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NEUTRON DOSIMETRY SYSTEM SAIPS:

MANUAL FOR USERS AND PROGRAMMERS
(Version 87-02)

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ABSTRACT

SAIPS is a system used for neutron dosimetry by foil activation, containing a package of programs and a data base of neutron activation cross-sections.

A description is given of the SAIPS indexed procedures and users language, which are designed for producing input data for programs unfolding neutron spectra from reaction rate measurements, for carrying out calculations and processing and comparing the results obtained, for utilizing the additional capabilities of the system, and for setting up a working version of the system from the magnetic tapes used for distribution. A description is given of the logical structure of the data sets containing the libraries of neutron cross-section and a priori spectra and also the libraries of calculated spectra. The annexes give examples of SAIPS in use, of the contents of the a priori spectra and neutron cross-section libraries, and of the contents of the SAIPS distribution tapes.

SAIPS was debugged on an ES-1022 computer running under the OS ES 6.1 MVT operating system and contains programs in PL/1 (opt), FORTRAN IV(H) and ASSEMBLER.

Introduction

The SAIPS data base and calculation system is a package of programs and data for unfolding neutron spectra from measured reaction rates which does not require the user to have any programming experience. SAIPS users have access

to the most up-to-date information, as work is constantly in progress to acquire, adapt and verify fresh data and neutron spectrum unfolding programs and to distribute updated versions of the system to users. Experience with distributing the system has shown that users often need assistance in carrying out their first calculations in SAIPS. This help is needed both to speed up and make easier the process of mastering the system's facilities, and to determine the unfolding method best suited to the type of job in hand. For this reason, even though SAIPS has been sent for distribution to the I.V. Kurchatov Institute of Atomic Energy and to the Radiation Shielding Information Center at Oak Ridge, USA the system developers should be contacted when the system is installed. This will also ensure that users have access to the latest versions of the system in the shortest possible time.

Users who wish to acquaint themselves with the capabilities of the SAIPS system and the information it contains should find it sufficient to read through Chapter 1 of the present description and to look through Annexes 1 and 2. Chapter 2 is directed at users who are also programmers and who wish to use SAIPS to carry out non-standard tasks. The logical structures of the system's data sets are described for this purpose. Chapter 3 contains a description of how to set up a working version of SAIPS, and is aimed at the systems programmer of the computing centre where SAIPS is to be used.

SAIPS has been developed to run on an ES computer under the OS ES operating system. SAIPS includes programs in PL/1 (opt), FORTRAN IV (H) and ASSEMBLER. The system was debugged on an ES-1022 computer running under OS ES 6.1 MVT.

If necessary, the system developers can be contacted at the following address:

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1. USER LANGUAGE AND NEUTRON SPECTRUM UNFOLDING PROCEDURES

The SAIPS data base and calculation system [1-3] is capable of recording in a uniform manner the flow of input from various neutron spectrum unfolding programs and of reproducing the results obtained with these different programs, as a uniform output. The system can also vary cross-section libraries, individual cross-sections and libraries of neutron spectra.

A number of signs and conventions are used in the descriptions of the procedures and language. Values in [] may be missing. Of values in <> and separated by the ! symbol, one must be selected. Underlined values (those with _ at the beginning of the word) are used as defaults situations, i.e. if none of the values is indicated or the operator is missing, the underlined value is used automatically. Variables are denoted by words beginning with the @ symbol, while ... indicate that a certain group of data is repeated. Darker - - - are used to indicate parameters requirement of which are defined by the rules of each computing centre.

A neutron spectrum unfolding job is written as follows:

```
//-------------JOB---------------------
//    EXEC GMERGE[,DS=@libname][,P=@N]
<user language statements>
//    EXEC Z@n
      .
      .
      .
//    EXEC Z@n
//    EXEC G@n[,P=@parm]
      .
      .
      .
//    EXEC G@n[,P=@parm]
//
```

A job consists of assembling the job control language procedures and the data written in the user language. The GMERGE JCL procedure defines the call for the program which analyses the input data, converts them into the form needed by the calculation programs and creates a library of cross-sections and a priori spectra of the required composition. When GMERGE is called, the DS parameter indicates the name of the library of a priori spectra to be used in the calculations. The names permitted in this version of SAIPS are given in Annex 1. The parameter P defines the input format for the user language statements: if P = N, the information in columns 73 to 80 is ignored (i.e. they can be used for card identification). The default is P = N. If P≠ n, operators can be coded in all columns.

Procedures involving names Z@n call calculation programs, where @n defines the name of the procedure for the calculation programs. Possible values for @n are SANDII, WINDOW, RFSPJ and LSQFIT, which correspond to the unfolding programs SAND-II [4,5], WINDOWS [6], RFSP-JUL [7] and PM [1].

The group procedure calls with names G@n is used to process the calculated data (printing, storing on tape, printing and comparing of data from tapes, output on graph plotter of output data).

1.1 SAIPS user language

The SAIPS user language is a somewhat modified form of the input language for the SAND-2 program. It enables the user to enter calculation data into the system. The user language operators are keywords defining a number of actions and an acquisition operator for data input. The user language operators are gouped in sections, the first of which describes the composition of the cross-section library to be used for further calculation; the following sections contain input data for the individual calculation variants. The sections are separated from each other by means of the symbol $, which is coded in the first colum of the individual card. The symbol does not appear after the last section.

A description of the SAIPS system user language operators is given below. The keywords for inputting calculation data correspond to the accepted terms used to describe calculation program parameters. To understand the physical nature of these parameters, the reader should consult the descriptions of the corresponding unfolding programs [1, 4-7].

A fragment of the first section would have the following general format:

```
      INDD=@name
@nm         [CD @t][B @t][AU @t]
  . . .
  . . .
  . . .
@nm         [CD @t][B @t][AU @t]
  . . .
  . . .
  . . .
```

where:

@name - is the name of the cross-section library from which the cross-sections for the reaction @nm are to be taken;

@nm - is the name of a reaction for which the cross-sections are taken from the library defined on the INDD=@name card; if the names are missing, all the data in the library are used;

@t - is the thickness of the corresponding cover in $barn^{-1}$ for the reaction @nm (see Ref. [4]).

The names of the cross-section and reaction libraries are listed in Annex 2.

The first section may consist of several such fragments. At the beginning of each fragment the cross-section library is indicated, followed by a list of the cross-sections to be selected from that library. At the end of the section there should be a $ symbol.

The operators in the calculation variant section can be subdivided into four groups:

(1) Operators controlling the calculation process:

[ACTIVITY ! _ITERATION] indicates the type of calculation; ITERATION defines the calculation of the differential neutron spectrum, i.e. the input flows for the spectrum unfolding programs are set up, and ACTIVITY defines the calculation of the reaction rates on the basis of the a priori spectrum using the SAND-2 program;

LIMIT [_15 ! @n] - @n is the maximum permissible number of iterations for programs SAND-2, RFSP-JUL and WINDOWS;

DEVIATION [_5 ! @d] - @d is the mean square deviation in % of the calculated from the measured reaction rates at which calculation by the SAND-2, RFSP-JUL and WINDOWS programs stops;

DISCARD [_2.3 ! @d] - @d is the criterion for the SAND-2 program to take a particular detector out of the calculation;

SDEG [_0 ! @n] - @n is the initial degree of the polynomial for the PM program;

FDEG [_5 ! @n] - @n is the final degree of the polynomial for the PM program;

VR [VNO <_10 ! @n>] [VIG <_0 ! @i>]

[VDEV @d] [VX <_13 ! @x>] [VY <_13387 ! @y>] - this operator is intended for studying the effect on the unfolded spectrum of the error in the measurement of the activation integrals. To this end, @n variants of the calculation are

set up in which normally distributed random quantity with a mean value equal to the entered activities and dispersion @d is used for the activation integrals. If @d is not given, then the value given in the DEVIATION operator is used for the dispersion. @x and @y are the parameters of the pseudorandom number generator [8]. @i defines how many of the variants generated are ignored, i.e., @i out of the @n variants generated are not transmitted to the unfolding programs;

(2) Calculation data input operators:

@n FOILS

@name @a [_0.05 ! @e][CD @t][B @t][AU @t]

. . .

. . .

. . .

@name @a [_0.05 ! @e][CD @t][B @t][AU @t]

- Detector input description, where

@n is the number of detectors used, and must be ≤ 35 if SAND-2 is being used for spectrum unfolding, ≤ 30 for WINDOWS and ≤ 30 for RFSP-JUL; for PM, @n is limited by the size of the working memory;

@name is the name of the reaction;

@a is the measured reaction rate;

@e is the relative error of measurement of the reaction rate @a;

@t is the thickness in barn $^{-1}$ of the corresponding filter for the detector. The thicknesses indicated here must agree with as those given in the description section of the cross-section library;

SPECTRUM LIBRARY @n indicates the selection as a first approximation of the @n-th spectrum from the library of a priori spectra. The identification numbers of the spectra and their descriptions for particular libraries are given in Annex 1.

