	yes	1322430	264192		note f
20000.50c	endf/b-v	300	yes	1268993	253952		note a
73181.50c	endf/b-v	300	yes	1230842	245760		note a
92235.50c	endf/b-v	300	yes	1225820	245760	both	
64154.55c	grp./t-2	300	yes	1212108	241664		note f
53127.55c	grp./t-2	300	no	1210325	241664		note e
94240.50c	endf/b-v	300	yes	1193987	239616	both	note a
5011.56c	grp./t-2	300	yes	1153730	231424		
67165.55c	grp./t-2	300	yes	1147169	229376		
12000.50c	endf/b-v	300	yes	1141661	229376		note a
90232.35c	endl-85	0	yes	1136720	227328	prompt	note k
24000.51c	endf/b-v	300	yes	1127081	225280		note k
22000.50c	endf/b-v	300	yes	1110638	223232		note a
64155.55c	grp./t-2	300	yes	1101381	221184		note f
13027.50c	endf/b-v	300	yes	1097678	219136		
20000.51c	endf/b-v	300	yes	1081640	217088		note a k
11023.50c	endf/b-v	300	yes	1058960	212992		note a
72000.50c	endf/b-v	300	no	1058555	212992		note a
40000.50c	endf/b-v	300	no	1055153	210944		note a
29000.50c	endf/b-v	300	yes	1050860	210944		
33075.35c	endl-85	0	yes	1032230	206848		
33074.35c	endl-85	0	yes	1031258	206848		note k
74000.55c	grp./t-2	300	yes	1026317	204800		
41093.35c	endl-85	0	yes	1022348	204800		note k
39089.35c	endl-85	0	yes	1011089	202752		
63152.50c	endf/b-v	300	no	999506	200704		note a k
12000.51c	endf/b-v	300	yes	991487	198656		note a k
69169.55c	grp./t-2	300	no	971688	194560		note g
64157.55c	grp./t-2	300	yes	958092	192512		note f
96244.50c	endf/b-v	300	yes	932195	186368	total	note a
7014.50c	endf/b-v	300	yes	921422	184320		note a
64156.55c	grp./t-2	300	yes	899772	180224		note f
9019.50c	endf/b-v	300	yes	894530	180224		
77000.55c	grp./t-2	300	no	873030	176128		note h
28058.35c	endl-85	0	yes	866423	174080		note k
95241.50c	endf/b-v	300	yes	853058	172032	total	note a
54000.35c	endl-85	0	yes	839855	167936		
62152.50c	endf/b-v	300	no	836210	167936		note k

Table 7. X6XSA Neutron Cross-Sections (Sorted by File Size)

ZAID	SOURCE	TEMP (K)	PHOTON PROD.	TYPE 1 LENGTH	TYPE 2 LENGTH	NUBAR	COMMENTS
95243.35c	endl-85	0	yes	798707	159744	prompt	note k
27059.35c	endl-85	0	yes	789797	159744		note k
94241.50c	endf/b-v	300	yes	782588	157696	both	note a
60145.50c	endf/b-v	300	no	779996	157696		note k
23000.50c	endf/b-v	300	yes	776675	155648		note a
8016.50c	endf/b-v	300	yes	769223	155648		note a
82000.50c	endf/b-v	300	yes	762986	153600		
63154.50c	endf/b-v	300	no	750269	151552		note a k
13027.35c	endl-85	0	yes	748001	151552		note k
42000.50c	endf/b-v	300	yes	722486	145408		note a
62147.50c	endf/b-v	300	no	684821	137216		note k
73181.35c	endl-85	0	yes	680204	137216		note k
64152.55c	grp./t-2	300	yes	660822	133120		note f
93237.55c	grp./t-2	300	no	660197	133120	both	
92237.50c	endf/b-v	300	yes	657929	133120	total	
79197.35c	endl-85	0	yes	646265	131072		note k
22000.51c	endf/b-v	300	yes	645455	131072		note a k
9019.35c	endl-85	0	yes	639704	129024		note k
26000.35c	endl-85	0	yes	628283	126976		note k
96242.50c	endf/b-v	300	yes	626582	126976	total	
92233.35c	endl-85	0	yes	601796	120832	prompt	note k
47000.55c	grp./t-2	300	yes	589970	118784		
27059.51c	endf/b-v	300	yes	575066	116736		note a k
98249.35c	endl-85	0	yes	568991	114688	prompt	
37085.55c	grp./t-2	300	no	553739	112640		note e
92238.35c	endl-85	0	yes	551009	112640	prompt	note k
92235.51c	endf/b-v	300	yes	523388	106496	both	note k
25055.51c	endf/b-v	300	yes	521849	106496		note k
95241.35c	endl-85	0	yes	513020	104448	prompt	note k
96245.35c	endl-85	0	yes	489449	100352	prompt	note k
92238.51c	endf/b-v	300	yes	484022	98304	both	note k
6012.50c	endf/b-v	300	yes	473249	96256		note b
6000.50c	endf/b-v	300	yes	473249	96256		note b
17000.50c	endf/b-v	300	yes	473006	96256		note a
11023.35c	endl-85	0	yes	462152	94208		note k
54131.50c	endf/b-v	300	no	457940	94208		note a k
19000.50c	endf/b-v	300	yes	447410	92160		note a
96242.35c	endl-85	0	yes	439391	90112	prompt	note k
96243.35c	endl-85	0	yes	437852	90112	prompt	
73181.51c	endf/b-v	300	yes	436799	90112		note a k
96245.52c	ndfb-v.2	300	yes	431203	88064	both	note a j
96244.35c	endl-85	0	yes	430076	88064	prompt	note k
94242.35c	endl-85	0	yes	429347	88064	prompt	note k
7015.55c	grp./t-2	300	yes	424487	86016		
95242.35c	endl-85	0	yes	424244	86016	prompt	note k
96247.35c	endl-85	0	yes	411284	83968	prompt	
93237.35c	endl-85	0	yes	410474	83968	prompt	note k
5010.50c	endf/b-v	300	yes	409907	83968		
48000.50c	endf/b-v	300	no	400106	81920		
91233.50c	endf/b-v	300	no	396137	81920	total	note a
91233.35c	endl-85	0	yes	389090	79872	prompt	note k
14000.35c	endl-85	0	yes	385931	79872		note k
45103.50c	endf/b-v	300	no	383015	77824		note a
92233.50c	endf/b-v	300	no	381881	77824	both	note a
94238.50c	endf/b-v	300	no	380828	77824	total	note a
83209.35c	endl-85	0	yes	371756	75776		note k
96248.35c	endl-85	0	yes	369002	75776	prompt	
90232.51c	endf/b-v	300	yes	363899	75776	both	note a k
98252.35c	endl-85	0	yes	363494	73728	prompt	
60143.50c	endf/b-v	300	no	349481	71680		note k
40000.51c	endf/b-v	300	no	341381	69632		note a k
75185.35c	endl-85	0	yes	325667	67584		
94242.51c	endf/b-v	300	yes	318863	65536	both	note a k
62149.50c	endf/b-v	300	no	318053	65536		note a k

