A user's guide to the RESAB program system for the B6700 computer

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A User's Guide to the RESAB Program System for the B6700 Computer

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Abstract

A revised description is given of the use of RESAB, an ALGOL program for calculation of resonance reactions in a reactor. This program was converted to match the B6700 computer, and the present report replaces Risø-M-1378, which described the original version.

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CONTENTS

Page

1. INTRODUCTION

The conversion of the RESAB program system from IBM 7094 to the Burroughs computer B6700 at Risø has involved changes in the structure of the program. Consequently, it was necessary to rewrite the user's guide (ref. 9) to match the new conditions.

A previously issued report ("The Neutron Resonance Reactions in Thermal Nuclear Reactors Determined by Semi-Analytic as well as Numerical Methods", Risø-R-234, ref. 1) describes all the theories applied while the present guide is written for the user familiar with the topic beforehand.

2. THE RESAB PROGRAM SYSTEM

The program system consists of three ALGOL programs named RESABFILE1, RESABFILE2 and RESABFILE3 that communicate with each other via magnetic tapes. A list of most of the ALGOL procedures in the system is given in tables 17 and 18.

2.1. RESABFILE1

This program performs the slowing-down calculation and effective group cross section determination. It consists of two parts named SDP (ref. 1, chapter 5) and LINK ALFA (ref. 1, chapter 4). By means of SDP numerical multi-region collision probability slowing-down calculations are performed throughout the resonance region, while LINK ALFA comprises a simple, homogeneous slowing-down procedure, RESCOLDENS, together with most of the semi-analytic methods in common use for treating of the resonance reactions. A graph of the structure of the program is shown in fig. 1.

2.2. RESABFILE2

The cross section tabulations and energy mesh structures applied in SDP are produced by RESABFILE2 (ref. 1, chapter 3 and section 5.4).

2.3. RESABFILE3

Detailed cross sections and flux spectra determined by SDP are (if wanted) printed on magnetic tape. The RESABFILE3 program reads such

an SDP output tape and produces a paper-tape that controls a digital plotter who produces cross-section and flux curves.

2.4. Running Time

The experience from test jobs has shown that a job running 100 sec. on IBM 7094 roughly took 60 sec. CPU-time and 85 sec. real-time on B6700, but large fluctuations occur. The real-time as the more realistic of these two time measures is referred to below.

The running times are greatly dependent on the resonance structure of the materials considered and the chosen combination of approximations. Typical running times for LINK ALFA extend from 0.1-0.7 min per nuclide and configuration. For SDP the times are reported per narrow group. If the collision probabilities are obtained by means of the corrected Nordheim's approximation, the time per group is about 0.0005 min, while the corresponding time when exact collision probabilities in two regions (5 Gauss points) are used is about 0.001 min. In a 15-region problem the time per group is 0.017 min (2 Gauss points). It is seen that a heterogeneous slowing-down calculation for ^{238}U in the interval 3500-0.5 eV may be performed in about 1 min (188 resonances). The use of tabulated collision probabilities speeds up the calculation somewhat (cf. p. 19). Production of SDP input tapes usually takes 1-4 min if multi-level formalism is not applied. Generation of tape AEK033 took 20 min.

As a rule, the RESAB codes are fed into the machine in source form whereby modifications become possible. Compilation times are about 90 sec for RESABFILE1 and 50 sec. for RESABFILE2.

2.5. Use of Tape and Disk Files

The program system, which comprises about 8000 source-program cards, is generally read into the machine from a magnetic program tape (month library). The user need only supply a loader deck (sec. 2.6 and table 1).

Further, on run time the RESAB codes use a number of external files, tape as well as disk. It has been the policy to reserve the tapes for data files with an external function, i.e. input/output files, whereas internal working files are placed on the disk. However, the classification as an internal or external file is not always clear.

A list of the file names and kinds is given in table 2 and the corresponding file declarations in the ALGOL programs in table 3. With this information, it should be possible to change some of the files in the programs, if necessary.

Resonance parameters are supplied from punched cards or from a disk file.

If, exceptionally, RESAB is run with external storage attached to SDP, 2 disk files are used per externally stored nuclide.

A generation of an SDP input tape by means of RESABFILE2 uses up to 8 files (5 disk + 3 tape). The rather small size of the IBM 7094 core (32 K) caused this extensive use of external storage in the original program; the consistent retainment of this file structure by conversion to B6700 proved to imply an efficient utilization of this computer.

2.6. The Loader Decks

Table 1 shows the set-up of loader decks for RESABFILE1, RESABFILE2 and RESABFILE3.

The first card is the familiar ^COMPILE-card. After this and before the DATA-card a number of file cards follow. The first contains the name of the program file on the library tape, SOURCE/ PROGRAMNAME
The others refer to registrated tapes kept at the AEK tape library.

Immediately after $SET MERGE the program correction cards are inserted, if any.

In the example of RESABFILE2 an SDP input tape AEK035 is prepared from the LIST2-tape AEK025 by RESABFILE2, and RESABFILE1 uses this tape to solve the test example "JOB1" (cf. 6.3.1); the final SDP-tape is scratched.

It is very important to give the operator accurate tape mounting instructions, e.g. by a written message following the loader. In our case, this message would be:

RESABFILE2:

>> The program will read from the tape RESFIL9 = AEK025 and will produce a tape RESFIL11 = AEK035 which is stored in the tape library <<.

RESABFILE1:

>> The program will read from the tape RESFIL12 = AEK035 and needs one scratch tape <<.

If a scratch tape is used before another, permanent, tape is produced, this cause-of-action should be told the operator to avoid confusing situations about the tape catalogue numbers.

3. INPUT SCHEMES

As a READ instruction in B6700 ALGOL causes the card reader to read from a new card, the user must know the termination marks in the data file corresponding to all READ instructions in the program. The data between neighbour marks is one logical record. In the following input schemes, the logical records are separated by solid lines.

An asterisk indicates that the meaning of the quantity is explained in detail below. If the column with the heading "Conditions" contains a logical expression the input quantity concerned must be skipped if the value of the expression is "false". The following abbreviations are applied:

AL	Alphameric quantity, only one on each punched card (beginning in column number one)
R	Real number
I	Integer number
RA [1:N]	Real array with indicated dimension
IA [1:N, 1:M]	Integer do.
B	Block of data. The contents will be described in a subsequent section
ABS	The absolute value of the quantities have the meaning indicated in the column with the heading "Explanation" while the signs influence on the input scheme or the path through the program. A plus sign is generally connected with a straightforward use of the program.
ABS(X)	Absolute value of X

3.1. Input Data for RESABFILE1

3.1.1. Job Control Data

Symbol	Conditions	Explanation
(1)		
CALTYPE ,I		Indication of the main path through the programme (⟩ -10)*
NRES ,I	CALTYPE = 4	Number of single resolved resonances for which SDP must be applied (⟩ 0)
NEGRHOM ,I	0 ⟨ CALTYPE ⟨ 11	Number of LINK ALFA energy groups
TAPEOPT ,I		Number of files whose functions are changed by the job (≥ 0)*
FORMTAPEI ,IA [1:TAPEOPT, 1:2]	TAPEOPT ⟩ 0	New logical/external file correspondence*
RESAB RES. RAR. LIBRARY or do. LOADER ,B		RESAB resonance parameter library (only list of contents if the library is available on the disk)
(2)		
DFN ,I		Identifier for the resonance absorber (controls the loading of the corresponding resonance parameters)
LINK ALFA DATA ,B		Input to LINK ALFA
Input a "-1" or repeat from (2)		
SDP DATA ,B	CALTYPE ⟨ 11	Input to SDP
Input a "-10" or repeat from (1)		

CALTYPE ⟩ 0

CALTYPE

= -2 Pure SDP calculation. Punched cards output (section 5.4). If the case is homogeneous then partial resonance integrals are obtained for each energy group (cf. "the two-parameter description", ref. 1, sections 4.3, 6.4.2, 8.1.2 and 8.1.3). If the case is heterogeneous the punched cards contain effective group cross sections. (The data processing and cross section condensation routine CRS [2] comprises facilities for reading these punched cards directly. The RESAB results then replace the original UKNDL, infinite dilution data.)

= -1 Pure SDP calculation for one isolated resonance. The resonance cross sections are obtained from single-level resonance parameters (cf. ref. 1, section 5.4, p. 62. No cross section, SDP input tape is applied).

= 0 Pure SDP calculation. No punched cards output.

= 11 Pure LINK ALFA calculation. No punched cards output.

= 12 Pure LINK ALFA calculation. The computation and the results obtained correspond to the SDP case with CALTYPE = -2. However, only one resonance absorber may be treated in one problem.

= 2 Combined SDP and LINK ALFA calculation. The results obtained by SDP are corrected for p-wave resonance absorption by means of statistical LINK ALFA treatment. However, only resonance absorber number one in SDP is treated in this way while the calculation for the other resonance absorbers is restricted to SDP treatment. The cross section, SDP input tape must not include contributions from p-wave resonances for resonance absorber number one (as UKNDL does). This is presumably the most accurate method available for including the p-wave absorption for fertile isotopes (ref. 1, p. 22). Punched cards output as in the cases with CALTYPE = -2 and 12.

= 4 Combined SDP and LINK ALFA calculation. The NRES resonances specified by means of the array BSSDPNR (p. 10) are treated by SDP (isolated single-level resonances). Apart from this all calculations are performed by means of LINK ALFA.

This procedure should be applied if the energy groups round a very wide resonance are so narrow that the resonance covers more than one group. In LINK ALFA a resonance is considered an indivisible whole belonging completely to the group in which the resonance peak is situated (ref. 1, p. 37). No punched cards output.

Administration of Files, TAPEOPT, FORMTAPEI

According to table 2, RESABFILE1 may use up to six different files. Internally in the program a so-called "logical no" is attached to each mode of operation of a file (seven different functions), and the connection between a specified function of a file and an external or "physical" file name RESFILn (n = 1, 4, 7, 10, 11, or 12) is established through the integer array FORMTAPE [1:7]. Each time the program reads a new value of CALTYPE the standard connection indicated in table 2 between mode of operations and file names is reestablished.

The array FORMTAPE is defined FORMTAPE [logical no] = n, RESFILn being the (external) name of the file.

The mode of operation of one file may be changed as follows. If for instance we want to store the resonance parameters on the tape file RESFIL11 we have

TAPEOPT = 1
FORMTAPEI [1,1] = 7, FORMTAPEI [1,2] = 11

Now the program accomplishes the following operation:

FORMTAPE [FORMTAPEI [1,1]] = FORMTAPEI [1,2].