SPECTRUM TABULAR
@n POINTS
@e(1) @f(1) . . .
. . .
. . .
. . .
. . . @e(@n) @f(@n) reads in an a priori spectrum from a card; here

@n is the number of energy points for which the spectrum is given (@n ≤ 200);

@e(i) is the value of the energy in MeV;

@f(i) is the value of the neutron spectrum at energy point @e(i);

LOW END [THERMAL <_20 ! @t> ! SQRTE ! _e] is the type of extrapolation to the low energy regions;

THERMAL [_20 ! @t] is a Maxwellian extrapolation with temperature @t C;

SQRTE - expansion of the spectrum by the function SQRT(E);

E - expansion of the spectrum by the function 1/E;

HIGH END [_FISSION ! FUSION] is the rule for extrapolating the spectrum to the high energy regions;

FISSION - extrapolation by the fission spectrum;

FUSION - extrapolation by the fusion spectrum;

SMOOTH [_1 ! @n] is the parameter for smoothing the spectrum using the SAND-2 program;

OMEGA [_1 ! @o] is the ω parameter of the RFSP-JUL program;

@name FPOINTS
@e(1) @e(2) . . .
. . .
. . .
. . .

@e(@n) is for inputting the energy values at which the RFSP-JUL program calculates the neutron spectra, where @n is the number of energy points (@n ≤ 50);

@e(j) gives energy values in MeV; these are indicated in ascending order (j=1, ... , @n); if this operator is omitted, then

(a) if SPECTRUM TABULAR has been given and the number of energy points in the input spectrum is less than 51, those energy points are used for which the a priori spectrum has been given;

(b) otherwise, 50 energy points are used: @j/5.55555 (MeV), (j=1, ... , 50);

(c) Comments operator: T @v, where @v is any alphanumeric information identifying the calculation variant;

(d) Operator of controlling of default values (must be coded first in the calculation data sections) - TYPE [SANDII][WINDOW][LSQFIT][RFSPJUL] controls the default values of the calculation data. Coding TYPE and the parameters produces input data streams only for those calculation programs listed in the parameters. If this parameter is used when passing to the next calculation variant the standard default values are not reinstated; in this case the values of the preceding section are adopted by default. Using TYPE without parameters produces an input data stream for all programs using the standard default parameters, i.e. when TYPE is entered without parameters all the data entered in the previous calculation data section are lost;

By using this operator, calculation variants having only slight differences can be set up. For example, if a variant differs from the one before by one or a few parameters, then only the differing parameters need to be entered for the second variant, and all the remaining data from the previous section will be used.

DVAL [CD <@t ! _0>][b <@t ! _0>][au <@t ! _0>] controls default values of the cover thickness. If this operator is coded, there is no need to specify the filter data in each detector description;

If several variants are to be calculated, then the necessary operators are coded for each one and the variants separated by the $ symbol.

This version of the user language has no diagnostic information included; incorrect operators are ignored. When the user language operator cannot be further interpreted, the offending statement is marked, and the following ones simply printed out. Examples of input data unfolding of neutron spectra using SAIPS are shown in Annex 3.

1.2. Procedures for processing calculated spectra

The procedure for processing the calculated spectra are used immediately after the calculations themselves; in this way the results can be stored on tape. When this is done, the GMERGE and calculation program procedures do not need to be called to process unfolded spectra.

1.2.1 Calculated spectrum printout procedure - GPRINT

The GPRINT procedure is designed to print out the unfolded spectra on an alphanumeric printer directly after tha calculations are carried out. When required, the P='[<_1E-10 ! @el>[, <_18 ! @eh>]]' parameter can be used, where @el and @eh give the energy range (in MeV) in which the spectra is to be printed out.

1.2.2. Procedure for storing data on magnetic tape - GPRINTP

The GPRINTP procedure is designed to create a library of calculated spectra and to fill it with unfolding data (a priori spectra, calculated spectra, calculated spectrum errors). The following parameters are used:

(1) DSP=[_MOD ! NEW], where NEW indicates that a new library of calculated spectra is to be created and MOD that data are to be added to an old library;

(2) V=[_SAIPSO ! @volser], where @volser defines the serial number of the volume in the calculated spectrum library. We suggest that tapes with standard labels be used for this procedure;

(3) L=[_1 ! @l], where @l is the number of the data set from the calculated spectrum library;

(4) U=[_SYSSQ ! @unit], where @unit is the type name of the device on which the volume with the library is installed;

(5) D=[_SAIPS.DATA.OUTPUT ! @DS], where @DS is the name of the data set from the library of unfolded spectra.

1.2.3. Procedure for storing data on magnetic tape in the event of faulty job completion

The GPRINTA procedure enables the user to insert only some of the unfolded spectra into the library of calculated spectra if there has been a fault in carrying out the spectrum unfolding job (for example, a computer error or an input/output error). The procedure is called up in the individual job without repetition of the call for the GMERGE and unfolding procedures. For GPRINTA, the same parameters can be used as for GPRINTP.

1.2.4. Procedure for printing data from the library of unfolded spectra - GPRINTW

The GPRINTW procedure can be used in a separate job. Information on the spectra to be processed and the type of printout is given by the parameters of the procedure through the input stream. The Parameter P is coded in the form P=[<ALL ! I ! _>[%]]. If ALL is indicated, then the Spectra are printed out in the 620-group energy division of the SAND-2 program. If I is given, the energy division is specified in the input stream for the procedure. Otherwise (if not or ALL is specified) the following 49-group division is used for printing:

1E-7, 1E-6, ..., 1E-2, 0.1, 0.2, ..., 1.0, 1.5, 2.0, ..., 17.5, 18.0 MeV.

The input stream for the procedure is arranged as follows:

```
[@k @e(1), ..., @e(@k)]
@n @s(1), ..., @s(@n)
.
.
.
```

where @k is the number of points in the energy division entered by the user; @e(j) (j=1, ..., @k) are the energy values (in increasing order in MeV). This group of data is entered only if I is indicated in parameter P. @n is the number of spectra to be printed out (@n ≤ 11), and @s(k) (k=1, ..., @n) are the numbers in the unfolded spectrum library of the spectra to be printed. These identification numbers are printed by the GPRINTP and GPRINTA procedures when the spectra are written into a library. They can also be obtained by printing out the library contents using the COUNTER procedure.

If P contains the symbol %, the absolute values for the @s(1)th spectrum are printed along with r(j) = (f(@s(j)) - f(@s(1))/f(@s(1)) * 100%, (j=2, ..., @n), where f(@s(j)) are the values of the spectra numbered @s(j); otherwise the absolute values of the indicated spectra will be printed. The unfolded spectrum library to be used is indicated by the parameters D=, V=, U= and L=, which are analogous to the parameters for the GPRINTP procedure.

1.2.5. Procedure for adding the mean and mean square values of a group of spectra

The parameters of the procedure which describes the location of the unfolded spectrum library are the same as those ones for the GPRINTP procedure. The following data are included in the input stream:

@n @s(1), ..., @s(@n)

.

.

.

where @n is the number of spectra for which the mean values and mean square deviations are to be calculated; @s(k) (k=1, ..., @n) are the identification numbers of the spectra to be processed. For each group of spectra, the means and mean square deviations are calculated using only unfolded spectrum data. Three groups of records are added to the library: the first contains the mean values of the group of spectra in the form of an unfolded spectrum, while the second and third groups contain the mean value + - the mean square deviation. In all groups the values of the a priori spectrum are taken to be zero, and zeros are therefore carried over into the error file also. It is assumed that all the spectra in the group have one energy division.

1.2.6. Procedure for printing out the contents of an unfolded spectrum library

The COUNTER procedure enables the user to print out from the unfolded spectrum library all or some of the data describing the unfolding variant and the unfolding program. The library is described by the parameters V=, D=, U= and L=, as for the GPRINTP procedure. To print out part of the library, the P parameter can be used:

P='[<_1 ! @is>[,<_32767 ! @ie>]]', where @is and @ie define the range of identification numbers of the library data to be printed out.

1.2.7. The CSPS procedure for copying unfolded spectrum libraries

The following parameters are used to define the input and output unfolded spectrum libraries:

VF=[_SAIPS1 ! @volfrom], VT=[SAIPSO ! @volto], the serial numbers of the input and the output libraries;

UF=[_SYSSQ ! @unitfrom], UT=[_SYSSQ ! @unitto], the type names of the devices for the input and output libraries;

LF=[_(2,blp) ! @labfrom], LT=[_1 ! @labto], the input and output library label types;

DF=[_SAIPS.DATA.OUTPUT ! @DSf], DT=[_SAIPS.DATA.OUTPUT ! @DSt], the names of the data sets of the libraries;

DSP=[_NEW ! MOD], which determines whether a new output library is to be created or an old library added to. Information about the data to be copied is included in the input stream in the form:

@n(1) [-]@n(2) @n(3) [-]@n(4) . . ., where @n(k) is the number of the spectrum to be copied. If @n(k) is given along with the " - " sign, then the group of spectra with numbers in the interval [@n(k-1), @n(k)] is copied. If @n(k-1) < @n(k), then the spectrum with the number @n(k-1) is copied.

