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1. ActLib-J5

ActLib-J5 is a set of activation cross section libraries for ORIGEN in SCALE6.2 and ORIGEN-S in SCALE6.0 produced from JENDL-5 and JENDL/AD-2017. ActLib-J5 used the JENDL-5 activation cross section data up to UPD11 in several JENDL-5 sub-libraries. The JENDL-5 activation cross section data include activation data of 794 nuclei, which are enough as activation cross section libraries for ORIGEN and ORIGEN-S. On the contrary, JENDL/AD-2017 includes activation data of only 311 nuclei, which are not enough. As described in Sec. 6, the shortage of nuclei is no problem for ORIGEN-S three-group libraries because only data of JENDL/AD-2017 are replaced in the bundled ORIGEN-S three-group library. However, insufficient nuclei were covered with JEFF/A-3.0 because the ORIGEN activation cross section library is a stand alone. We will present the production methods and test results of these libraries at the 30th International Conference on Nuclear Engineering (ICONE30) in May, 2023. Its proceedings will be published in Mechanical Engineering Journal. Please refer Mechanical Engineering Journal with the references in Sec. 11 of this memorandum.

2. Directory structure of ActLib-J5

The directory structure of ActLib-J5 is as follows:

ActLib-J5

- README_jp.txt : this file
- ORACT : activation cross section library set for ORIGEN in SCALE6.2
 - ORACT-J5.200 : 200 group activation cross section library produced from JENDL-5
 - origen.rev03.j5a200g : 200-group activation cross section library file produced from JENDL-5
 - ORACT-J5.48 : 48-group activation cross section library produced from JENDL-5
 - origen.rev03.j5a48g : 48-group activation cross section library file produced from JENDL-5
 - ORACT-JAD17.200 : 200-group activation cross section library produced from JENDL/AD-2017
 - origen.rev03.jad200g : 200-group activation cross section library file produced from JENDL/AD-2017
 - ORACT-JAD17.48 : 48-group activation cross section library produced from JENDL/AD-2017
 - origen.rev03.jad48g : 48-group activation cross section library file produced from JENDL/AD-2017
- MAXS : activation cross section library set for ORIGEN-S in SCALE6.0
 - MAXS-J5.zip : 199-group MAXS file set produced from JENDL-5 for three-group

activation cross section libraries of ORIGEN-S in SCALE6.0 (compressed)

- | - `origen.rev03.pwrj5.data` : three-group activation cross section library of ORIGEN-S in SCALE6.0 produced from MAXS-J5 (we used a similar weighting function [attached flux file] as that used in the three-group activation cross section library bundled in SCALE6.0 ORIGEN-S)
- | - `MAXSJAD-2017.zip` : 199-group MAXS file set produced from JENDL/AD-2017 for three-group activation cross section libraries of ORIGEN-S in SCALE6.0 (update of MAXS/AD-2017) (compressed)
- | - `origen.rev03.pwrad17.data` : three-group activation cross section library of ORIGEN-S in SCALE6.0 produced from MAXSJAD-2017 (we used a similar weighting function [attached flux file] as that used in the three-group activation cross section library bundled in SCALE6.0 ORIGEN-S) [Combination of neutron energy and neutron flux. Note that the neutron energy is not used.]
- | - `origen-s.lib-prod.r1.f` : a simple FORTRAN program which replaces parts of ORIGEN-S three-group activation cross section library with MAXS files (update of `origen-s.lib-prod.f` bundled in MAXS/AD-2017)
- | - `array.inc` : include file for `origen-s.lib-prod.r1.f`
- | - `flux` : a sample 199-group neutron spectrum to collapse 199-group MAXS files to three-group data (similar as that used in the three-group activation cross section library attached in SCALE6.0)
- | - `maxs_to_3g.sh` : a LINUX sample shell script which replaces parts of ORIGEN-S three-group activation cross section library with MAXS files

3. Specifications of ORACT file

- Processing code : AMPX-6 in SCALE6.2
- Temperature : 300 K
- Group structure : 200-group (the same as one of the libraries bundled in SCALE6.2) and 48-group which was used in the JPDR (Japan Power Demonstration Reactor) activation analysis (Sec. 11 specifies the energy boundary.)
- Weighting function : Maxwell + $1/E$ + fission spectrum + $1/E$ above 10 MeV
- Infinite dilution
- Format : SCALE6.2 original binary format

4. Specifications of MAXS file

- Processing code : PREPRO2018
- Temperature : 300 K
- Group structure : 199-group (the same as VITAMIN-B6)
- Weighting function : Maxwell + $1/E$ + fission spectrum
- Infinite dilution

- Format : MAXS text format proposed by Dr. Okumura, JAEA. See Reference (5).

5. How to use ORACT files in COUPLE and ORIGEN

- (1) to copy an ORACT file which you use to the “data” directory in the SCALE6.2 directory.
- (2) to rename the file name of unit number, assigned in the COUPLE code, in the “origen_filenames” file of the “data” directory in the SCALE6.2 directory with the name without “origen.rev03.” from the ORACT file name. For example, the name is “j5a200g” for “origen.rev03.j5a200g”.
- (3) to execute the COUPLE and ORIGEN codes. The ORACT file assigned is used in the COUPLE and ORIGEN codes.

6. How to make a three-group cross section file from MAXS files

MAXS files have two kinds of files; 199 group cross section files (*.maxs-xs) and 199 group isomer ratio files (*.maxs-isom). These files are not directly used in the ORIGEN-S code. The following procedure is required.