FRICOR

If external storage is necessitated by SDP (cf. ref. 1, sec. 5.5; this situation is exceptional and is likely to occur only for deuterium and graphite), the files with logical nos. 1 and 2 are applied in case of one isotope. If two isotopes require external storage, files 3 and 4 are occupied too. External storage for more than two isotopes is not provided for in the present version of the program. To keep track of the available fast memory and be able to decide whether external storage must be used, a real procedure "FRICOR" was incorporated in the old IBM 7094-version; it returned the momentary free core space in words, and certain arrays in SDP were dimensioned according to this value. No similar concept exists on B6700; it was instead

decided to introduce a dummy procedure FRICOR always returning some fixed value, say 20000. The user may insert another value than 20000 by correcting the card

REAL PROCEDURE FRICOR; FRICOR: = 20000; 00002400

The actual choice has some influence on the efficiency, and also on whether external storage becomes necessary. The same problem may be run with a large FRICOR and no external storage, or with low FRICOR and external storage; often the former alternative is the more efficient. See also pp. 19 and 51.

3.1.2. LINK ALFA DATA, Homogeneous Calculation

Symbol	Conditions	Explanation
FF ,AL		Control parameter
(3)		
PROBLEMNO ,I		LINK ALFA problem number (⟩ 0)
DAY ,I		Day of the month
MONTH ,I		Month (≤12)
YEAR ,I		Year
BSSDPNR ,IA [1:NRES]	CALTYPE = 4	The resonances for which SDP is going to be applied (The resonance numbering starts at the resonance with the lowest energy) BSSDPNR [1] = -1; Pure LINK ALFA statistical p-wave calculation
DFN1 ABS ,I		= DFN, checking that the right set of res. par. has been loaded *
DETAIL ,I		= 3: The output comprises only input data and effective group cross sections = 2: Detailed output = 0, 1, 10, 11, 12, 13 *
TOM, ABS ,I		Number of energy groups (= NEGRHOM if 0 ⟨ CALTYPE ⟨ 11) *

Symbol	Conditions	Explanation
EO , ABS ,RA [0:ABS(TOM)]		Group boundaries (eV) beginning at the highest energy *
TEMP , ABS ,R		Temperature (^{o}K) *
AM ,ABS ,R		If ABS(AM) ⟨ 0.6 then the heterogeneous input scheme below is applied. ABS(AM) ⟩ 0.6: Mass (amu) of a non-NR moderator e.g. O in UO_2 *
S ,ABS ,R	ABS(AM) ⟨ 0.6	Non-NR moderator cross section per absorbing atom (barns) *
SY R	ABS(AM) ⟨ 0.6	NR moderator cross section per absorbing atom (barns) (SY ⟩ 0)
R, RA [1:3]	ABS(AM) ⟨ 0.6	R [1]: pin radius, R [2]: cladding outer radius, R [3]: cell dimension (see OPT3). (cm)
N, IA [1:3]	ABS(AM) ⟨ 0.6	Number of different isotopes in fuel, cladding and moderator region
OPT3 ,I	ABS(AM) ⟨ 0.6	= 1: R [3] = cell outer radius = 2: R [3] = pitch in sq. lattice = 3: R [3] = vol. ratio (cell-fuel)/ fuel = 4: R [3] = do. mod. /fuel = 5: R [3] = pitch in hex. lattice = 6: R [3] = diameter of cir. cell
A1 ,ABS ,RA [1:N [1], 1:3]	ABS(AM) ⟨ 0.6	Isotopes in the fuel. A1 [K, 1]: Mass (amu). Isotope number one (K = 1) is the res. absorber *. A1 [K, 2]: Atoms per molecule. A1 [K, 2] ⟨ 0: Number density (10^{24} nuclides/ cm^3). A [K, 3]: Cross section (barns) *

Symbol	Conditions	Explanation
RO1 ,R	A1 [K, 2] ⟩ 0	Density of fuel material (g/cm^3)
A2 ,ABS ,RA [1:N [2], 1:3]	R [1] ≠ R [2]	Isotopes in the cladding A2 [K, 1] : Mass (amu). A2 [K, 2] and A2 [K, 3] : see A1
RO2 ,R	A2 [K, 2] ⟩ 0	Density of cladding (g/cm^3)
A3 ,ABS ,RA [1:N [3], 1:3]		Moderator: A3 [K, 1], A3 [K, 2] and A3 [K, 3] : see A2
RO3 ,R	A3 [K, 2] ⟩ 0	Density of moderator (g/cm^3)
OPT ,I	ABS(AM) ⟨ 0.6	Choice of equivalence principle (generally 1 or 2)*
OPT1 ,I		Determination of Dancof factor: = 1: Cylindrical CPM (very fast) = 4: Sq. } Carlvik's = 6: Hex. } method (ref. 3)
OPT2 ,I		Type of effective group cross sections = 1: Effective "rod cross sections", ref. 1, eq. (8.1) = 2: Effective "cell cross sections", ref. 1, eq. (8.2)
FF ,AL		Control parameter
Input a "-1" or repeat from (3)		

The Influence of a Negative Sign in Front of the Following Quantities

DFN1 ⟨ 0 — The slow but accurate J-function of Neltrup is applied in the statistic calculation (else the fast approximation of Steen is used) - ref. 1, section 4.5.5.

TOM ⟨ 0 — The output comprises the res. parameters and res. integrals for all resonances in the group of lowest energy.

EO — If the largest group boundary is supplied with a negative sign no statistic calculation is performed (neither for p-wave resonances in the resolved region).

TEMP ⟨ 0 — Just after TEMP the program reads the quantities TU(R) and EAF(R).

TU = -1 — No p-wave contribution included

TU ⟩ 0 — The parameter has no influence.

EAF:

1: 0 ⟩ EAF and -EAF ⟩ the lowest resonance energy in the library. -EAF is used as upper cut-off energy for the resolved region (instead of the largest resonance energy in the library).

2: EAF ⟩ the largest resonance energy: Pure statistic calculation.

3: EAF = 10^{-6} the parameter has no influence

AM ⟨ 0 — Statistic p-wave contribution in the resolved region excluded.

A1 [1, K] ⟨ 0, K ⟩ 1: The internal moderator is treated in the NR approx.

S ⟨ 0 or A1 [1, 3] ⟨ 0 — The influence of scattering interference is neglected.

Choice of Equivalence Principles, OPT

OPT =

6: The cell is homogenized. Pure NR-moderated

5: Carlvik's collision probability approximation (ref. 1, section 4.2 - two terms rat. approx.)

4: Two terms } Leslie, Hill, Jonsson

3: One term (non-isolated rod) } (ref. 4).

2: NR cladding treatment (ref. 1, eq. (6.3)) } Bell factor coll. prob.

1: WR cladding approx. (refs. 5 and 6) } (ref. 1, section 4.2)

0: As 2 but } Wigner's rational approx. for

-1: As 1 but } coll. prob. (ref. 1, section 4.2).

OPT = 1 (or 2) — is recommended possibly combined with the vacuum cladding approximation (ref. 1, section 6.3.4).

Beyond this the user of the program may construct an equivalence

principle of his own (DETAIL = 2, 3, 12 or 13). To do this the lower boundary of the group of lowest energy must be supplied with a negative sign. With AM > 0.6 the program reads+ |SY1(,DKK if SY1 > 0), |AVCROS, |PSHET and VOLRAT just after SY (all real numbers). If SY1 = -1 eq. (4.26) in ref. 1 is applied (S = SY), while eq. (4.28) is used if SY1 > 0 ($r_1 \sigma_{ex}$ = SY, $r_2 \sigma_{ex}$ = SY1 and d = DKK). If AVCROS = -10 then S_{eff} = S (cf. eqs. (8.14) and (8.20). If SY1 > 0: S_{eff} = (DKK $\sqrt{SY}$ - (1 - DKK) $\sqrt{SY1}$)^2). This is in fact the method applied whenever nothing else is specified. If AVCROS = -1 the method sketched in eq. (8.5), ref. 1, is used, while S_{eff} = AVCROS if AVCROS > 0. PSHET is the heterogeneous slowing down power per absorbing atom (eq. (4.30), ref. 1. Infinite slowing down power: PSHET > 10^5). VOLRAT = (non-fuel volume)/(fuel volume), cf. eq. (8.20) in ref. 1. If VOLRAT = 0 effective "rod cross sections" are calculated. With AM > 0.6 the program reads only AVCROS after AM.)

The Combination of the Single Resonance Approximations, DETAIL

This subject was discussed thoroughly in ref. 1, section 4.5. LINK ALFA contains the parameters PC(R) and EXACT(R). PC indicates the fraction (%) of the resonance integral (in fact only that part of the resolved s-wave resonance integral, which is determined by LINK ALFA is considered), that will be treated by method 3 and method 4 (ref. 1, p. 37). EXACT is the number of resonances, for which method 4 is going to be applied. For DETAIL = 0, 1, 2 or 3 we have

PC = 90%
EXACT = 3 } for ^{238}U and ^{232}Th

PC = 0%
EXACT = 0 } in all other cases

If a different combination of the methods is wanted 10 must be added to the values of DETAIL listed above. Then the input scheme comprises PC, EXACT between TOM and EO (0 ≤ PC ≤ 100. If the spin of the target nucleus is greater than zero, method 3 must not be applied). It is the EXACT largest resonances that are treated by method 4 unless EXACT is supplied by a negative sign. In the latter case, however, the real array RESNO [1:ABS(EXACT)] specifies the resonances, for which method 4 is used. If EXACT < 0 the program reads RESNO just after EXACT.

+ The symbol |_____ indicates one data record.

Non-1/v Resonance Integral Calculation DETAIL

DETAIL = 0 (output as for DETAIL = 2) or
DETAIL = 1 (do. = 3)
(CALTYPE = 11, AM > 0.6 only)

In this case only non-1/v partial resonance integrals are calculated. The lower boundary of the group of lowest energy is always 0 eV for which reason this boundary is omitted in the input.

Calculation at Infinite Dilution

SY ≥ 10^{17} b. (If DETAIL < 10: PC, EXACT = 0, 0 always).