1.2.8. Procedure for preparing data to plot graphic output of calculated spectra

The GPLOT procedure is designed to put data onto magnetic tape to be read subsequently by an ES-9002 reader driving an ES-7054 graph plotter. Information about the type of graphics to be produced is given by the P parameter, while the numbers of the spectra to be processed are given in the input stream. The parameter is coded in the form P='[*][E]', where the * in the parameter field means that a graph will be plotted giving the values of

the spectrum multiplied by the value of the energy; otherwise, data are extracted to plot the values of the spectra indicated. The letter E in the parameter field indicates that the values of the spectrum (spectrum multiplied by energy) and its values + - the unfolding error will be traced. If the error file contains only zeros, then only one curve is plotted. The format of the input stream is as follows:

```
[-1,[_0 ! @x0],[_29.7 ! @xn],[_0 ! @y0],[_21.0 ! @yn],
[_0.42 ! @h],[_1 ! @p1],[_1 ! @p2],[_'energy (MeV)' ! @xtxt],
[@ytxt],[<0 ! @n>[,@s(1), ..., @s(@n)]]]
@k @l(1), ..., @l(@k),[_1E-8 ! @el],[_18 ! @eh],[@fl],[@fh]
.
.
.
```

where the first group of data defines the graph parameters; @x0, @xn, @y0 and @yn are the graph co-ordinates in cm, with the initial position of the plotter's tracer pen taken as the origin; @h is the size of the letters for the graph legends; @p1 and @p2 are the numbers of the tracer pens which will trace the graph axes and the curves themselves; @xtxt and @ytxt are the legends for the graph axes; and @s(1), ..., @s(@k) are the numbers of the spectra to be shown as broken lines. In the second group of data, the following are entered: @k, the number of spectra to be processed; @l(1), ..., @l(@k), the identification numbers of the spectra to be processed; [@el, @eh], the interval between the energies to be traced; [10**@fl, 10**@fh], the values between which the function is to be traced out (spectrum or spectrum times energy); if @fl and/or @fh are not given, then the interval is found which accommodates all values of the functions to be plotted out.

Both data groups can be coded any number of times. The location of the unfolded spectrum library to be used is given by the same parameters as for the GPRINTP procedure. The ls=@l parameter can be used to indicate the data set number on a magnetic tape containing graph plotter data (we suggest that a tape with no labels and the volume serial number PLOTTP be used).

1.2.9. The ACTS activation integral calculation procedure

The ACTS procedure is designed to calculate activation integrals for all detectors of a given neutron cross-section library in a spectrum selected from a given a priori spectrum library. The following parameters are used:

D=@cname, the name of the neutron cross-section library. Permitted names in this version of SAIPS are given in Annex 2;

DS=@sname, the name of the a priori spectrum library. Permitted names are given in Annex 1;

P='@s[,@en[,@prc]]' are the calculation parameters: @s is the spectrum number; @en is the normalization energy in MeV for the spectrum selected; and @prc is the calculation parameter for the energy interval in which the detector picks up 100%-2*@prc of the activation integral.

2. STRUCTURE OF THE SAIPS DATA BASE

The SAIPS data base consists of individual data sets containing libraries of dosimetric neutron cross-sections, libraries of neutron spectra, job control language procedures and libraries of loading modules holding the SAIPS programs.

The names of the neutron cross-section data sets take the following form: SAIPS.DATA.CROSS.@d, where @d is the name of the cross-section library. The a priori spectrum libraries have names of the form: SAIPS.DATA.SPECTRA.@DS, where @DS is the name of the library of a priori spectra. The loading module library name is SAIPS.LIBRARY.LOAD.

In describing the structure of the SAIPS data sets, the descriptors of the types of data arrays adopted in the PL/1 algorithmic language are used. For each kind of data set there is a description of the logical records in that data set and their sequence.

2.1. Structure of the SAIPS a priori spectrum library

The SAIPS libraries of a priori spectra consist of the following logical records:

nref - the number of a priori spectra in the library (FIXED BIN (31))

kref - the number of detectors for which the activation integrals are given in the given spectra;

kref x {
- names - the names of the reactions for which activation integrals are given (CHAR(8*kref))
- name - the name of the reaction (CHAR(8))
- a - the values of the activation integrals for each of the spectra in the library and for a detector without a cover and with cadmium (0.5 mm thick), boron (1 mm) and gold (1 mm) covers ((nref,4) FLOAT DEC(6));

nref x {
- txt - characters describing the a priori spectrum (CHAR(80));
- psi - the a priori spectrum values ((621) FLOAT(6)).

The values of the activation integrals from the a priori spectrum libraries are used to select, by the least squares method, the best spectrum, for use as an initial approximation in the SAND-2 program. If this selection from a particular library is not used, 1 can be used for kref and the reaction names and activation integral values can be represented by hexadecimal zeros. The spectrum libraries supplied with SAIPS have no activation integral data and cannot be used to select an initial approximation with SAND-2 unfolding program.

2.2. SAIPS neutron cross-section libraries

The SAIPS neutron cross-section libraries consist of the following logical records:

mpll - the number of energy points for which the cross-section values are given (FIXED BIN (31))

e - the energy values ((mpll) FLOAT DEC(6))

ncov - the number of absorbers (FIXED BIN (31))

ncov x {
- aname - the name of the absorber (CHAR(4));
- att - absorber cross-section ((mpll) FLOAT DEC(6));

nlib - number of reactions for which cross-sections are given (FIXED BIN (31))

nlib x {
- name - the name of the reaction (CHAR(24)); the first eight characters are an abbreviation of the name of the reaction used in user language statements to identify the detector. The last 16 characters give the full name of the reaction;
- clam - half-life of the reaction's end product (FLOAT DEC(6));
- sig - cross-section values ((mpll) FLOAT DEC(6))

2.3. SAIPS unfolded spectrum libraries

The SAIPS unfolded spectrum libraries consist of the following logical records:

title - character data describing the calculation variant (CHAR(80); the information in title is taken from the last comments card of the user language;

prgid - character data describing the unfolding program (CHAR(80));

mpll - the number of energy points for which results are presented (FIXED BIN (15));

e - the energy scale for the results ((mpll) FLOAT DEC(6));

fi0 - the starting spectrum for the calculation ((mpll) FLOAT DEC(6));

fi - the unfolded spectrum ((mpll) FLOAT DEC(6));

er - the absolute error in the unfolded spectrum ((mpll) FLOAT DEC(6)).

This group of logical records in the library can be repeated. The absence of information in any data array is indicated by all the elements in the array having a value of zero. The data in the unfolded spectrum library are accessed by the SAIPS procedures using the sequence number of the record group.

3. CREATING A WORKING VERSION OF THE SAIPS SYSTEM

The SAIPS data base and calculation system is distributed in two forms: (1) on magnetic tape with ready-to-use programs and data sets (hexadecimal form of distribution tape); and (2) on magnetic tape containing the program source codes and data in character form. From the point of view of the programmer, these two versions differ only in the kind of work that has to be carried out to prepare SAIPS for use, while from the user's point of view both versions are identical.

3.1. The SAIPS character text distribution tape

On the magnetic tape are recorded the source of the SAIPS system programs, a system test job and a listing of the test job naming, data from the SAIPS cross-section and a priori spectrum libraries in "DKOJ" (EBCDIC) code, and spectrum unfolding programs; also given are the SAIPS job control language

procedures and an example job for setting up a working version of the system. A description of the tape contents is given in Annex 4.

In order to create a working version of SAIPS from the magnetic tapes, the following steps have to be performed:

(1) Creating and cataloging of the libraries for the loading modules SAIPS.LIBRARY.LOAD and the sequential data sets SAIPS.DATA.ABEND and SAIPS.DATA.DINT;

(2) Inclusion in the SAIPS.LIBRARY.LOAD library of all the system programs, i.e., translation and editing of the programs marked + in Annex 4;

(3) Converting to hexadecimal for the data libraries, using the procedures in PL/1 language from the data sets on magnetic tape marked & (converting a priori spectrum libraries) and # (converting the neutron cross-section libraries), and from the data in the files marked $ (cross-section library data) and % (a priori spectrum library data) in Annex 4. The convertion procedures are read from the tape using the SYSIN program file and the data libraries are created using the CRSLIB (for the cross-section libraries) and SPCLIB (for the a priori spectrum libraries) files;

(4) Inclusion in the system library of the SAIPS system job control language procedures.

All the SAIPS programs must be translated by the optimizing PL/1 compiler, while programs in FORTRAN should be compiled by the FORTRAN IV(H) translator. An example job generating SAIPS from the character text distribution tape is recorded on the tape itself (see Annex 4).

3.2. The SAIPS hexadecimal data format distribution tape

The hexadecimal version of the distribution tape has the serial volume number SAIPS1. The following steps must be carried out before SAIPS can be used:

(1) Translate, edit and run the PL/1 program recorded on the tape in source code form in the second data set under the name SAIPS.GNRPRG. The program processes the data from the third data set, called SAIPS.GNRDTA, using the SYSUT1 file and information input by the operator, and sets up the job to copy SAIPS from the tape into the direct access volume (job length about 50 cards) using the SYSUT2 program file;

(2) Run this job, which sets up the SAIPS loading module library and the cross-section and a priori spectrum libraries, cataloging all (approximately 21) data sets and writes the SAIPS procedures (about 260 cards) into the SYS1.PROCLIB library.