Table 7. X6XSA Neutron Cross-Sections (Sorted by File Size)

ZAID	SOURCE	TEMP (K)	PHOTON PROD.	TYPE 1 LENGTH	TYPE 2 LENGTH	NUBAR	COMMENTS
94238.35c	endl-85	0	yes	317162	65536	prompt	note k
59141.50c	endf/b-v	300	no	317162	65536		
42095.50c	endf/b-v	300	no	312950	65536		note k
78000.35c	endl-85	0	yes	312140	65536		
94240.51c	endf/b-v	300	yes	307361	63488	both	note a k
83209.50c	endf/b-v	300	yes	303392	63488		note a
75187.35c	endl-85	0	yes	299990	61440		
40000.35c	endl-85	0	yes	299342	61440		note k
41093.51c	endf/b-v	300	yes	298046	61440		note a k
47109.50c	endf/b-v	300	no	296264	61440		note a
95243.51c	endf/b-v	300	yes	277958	57344	total	note a k
47109.35c	endl-85	0	yes	273260	57344		note k
22000.35c	endl-85	0	yes	272693	57344		note k
94241.51c	endf/b-v	300	yes	272288	57344	both	note a k
3007.55c	grp./t-2	300	yes	267590	55296		
47107.35c	endl-85	0	yes	266861	55296		note k
20000.35c	endl-85	0	yes	262811	55296		note k
17000.35c	endl-85	0	yes	262163	55296		note k
96246.35c	endl-85	0	yes	253820	53248	prompt	
95241.51c	endf/b-v	300	yes	251471	53248	total	note a k
48000.35c	endl-85	0	yes	249608	51200		note k
43099.50c	endf/b-v	300	no	246935	51200		note a k
47107.50c	endf/b-v	300	no	246125	51200		note a
97249.35c	endl-85	0	yes	239483	51200	prompt	
94237.35c	endl-85	0	yes	229682	49152	prompt	
39088.35c	endl-85	0	yes	229682	49152		note k
19000.35c	endl-85	0	yes	226280	47104		note k
98251.35c	endl-85	0	yes	223040	47104	prompt	
60148.50c	endf/b-v	300	no	220934	47104		note k
63152.51c	endf/b-v	300	no	220610	47104		note a k
96244.51c	endf/b-v	300	yes	220529	47104	total	note a k
94243.35c	endl-85	0	yes	218828	47104	prompt	
98250.35c	endl-85	0	yes	213239	45056	prompt	
35079.55c	grp./t-2	300	no	212089	45056		note e
36084.59c	grp./t-2	300	yes	210853	45056		note c
63154.51c	endf/b-v	300	no	210809	45056		note a k
8016.35c	endl-85	0	yes	210647	45056		note k
92237.51c	endf/b-v	300	yes	209837	45056	total	note k
36080.50c	endf/b-v	300	no	206759	43008		note a
42000.51c	endf/b-v	300	yes	206192	43008		note a k
3006.50c	endf/b-v	300	yes	201980	43008		
92239.35c	endl-85	0	yes	199550	43008	prompt	
96242.51c	endf/b-v	300	yes	198659	43008	total	note k
12000.35c	endl-85	0	yes	197039	40960		note k
93235.35c	endl-85	0	yes	193070	40960	prompt	
92237.35c	endl-85	0	yes	190478	40960	prompt	note k
90233.35c	endl-85	0	yes	190235	40960	prompt	
62150.50c	endf/b-v	300	no	190154	40960		note k
24000.35c	endl-85	0	yes	187562	40960		note k
90231.35c	endl-85	0	yes	186347	38912	prompt	
61147.50c	endf/b-v	300	no	186185	38912		note k
36078.50c	endf/b-v	300	no	184322	38912		note a
4009.50c	endf/b-v	300	yes	180839	38912		
93238.35c	endl-85	0	yes	180677	38912	prompt	
94241.35c	endl-85	0	yes	179948	38912	prompt	note k
93236.35c	endl-85	0	yes	179543	38912	prompt	
36086.59c	grp./t-2	300	yes	177805	38912		note c
92236.35c	endl-85	0	yes	177032	36864	prompt	note k
42000.35c	endl-85	0	yes	175574	36864		note k
95242.50c	endf/b-v	300	yes	174926	36864	total	note a
92234.35c	endl-85	0	yes	174197	36864	prompt	note k
92240.35c	endl-85	0	yes	172901	36864	prompt	
37087.55c	grp./t-2	300	no	171176	36864		note e
36083.59c	grp./t-2	300	yes	164278	34816		note c