3.1.3. SDP DATA, Continuous Numerical Slowing-Down Calculation

Some sequences of data must be repeated as many times as indicated in the column with the heading "Repetitions"

Symbol	Repetitions	Conditions	Explanation
FF ,AL			Control parameter
(4) PROBLENNO ,I			SDP problem number (> 0)
DAY ,I			Day of the month
MONTH ,I			Month (≤ 12)
YEAR ,I			Year
TEST ,ABS ,I			Control of "narrow group" print-out. Generally TEST = -1, -2 or -3 *
TEST1 ,ABS ,I			ABS(TEST1) = 1: Effective "rod cross sections". ABS(TEST1) = 2: Effective "cell cross sections". Cf. ref. 1, section 8.1.1.*
MR ,ABS ,I			Number of material regions (≠ 0)

Symbol	Repetitions	Conditions	Explanation
NRRES , ABS , I		MR ⟨ 0	Number of res. absorbing isotopes. If MR ⟩ 0: NRRES = 1. (NRRES ≤ the number of isotopes listed on the cross section, SDP input tape)
NRNARROW, ABS , I		NRRES ⟨ 0	Number of NR-moderators. If NRRES ⟩ 0: NRNARROW = 0. (If NRNARROW ⟩ 0 then the slowing-down power is infinite)
NEGR , ABS , I		TEST ⟨ 0	Number of wide groups*
CPMC , I		ABS(MR) ⟩ 1	Choice of collision prob. routine *
RES , ABS , IA [1:ABS(NRRES)]			The material regions in which the different resonance absorbers are situated. In cylindrical geometry the region numbering starts at the centre (RES [1] ≠ RES [2] etc.)
NNUCL, ABS , IA [1:ABS(MR)]			Number of different isotopes in each material region (NNUCL [1] ⟩ 0: no subdivision of homogeneous material regions. NNUCL [1] ⟨ 0:Subdivision)
NRMR , IA [1:ABS(MR)]		NNUCL [1] ⟨ 0	Number of subregions inside each homogeneous material region. (If NNUCL [1] ⟩ 0: all NRMR [I] = 1)
ENGR , RA [0:ABS(NEGR)]		NEGR ⟩ 0 and TEST ⟨ 0	Group boundaries (eV) beginning at the highest energy*
ANARROW , RA [1:NRNARROW]		NRNARROW ⟩0	"Mass" (amu) of the NR moderators in the material description below

Symbol	Repetitions	Conditions	Explanation
	for K = 1 step 1 until ABS(MR)		Material region number K:
	for I = 1 step 1 until ABS(NNUCL [K])		Isotope number I:
AMAS , ABS , R		RES [1] ⟩ 0	Isotopic mass (amu)*
MOL , ABS , R			Atoms per molecule. If MOL ⟨ 0 (all I for K fixed): Number density (10^{24} nuclides/cm^3)
SS , ABS , R			Potential scattering cross section (barns)*
SS1 , ABS , R		RES [1] ⟨ 0	Macroscopic scattering cross section (1/cm)*
RO , R		MOL ⟩0 and RES [1] ⟩ 0	Density of the material in region K (g/cm^3)
			(If the region contains resonance absorbers these must occupy the lowest values of I)
AR, RA [1:ABS (NRRES)]		RES [1] ⟨0	Number densities of the resonance absorbers (10^{24} nuclides/cm^3)
RAD , ABS , RA [1:NR], where $NR = \sum_{I=1}^{MR} NRMR[I]$			(Sub-)region outer radii or distance to region interfaces from symmetry plane in slab geometry (cm. RAD [2]⟨ 0: slab geometry else cylindrical geometry)*
DC , R		RAD [1] ⟨ 0	If CPMC ≠ 1: Dancof factor (RAD [-1])* If CPMC = 1: Rod radius (If RAD [1] ⟩ 0 then rod radius = RAD [NRMR [1]])
TAPENR , I		(CALTYPE ≠ 4 or BSSDPNR [1] = -1) and (CALTYPE ≠ -1)	Number of the magnetic tape containing the cross section, SDP input
DFN			Identifier for the sequence of cross section data, which is going to be applied in SDP

Symbols	Repetitions	Conditions	Explanation
ERES ,R		CALTYPE=-1	Resonance energy (eV)
GAMN1 ,ABS ,R			Reduced neutron width (Γ_n^o, meV. GAMN1 < 0: Scattering interference neglected)
GAMG1, ABS ,R			Radiation width (Γ_γ, meV) *
GAMF1 ,R			Fission width (Γ_f, meV)
STACG ,R			Statistical spin factor (g_J)
TEMP ,ABS ,R			Temperature (^oK) *
FF ,AL			Control parameter
Input a "-1" or repeat from (4)			

Attention is drawn to the fact that a cross section, SDP input tape must be mounted unless CALTYPE = 4 or -1 (CALTYPE < 11).

TEST

ABS(TEST) = 1. Print-out of "narrow group" fluxes (alternating sign from material region to material region).
= 2. Detailed print-out for each "narrow group".
= 3. No "narrow group" results are printed.

TEST < 0: Calculation of effective group cross sections (partial resonance integrals) in "wide groups". TEST > 0: Total resonance integrals with 1/v-absorption subtracted (CALTYPE = -1 only).

Storage of "Narrow Group" Fluxes and Cross Sections on Magnetic Tape for Off-Line Use, TEST1

TEST1 < 0 Storage on the tape with logical no. 5
TEST1 > 0 No storage.

The contents of SDP output tapes is described in section 5.3.

Input of Wide Group Structure, NEGR, ENGR

If 0 < CALTYPE < 11, i.e. LINK ALFA is applied immediately before the call of SDP, then the group structure applied in LINK ALFA may be transferred to SDP simply by supplying NEGR by a negative sign. If ABS(NEGR) < ABS(TOM) the groups introduced in SDP are those of lowest energy. This is of some importance when CALTYPE = 4. In all cases: NEGRHOM = ABS(TOM) ≥ ABS(NEGR).

External Storage on Disk Files, Logical No. 1, 2, 3 and 4, AMAS

(See pp. 10 and 51 and ref. 1, section 5.5). If, in rare cases, external storage is used for one or more isotopes, the mass (AMAS) of the isotope(s) in question must be provided with a negative sign. The error message "MAXL IS TOO LOW", obtained when running SDP, indicates that the job cannot be executed with the actual FRICOR without use of external storage.

Anisotropic Scattering, SS, SS1

For isolated rods anisotropic scattering in the external moderator may be of some importance, when subdivision of the external region is performed. The SDP transport correction (ref. 1, section 7.1.2.1) may be activated in such cases by placing a minus sign in front of the potential scattering cross section (only for the lightest moderator nuclide). In this case and all other cases SS or SS1 must not be transport corrected.

Collision Probabilities, CPMC, RAD

The parameter CPMC controls the choice of the type of collision probability routine. At the moment the following routines are available (cf. ref. 1, section 4.2. The possibility of using tabulated collision probabilities was first investigated after the printing of ref. 1 for which reason a few remarks concerning this procedure are collected below).

CPMC

- 5 Five Gauss points; Flurig scheme, multiregion
- 2 Two Gauss points; Flurig scheme, multiregion
- 6 p_o: exact, Nordheim; two regions; Sq. cell; Cylindrical
- 7 p_o: Carlvik rat. approx., Nordheim; two regions; Sq. cell; Cylindrical
- 8 p_o: exact, Nordheim corrected; two regions; Sq. cell; Cylindrical
- 1 p_o: Tabulation, multi-region (tables from CPMC = 5 at present)
- 9 Slab geometry, exact, multi-region.

CPMC = 6, 7 and 8 makes use of a Dancof factor, For 0 ⟨ CALTYPE ⟨ 11 this is supplied directly from LINK ALFA, while it must be provided through the input data in all other cases (cf. RAD [1] ⟨ 0).

Tabulated Collision Probabilities

CPMC = 1

Just after reading the geometrical data the program produces a table of collision probabilities (at present only cylindrical geometry) as functions of Z, where

$$Z = \begin{cases} \Sigma_T(E)\cdot\bar{l} & \text{if } \Sigma_T(E)\cdot\bar{l} \leq 1 \\ 2 - 1/(\Sigma_T(E)\cdot\bar{l}) & \text{if } \Sigma_T(E)\cdot\bar{l} > 1 \end{cases}$$

$\Sigma_T(E)$ is the macroscopic fuel material cross section as a function of the energy E and $\bar{l}$ (=2 × RAD [-1] in the scheme above) symbolizes the mean chord length. The table comprises 14 values of Z (0.005, 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4, 1.6, 1.7, 1.8, 1.9, 1.98, 1.998). The collision probabilities applied in SDP are then obtained by a three-point interpolation in this table. In problems with many (sub-) regions the use of this procedure speeds up the calculation very much. Some results and running times obtained for a Yankee reactor cell at a burnup of 3890 MWD/TU are shown in table 4 (1.855-3354.6 eV; three regions - no subdivision). In table 5 the results obtained for an isolated ^{238}U-rod (radius = 1.2 cm) surrounded by graphite are listed (0.5-1200 eV, subdivision - 8 fuel regions and 7 moderator regions have been applied).

The use of tabulated collision probabilities makes SDP calculations on a complete light-water assembly practicable, and the possibility of studying corner and edge Dancof effects are open for everybody who has the time for it.

Narrow Group (Energy Mesh) Structure

This is generally supplied through the cross section, SDP input tape or from a routine in RESABFILE1, whicb constructs the mesh structure recommended in ref. 1, section 5.4 (single resonance treatment: CALTYPE = 4 or -1). An array BETA (RA [1:12]) contains all important quantities for this group structure evaluation.

The extension of the region with very narrow groups (cf. ref. 1, section 5.4) round the resonance energy, E_r (eV), is determined by

$$|E - E_r| \langle \beta_6 \Gamma_t$$

where the symbolism β_n = BETA[n] has been applied. E is any energy (eV) within the region and Γ_t the Doppler-broadened total resonance width. In this region the group width Δ_r is

$$\Delta_r = \frac{\beta_1\cdot E_1^2 + \beta_2 E_r^2}{E_1^2 + E_r^2}\,\Gamma_t\,, \quad E_1 = \beta_5$$

Outside this region the group width is

$$\Delta = \left(\frac{\beta_3\cdot E_1^2 + \beta_4 E_r^2}{E_1^2 + E_r^2}\,E_r^2 + \beta_{11}\,E_2^2\right)/(E_r^2 + E_2^2)\,, \quad E_2 = \beta_{12}$$

When a single resonance is considered the outer region extends so far that the total resonance cross section, $\sigma_{rt} = \sigma_S + \sigma_R - \sigma_p$ (eqs. (3.1) and (3.2) ref. 1), is smaller than $\beta_7\cdot\sigma_p/g_J$. Furthermore the distance from the resonance to the limit of the outer region is always larger than $(\Gamma_n + \Gamma_\gamma + \Gamma_f)/2 \times \sqrt{6\cdot\theta/\beta_8}$ in order to ensure that the Doppler-broadening is negligible at the limit. At larger distances from the resonance analytic rest terms suffice (ref. 1, section 4.5.4). On page 59, ref. 1, it is mentioned that group, average reaction, cross sections are employed in those of the relatively wide groups which are next to the extremely narrow resonance groups. This averaging is controlled by β_9 and β_{10} combined with β_5. (A point of integration is introduced each time the reaction cross section changes with a fraction equal to

$$(\beta_9\cdot E_1^2 + \beta_{10}\cdot E^2)/(E_1^2 + E^2)\,, \quad E_1 = \beta_5).$$

Internal in the programme the following values are stored

$\beta_1 = 0.5$, $\beta_2 = 1$, $\beta_3 = 0.25$, $\beta_4 = 10$

$\beta_5 = 1000$, $\beta_6 = 2.7$, $\beta_7 = 0.01$, $\beta_8 = 0.01$

$\beta_9 = 0.2$, $\beta_{10} = 0.4$, $\beta_{11} = 0.08$, $\beta_{12} = 40$

When CALTYPE is equal to -1 the mesh structure may alternatively be chosen by the user himself in the following way:

GAMG1 $\langle$ 0. The program reads the integer NEGRO(ABS, I) just after TEMP. This is the number of intervals with different mesh width (= 3 in the recommended scheme above). If TEMP $\langle$ 0 BETA, RA [1:12], follows now, and provided (GAMG1 $\langle$ 0 and NEGRO $\langle$ 0) and ABS(NEGRO) $\rangle$ 3 the input comprises BETA1, RA [1:ENTIER(ABS(NEGRO)/2) - 1, 1:2]. If the program reads BETA1 then ENTIER(ABS(NEGRO)/2) - 1 regions with mesh widths equal to $\Delta \cdot$ BETA1 [N, 2] are placed between the region width the extremely narrow resonance groups (Δ_r) and the region with the relatively wide off resonance groups (Δ) on each side of the resonance. The outer boundary of such an interstitial region is determined so that $\sigma_{rt} \langle \sigma_p \cdot$ BETA1 [N, 1] (cf. β_7) on the boundary. The possibility of using these interstitial regions was indicated but not recommended in ref. 1, p. 59. Finally the mesh structure may be introduced directly. If GAMG1 $\langle$ 0 and NEGRO $\rangle$ 0 the program reads ENGRO, RA [0:NEGRO] and DELTA0, ABS, RA [1:NEGRO]. ENGRO indicates the energy region boundaries (eV) and DELTA0 the lethargy width of the meshes between these boundaries. If DELTA0 [N] $\langle$ 0 the average reaction cross sections instead of mid-point cross sections are applied in energy region N.