It is possible to carry out the above steps with the following OS ES job:

```
//------- JOB ----------
//TTTTTTTT EXEC PL1LFCLG
//PL1L.SYSIN DD DSN=SAIPS.GNRPRG,DISP=SHR,VOL=SER=SAIPS1,
//      UNIT=SYSSQ,LABEL=2
//GO.   SYSUT1 DD DSN=SAIPS.GNRDTA,DISP=SHR,VOL=SER=SAIPS1,
//      UNIT=SYSSQ,LABEL=3
//GO.   SYSUT2 DD DSN=SAIPS.SYSIN,DISP=(,KEEP),
//      VOL=SER=444444,UNIT=SYSSQ,SPACE=(80,(250,50))
//
```

- assuming that a disk with serial number 444444 is used as the scratch disk. While the job is running, the operator must enter the following data from the console:

(1) In response to SPS000A ENTER GTYPE, a line of characters defining the SAIPS generating type must be entered. Input lines may be made up of a combination of the following characters:

C - cards are included in the generating job which remove the data set of the system catalogue SYSCTLG from the disk unit where SAIPS is to be stored, reallocate it and merge the SAIPS index into it. This is necessary if the SAIPS data sets cannot be indexed on the OS ES resident volume;

B - a step copying the SAIPS procedures into the OS ES system library of procedures is included as part of the SAIPS generating job;

L - a step copying the SAIPS RDRS procedure into the OS ES procedures library is included. This must be done if there is not enough room in the OS ES system library for all the SAIPS procedures. The RDRS procedure makes it possible to access the SAIPS procedures and is run instead of the standard OS ES RDR procedure: the serial number of the volume containing the SAIPS procedures is indicated by the parameter V=@volser; _0 ! _1 ! _2 sets up only that part of the generating job which is given by the identification numbers; it can be used if the generating job is to be restarted or if it cannot be completed as a single job. If none of these options is needed, an empty line can be entered;

(2) In response to SPS010A ENTER JOB CARD, a job card fulfilling all of the requirements of the computing centre in question should be inserted;

(3) In response to SPS020A ENTER SYS1.PROCLIB VOLUME SERIAL, the serial number of the volume in which the SYS1.PROCLIB library is located should be entered;

(4) In response to SPS030A ENTER SYS1.PROCLIB VOLUME UNIT TYPE, enter the type name of the device where the volume containing the SYS1.PROCLIB library is held;

(5) In response to SPS040A ENTER SAIPS SYSTEM VOLUME SERIAL, enter the serial number of the volume in which the SAIPS system is to be stored;

(6) In response to SPS050A ENTER SAIPS SYSTEM UNIT TYPE, the type name of the device holding the SAIPS system volume should be entered.

When the job has finished, the SAIPS unfolding job which has therby been set up must be run, for example by the operator command S RDR,SYSSQ,444444,DSN=SAIPS.SYSIN. As additional user information, the text of the present description is to be found on the SAIPS1 tape in data set 1 under SAIPS.DESCRI. The test job SAIPS.TESTDT is contained in data set 4, and the test job run listing is in data set 5 under SAIPS.TESTOU. If necessary, these data sets can be printed out by the following OS ES job:

```
//---------JOB--------------------------
//*to print description*
//P1        EXEC PGM=IEBGENER
//SYSPRINT DD SYSOUT=A
//SYSIN     DD DUMMY
//SYSUT1    DD DSN=SAIPS.DESCRI,DISP=SHR,
//          VOL=(,RETAIN,SER=SAIPS1),UNIT=SYSSQ,LABEL=1
//SYSUT2    DD SYSOUT=A,DCB=(RECFM=F,LRECL=124,BLKSIZE=124),
//          SPACE=(124,(3200,600))
//* to print test job*
//P2        EXEC PGM=IEBGENER
//SYSPRINT DD SYSOUT=A
//SYSIN     DD DUMMY
//SYSUT1    DD DSN=SAIPS.TESTDT,DISP=SHR,
//          VOL=(,RETAIN,SER=SAIPS1),UNIT=SYSSQ,LABEL=4
//SYSUT2    DD SYSOUT=A,DCB=(RECFM=F,LRECL=80,BLKSIZE=80),
//          SPACE=(80,(400,100))

//* to print the test job listing *
//P3        EXEC PGM=IEBGENER
//SYSPRINT DD DUMMY
```

```
//SYSIN     DD DUMMY
//SYSUT1[*]DD DSN=SAIPS.TESTOU,DISP=SHR,
//          VOL=(,RETAIN,SER=SAIPS1),UNIT=SYSSQ,LABEL=5
//SYSUT2    DD SYSOUT=A,DCB=(RECFM=F,LRECL=133,BLKSIZE=133),
//          SPACE=(133,(5000,500))
//
```

---

[*] Translator's Note: Russian original says 115YSUT2

4. Appendices.

4.1. Appendix 1. Libraries of SAIPS apriori spectra.

1. Library SANDLIB [4] contains the following spectra:

1. Fission Form 1, Watt. 0.484*sinh(sqrt(2E))*exp(-E)
2. Fission Form 2, Frye. 0.453*sinh(sqrt(2.29E))*exp(-E/.965)
3. Fission Form 3, Maxwellian (Cranberg). .77*sqrt(E)*exp(-.776E)
4. Fission Form 4, Adjusted Maxwellian (Grundl).
5. Godiva Fast Burst Reactor.
6. Reciprocal Energy (0.038586/E).
7. One/E + Watt Fission Form, Matched at 0.5 Mev.
8. Thermal Maxwellian Form, 20 Degrees C.
   1.5918E15*E*exp(-3.987E7*E)
9. Thermal Maxwellian Form,100 Degrees C.
   9.7505E14*E*exp(-3.12E7*E)
10. Thermal Maxwellian Form,1000 Degrees C.
    8.1273e13*e*exp(-9.01E6*E)
11. 20 Deg.C. Maxwellian Matched to Spectrum 7 at 5.0E-8 Mev.
12. 20 Deg.C. Maxwellian Matched to Spectrum 7 at 1.4E-7 Mev.
13. 20 Deg.C. Maxwellian Matched to Spectrum 7 at 2.0E-7 Mev.
14. 20 Deg.C. Maxwellian Matched to Spectrum 7 at 3.0E-7 Mev.
15. 20 Deg.C. Maxwellian Matched to Spectrum 7 at 4.0E-7 Mev.
16. 20 Deg.C. Maxwellian Matched to Spectrum 7 at 6.0E-7 Mev.
17. 100 Deg.C. Maxwellian Matched to Spectrum 7 at 6.4E-8 Mev.
18. 1000 Deg.C. Maxwellian Matched to Spectrum 7 at 2.2E-7 Mev.
19. Ground Test Reactor.
20. Non-equilibrium 'Thermal' (5.3E+4 Deg.C.) + Spectrum 7.
21. Non-equilibrium 'Thermal' (5.3E+4 Deg.C.) + Spectrum 7 + Fussion Peak
22. Non-equilibrium 'Thermal' (5.3E+5 Deg.C.) + Spectrum 7.
23. Non-equilibrium 'Thermal' (5.3E+5 Deg.C.) + Spectrum 7 + Fussion Peak
24. Maxwellian Thermal(100,000,000 Deg.C.) + Spectrum 7.
25. Spectrum 24 + Nominally 3 Percent Fusion.
26. Spectrum 24 + Nominally 10 Percent Fusion.
27. Spectrum 24 + Nominally 30 Percent Fusion.
28. Spectrum 24 + Nominally 70 Percent Fusion.
29. Calculated 3 Percent Fusion + Thermal Below 1 Kev.
30. Calculated 3 Percent Fusion + E Below 1 KeV.
31. Thirty Percent Fusion + E Below 5.0E-5 Mev.
32. Thirty Percent Fusion + Thermal Below 5.0E-5 Mev.
33. ZPR-6 Assembly 4Z + E Below 1.4 KeV + Fission Above 0.9 Mev.
34. ZPR-6 Assembly 4Z + Thermal Below 1.4 KeV + Fission Above 0.9 Mev.
35. Avogadro 1 + Thermal Below 0.5 Mev.
36. EBR Hole 1 + Fission Below .05 Mev and Above 3 Mev.
37. EBR Hole 348 + Fission Below .05 Mev and Above 2 Mev.
38. Heavy Water Flooded Clusters + Thermal Below 10 KeV.
39. CPS Dummy + Thermal Below 76.5 KeV + Fission Above 10 Mev.

40. Typical Fast Breeder core + Godiva Below .01 Mev + Fission Above 5 Mev
41. BNLST SPACE Point 90 + Godiva Below 0.1 Mev + Fission Above 9 Mev.
42. GTR Incident on Beryllium Reflector + Fission Below 0.5 Mev and Above 9 Mev.
43. GTR Reflected from Beryllium Reflector + Fission Below 0.5 Mev and Above 9 Mev.
44. Fission Through 10 cm. Carbon + Thermal Below 2 KeV + Fission Above 15 Mev.
45. Fission Through 90 cm. Water + Thermal Below 2 KeV + Fission Above 15 Mev.
46. EBR-1-VW + Thermal Below .02 Mev + Fission Above 5.25 Mev.
47. EBR-1-VW + Godiva Below .02 Mev + Fission Above 5.25 Mev.
48. UO(2)F(2) Intermediate Reactor + Thermal Below 1 KeV + Fission Above 10 Mev.
49. 20 cm. Li-H slab (NIOBE) + Thermal Below 0.2 Mev + Fission Above 14 Mev.
50. Etr Water Loop G-7 + Thermal Below 9.15E-2 Mev + Fission Above 8.895 Mev.
51. Graphite Test Lattice + Thermal Below 2.195E-7 Mev + Fission Above 8.895 Mev.
52. Fermi Reactor Test Shield + Thermal Below 2.195E-7 Mev + Fission Above 8.895 Mev
53. ETR Pressure Vessel + Thermal Below 9.15E-2 Mev + Fission Above 8.895 Mev.
54. BSF Reactor (7.5 cm. Beryllium Oxide + 5 cm. Water), + Thermal Below 1.325 Mev.
55. BSF Reactor (7.5 cm. Beryllium Oxide + 20 cm. Water), + Thermal Below 1.36 Mev.
56. BSF Reactor (7.5 cm. Beryllium Oxide + 30 cm. Water), + Thermal Below 1.39 Mev.
57. AE-6 (AIM-6/CAESAR-II Calc.) + Thermal Below 4.14E-7 Mev + Fission Above 3 Mev.
58. SGRCF (AIM-6/CAESAR-IV Calc.) + Thermal Below 4.14E-7 Mev + Fission Above 3 Mev.
59. ECEL Core 14-13 Calculation + Godiva Below 0.00926 eV + Fission Above 3 Mev.