Table 7. X6XSA Neutron Cross-Sections (Sorted by File Size)

ZAID	SOURCE	TEMP (K)	PHOTON PROD.	TYPE 1 LENGTH	TYPE 2 LENGTH	NUBAR	COMMENTS
31000.50c	endf/b-v	300	yes	161399	34816		note a
64000.35c	endl-85	0	yes	160427	34816		
92233.51c	endf/b-v	300	no	157106	34816	both	note a k
31000.35c	endl-85	0	yes	152975	32768		note k
25055.35c	endl-85	0	yes	152651	32768		note k
54134.35c	endl-85	0	yes	152003	32768		note k
92236.51c	endf/b-v	300	no	148763	32768	total	note a k
62151.50c	endf/b-v	300	no	148763	32768		note k
16032.35c	endl-85	0	yes	143741	30720		note k
29000.35c	endl-85	0	yes	143417	30720		note k
91231.50c	endf/b-v	300	no	143174	30720	total	note i
36082.59c	grp./t-2	300	yes	142813	30720		note c
63000.35c	endl-85	0	yes	141149	30720		
16032.50c	endf/b-v	300	yes	138395	30720		note a
48000.51c	endf/b-v	300	no	137261	30720		note k
82000.35c	endl-85	0	yes	135317	28672		note k
92234.51c	endf/b-v	300	no	131024	28672	total	note a k
21045.55c	grp./t-2	300	no	123800	26624		note d
94238.51c	endf/b-v	300	no	123734	26624	total	note a k
56138.50c	endf/b-v	300	yes	122762	26624		note k
56138.35c	endl-85	0	yes	122114	26624		note k
1002.55c	grp./t-2	300	yes	122033	26624		
50000.35c	endl-85	0	yes	121790	26624		
15031.35c	endl-85	0	yes	119846	26624		note k
15031.50c	endf/b-v	300	yes	117011	26624		note a
91233.51c	endf/b-v	300	no	115148	26624	total	note a k
18000.35c	endl-85	0	yes	114014	24576		
54135.50c	endf/b-v	300	no	112880	24576		note a k
35081.55c	grp./t-2	300	no	109049	24576		note e
44101.50c	endf/b-v	300	no	108182	24576		note k
6012.35c	endl-85	0	yes	105266	24576		note k
6013.35c	endl-85	0	yes	99839	22528		
46105.50c	endf/b-v	300	no	94979	22528		note k
46108.50c	endf/b-v	300	no	93035	20480		note k
63155.50c	endf/b-v	300	no	92630	20480		note k
5011.35c	endl-85	0	yes	87770	20480		note k
2004.50c	endf/b-v	300	no	62903	14336		
44103.50c	endf/b-v	300	no	62660	14336		note k
1001.50c	endf/b-v	300	yes	56909	14336		
40093.50c	endf/b-v	300	no	53102	14336		note k
1003.50c	endf/b-v	300	no	50024	12288		
2003.50c	endf/b-v	300	no	47837	12288		
61149.50c	endf/b-v	300	no	42815	12288		note k
60147.50c	endf/b-v	300	no	37631	10240		note k
61148.50c	endf/b-v	300	no	34148	10240		note k
45105.50c	endf/b-v	300	no	33095	10240		note k
1003.35c	endl-85	0	no	26615	8192		note k

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