3.2. Input Data for RESABFILE2

Three types of tape and disk files are applied in RESABFILE2:

1. UKNDL (UK): Tape. United Kingdom Nuclear Data Library (ref. 1, section 5.4).
2. Tables of cross sections (CR): Normally disk. One CR-file may comprise many data "subfiles" (MAT subfiles). One subfile is a point-wise cross section tabulation.
3. Cross section, SDP input tapes (IN): Normally tape. Only one subfile on each tape. One subfile may comprise many resonance absorbers. The data stored on the tape are the common narrow group (energy mesh) structure for the mixture of resonance absorbers possibly together with the narrow group cross sections for NRRES isotopes (NRRES $\geq$ 0).

Each tape (or disk) file is associated with a number (TAPENR). A data file number (DFN) is attached to each subfile.

3.2.1. Job Control Data

Symbol		Conditions	Explanation
(1)			
TAPEOPT	,I		Number of files whose functions are changed by the job ($\geq$ 0)
FORMTAPEI [1:TAPEOPT, 1:2]	,IA	TAPEOPT $\rangle$ 0	New logical/external file correspondence. As described for RESABFILE1
FF	,AL		Control parameter
(2)			
PROBLEMNO	,I		RESABFILE2 problem number ($\rangle$ 0)
DAY	,I		Day of the month
MONTH	,I		Month ($\leq$ 12)
YEAR	,I		Year
OPT1	,I		Control of resonance parameters, UKNDL and construction of narrow group structure for one resonance absorber (cf. fig. 2)
OPT2	,I		Control of mixing of narrow group structures (cf. fig. 2)
OPT3	,I		Control of DORES (cf. fig. 2 and ref. 1, pp. 12 and 59)
OPT4	,I		Control of narrow group cross sections (cf. fig. 2)

Symbol	Conditions	Explanation
LIST2 DATA ,B	OPT1 = 5 or 6 or 7 or 8	Conversion of UK-tape to CR-file
RESAB RES. PAR. LIBRARY or do. LOADER ,B	OPT1 = 3 or 4 or 7 or 8	RESAB resonance parameter library (only list of content if the library is available as a disk file)
DFN RES. PAR. ,I		*Identifier* for the resonance absorber (loading of res. par.)
(3)		
NARROW GROUP STRUCTURE DATA ,B	OPT1 = 2 or 3 or 6 or 8	Construction of narrow groups for one resonance absorber
MIXING DATA ,B	OPT2 = 2	Mixing of group structures
GROUPS → POINTS DATA ,B	OPT3 = 2 or 5 or 6	Conversion of group structure (IN-file) to DORES input file (CR-file)
DORES DATA ,B	OPT3 = 2 or 3 or 4 or 5	Input to DORES
TABEL1 DATA ,B	OPT4 = 2 or 3 or 4 or 5	The IN-file is supplied with cross sections from a CR-file
AVERAGING DATA ,B	OPT4 = 4 or 5 or 6	Group averaging of capture cross sections in the groups next to the extremely narrow resonance groups (only DORES cross sections, cf. ref. 1, p. 59)
OUTP ,I		Number of files which are going to be dumped (≥ 0)
DUMP DATA ,B	OUTP > 0	Print-out of files

Symbol	Conditions	Explanation
RPDFN ,I		1 or -1. Control of repetition
OPT1 ,I OPT2 ,I OPT3 ,I OPT4 ,I	RPDFN = 1	Control data as above
Repeat from (3)		
DFN RES. PAR. ,I	OPT1 = 3 or 4 or 7 or 8	Identifier for the (new) resonance absorber (loading of res. par.) and control of repetition
Repeat from (3)	DFN RES. PAR. ≥ 0	
FF ,AL		Control parameter
Input a "-1" or repeat from (2)		
Input one more "-1" or repeat from (1)		

File Administration in RESABFILE2, TAPEOPT, FORMTAPEI

The most complicated part of the running of RESABFILE2 is certainly the file administration. The operation of the files is organized in the same way as in RESABFILE1 (cf. FORMTAPE, FORMTAPEI, TAPEOPT). Each time the program reads TAPEOPT, the connection indicated on the lower part of table 2 between the logical (internal-program) and the physical (file-name) list-of-files is re-established.

3.2.2. LIST2, Conversion of UK-Tape to CR-File

This part of RESABFILE2 comprises the procedure PLUCK from SIGMA, the Danish version of the GALAXY program. LIST2 picks out the elastic scattering-, the capture-, and the fission cross sections from a

specified sequence of data subfiles (MAT subfiles) in the UKNDL and produces a CR-file (containing MAT subfiles). LIST2 makes use of three auxiliary disk files apart from the UKNDL tape and the output CR-file (TAPENR 0). The LIST2 DATA are as follows:

Symbol		Explanation
MAT	,I	Number of UKNDL-subfiles, which are going to be converted ( ) 0)
TAPENR 0	,I	Number of the CR-file
TEMP		Temperature (^{o}K. At present always 300^{o}K)
DFN, IA [1 : MAT]		Data file numbers in the UKNDL
TXT	,AL	Problem text (e. g. 238U)

LIST2 always prints out the cross sections selected (line printer).

3.2.3. RESAB Resonance Parameter Library

The contents of the library are described in chapter 4.

3.2.4. Construction of NARROW GROUP STRUCTURE for one Resonance Absorber

Before running this link the user should consult ref. 1, section 5.4. The groups are obtained either from UKNDL (OPT1 = 2 or 6 or 8) or from the resonance parameters (OPT1 = 3). In the first case the quantity SUBI indicates the number of groups which on the average are introduced per UKNDL energy point (generally SUBI = 1 suffices). The UKNDL data are provided through a CR-file produced by LIST2 (TAPENR I). When resonance parameters are applied the group (energy mesh) structure round each resonance is constructed as indicated in connection with the description of SDP (cf. p. 20, especially the definition of the BETA array). By means of the procedure MIXING described in the next section a continuous series of groups is produced afterwards. The output from the link consists of an IN-file (TAPENR 0) without cross sections (NRRES = 0). The input data are as follows:

Symbol		Conditions		Explanation
TEMP , ABS	,R			Temperature (^{o}K. Generally TEMP ⟨ 0)*
EST	,R			Approximate upper cut-off energy (eV)
ESL	,R			Approximate lower cut-off energy (eV)
TAPENR 0	,I			Number of the output IN-file
DFN	,I			Data file number
NEGR	,I			= NEGRO p. 22 (= 3 generally)
BETA, RA [1:12]			TEMP	Cf. p. 20
BETA1, RA[ ]		NEGR ⟩ 3	⟩ 0	Cf. p. 22
TAPENR I	,I	OPT1 = 3		Input CR-file number
SUBI	,R			Described above (= 1 generally)

TEMP if OPT1 ≠ 3 then TEMP ⟨ 0
if OPT1 = 3 and TEMP ⟨ 0 the recommended values indicated at p. 21 for the elements in BETA are applied.

3.2.5. MIXING of Group Structures

This link builds up a common group structure for two IN-files. The new mesh structure is at all energies as close as the group structure of any of the two source IN-files. The procedure MIXING forms the heart in this operation. In detail an output IN-file (TAPENR 0, DFN 0) with no cross sections (NRRES = 0) is produced. Above the energy EST this file contains the group structure from one of the input IN-files (TAPENR I1, DFN I1), while the mixed structure appears below EST. If EST is larger than the upper cut-off energy of the file TAPENR I1 then this cut-off energy constitutes the limitation of the new file too. Apart from the three files mentioned above the link makes use of one auxiliary file.

MIXING DATA

Symbol		Explanation
TAPENR I1	,I	Input IN-file number one
DFN I1	,I	The corresponding data file no.
TAPENR I2	,I	Input IN-file number two
DFN I2	,I	The corresponding data file no.
TAPENR 0	,I	Output IN-file
DFN 0	,I	Output data file number
EST	,R	Upper limit for the mixing (eV, described above)

3.2.6. GROUPS → POINTS, Conversion of Group Structures to DORES Input Files

According to ref. 1, p. 61, the group mid-point cross sections may be calculated by the multi-level routine DORES. The energy-point input to DORES is formed by a CR-file and the link described in the present section converts an IN-file (TAPENR I, DFN) to the corresponding mid-point CR-file (TAPENR 0) with one subfile (DFN).

Symbol		Explanation
TAPENR I	,I	Input IN-file
DFN	,I	Data file number
TAPENR 0	,I	Output CR-file
Z	,I	Atomic number
TXT	,AL	Subfile text (e.g. 238U)
TEMP	,R	Temperature (^{O}K)

3.2.7. The Multi-Level Routine DORES

The multi-level cross sections (cf. ref. 1, pp. 13 and 59) are calculated at a series of energies provided by a CR-file (TAPENR I1, DFN). The output constitutes a new CR-file (TAPENR 0) with one or more subfiles (the last one of these is DFN). The use of DORES is rather expensive as to computer time. For this reason, it was made possible to perform the calculation in steps, although this use of the program should be exceptional

on B6700. A new file is initiated if OPT3 = 2 or 3 (START) and cross sections are calculated at the energies above ESL. If ESL is larger than the smallest energy in subfile DFN, TAPENR I1, then the next step in the calculation must be performed with OPT3 = 4 or 5 (RESTART). The cross sections above EST (= ESL in the first step) are now transferred from the file produced in the first step (now TAPENR I2) to the new output CR-file (TAPENR 0) and then DORES produces cross sections between EST (= ESL at TAPENR I2) and a new ESL. With OPT3 = 4 or 5 this procedure must be continued until ESL is smaller than the smallest energy in subfile DFN, TAPENR I1.

If it is wanted to store the new cross section table together with some other CR-subfiles (say MATGAL subfiles) on one file, RESTART (OPT3 = 4 or 5) may be applied too. Now MAT, which is the number of data subfiles on the DORES output file (TAPENR 0), equals MATGAL + 1. The MATGAL old subfiles are then transferred from TAPENR I2 to TAPENR 0 and the new data subfile (DFN) is printed as the last subfile on the output file.