2. Library IRDF82 [10] contains the following spectra:

1. ** NBS CF 252 Spontaneos Fission **
2. ** NBS U 235 Thermal Fission **
3. ** ENDFB/V U 235 Fission **
4. ** Intermidiate-Energy Standard Neutron Field - ISNF **
5. ** Coupled Fast Reactivity Measurement Facility - CFRMT **
6. ** 10% Enriched Uranium Cyl. Crit. Assembly (BIG TEN) **
7. ** Coupled Thermal/Fast U and B Carbide Spm.Ass. (SIGMA-SIGMA) **
8. ** ORR **
9. ** YAYOI **
10. ** Cetral Zone Flux of NEACRP Benchmark Spectra **

3. Library BKS1 [11] contains the following spectra:

1. Spectrum 1.1 U235 Watt Fission Form
2. Spectrum 1.2 CF252 Fission Form sqrt(e)*exp(-E/1.46)
3. Spectrum 1.3 Reciprocal Energy 1.0/E
4. Spectrum 2.1 CTR Fussion Form (anisn code calculation)
5. Spectrum 3.1 MOL - SIGSIG (NUC. Techn. 25 feb. 1975)
6. Spectrum 3.2 BIG - TEN (NUC. Techn. 25 feb. 1975)

7. Spectrum 3.3 CFRME (NUC. Techn. 25 feb. 1975)
8. Spectrum 3.4 Fast neutron spectrum through lithium
9. Spectrum 3.5 fermi reactor Through natrium (mont-carlocalculatior
10. Spectrum 3.6 ZPR - 3 - 10 (critical experiments calculations)
11. Spectrum 5.5 IM T R (anisn code calculation)
12. Spectrum 5.6
13. Spectrum 6.1 B R Through 16 cm NI
14. Spectrum 6.2
15. Spectrum 6.3 U235 Fission Form Through 10 cm FE (calculated)
16. Spectrum 6.4
17. Spectrum 7.1
18. Spectrum 7.2
19. Spectrum 7.3
20. Spectrum 8.1
21. Spectrum 4.1 G T R
22. Spectrum 4.2 U235 Fission Form through 90 cm Water
23. Spectrum 4.3 E T R (monte-carlo calculation)
24. Spectrum 4.4 U235 Fission Form through 30 cm polietilen
25. Spectrum 4.5
26. Spectrum 4.6
27. Spectrum 5.1 eepo reactor (monte-carlo calculation)
28. Spectrum 5.2
29. Spectrum 5.3
30. Spectrum 5.4 U235 Fission Form through 10 cm grafit

4. Library KUIJPRS [12] contains the following spectra:

1. T * Kuijpers & Markovskij * R=0.100 m
2. T * Kuijpers & Markovskij * R=0.200 M
3. T * Kuijpers & Markovskij * R=0.308 M
4. T * Kuijpers & Markovskij * R=0.400 M
5. T * Kuijpers & Markovskij * R=0.528 M
6. T * Kuijpers & Markovskij * R=0.600 M
7. * Reference Blanket Spectrum * L.J.M.Kuijpers 1977.
8. * Be-Li Blanket 0.100 M Calc. With MORSE in 99 En.Groups * Kuijpers
9. * Be-Li Blanket 0.308 M Calc. With MORSE in 99 En.Groups * Kuijpers
10. * Be-Li Blanket 0.528 M Calc. With MORSE in 99 En.Groups * Kuijpers
11. * Li Blanket 0.100 M Calc. With MORSE in 99 En.Groups * Kuijpers
12. * Li Blanket 0.308 M Calc. With MORSE in 99 En.Groups * Kuijpers
13. * Li Blanket 0.528 M Calc. With MORSE in 99 En.Groups * Kuijpers

5. Library ATK25 [13] contains the following spectra:

1. * B3K-1 , Kernenergie,VOL 25,# 3, 1981, pp. 105-108 *
2. * PP , Kernenergie,VOL 25,# 3, 1981, pp. 105-108 *
3. * T1 , Kernenergie,VOL 25,# 3, 1981, pp. 105-108 *
4. * T2 , Kernenergie,VOL 25,# 3, 1981, pp. 105-108 *
5. * T3 , Kernenergie,VOL 25,# 3, 1981, pp. 105-108 *
6. * T4 , Kernenergie,VOL 25,# 3, 1981, pp. 105-108 *
7. * T5 , Kernenergie,VOL 25,# 3, 1981, pp. 105-108 *
8. * T6 , Kernenergie,VOL 25,# 3, 1981, pp. 105-108 *

6. Library GTRT [14] contains the following spectra:

```
1. * GRTR * d=0.291 Mev, E=14.1 Mev, t=15 KeV
2.  1.0/sqrte(2*pi*0.291)*exp(-(E-14.1)**2/0.291**2/2)
3. * Neutron spectrum is blanket behind 15 cm Pb *
4. * Neutron spectrum is blanket behind 7.5 cm Pb *
```

4.2. Appendix 2. Libraries of SAIPS neutron cross sections.

1. Library ENDFBIV [15] contains cross sections for the following reactions (reaction is given in short and full title):

1.	LI6A	LI6(N,A)H3	2.	B10A	B10(N,A)LI7
3.	NA23G	NA23(N,G)NA24	4.	AL27A	AL27(N,A)NA24
5.	AL27P	AL27(N,P)MG27	6.	S32P	S32(N,P)P32
7.	SC45G	SC45(N,G)SC46	8.	TI46P	TI46(N,P)SC46
9.	TI47NP	TI47(N,NP)SC47	10.	TI47P	TI47(N,P)SC47
11.	TI48NP	TI48(N,NP)SC47	12.	TI48P	TI48(N,P)SC48
13.	FE54P	FE54(N,P)MN54	14.	MN552	MN55(N,2N)MN54
15.	FE56P	FE56(N,P)MN56	16.	FE58G	FE58(N,G)FE59
17.	NI58P	NI58(N,P)CO58	18.	NI582	NI58(N,2N)NI57
19.	CO59A	CO59(N,A)MN56	20.	CO59G	CO59(N,G)CO60
21.	CO592	CO59(N,2N)CO58	22.	NI60P	NI60(N,P)CO60
23.	CU63A	CU63(N,A)CO60	24.	CU63G	CU63(N,G)CU64
25.	CU652	CU65(N,2N)CU64	26.	IN115G	IN115(N,G)IN116
27.	IN115N	IN115(N,N)IN115M	28.	I1272	I127(N,2N)I126
29.	AU197G	AU197(N,G)AU198	30.	TH232F	TH232(N,F)FP
31.	TH232G	TH232(N,G)TH233	32.	U235F	U235(N,F)FP
33.	PU239F	PU239(N,F)FP	34.	U238F	U238(N,F)FP
35.	U238G	U238(N,G)U238	36.	NP237F	NP237(N,F)FP

2. Library ENDL78 [16] contains cross sections for the following reactions (reaction is given in short and full title):

1.	S322	S32(N,2N)S31	2.	S32P	S32(N,P)P32
3.	S32A	S32(N,A)SI29	4.	CL02	CL0(N,2N)CL
5.	CL0P	CL0(N,P)S	6.	CL0A	CL0(N,A)P
7.	AR02	AR0(N,2N)AR	8.	AR0P	AR0(N,P)CL
9.	AR0A	AR0(N,A)S	10.	K02	K0(N,2N)K
11.	K0P	K0(N,P)AR	12.	K0A	K0(N,A)CL
13.	CA02	CA0(N,2N)CA	14.	CA0P	CA0(N,P)K
15.	CA0A	CA0(N,A)AR	16.	TI02	TI0(N,2N)TI
17.	TI0P	TI0(N,P)SC	18.	TI0A	TI0(N,A)CA
19.	V512	V51(N,2N)V50	20.	V51P	V51(N,P)TI51
21.	V51A	V51(N,A)SC48	22.	CR02	CR0(N,2N)CR
23.	CR0P	CR0(N,P)V	24.	MN552	MN55(N,2N)MN54
25.	MN55P	MN55(N,P)CR55	26.	MN55A	MN55(N,A)V52
27.	FE02	FE0(N,2N)FE	28.	FE0P	FE0(N,P)MN
29.	FE0A	FE0(N,A)CR	30.	CO592	CO59(N,2N)CO58
31.	CO59P	CO59(N,P)FE59	32.	CO59A	CO59(N,A)MN56
33.	NI02	NI0(N,2N)NI	34.	NI0P	NI0(N,P)CO
35.	NI0A	NI0(N,A)FE	36.	NI582	NI58(N,2N)NI57
37.	NI58P	NI58(N,P)CO58	38.	NI58A	NI58(N,A)FE55
39.	CU02	CU0(N,2N)CU	40.	CU0P	CU0(N,P)NI
41.	CU0A	CU0(N,A)CO	42.	GA02	GA0(N,2N)GA
43.	GA0P	GA0(N,P)ZN	44.	GA0A	GA0(N,A)CU