- (1) to collapse MAXS 199 group cross section data to three-group cross section data with an adequate neutron spectrum as the weighting function. It is desirable that the neutron spectrum at a position where an ORIGEN-S calculation or similar one is adopted.
- (2) to replace three-group cross section data of the ORIGEN-S activation cross section library (origen.rev03.pwrlib.data) with the corresponding three-group cross section data produced in (1).

A program “origen-s.lib-prod.r1.f” (update of “origen-s.lib-prod.f” in MAXS/AD-2017) attached in ActLib-J5 is used for the above procedure.

The LINUX shell script “maxs_to_3g.sh” attached in ActLib-J5 performs the above procedure for all nuclei in a MAXS directory assigned in maxs_to_3g.sh. The following is how to use “maxs_to_3g.sh”.

- (3) to compile origen-s.lib-prod.r1.f
- (4) to copy the three-group cross section file “origen.rev03.pwrlib.data” bundled in SCALE6.0 to the “data” directory in the SCALE6.0 directory.
- (5) to change MAX in line 4 of “maxs_to_3g.sh” to a full path directory where the MAXS file which you use exists.
- (6) to replace the flux file with an adequate neutron spectrum.
- (7) to execute “maxs_to_3g.sh”. The above (1) and (2) are performed and a new three-group cross section file “origen.rev03.pwrmaxs.data” is produced. Note that data of nuclei and reactions which do not exist in the MAXS files in “origen.rev03.pwrmaxs.data” are the

same as those in `origen.rev03.pwrlib.data`.

7. How to use the new three-group cross section file in ORIGIN-S

- (1) to copy the new three-group cross section file to the “data/origen_data” directory in the SCALE6.0 directory.
- (2) to rename “pwrlib” in line 7 of the “origen_filenames” file in the “data” directory of the SCALE6.0 directory with the name without “origen.rev03.” and “.data” from the new three-group cross section file name. For example, the name is “pwrlj5a” for “origen.rev03.pwrlj5a.data”.
- (3) to execute the ORIGIN-S code. ORIGIN-S uses the new three-group cross section file.

8. Download site of ActLib-J5

<https://rpg.jaea.go.jp/main/en/ActLib-J5/>

9. References of ActLib-J5

- (1) Chikara Konno, Mami Kochiyama, Hirokazu Hayashi, “SCALE6.2 ORIGIN library produced from JENDL/AD-2017,” JAEA-Conf 2021-001, pp. 132-137 (2022). [<https://jopss.jaea.go.jp/pdfdata/JAEA-Conf-2021-001.pdf>]
- (2) Chikara Konno, “Development of multi-group neutron activation cross-section library from JENDL/AD-2017,” JAEA-Conf 2020-001, pp. 193-197 (2020). [<https://jopss.jaea.go.jp/pdfdata/JAEA-Conf-2020-001.pdf>]
- (3) O. Iwamoto et.al, “Japanese evaluated nuclear data library version 5: JENDL-5,” J. Nucl. Sci. Technol., 60, 1-60 (2023). [<https://doi.org/10.1080/00223131.2022.2141903>]
- (4) K. Shibata, N. Iwamoto, S. Kunieda, F. Minato, O. Iwamoto, “Activation Cross-section File for Decommissioning of LWRs,” JAEA-Conf 2016-004, pp.47-52 (2016). [<https://jopss.jaea.go.jp/pdfdata/JAEA-Conf-2016-004.pdf>]
- (5) K. Okumura, K. Kojima, K. Tanaka, “Development of multi-group neutron activation cross-section library for decommissioning of nuclear facilities,” JAEA-Conf 2015-003, pp.43-47 (2015). [<https://jopss.jaea.go.jp/pdfdata/JAEA-Conf-2015-003.pdf>]
- (6) D.E. Cullen, “PREPRO 2019,” IAEA-NDS-0229 (2019).

10. Contact

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11. Appendix (48 group energy boundary)

Group No.	Upper energy [eV]	Lower energy [eV]
1	1.733e+07	1.492e+07

2	1.492e+07	1.419e+07
3	1.419e+07	1.350e+07
4	1.350e+07	1.000e+07
5	1.000e+07	7.408e+06
6	7.408e+06	6.065e+06
7	6.065e+06	4.966e+06
8	4.966e+06	4.066e+06
9	4.066e+06	3.679e+06
10	3.679e+06	2.725e+06
11	2.725e+06	2.365e+06
12	2.365e+06	2.307e+06
13	2.307e+06	2.231e+06
14	2.231e+06	1.653e+06
15	1.653e+06	1.353e+06
16	1.353e+06	8.629e+05
17	8.629e+05	8.208e+05
18	8.208e+05	7.427e+05
19	7.427e+05	6.081e+05
20	6.081e+05	4.979e+05
21	4.979e+05	3.688e+05
22	3.688e+05	2.985e+05
23	2.985e+05	2.972e+05
24	2.972e+05	1.832e+05
25	1.832e+05	1.111e+05
26	1.111e+05	6.738e+04
27	6.738e+04	4.087e+04
28	4.087e+04	2.479e+04
29	2.479e+04	2.358e+04
30	2.358e+04	1.503e+04
31	1.503e+04	9.119e+03
32	9.119e+03	5.531e+03
33	5.531e+03	3.355e+03
34	3.355e+03	2.035e+03
35	2.035e+03	1.234e+03
36	1.234e+03	7.485e+02
37	7.485e+02	4.540e+02
38	4.540e+02	2.754e+02

39	2.754e+02	1.670e+02
40	1.670e+02	1.013e+02
41	1.013e+02	6.144e+01
42	6.144e+01	3.727e+01
43	3.727e+01	1.068e+01
44	1.068e+01	1.855e+00
45	1.855e+00	4.140e-01
46	4.140e-01	5.452e-02
47	5.452e-02	3.341e-03
48	3.341e-03	3.310e-05