Each time a new subfile is initiated the cross sections at the energies above EST in subfile DFN, TAPENR I1 are copied on TAPENR 0 and the DORES cross sections are first introduced below EST. It is, however, allowed to use a value of EST larger than any energy in subfile DFN, TAPENR I1. If EST or/and ESL are smaller than the largest energy in subfile DFN, TAPENR I1 and larger than the smallest energy in the subfile, then EST or/and ESL are only allowed to adopt energy values between two records (cf. the record description below).

Finally it is mentioned that DORES makes use of one auxiliary file and a sequence of resonance parameters from the RESAB resonance parameter library, which therefore must be loaded before DORES is called (DFN and DFN RES. PAR. are independent of each other).

DORES DATA:

Symbol	Condition	Explanation
DFN ,I		Data file number
TAPENR I 1 ,I		Input CR-file (energy points)
TAPENR 0 ,I		Output CR-file
MAT ,I		Number of isotopes (sub-files) on the output file after the calculation
EST ,R		Upper energy limit for the DORES multi-level calculation (eV. Described above)
ESL ,R		Lower energy limit for the DORES multi-level calculation (eV. Described above)
TEMP ,ABS ,R		Temperature (^{O}K)
S ,I		Number of single-level "tails" at each energy ($\geq$ 1. 30 recommended)
Q ,I		Number of consecutive resonances included in the multi-level treatment ($\geq$ 0. 4 recommended for 238U)
IF ,I		= 0: non fissile isotope*
IP ,I		= 0: no p-wave resonances*
FIT, RA [1:4]	TEMP $<$ 0	Corrections below the lowest lying positive energy resonance*
TAPENR I2 ,I	OPT3 = 4 or 5	Input CR-file number two (see above)

FIT

FIT [1] (barns) are added to the scattering cross section.

To the capture cross section the following contribution is added

$$\sqrt{\frac{0.0253}{E}\,(FIT\,[2] + FIT\,[3]\left(\frac{0.0253-FIT\,[4]}{E-FIT\,[4]}\right)^2)}$$

E is the energy point (eV).

It is evident that FIT [2] indicates a 1/v correction (barns) and FIT [3] is a negative energy resonance contribution, both indicated at 0.0253 eV. FIT [4] is the negative resonance energy (eV, FIT [4] $<$ 0).

DORES always prints out all calculated cross sections (line printer).

Fission and p-Wave Resonances, IF, IP

If IP $\neq$ 0 the program reads M, P just after TAPENR I2. M is the number of p-wave resonances and P is the number of p-wave resonance "tails" at each energy. If IF $\neq$ 0 the next input data is FK - the number of fission channels. Now follows the fission and p-wave resonance parameters in the formats of the original version of DORES (including the fission widths). Cf. ref. 7.

3.2.8. TABEL1

An IN-file (TAPENR I2, DFN I2) may be supplied with a new sequence of cross sections from a CR-file (TAPENR I1, DFN I1) by use of the routine TABEL1. The quantity ACNRRES indicates the number in the series of isotopes in the output IN-subfile (TAPENR 0, DFN 0) that the new added isotope (from TAPENR I1, DFN I1) occupies. 1 $\leq$ ACNRRES $\leq$ NRRES I + 1, where NRRES I is the number of isotopes at the old IN-file (TAPENR I2, DFN I2). If ACNRRES $\leq$ NRRES I the new isotope replaces another isotope and the number of isotopes stored on the output IN-file is still NRRES I. If ACNRRES = NRRES I + 1 the series of isotopes are increased with one.

TABEL1 DATA:

Symbol		Explanation
TEMP	,R	Temperature (input CR-file) (^{o}K)
TAPENR I1	,I	Input CR-file *
DFN I1	,I	Data file number at the input CR-file
TAPENR I2	,I	Input (old) In-file
DFN I2	,I	Corresponding data file number
TAPENR 0	,I	Output (new) In-file
DFN 0	,I	Corresponding data file number
ACNRRES	,I	Number of the added isotope in the list of isotopes

The Input CR-File, TAPENR I1 may either be a LIST2 output file (OPT4 = 3 or 5) or a DORES output file (OPT4 = 2 or 4).

OPT4 = 3 or 5: The narrow group cross sections are group average cross sections determined in accordance with the interpolation in a double logarithmic scale recommended for UKNDL (cf. ref. 1, p. 59). The output tape is a completed cross section, SDP input tape.

OPT4 = 2 or 4: It is important that the input In-file in TABEL1 is identical to the In-file applied in the GROUPS → POINTS conversion initiating the DORES calculation. The output (new) In-file is supplied with group mid-point multi-level cross sections while the averaging is performed in the next step of the calculation (AVERAGING).

3.2.9. AVERAGING (Only DORES Cross Sections)

The group averaging of capture cross sections in the groups next to the extremely narrow resonance groups (cf. ref. 1, p. 59) is performed by adding to the DORES results the differences between mid-point and average cross sections in the actual groups. These differences are calculated by single-level formalism in order to speed up the cross section generation. The link makes use of a sequence of resonance parameters from the RESAB resonance parameter library, which therefore must be loaded before the link is called (DFN and DFN RES. PAR. are independent of each other).

AVERAGING DATA:

Symbol		Condition	Explanation
TAPENR I	,I		Input In-file (output In-file from TABEL1)
DFN	,I		Data file number
TAPENR 0	,I		Output In-file (completed cross section, SDP input tape)
ACNRRES	,I		Number of the isotope in the list of isotopes (= ACNRRES in the preceding TABEL1 calculation)
TEMP ,ABS	,R		Temperature (^{o}K) *

If the sign of TEMP is negative, the input scheme comprises BETA[5], BETA[9] and BETA[10] (cf. p. 21. If TEMP > 0 the values previously recommended are adopted).

3.2.10. DUMPING of Tape and Disk Files

DUMPING DATA:

Symbol		Conditions	Explanation
TAPEN	,I		Logical (internal program) no. for the file
OPT	,I		= 1 CR-file = 2 In-file
NRRES B	,I	OPT = 2	FORMAT description*
NRRES E	,I		

The cross sections are only dumped for the isotopes with numbers from NRRES B to NRRES E in the series of isotopes on the In-file. NRRES E - NRRES B ≤ 2. If NRRES = 0 (NRRES indicates as usual the total number of isotopes) then NRRES E < NRRES B.

3.3. Input Data for RESABFILE3

Symbol		Conditions	Explanation
FF	,AL		Control parameter
(1)			
PROBLEMNO	,I		RESABFILE3 problem number ( ) 0)
DAY	,I		Day of the month
MONTH	,I		Month (≤ 12)
YEAR	,I		Year
CROSSEC	,I		With the symbols of section 5.3: = 1 SS is plotted = 2 SA is plotted = 3 SF is plotted = 4 ST is plotted = 0 No cross section is plotted
J	,I	CROSSEC > 0	The number of the res. absorber whose cross section is going to be plotted (1 ≤ J ≤ NRRES)
NIVEAU1 , ABS	,R	CROSSEC > 0	Ordinate of the abscissa (energy axis) = |NIVEAU1| barns (NIVEAU1) 0: Parallel displacement at the lower and upper cut-off (cf. fig. 8.12, ref. 1) NIVEAU1 < 0: No parallel displacement)
DK1	,I	CROSSEC > 0	Number of decades on the ordinate (cross section) axis
CMDK1	,R	CROSSEC > 0	cm per decade

Symbol		Conditions	Explanation
M , ABS	,I		The number of spatial regions whose fluxes are going to be plotted (1 ≤ ABS(M) ≤ NR) (M) 0 one co-ordinate system for each region. M < 0 a common co-ordinate system is applied)
AFAX	,R		Distance between the abscissa axes (cm)
K, IA [1: ABS(M)]			The numbers on the spatial regions whose fluxes are going to be plotted
NIVEAU2 , ABS	,R		Ordinate of the abscissa (energy) axis = |NIVEAU2| neutrons/cm²/lethargy unit (sign: as for NIVEAU1)
DK2	,I		Number of decades on the ordinate (flux) axis('es)
CMDK2	,R		cm per decade
E1	,R		Upper cut-off energy for the plots (eV)
E2	,R		Lower cut-off energy for the plots (eV)
CME	,R		Dimension of the energy axis('es) (cm). Max. value = 26
EA	,R		The highest energy indicated on the axis('es) (eV)
EAM	,R		Distance between the energies indicated on the axis('es) (eV)
FF	,AL		Control parameter
Input a "-1" or repeat from (1)			

4. LIBRARIES

4.1. The RESAB Resonance Parameter Library

The present status of the library was described in ref. 1, section 3.3. The objective of the present section in only to describe the formal arrangement of the library. Apart from this, table 6 contains a print-out of the library without any description. Table 3.1, ref. 1 shows a summary of the contents of the library.

4.1.1. The Library Set Up

Symbol	Repetitions	Conditions	Explanation
NOMAT ,I			Number of materials (isotopes)
DFNILIB [1:NOMAT] ,IA			The data file numbers characterizing the different materials
-1			Control parameter
488	for N = 1 step 1 until NOMAT		Contents of data file number DFNILIB [N]:
DFNILIB [N] ,I			As above
NO ,ABS ,I			Number of resolved, s-wave, positive energy resonances *
SPIN ,I			Spin quantum number of target nucleus
A ,R			Mass (amu)
SPA, ABS ,R			Potential scattering cross section (barns) (SPA < 0: fissile nuclide)
GAMG ,R			Average radiation width (meV)
KONTROL1 ,I			Number of intervals with different "smooth" corrections (≥ 0)*

Symbol	Repetitions	Conditions	Explanation
BS1 , ABS ,R	for N = 1 step 1 until NOMAT		Resonance energy for a negative energy resonance (eV. No negative energy resonance: BS1 > 0)
BS2 ,R			Contribution to the capture cross section at 0.0253 eV from this resonance (barns)*
BS3 ,R		SPA < 0	Contribution to the fission cross section at 0.0253 eV from this resonance (barns) *
BS4 ,R		SPA < 0 or NO < 0 or SPIN > 0	Without any influence
	for K = 1 step 1 until ABS(NO)		Resonance parameters for positive energy resonance number K (the numbering is initiated at the resonance of lowest energy):
BSK1 ,R			Resonance energy (eV)
BSK2 ,R			Reduced neutron width (Γ_n^o, meV)
BSK3 ,R		SPA < 0	Fission width (Γ_f, meV)
BSK4 ,R		SPA < 0 or NO < 0 or SPIN > 0	Statistic spin factor g_j × percentage of the individual isotope a_i (a_i = 1 for a pure isotope, cf. ref. 1, p. 18)*
SO ,R			s-wave strength function
S1 ,R			p-wave strength function
DO ,R			Observer average level spacing between all resolved s-wave resonances (eV)