45. ZR02	ZR0(N,2N)ZR	46. ZR0P	ZR0(N,P)Y
47. NB932	NB93(N,2N)NB92	48. NB93P	NB93(N,P)ZR93
49. NB93A	NB93(N,A)Y90	50. M002	M00(N,2N)M0
51. AG1072	AG107(N,2N)AG106	52. AG107P	AG107(N,P)PD107
53. AG107A	AG107(N,A)RH104	54. AG1092	AG109(N,2N)AG108
55. AG109P	AG109(N,P)PD109	56. AG109A	AG109(N,A)RH106
57. CD02	CD0(N,2N)CD	58. SN02	SN0(N,2N)SN
59. BA1382	BA138(N,2N)BA137	60. BA138P	BA138(N,P)CS138
61. BA138A	BA138(N,A)XE135	62. EU02	EU0(N,2N)EU
63. GD02	GD0(N,2N)GD	64. H01652	H0165(N,2N)H0164
65. TA1812	TA181(N,2N)TA180	66. TA181P	TA181(N,P)HF181
67. W02	W0(N,2N)W	68. RE1852	RE185(N,2N)RE184
69. RE1872	RE187(N,2N)RE186	70. PT02	PT0(N,2N)PT
71. AU1972	AU197(N,2N)AU196	72. AU197P	AU197(N,P)PT197
73. AU197A	AU197(N,A)IR194	74. PB02	PB0(N,2N)PB
75. TH2312	TH231(N,2N)TH230	76. TH2322	TH232(N,2N)TH231
77. TH2332	TH233(N,2N)TH232	78. U2332	U233(N,2N)U232
79. U2342	U234(N,2N)U233	80. U2352	U235(N,2N)U234
81. U2362	U236(N,2N)U235	82. U2372	U237(N,2N)U236
83. U2382	U238(N,2N)U237	84. U2392	U239(N,2N)U238
85. U2402	U240(N,2N)U239	86. NP2372	NP237(N,2N)NP236
87. PU2382	PU238(N,2N)PU237	88. PU2392	PU239(N,2N)PU238
89. PU2402	PU240(N,2N)PU239	90. PU2412	PU241(N,2N)PU240
91. PU2422	PU242(N,2N)PU241	92. PU2432	PU243(N,2N)PU242
93. AM2412	AM241(N,2N)AM240	94. AM2422	AM242(N,2N)AM241
95. AM2432	AM243(N,2N)AM242	96. CM2422	CM242(N,2N)CM241
97. CM2432	CM243(N,2N)CM242	98. CM2442	CM244(N,2N)CM243
99. CM2452	CM245(N,2N)CM244	100. CM2462	CM246(N,2N)CM245
101. CM2472	CM247(N,2N)CM246	102. CM2482	CM248(N,2N)CM247
103. BK2492	BK249(N,2N)BK248	104. CF2492	CF249(N,2N)CF248
105. CF2502	CF250(N,2N)CF249	106. CF2512	CF251(N,2N)CF250
107. CF2522	CF252(N,2N)CF251	108. ES1202	ES120(N,2N)ES119
109. H22	H2(N,2N)H1	110. H32	H3(N,2N)H2
111. HE3P	HE3(N,P)H3	112. LI62	LI6(N,2N)LI5
113. LI6P	LI6(N,P)HE6	114. LI72	LI7(N,2N)LI6
115. BE7P	BE7(N,P)LI7	116. BE7A	BE7(N,A)HE4
117. BE9P	BE9(N,P)LI9	118. BE9A	BE9(N,A)HE6
119. B102	B10(N,2N)B9	120. B10A	B10(N,A)LI7
121. B112	B11(N,2N)B10	122. B11P	B11(N,P)BE11
123. B11A	B11(N,A)LI8	124. C12P	C12(N,P)B12
125. C12A	C12(N,A)BE9	126. N142	N14(N,2N)N13
127. N14P	N14(N,P)C14	128. N14A	N14(N,A)B11
129. O162	O16(N,2N)O15	130. O16P	O16(N,P)N16
131. O16A	O16(N,A)C13	132. F192	F19(N,2N)F18
133. F19P	F19(N,P)O19	134. F19A	F19(N,A)N16
135. NA232	NA23(N,2N)NA22	136. NA23P	NA23(N,P)NE23
137. NA23A	NA23(N,A)F20	138. MG02	MG0(N,2N)MG
139. MG0P	MG0(N,P)NA	140. AL272	AL27(N,2N)AL26
141. AL27P	AL27(N,P)MG27	142. AL27A	AL27(N,A)NA24
143. SI02	SI0(N,2N)SI	144. SI0P	SI0(N,P)AL
145. SI0A	SI0(N,A)MG	146. P312	P31(N,2N)P30
147. P31P	P31(N,P)SI31	148. P31A	P31(N,A)AL28

3. Library IRDF82 [10] contains cross sections for the following reactions (reaction is given in short and full title):

1. F192	F19(N,2N)F18	2. AM241F	AM241(N,F)FP
3. NA232	NA23(N,2N)NA22	4. MG24P	MG24(N,P)NA24
5. P31P	P31(N,P)SI31	6. CU632	CU63(N,2N)CU62

7. ZN64F	ZN64(N,P)CU64	8. ZR902	ZR90(N,2N)ZR89
9. NB93N	NB93(N,N)NB93	10. RH103N	RH103(N,N)RH103
11. NA23G	NA23(N,G)NA24	12. AL27F	AL27(N,P)MG27
13. AL27A	AL27(N,A)NA24	14. MN552	MN55(N,2N)MN54
15. CO592	CO59(N,2N)CO58	16. CO59G	CO59(N,G)CO60
17. CO59A	CO59(N,A)MN56	18. NP237F	NP237(N,F)FP
19. AU197G	AU197(N,G)AU198	20. TH232F	TH232(N,F)FP
21. TH232G	TH232(N,G)TH233	22. U235F	U235(N,F)FP
23. U238F	U238(N,F)FP	24. U238G	U238(N,G)U239
25. PU239F	PU239(N,F)FP	26. LI6A	LI6(N,A)H3
27. B10A	B10(N,A)LI7	28. SC45G	SC45(N,G)SC46
29. TI46P	TI46(N,P)SC46	30. TI47NP	TI47(N,NP)SC47
31. TI47P	TI47(N,P)SC47	32. TI48NP	TI48(N,NP)SC48
33. TI48P	TI48(N,P)SC48	34. FE54P	FE54(N,P)MN54
35. FE56P	FE56(N,P)MN56	36. FE58G	FE58(N,G)FE59
37. NI582	NI58(N,2N)NI57	38. NI58P	NI58(N,P)CO58
39. NI60P	NI60(N,P)CO60	40. CU63G	CU63(N,G)CU64
41. CU63A	CU63(N,A)CO60	42. CU652	CU65(N,2N)CU64
43. IN115N	IN115(N,N)IN115	44. IN115G	IN115(N,G)IN116
45. I1272	I127(N,2N)I126	46. S32P	S32(N,P)P32
47. ST-ASTM	ASTM-DISPL-STEEL	48. ST-EUR	EUR-DISPL-STEEL

4. Library DETAN74 [17] contains cross sections for the following reactions (reaction is given in short and full title):

1. CU63AM	CU63(N,A)CO60M	2. AG109G	AG109(N,G)AG110M
3. CO59A	CO59(N,A)MN56	4. FE58G	FE58(N,G)FE59
5. NI60P	NI60(N,P)CO60	6. CU63A	CU63(N,A)CO60
7. NI58P	NI58(N,P)CO58	8. PU239F	PU239(N,F)FP
9. SC45G	SC45(N,G)SC46	10. NA23G	NA23(N,G)NA24
11. TH232G	TH232(N,G)TH233	12. U238G	U238(N,G)U239
13. AU197G	AU197(N,G)AU198	14. CO59G	CO59(N,G)CO60
15. IN115G	IN115(N,G)IN116M	16. MN55G	MN55(N,G)MN56
17. CU63G	CU63(N,G)CU64	18. TH232F	TH232(N,F)FP
19. ZN64P	ZN64(N,P)CU64	20. FE54P	FE54(N,P)MN54
21. S32P	S32(N,P)P32	22. SI28P	SI28(N,P)AL28
23. S34A	S34(N,A)SI31	24. MG24P	MG24(N,P)NA24
25. CL35A	CL35(N,A)P32	26. NI582	NI58(N,2N)NI57
27. I1272	I127(N,2N)I126	28. ZR902	ZR90(N,2N)ZR89
29. TI46P	TI46(N,P)SC46	30. TI47P	TI47(N,P)SC47
31. TI48P	TI48(N,P)SC48	32. CU632	CU63(N,2N)CU62
33. P31P	P31(N,P)SI31	34. FE56P	FE56(N,P)MN56
35. AL27P	AL27(N,P)MG27	36. NP237F	NP237(N,F)FP
37. U238F	U238(N,F)FP	38. U235F	U235(N,F)FP
39. AL27A	AL27(N,A)NA24	40. IN115N	IN115(N,N)M

5. Library AUST [18] contains cross sections for the following reactions (reaction is given in short and full title):

1. MO98G	MO98(N,G)MO99	2. LA139G	LA139(N,G)LA140
3. SM152G	SM152(N,G)SM153	4. DY164G	DY164(N,G)DY165
5. W186G	W186(N,G)W187		

6. Library DOSCROS [19] contains cross sections for the following reactions (reaction is given in short and full title):

1. TI46P	TI46(N,P)SC46	2. TI47P	TI47(N,P)SC47

3. TI48F	TI48(N,F)SC48	4. IN115N	IN115(N,N)IN115M
5. AM241F	AM241(N,F)FP		

7. Library ENDFBV [20] contains cross sections for the following reactions (reaction is given in short and full title):

1. NA23G	NA23(N,G)NA24	2. AL27P	AL27(N,P)MG27
3. AL27A	AL27(N,A)NA24	4. MN552	MN55(N,2N)MN54
5. CO592	CO59(N,2N)CO58	6. CO59G	CO59(N,G)CO60
7. CO59A	CO59(N,A)MN56	8. NP237F	NP237(N,F)FP
9. AU197G	AU197(N,G)AU198	10. TH232F	TH232(N,F)FP
11. TH232G	TH232(N,G)TH233	12. U235F	U235(N,F)FP
13. U238F	U238(N,F)FP	14. U238G	U238(N,G)U239
15. PU239F	PU239(N,F)FP	16. SC45G	SC45(N,G)SC46
17. TI46P	TI46(N,P)SC46	18. TI47P	TI47(N,P)SC47
19. TI48P	TI48(N,P)SC48	20. FE54P	FE54(N,P)MN54
21. FE56P	FE56(N,P)MN56	22. FE58G	FE58(N,G)FE59
23. NI582	NI58(N,2N)NI57	24. NI58P	NI58(N,P)CO58
25. NI60P	NI60(N,P)CO60	26. CU63G	CU63(N,G)CU64
27. CU63A	CU63(N,A)CO60	28. CU652	CU65(N,2N)CU64
29. IN115N	IN115(N,N)IN115	30. IN115G	IN115(N,G)IN116
31. I1272	I127(N,2N)I126		

8. Library REAL80 [21] contains cross sections for the following reactions (reaction is given in short and full title):

1. NA23G	NA23(N,G)NA24	2. MG24P	MG24(N,P)NA24
3. AL27A	AL27(N,A)NA24	4. AL27P	AL27(N,P)MG27
5. SC45G	SC45(N,G)SC46	6. TI46P	TI46(N,P)SC46
7. TI47P	TI47(N,P)SC47	8. TI48P	TI48(N,P)SC48
9. FE54A	FE54(N,A)CR51	10. FE54P	FE54(N,P)MN54
11. MN55G	MN55(N,G)MN56	12. FE56P	FE56(N,P)MN56
13. NI58P	NI58(N,P)CO58	14. FE58G	FE58(N,G)FE59
15. CO59A	CO59(N,A)MN56	16. CO59G	CO59(N,G)CO60
17. NI60P	NI60(N,P)CO60	18. IN115N	IN115(N,N)IN115M
19. W186G	W186(N,G)W187	20. AU197G	AU197(N,G)AU198
21. AU1972	AU197(N,2N)AU196	22. U235F	U235(N,F)FP
23. NP237F	NP237(N,F)FP	24. NP237G	NP237(N,G)NP238
25. U238F	U238(N,F)FP	26. U238G	U238(N,G)U239
27. ST-EUR	EUR-DISPL-STEEL	28. ST-ASTM	ASTM-DISPL-STEEL

9. Library ENDFBIVG [22] contains cross sections for the following reactions (reaction is given in short and full title):

1. CL0G	CL0(N,G)CL1	2. LI7A	LI7(N,NA)H3
3. PU240F	PU240(N,F)FP	4. PU238F	PU238(N,F)FP
5. AM241F	AM241(N,F)FP	6. AM243F	AM243(N,F)FP
7. DY164G	DY164(N,G)DY165	8. LU175G	LU175(N,G)LU176
9. LU176G	LU176(N,G)LU177	10. U233F	U233(N,F)FP
11. U233G	U233(N,G)U234	12. U234F	U234(N,F)FP
13. U236F	U236(N,F)FP		

10. Library JENDL1 [23] contains cross sections for the following reactions (reaction is given in short and full title):

1. LI6A	LI6(N,A)H3	2. B102	B10(N,2N)B9

3. B10A	B10(N,A)LI7	4. NA232	NA23(N,2N)NA22
5. NA23P	NA23(N,P)NE23	6. NA23A	NA23(N,A)F20
7. AL272	AL27(N,2N)AL26	8. AL27P	AL27(N,P)MG27
9. AL27A	AL27(N,A)NA24	10. SI02	SI0(N,2N)SI
11. SI0P	SI0(N,P)AL	12. SI0A	SI0(N,A)MG
13. CR02	CR0(N,2N)CR	14. CR0P	CR0(N,P)V
15. CR0A	CR0(N,A)TI	16. CR502	CR50(N,2N)CR49
17. CR50P	CR50(N,P)V50	18. CR50A	CR50(N,A)TI47
19. CR522	CR52(N,2N)CR51	20. CR52P	CR52(N,P)V52
21. CR52A	CR52(N,A)TI49	22. CR532	CR53(N,2N)CR52
23. CR53P	CR53(N,P)V53	24. CR53A	CR53(N,A)TI50
25. CR542	CR54(N,2N)CR53	26. FE02	FE0(N,2N)FE
27. FE0P	FE0(N,P)MN	28. FE0A	FE0(N,A)CR
29. FE542	FE54(N,2N)FE53	30. FE54P	FE54(N,P)MN54
31. FE54A	FE54(N,A)CR51	32. FE562	FE56(N,2N)FE55
33. FE56P	FE56(N,P)MN56	34. FE56A	FE56(N,A)CR53
35. FE572	FE57(N,2N)FE56	36. FE57P	FE57(N,P)MN57
37. FE57A	FE57(N,A)CR54	38. FE582	FE58(N,2N)FE57
39. FE58P	FE58(N,P)MN58	40. FE58A	FE58(N,A)CR55
41. NI02	NI0(N,2N)NI	42. NI0P	NI0(N,P)CO
43. NI0A	NI0(N,A)FE	44. NI582	NI58(N,2N)NI57
45. NI58P	NI58(N,P)CO58	46. NI58A	NI58(N,A)FE55
47. NI602	NI60(N,2N)NI59	48. NI60P	NI60(N,P)CO60
49. NI60A	NI60(N,A)FE57	50. NI612	NI61(N,2N)NI60
51. NI61P	NI61(N,P)CO61	52. NI61A	NI61(N,A)FE58
53. NI622	NI62(N,2N)NI61	54. NI62P	NI62(N,P)CO62
55. NI62A	NI62(N,A)FE59	56. NI642	NI64(N,2N)NI63
57. NI64A	NI64(N,A)FE61	58. CU02	CU0(N,2N)CU
59. CU632	CU63(N,2N)CU62	60. CU652	CU65(N,2N)CU64
61. TA1812	TA181(N,2N)TA180	62. TA181P	TA181(N,P)HF181
63. TH2322	TH232(N,2N)TH231	64. PA2332	PA233(N,2N)PA232
65. U2342	U234(N,2N)U233	66. U2352	U235(N,2N)U234
67. U2382	U238(N,2N)U237	68. NP2392	NP239(N,2N)NP238
69. PU2392	PU239(N,2N)PU238	70. PU2402	PU240(N,2N)PU239
71. PU2412	PU241(N,2N)PU240	72. AM2412	AM241(N,2N)AM240

11. Library BOSPOR80 [24] contains cross sections for the following reactions (reaction is given in short and full title):

1. H22	H2(N2N)H1	2. LI6P	LI6(NP)HE6
3. LI62	LI6(N2N)LI5	4. BE92	BE9(N2N)BE8
5. B10T	B10(NT)BE8	6. C12P	C12(NP)B12
7. N14A	N14(NA)B11	8. N142	N14(N2N)N13
9. O16P	O16(NP)N16	10. O16A	O16(NA)C13
11. F19P	F19(NP)O19	12. F19A	F19(NA)N16
13. F192	F19(N2N)F18	14. NA23P	NA23(NP)NE23
15. NA23A	NA23(NA)F20	16. NA232	NA23(N2N)NA22
17. AL27A	AL27(NA)NA24	18. AL27P	AL27(NP)MG27
19. MG24P	MG24(NP)NA24	20. SI28P	SI28(NP)AL28
21. P31P	P31(NP)SI31	22. P31A	P31(NA)AL28
23. P312	P31(N2N)P30	24. S32P	S32(NP)P32
25. S32A	S32(NA)SI29	26. S32T	S32(NT)P30
27. S322	S32(N2N)S31	28. S34A	S34(NA)SI31
29. CL35A	CL35(NA)P32	30. CL352	CL35(N2N)CL34
31. CL352M	CL35(N2N)CL34M	32. K39P	K39(NP)AR39
33. K39A	K39(NA)CL36	34. K392	K39(N2N)K38
35. K41P	K41(NP)AR41	36. K41A	K41(NA)CL38
37. CA42P	CA42(NP)K42	38. CA44P	CA44(NP)K44
39. CA44A	CA44(NA)AR41	40. SC45A	SC45(NA)K42