Symbol	Repetitions	Conditions	Explanation
B ,R	for N = 1 step 1 until NOMAT		Neutron binding energy + pairing correction (eV. Cf. ref. 1, p. 14)
GO ,R			Single-particle level density (1/eV. Cf. ref. 1, p. 14)
EKS2200 ,R			Capture cross section at 0.0253 eV (barns. EKS2200 = -1: the cross section is equal to the sum of the resonance "tails" at 0.0253 eV)
AAV ,R			Average contents of one isotope ($= \sum_i a_i^2$. Cf. ref. 1, pp. 20 and 39) *
GAMF ,RA [1:3, 1:3]		SPA ≠ 0	Average fission widths GAMF [K, M] = Γ_{fM}, ref. 1, p. 17. K = 1: s-wave - larger spin. K = 2: s-wave - smaller spin. K = 3: p-wave (meV)
DEGF ,IA [1:3]			DFGF [K]: Number of degrees of freedom in the fission width averaging. (0 < DEGF [K] ≤ 4. K: as above)
EKSF2200 ,R			As EKS2200 but fission instead of capture
KONTROL ,I			= 1: no resonances with individually determined Γ_γ. Else = 0

Symbol	Repetitions	Conditions	Explanation
DFNILIB [N] ,I	for N = 1 step 1 until NOG for K = 1 step 1 until 3	KONTROL = 0	As above
NOG ,I			Number of individually determined Γ_γ's
GAMG ,R			Average radiation width (meV)
BSG1 ,I			Resonance number
BSG2 ,R			Radiation width (meV)
SAA2200 ,RA [1:KONTROL1, 1:2]	for N = 1 step 1 until NOMAT	KONTROL1 > 0	SAA2200 [N, 1]: Upper energy limit for interval number N with "smooth" correction. (eV. SAA2200 [1, 1] < SA2200 [2, 1] etc. SAA2200 [KONTROL1, 1] > 10^7). SAA2200 [N, 2]: "Smooth" capture cross section in this interval (1/v-cross section quoted at 0.0253 eV. barns) *
SFA2200 ,RA [1:KONTROL1]		SPA < 0	As SAA [N, 2] but fission * instead of capture (barns)
Input "-1, -1, -1, -1, -1, -1, -1, -1"			

If NO < 0 or SPIN > 0 the program reads the quantity $a_i \cdot g_J$ for each resonance (BSK4). In all other cases $a_i \cdot g_J = 1$. The quantities a_i and AAV are of importance for the construction of a joint tabulation for an element (containing all stable isotopes with equal spin). The possibility of using joint tabulations was described in ref. 1, sections 3.3 and 4.5.1.

Negative Energy Resonance, BS2, BS3

The contribution to the capture cross section at 0.0253 eV (BS2) may be calculated from the resonance parameters:

$$BS2 = 2.603 \cdot 10^{6} \cdot ((1.009 + A)/A)^{2}$$

$$\times \frac{\Gamma \cdot (\Gamma_n^o \cdot g_J)}{\sqrt{E}} \quad \frac{1}{4(E-BS1)^2}$$

E = 0.0253 eV, BS1 < 0. The widths are in eV ($\Gamma \simeq \Gamma_\gamma$).

Smooth Correction, KONTROL1, SAA2200, SFA2200

The possibility of adding smooth contributions to the cross sections in order to obtain recommended infinite dilution resonance integrals was mentioned in ref. 1, p. 19. As to principle these contributions take into account the multi-level effects (fissile nuclides). The correction is treated as an additional 1/v-cross section. Each of the KONTROL1 energy intervals has its own 1/v-cross section. These 1/v cross sections are indicated in the library by means of the values the cross sections would adopt at 0.0253 eV if this energy belonged to the energy intervals. In interval j with the energy limits e_1 and e_2 ($e_1 < e_2$) we have

$$SFA[j] = (C-C_1)/\left(\sqrt{\frac{E}{e_1}} - \sqrt{\frac{E}{e_2}}\right)/2 + SF2200,$$

E = 0.0253 eV,

where C is the recommended partial fission integral in the interval and C_1 is the uncorrected infinite dilution partial integral in the interval including the "tails" of positive and negative energy resonances as the only 1/v-contribution (C_1 may be calculated by RESAB with EKSF2200 = -1, KONTROL = 0 and SY = 10^{17} (LINK ALFA)). SF2200 is the sum of the "tails" at 0.0253 eV (barns. The value of SF2200 is also obtained in the calculation mentioned above.)

Example: ^{235}U-fission below 300 eV. Recommended partial integrals: Hennies, ref. 8. SF2200 = 568 barns. EKSF2200 = 582 barns.

Energy limits (eV)	Partial inf. dil. res. int. (barns)		SFA2200 [N] (barns)
	KONTROL1 = 0 EKSF2200 = 582 barns	KONTROL1 > 0 (RESAB res. int. = those of Hennies)	
0.35-0.18	65.07	77.07	633
0.18-5	16.85	16.57	579
5-10	31.94	35.86	676
10-20.5	27.40	32.53	751
20.5-41	24.61	28.92	791
41-60	15.63	16.47	679
60-100	10.26	11.85	754
100-300	19.24	22.59	831

4.1.2. Library LOADER

Indicated by means of the symbols applied above the "loader" contains the quantities:-NOMAT, DFNILIB, -1 (each on a separate card).

Generally the complete resonance parameter library is read from punched cards the first time in a job the library is applied. By this a binary library is generated on an auxiliary disk file and this file is applied in conjunction with the library loader in the rest of the job.

4.2. Cross Section, SDP Input Tapes

Even though all input tapes may be reproduced at any time by means of the RESAB resonance parameter library and/or the UKNDL, input tapes for some frequently occurring configurations have been preserved as library tapes. In table 7 these are listed together with the data from which they originates. This table replaces table 5.2 in ref. 1. A complete print-out of the tapes does only exist in one copy named RESAB volume 3.

5. FORMATS

5.1. Input Data and Resonance Parameter Library (Punched Cards)

Apart from the Alphameric quantities the data are in "free-field" format. One should be careful in providing card shifts after each logical input record, as indicated by solid lines on the input schemes.

5.2. Files Generated by RESABFILE2 (cf. p. 22)

5.2.1. Cross Section, SDP Input Tapes (IN)

Symbol	Record length	Conditions	Repetitions	Explanation
TNRRES ,IA [1:5]				TNRRES [1] = Number of isotopes with cross sections tabulated on the tape = NRRES ($\rangle$ 0). TNRRES [N] = 0 for N $\rangle$ 1
BB, RA [1: NRRES + 5]				BB [N], N $\leq$ NRRES: Mass (amu) of the isotopes in the order in which the cross sections are printed on the tape. BB [N] = 0 for N $\rangle$ NRRES
DAY ,I				Date of evaluation
MONTH ,I				
YEAR ,I				
TAPENR ,I				Number of the magnetic tape
NG ,I				Total number of narrow groups (energy meshes)
NR ,I				Number of cross section records = ENTIER (NG/50-0.01) + 1
DFN ,I				Data file number

Symbol	Record length	Conditions	Repetitions	Explanation
			for K = 1 step 1 until NR	Each of the following records comprises 50 narrow groups in order of decreasing energy
E, RA [1:50]				Lower group boundaries (eV)
U, RA [1:50]				Lethargy widths of the groups
SA, RA [1:50, 1:NRRES]		NRRES $\rangle$ 0		Narrow group capture cross sections. The NRRES isotopes are ordered in accordance with the list of the masses (cf. BB)(barns)
SS, RA [1:50, 1:NRRES]				Narrow group elastic scattering cross sections (barns)
SF, RA [1:50, 1:NRRES]				Narrow group fission cross sections (barns)

In the first cross section record U [1], SA [1,N], SS [1,N], SF [1,N], 1 $\leq$ N $\leq$ NRRES have no meaning. This is also true for E [J], U [J], SA [J,N], SS [J,N], SF [J,N], 1 $\leq$ N $\leq$ NRRES, NG-(NR-1) $\times$ 50 $\langle$ J $\leq$ 50 in the last record.

5.2.2. Tables of Cross Sections (CR-Files)

Symbol	Record length	Repetitions	Explanation
DAY ,I			Date of evaluation
MONTH ,I			
YEAR ,I			
TAPENR ,I			Number of the file
MAT ,I			Number of subfiles (isotopes)

Symbol	Record length	Repetitions	Explanation
NP ,I		for K = 1 step 1 until MAT	Number of energy points
NR ,I			Number of cross section records = ENTIER(NP/50-0.01) + 1
DFN ,I			Data file number
TXT ,AL			Text
MK ,R			Isotopic mass (amu)
Z ,I			Atomic number
TEMP ,R			Temperature (^{O}K)
			Each of the following records comprises 50 points in order of decreasing energy
E, RA [1:50]		for L = 1 step 1 until NR	Energy points (eV)
SA, RA [1:50]			Capture cross sections (barns)
SS, RA [1:50]			Elastic scattering cross sections (barns)
SF, RA [1:50]			Fission cross sections (barns)

In the last record E[J], SA[J], SS[J], SF[J], NP-(NR-1) × 50 < J ≤ 50 have no meaning.

5.3. Binary Storage of "Narrow Group" Fluxes and Cross Sections on Magnetic Tape for Off-Line Use, RESABFILE1 Output Tape

Symbol	Record length	Explanation
DAY ,I		Date of calculation
MONTH ,I		
YEAR ,I		
N ,I		Number of narrow groups per record

Symbol	Record length	Explanation
NRRES		Number of resonance absorbing isotopes
NR ,I		Number of spatial (sub-) regions (cf. SDP input data)
(1)		Each of the following records comprises N narrow groups in order of decreasing energy
E, RA [1:N]		Lower group boundaries (eV)
U, RA [1:N]		Lethargy widths of the groups
SS, RA [1:N, 1:NRRES]		Microscopic elastic scattering cross sections of the resonance absorbing isotopes ordered in accordance with the list of isotopes in the RESABFILE1 source problem (barns)
SA, RA [1:N, 1:NRRES]		Microscopic capture cross sections. Cf. SS. (barns)
SF, RA [1:N, 1:NRRES]		Microscopic fission cross sections. Cf. SS. (barns)
ST, RA [1:N, 1:NRRES]		Total cross section per atom of the different resonance absorbers
F, RA [1:N, 1:NR]		The narrow group fluxes in the NR spatial regions per unit lethargy
If all E[M] > 0, 1 ≤ M ≤ N then repeat from (1). (The RESABFILE1 source calculation prints an energy value equal to -10^{20} when the calculation is finished.)		

5.4. Punched Cards Output from RESABFILE1 (cf. CALTYPE = -2, 2 or 12)

5.4.1. The RESABFILE1 Source Calculation is Heterogeneous

Symbol	FORMAT (B6700 Algol)	Rep.	Con.	Explanations
PROBLEMNO,I	5F9.0			RESABFILE1 source problem
DAY ,I				
MONTH ,I				
YEAR ,I				
NEGR ,I				Number of wide groups
AMAS ,R	2E12.5	for K = 1 step 1 until NRRES		Isotopic mass (amu)
ENGRO ,R				Upper energy cut-off (eV)
SCROS,RA [1:NEGR]	6E12.5			Effective scattering cross sections for resonance absorber number K (beginning in the group of largest energy. barns)
ACROS,RA [1:NEGR]	6E12.5			Effective capture cross sections (barns)
-1	1E12.5		no fission	Indication of lacking fission cross sections
FCROS,RA [1:NEGR]	6E12.5		if fissile	Effective fission cross sections (barns)

Rep. = Repetitions Con. = Conditions

5.4.2. The RESABFILE1 Source Calculation is Homogeneous

Symbol	FORMAT	Rep.	Con.	Explanation
PROBLEMNO,I	5F9.0			RESABFILE1 source calculation
DAY ,I				
MONTH ,I				
YEAR ,I				
NEGR ,I				Number of wide groups

Symbol	FORMAT	Rep.	Con.	Explanation
AMAS ,R	2E12.5	for K = 1 step 1 until NRRES		Isotopic mass (amu)
S ,R				NR-moderator cross section (the last isotope in the SDP list) per absorbing atom number K (barns)
RIA,RA [1:NEGR]	6E12.5			Effective partial capture resonance integral for res. absorber number K (beginning in the group of largest energy. barns)
-1	1E12.5		no fission	Indication of lacking fission integrals
RIF,RA [1:NEGR]	6E12.5		if fissile	Effective partial fission resonance integrals (barns)

Rep. = Repetitions Con. = Conditions

6. PRINT-OUT OF THE PROGRAMS AND TEST EXAMPLES

6.1. Print-Out of the Programs

The complete code print-out (RESABFILE1, RESABFILE2 and RESABFILE3) covers about 130 pages for which reason only one copy has been produced (named RESAB volume 1).

6.2. Line Printer Output

The greater part of the output is self-explanatory. All input data to SDP, LINK ALFA, RESABFILE2 and RESABFILE3 are printed. In RESABFILE2 these data are printed uncommented with a fixed format (10E13.5). Furthermore, the RESABFILE2 input data are printed at the place where they are used, for instance, between the LIST2 and DORES results. The headline on each page includes CALTYPE in RESABFILE1 calculations and OPT1, OPT2, OPT3, OPT4 in RESABFILE2 calculations.

The quantities "ABSORBTION RATE" and "FISSION RATE" in the LINK ALFA (OPT2 = 1) output and "ABS. INTEGRAL" and "FISS. INTE-

GRAL" in SDP are equivalent to RI in ref. 1 (pp. 24 and 33) while RI and SUMRIA in LINK ALFA (sum of capture and fission) are related to the non 1/v-part of RI' in ref. 1 (p. 33). "1/v A" and "1/v F" are the contributions to RI' from the "tails" of the positive and negative energy resonances plus corrections (1/v-part). If TOM in LINK ALFA is negative then asterisks in the output indicate the resonances, which have not been treated by the standard version of the IR method (ref. 1, section 4.5). In the LINK ALFA output with the heading "RESOLVED REGION", "RIL" is the non 1/v resolved resonance integral (RI') when all resonances are treated by the standard version of the IR method, while "RIE" indicates the same quantity after the application of RESCOLDENS and the complete IR method (ref. 1, section 4.5). "P-wave RI" is the statistic p-wave contribution in the resolved s-wave resonance region (cf. ref. 1, p. 22). "SAEFF", "SFEFF", "SSEFF" are wide group effective capture, fission and scattering cross sections respectively. "FLUX" is either "rod" or "cell" wide group fluxes per lethargy unit (ref. 1, p. 106). In the SDP output obtained with TEST = -1, the fluxes in the different material regions (MR ≠ NR) are printed with alternating signs (of course all fluxes are in fact positive).

6.3. Test Example

The use of the RESAB program system is illustrated by means of eight jobs containing 28 different problems. In the job description below the tape-mounting instructions to the operator are indicated together with the corresponding file cards. The line-printer output from the test examples exists only in one copy (RESAB volume 2). The input data are collected in tables 9-16 while a few comments on each problem follow below.

6.3.1. RESABFILE1

Job 1

^ FILE RESFIL12 = AEK035
The program will read from the tape RESFIL12 = AEK035.
RESAB Resonance Parameter Library.
CPU-time 5.1 min. Real-time 9.2 min. 57 pages output.

Ex. 1 1, 15/11, 1971 - 2, 15/11, 1971

Production of multi-group cross sections (on punched cards) for a Yankee Reactor pin at a burnup of 3890 MWD/TU.

Fuel material: Number density input.
Resonance absorbers: ^{238}U, ^{235}U and ^{239}Pu. Temperature = 861°K.
3355-1.855 eV. SDP calculation with ^{238}U p-wave contribution from LINK ALFA (Statistic calculation).

Ex. 2 3, 15/11, 1971

Continuation of the calculation above into the unresolved resonance region for ^{238}U.
Resonance absorber: ^{238}U.
111090-3355 eV. LINK ALFA.

Ex. 3 4, 15/11, 1971 - 5, 15/11, 1971

Tabulation of partial resonance integrals (MR = 1) on punched cards (homogeneous). NR moderation. Three resonance absorbers are treated at the same time (Resonance overlap at a standard enrichment is included by which the methods of ref. 1, section 6.4.2 become more reliable). 3355-1.855 eV. SDP calculation with ^{238}U p-wave contribution from LINK ALFA. The LINK ALFA output is reduced to a minimum (DETAIL = 3).

Job 2

^ FILE RESFIL12 = AEK026
The program will read from the tape RESFIL12 = AEK026.
CPU-time 6.1 min. Real-time 8.0 min. 33 pages output.

Ex. 4 1, 14/12, 1971

Production of multi-group cross sections (on punched cards) for ^{238}U at 1200°K (rod cross sections). Pure SDP calculation. The SDP output is reduced to a minimum (TEST = -3).

Ex. 5 2, 14/12, 1971

Calculation of multi-group cross sections for ^{238}U at 1200°K (cell cross sections: TEST1 = 2). Output only on line printer. Pure SDP calculation.

Ex. 6 3, 14/12, 1971

Non flat flux, subdivision. SDP calculation for the interval 13.84-0.5 eV. An (almost) isolated ^{238}U rod surrounded by graphite.

Job 3

CPU-time 2.8 min. Real-time 3.8 min. 29 pages output.

Ex. 7 4, 15/11, 1971

Pure LINK ALFA ^{238}U calculation for the Yankee Reactor pin (vacuum cladding correction). 3354.6-1.855 eV.

Ex. 8 5, 15/11, 1971

Calculation of the Ag resonance integral in an NR-moderated homogeneous system. Detailed print-out for all resonances (TOM < 0).

Ex. 9 6, 15/11, 1971

The same problem as in ex. 8, but the output is reduced to a minimum. Furthermore, the example illustrates the influence of a "negative" lower cut-off energy (cf. p. 15).

Ex. 10, 7, 15/11, 1971

Calculation of the Ag resonance integral at infinite dilution.

Ex. 11 8, 15/11, 1971

Calculation for a fissile nuclide. Pure LINK ALFA ^{235}U calculation for the Yankee Reactor pin. Production of punched cards containing the effective group cross sections.

Ex. 12 9, 15/11, 1971 - 10, 15/11, 1971

^{238}U calculation for the Yankee Reactor pin. Two single resonances are treated by SDP, while the remaining part of the problem is solved by use of LINK ALFA. Note ABS(NEGR) < NEGRHOM (cf. p. 19).

Ex. 13 11, 15/11, 1971

SDP calculation on a single resonance.

Job 4

^ FILE RESFIL12 = AEK033
The program will read from the tape RESFIL12 = AEK033.
FRICOR = 10000.
CPU-time 6.3 min. Real-time 12.0 min. 75 pages output.

Non flat flux - Subdivision, SDP calculation for the interval 1200-0.5 eV. An (almost) isolated ^{238}U rod surrounded by graphite. Tabulated collision prob. (CPMC = 1). External storage on auxiliary disk files is applied (AMAS for graphite < 0); this device is used here for illustrative purposes. In fact the same problem could be run more efficiently without the auxiliary files and with the standard value 20000 for FRICOR (see p. 10).

6.3.2. RESABFILE2

Job 5

^ FILE RESFIL9 = AEK025
^ FILE RESFIL11 = AEK031
The program will read from the tape RESFIL9 = AEK025 and produce the tape RESFIL11 = AEK031.
RESAB Resonance Parameter Library.
CPU-time 22.9 min. Real-time 26.8 min. 160 pages output.

Tape AEK025 is an output (CR)-tape from LIST2 containing DFN66 and 65 from UKNDL (^{235}U and ^{239}Pu respectively).

The job produces tape no. AEK031, DFN859120 (cf. table 7).

Ex. 14 1, 12/11, 1971 - 2, 12/11, 1971 - 3, 12/11, 1971

Narrow group structure for ^{235}U and ^{239}Pu. Mixing of these.

Ex. 15 4, 12/11, 1971

Res. par. input. Group structure for ^{238}U. Mixing with the group structure produced in ex. 14.

Ex. 16 5, 12/11, 1971

DORES calculation for ^{238}U.
TABEL1 and AVERAGING for ^{238}U.

Ex. 17 6, 12/11, 1971 - 7, 12/11, 1971

TABEL1 for ^{235}U and ^{239}Pu.

Job 6

^ FILE RESFIL11 = AEK026
The program will produce the tape RESFIL11 = AEK026.
RESAB Resonance Parameter Library.
CPU-time 13.4 min. Real-time 15.9 min. 104 pages output.

The job produces tape no. AEK026, DFN 238120

Job 7 LIST2 job

^FILE RESFIL7 = AEK119

^FILE RESFIL9 = AEK025

The program will read from the tape RESFIL7 = AEK 119 and produce the tape RESFIL9 = AEK025.

CPU-time 3.0 min. Real-time 4.4 min. 145 pages output.

The UKNDL tape AEK119 is used as input for LIST2, and the output tape AEK025 is input tape for job 5.

6.3.3. RESABFILE3

Job 8

^ FILE RESFIL7 = AEK028

The program will read from the magnetic tape RESFIL7 = AEK028 and produce a paper-tape, which is used as input for the GIER plotter program P-591.

CPU-time 0.2 min. Real-time (B6700) 1.1 min. 2 pages line printer output.

Illustration of cross-section and flux on SDP output tape (AEK028) corresponding to ex. 4 in job 2.

7. ACKNOWLEDGEMENT

H. Neltrup is acknowledged for his continuous assistance during the creation of the B6700 version of the RESAB program system.