41.	SC45P	SC45(NP)CA45	42.	SC452	SC45(N2N)SC44
43.	SC452M	SC45(N2N)SC44M	44.	TI46P	TI46(NP)SC46
45.	TI462	TI46(N2N)TI45	46.	TI47P	TI47(NP)SC47
47.	TI48P	TI48(NP)SC48	48.	TI49P	TI49(NP)SC49
49.	TI50P	TI50(NP)SC50	50.	ZN662	ZN66(N2N)ZN65
51.	ZN66P	ZN66(NP)CU66	52.	ZN642	ZN64(N2N)ZN63
53.	ZN64P	ZN64(NP)CU64	54.	CU652	CU65(N2N)CU64
55.	CU65P	CU65(NP)NI65	56.	CU632	CU63(N2N)CU62
57.	NI62A	NI62(NA)FE59	58.	NI60P	NI60(NP)CO60
59.	NI582	NI58(N2N)NI57	60.	NI58A	NI58(NA)FE55
61.	NI58D	NI58(ND)CO57	62.	NI58P	NI58(NP)CO58
63.	CO592	CO59(N2N)CO58	64.	CO59A	CO59(NA)MN56
65.	CO59P	CO59(NP)FE59	66.	FE562	FE56(N2N)FE55
67.	FE56P	FE56(NP)MN56	68.	FE542	FE54(N2N)FE53
69.	FE54A	FE54(NA)CR51	70.	FE54P	FE54(NP)MN54
71.	MN552	MN55(N2N)MN54	72.	CR522	CR52(N2N)CR51
73.	CR52P	CR52(NP)V52	74.	CR502	CR50(N2N)CR49
75.	GA692	GA69(N2N)GA68	76.	GA712	GA71(N2N)GA70
77.	GE702	GE70(N2N)GE69	78.	GE762	GE76(N2N)GE75
79.	AS75P	AS75(NP)GE75	80.	AS75A	AS75(NA)GA72
81.	AS752	AS75(N2N)AS74	82.	SE742	SE74(N2N)SE73
83.	SE762	SE76(N2N)SE75	84.	SE782	SE78(N2N)SE77
85.	SE802	SE80(N2N)SE79	86.	SE822	SE82(N2N)SE81
87.	BR792	BR79(N2N)BR78	88.	BR812	BR81(N2N)BR80
89.	BR812M	BR81(N2N)BR80M	90.	RB852	RB85(N2N)RB84
91.	RB872	RB87(N2N)RB86	92.	SR842	SR84(N2N)SR83
93.	SR882	SR88(N2N)SR87M	94.	Y892	Y89(N2N)Y88
95.	ZR90P	ZR90(NP)Y90	96.	ZR902	ZR90(N2N)ZR89
97.	NB932	NB93(N2N)NB92	98.	NB932M	NB93(N2N)NB92M
99.	MO922	MO92(N2N)MO91	100.	RH1032	RH103(N2N)RH102
101.	CD1062	CD106(N2N)CD105M	102.	CD111P	CD111(NP)AG111
103.	CD112A	CD112(NA)PD109	104.	CD1162	CD116(N2N)CD115
105.	IN1132	IN113(N2N)IN112	106.	IN1152M	IN115(N2N)IN114M
107.	IN1152	IN115(N2N)IN114	108.	SN1122	SN112(N2N)SN113
109.	SN118A	SN118(NA)CD115	110.	SB1212	SB121(N2N)SB120
111.	SB1232	SB123(N2N)SB122	112.	I1272	I127(N2N)I126
113.	CS1332	CS133(N2N)CS132	114.	CE1402	CE140(N2N)CE139
115.	CE1492	CE149(N2N)CE139M	116.	CE1422	CE142(N2N)CE141
117.	PR1412	PR141(N2N)PR140	118.	ND1422	ND142(N2N)ND141
119.	ND1462	ND146(N2N)ND145	120.	ND1482	ND148(N2N)ND147
121.	ND1502	ND150(N2N)ND149	122.	SM1442	SM144(N2N)SM143
123.	SM1482	SM148(N2N)SM147	124.	SM1502	SM150(N2N)SM149
125.	SM1522	SM152(N2N)SM151	126.	SM1542	SM154(N2N)SM153
127.	TM1692	TM169(N2N)TM168	128.	LU1752	LU175(N2N)LU174
129.	TA181P	TA181(NP)HF181	130.	TA1812	TA181(N2N)TA180
131.	TA1812M	TA181(N2N)TA180M	132.	IR1912	IR191(N2N)IR190
133.	IR1932	IR193(N2N)IR192	134.	AU1972	AU197(N2N)AU196
135.	TL2032	TL203(N2N)TL202	136.	TL2052	TL205(N2N)TL204
137.	PB2042	PB204(N2N)PB203	138.	PB2082	PB208(N2N)PB207M
139.	BI209	BI209(N2N)BI208	140.	TH2322	TH232(N2N)TH231
141.	U2382	U238(N2N)U237	142.	V51A	V51(NA)SC48

12. Library ZACRSS [9] contains cross sections for the following reactions (reaction is given in short and full title):

1.	F192	F19(N,2N)F18	2.	MG24P	MG24(N,P)NA24
3.	AL27P	AL27(N,P)MG27	4.	AL27A	AL27(N,A)NA24
5.	TI46P	TI46(N,P)SC46	6.	TI47P	TI47(N,P)SC47
7.	TI48P	TI48(N,P)SC48	8.	MN552	MN55(N,2N)MN54

9. FE54P	FE54(N,P)MN54	10. FE56P	FE56(N,P)MN56
11. CO59A	CO59(N,A)MN56	12. S32P	S32(N,P)P32
13. NI582	NI58(N,2N)NI57	14. NI58P	NI58(N,P)CO58
15. CU632	CU63(N,2N)CU62	16. CU63A	CU63(N,A)CO60
17. CU652	CU65(N,2N)CU64	18. ZN642	ZN64(N,2N)ZN63
19. ZN64P	ZN64(N,P)CU64	20. ZR90P	ZR90(N,P)I90
21. NB932	NB93(N,2N)NB92	22. RH103N	RH103(N,N)RH103M
23. IN115N	IN115(N,N)IN115M	24. I1272	I127(N,2N)I126
25. TH2322	TH232(N,2N)TH231	26. NP237F	NP237(N,F)FP
27. TH232F	TH232(N,F)FP	28. U238F	U238(N,F)FP

13. Library IRDF82 [25] contains cross sections for the following reaction (reaction is given in short and full title):

1. AL27P	AL27(N,P)MG27	2. AL27A	AL27(N,A)NA24
3. MN552	MN55(N,2N)MN54	4. CO592	CO59(N,2N)CO58
5. CO59G	CO59(N,G)CO60	6. CO59A	CO59(N,A)MN56
7. NP237F	NP237(N,F)F.P.	8. AU197G	AU197(N,G)AU198
9. TH232F	TH232(N,F)F.P.	10. TH232G	TH232(N,G)TH233
11. U235F	U235(N,F)F.P.	12. U238F	U238(N,F)F.P.
13. U238G	U238(N,G)U239	14. PU239F	PU239(N,F)F.P.
15. LI6A	LI6(N,A)H3	16. B10A	B10(N,A)LI7
17. SC45G	SC45(N,G)SC46	18. TI46P	TI46(N,P)SC46
19. TI47P	TI47(N,P)SC47	20. TI48P	TI48(N,P)SC48
21. FE54P	FE54(N,P)MN54	22. FE56P	FE56(N,P)MN56
23. FE58G	FE58(N,G)FE59	24. NI582	NI58(N,2N)NI57
25. NI58P	NI58(N,P)CO58	26. NI60P	NI60(N,P)CO60
27. CU63G	CU63(N,G)CU64	28. CU63A	CU63(N,A)CO60
29. IN115N	IN115(N,N)IN115	30. IN115G	IN115(N,G)IN116
31. I1272	I127(N,2N)I126	32. S32P	S32(N,P)P32
33. CR-DISPLCHROMIUM-DISPL.		34. CR-GP-H	CHROMIUM-GAS-H
35. CR-GP-D	CHROMIUM-GAS-D	36. CR-GP-T	CHROMIUM-GAS-T
37. CR-GPHE3CHROMIUM-GAS-HE3		38. CR-GP-HECHROMIUM-GAS-HE	
39. ST-D-ASTSTEEL-DISPL-ASTM		40. FE-GP-H	IRON-GAS-H
41. FE-GP-HEIRON-GAS-HE		42. NI-DISPLNICKEL-DISPL.	
43. NI-GP-H	NICKEL-GAS-H	44. NI-GP-D	NICKEL-GAS-D
45. NI-GP-HENICKEL-GAS-HE		46. NI59G-GPNI59(N,G)NI60-GP	
47. NI59P-GPNI58(N,P)CO59-GP		48. NI59A-GPNI59(N,A)FE56-GP	
49. NI58G-GPNI58(N,G)NI59-GP		48. ST-EUR	EUR-DISPL-STEEL

4.3. Appendix 3. Examples of work with the SAIPS system.

Examples of using the SAIPS system have been formed as a task for OS EC-computer

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//A05#TST1 JOB ----------------------------------
//* ************************************************************
//*  Test-example of neutron spectrum unfolding
//*  Kernenergie, vol. 25, # 3, 1981, pp105-108.  Codes SANDII
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