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Table 1

Set-up of loader decks for RESAB

RESABFILE1

```
ACOMPILE RESABFILE1  ALGOL          !PROCESS  00320,020019,PK
AALGOL FILE TAPE = SOURCE/RESABFILE1
AFILE RESFIL12 = AEK035
ADATA
$SET MERGE
$RESET LIST
ADATA RESFIL5
        DATA
AEND-OF-JOB B6700
```

RESABFILE2

```
ACOMPILE RESABFILE2  ALGOL          !PROCESS  01600,020019,PK
AALGOL FILE TAPE = SOURCE/RESABFILE2
AFILE RESFIL9 = AEK025
AFILE RESFIL11= AEK035
ADATA
$SET MERGE
$RESET LIST
ADATA RESFIL5
        DATA
AEND-OF-JOB B6700
```

RESABFILE3

```
ACOMPILE RESABFILE3  ALGOL          !PROCESS  00100,020019,PK
AALGOL FILE TAPE = SOURCE/RESABFILE3
AFILE RESFIL7 = AEK028
ADATA
$SET MERGE
$RESET LIST
ADATA RESFIL5
        DATA
AEND-OF-JOB B6700
```


Table 2

List of files in RESAB

Logical list		Physical list	
Application	Logical no.	File name	Medium
RESABFILE1			
SDP IN-OUT1 SCRATCH	1	RESFIL1	DISK
SDP IN-OUT1 SCRATCH	2	RESFIL4	DISK
SDP IN-OUT2 SCRATCH	3	RESFIL7	DISK
SDP IN-OUT2 SCRATCH	4	RESFIL10	DISK
SDP NARROW GROUPS RESULTS (pp. 18 and 44)	5	RESFIL11	TAPE
CROSS SECTION, SDP INPUT TAPE	6	RESFIL12	TAPE
RESAB RESONANCE PARAMETER LIBRARY	7	RESFIL1	DISK
RESABFILE2			
APPLICATION, SEE FIG. 2	1	RESFIL3	DISK
- " -	2	RESFIL9	TAPE
- " -	3	RESFIL10	DISK
- " -	4	RESFIL7	TAPE*
- " -	5	RESFIL11	TAPE
- " -	6	RESFIL12	DISK
- " -	7	RESFIL1	DISK
- " -	8	RESFIL4	DISK
RESABFILE3			
RESABFILE3 INPUT = SDP OUTPUT	None	RESFIL7	TAPE

*This is an EBCDIC tape; all the other files are binary.

Table 3

Declaration of files in RESAB

RESABFILE1

```
RESFIL1 (KIND=1,FILETYPE=6,BLOCKSIZE=300,AREASIZE=30,AREAS=100),          00000300
RESFIL4 (KIND=1,FILETYPE=6,BLOCKSIZE=300,AREASIZE=30,AREAS=100),          00000400
RESFIL7 (KIND=1,FILETYPE=6,BLOCKSIZE=300,AREASIZE=30,AREAS=100),          00000500
RESFIL10(KIND=1,FILETYPE=6,BLOCKSIZE=300,AREASIZE=30,AREAS=100),          00000600
RESFIL11(KIND=14,FILETYPE=6,BLOCKSIZE=300,SAVEFACTOR=2),                  00000700
RESFIL12(KIND=14,FILETYPE=6,BLOCKSIZE=300,SAVEFACTOR=2).                  00000800
```

RESABFILE2

```
RESFIL1(KIND=1,FILETYPE=6,BLOCKSIZE=300,AREASIZE=30,AREAS=100),           00000300
RESFIL3(KIND=1,FILETYPE=6,BLOCKSIZE=300,AREASIZE=30,AREAS=100),           00000400
RESFIL4(KIND=1,FILETYPE=6,BLOCKSIZE=300,AREASIZE=30,AREAS=100),           00000500
RESFIL7(KIND=14,MAXRECSIZE=14,BLOCKSIZE=280),                             00000600
RESFIL9(KIND=14,FILETYPE=6,BLOCKSIZE=300,SAVEFACTOR=2),                   00000700
RESFIL10(KIND=1,FILETYPE=6,BLOCKSIZE=300,AREASIZE=30,AREAS=100),          00000800
RESFIL11(KIND=14,FILETYPE=6,BLOCKSIZE=300,SAVEFACTOR=2),                  00000900
RESFIL12(KIND=1,FILETYPE=6,BLOCKSIZE=300,AREASIZE=30,AREAS=100),          00001000
```

RESABFILE3

```
RESFIL7(KIND=14,FILETYPE=6,BLOCKSIZE=300,SAVEFACTOR=2))                   00000300
```


Table 4

Yankee Reactor, 3 regions, 3405 narrow groups, 861°K

CPM applied	Running time (min) **)	Resonance integral (barns)				
		Capture			Fission	
		^{238}U *)	^{235}U	^{239}Pu	^{235}U	^{239}Pu
Flurig, 2 Gauss points	5.5	15.26	108.1	77.43	153.0	130.7
Flurig, 5 Gauss points	7.3	15.24	108.1	77.42	153.0	130.7
Tabulated (5 Gauss points)	4.2	15.27	108.7	77.78	153.9	131.4

*) s-wave resonances only.

**) on IBM 7094

Table 5

^{238}U-rod, 15 regions, 1721 narrow groups, 300°K

CPM applied	Running time (min) **)	^{238}U Resonance Integral (barns)
Flurig, 2 Gauss points	30.1	8.508*
Tabulated (5 Gauss points)	9.0	8.510

*) Flurig, 5 Gauss points, 2 regions 9.149

**) on IBM 7094

Table 6

The RESAB resonance parameter library 1/1 1972

```
10
239
232
107109
113115
110246
111113
235
239
240
14761
-1

488.234.188.0.23*.12.10.64.24.6
0
1.0
                                                6.58*.59.21.1.9.36.7.5.14.66.3.3.09
80.77*.23.102.78.5.5.116.43.3.33.145.8*.071.165.54*.27.190.34.10.9
208.65.3.9.23/.4.1.8.273.74.1.52.291.11**.9.311.12**.056.347.92.4.4.376.92
*058.397.56**.3.410.23*.95*.34.19*.4*463.31*.24.478.7**.14.518.59.1.9
535.49*.1.6.58*.2.1.12.595.15.3.35.019.9*.1.14.628.67**.16.661.18.4.5
693.23.1.3.708.46*.7.721.8*.05.732.26**.05.765.05*.24.779.14*.06.790.88
*18.821.58.2.05.851.02*.1.9.856.15.2.75.866.52*.14.905.11.1.5.909.9*.03
925.18*.28.936.87.4.8.953.43.5.1.991.78.11.1000.3**.04.1011.25*.06.1023
*.2.1029.08*.1.1053.93.2.3.1068.1**.025.1098.35*.45.1108.88*.9.1131.45
*.065.1140.38*.6.5.1167.46*.2.35.1177.62.1.85.1194.96.2.65.1210.93*.26
1245.12.6.5.1267.01*.75.1273.2**.8.1298.44*.*08.1317.21*.11.1335.72**.03
1393.3.7.1405.11.2.05.1419.64*.25.1427.73..8.1444.1**.57.1473.8.2.05
1523.1.5.5.1532.*.05.1550*.03.1565*.05.1598.16.8.1622.89.2.1.1638.19.1
1662.08.4.1688.33.1.9.1709.4.1.35.1723.*.33.1744*.04.1755.8.1.5.1782.3.11
1797.7**.05.1808.76**.4.1845.6*.31.1902.27*.48.1917.1**.5.1968.66.13
1974.65.10.5.2023.58.4.5.2031.06.1.1.2088.63*.3.2096.49*.22.2124.35*.1
2145.45*.75.2152.77.3.8.2172**.05.2185.99.7.8.2201.42.2.4.2229.96*.1
2235.7*.1.2259.46.1.38.2266.43.3.05.2281.27.2.3.2288.7*.05.2315.9*.3
2337.4*.1.2352.1.3.2455.1.3.2392.5*.23.2410.2**.09.2426.5.1.65.2446.2
2.25
2454**.05.2489.8.1.1.2520.7**.2.2548.7.6.8.2559.3.4.3.2580.7.4.4.2598.7.11
2620.6*.8.2631.6**.02.2672.8*.3.4.2675.6**.45.2710.8.1.36.2750.1**.75.2761.9
*.3.2787.9**.2.2804.2**.13.2828.6**.17.2866.1.1.48.2882.9.9.5.2897.8*.5
2923.6**.08.2932.3**.46.2956.3**.28.2967.4**.15.2987.4**.1.3003.1.1.7.3015
*.13.3029*.2.5.3041**.05.3060.2**.5.3081.1**.08.3109.4.1.8.3133.2**.1.3149.1.1
3160**.18.3179.4.1.1.3189**.77.3206.1.3226**.4.3249.2**.2.3280.1.1.8.3295**.15
3310.7**.1.65.3321.3.1.42.3334.1.3355.7.1.3.3371**.05.3387.5**.14.3409.1.8
3436.9.3.25.3459.1.6.5.3484.3.2.3492**.19.3512**.05.3526**.18.3561.5.2.4
3574.4*.3593**.26.3611**.05.3625**.05.3630.3.6.3693.4.3717.7.1.3733.3.2.5
3764.7**.56.3783.7.4.5.3832**.1.3858.1.5.5.3871.3.4.3895**.08.3904.4.4.3.6
9*-5.2.1*-4.20.8.4.07*6.1.536*-5.2.71.1

0
238.68.21.13
                                                1.23.43.2.33.83.3
26.33.4.26.07.5.21.17.6.25.95.7.25.72.10.23.21.11.21.49.12.19.53.13
23.91.14.22.4.16.20.44.18.37.5.19.26.61.20.25.1.21.18.7.23.25.2.24.29.3
25.22.26.21.79.27.33.1.29.25.12.30.20.2.31.25.8.37.19.5.38.20.1.39.23.1
41.18.4.43.41.44.20.9.45.12.3.46.10.9.49.12.5.51.16.1.53.20.2.54.16.9.56
15.2.57.19.9.58.17.7.59.19.60.14.61.21.6.62.28.3.63.33.67.20.68.20.8.70
22.3.71.15.2.72.18.8.73.10.4.77.17.5.78.13.5.79.17.1.80.15.5.81.17.4.82
23.4.83.20.6.85.19.4.86.31.2.88.13.6.89.11.8.90.12.1.91.14.7.92.21.93.14
94.18.95.12
```

to be continued

Continuation (table 6)

```
458.232.223.0.232.11.11.99.21.5
0
  -5.6.65
                                                21.69**.403.23.35*.707.59.34
*.433.68.95*.4.99.112.6.1.392.120.5.1.467.128**.01.128.8**.254.145.92**.003
154.34**.01.17*.4.52.192.2.1.103.196**.025.199*.595.220.7.1.85.251.1*1.88
262.5*1.39.285.1.1.677.305*1.323.328.8.4.13.341.2.2.01.365.06.1.46
369.31.1.45.400.32**.5.420.7**.01.454.34**.04.462.8.2.72.489.1.2.2.510.68
*.22.528.57**.7.534.75**.01.540.1**.03.569.8*1.245.578.19**.08.596.17*.37
617.93**.15.656.79.1.85.665.19**.75.675.19.8.687.4.2.4.700.96**.6.712.83
1.2.741.1.6.9*.778.74**.4.804.1.6.87.821.61**.02.842.4*1.01.850.82**.02
866.71**.5.890.3*1.1.897.2**.01.906.57**.06.943.65*1.2.963.05**.2.983.05**.95
990.71.2.4.1010.7.4.7.1039.54**.45.1065.8**.1.1077.36**.36.1093.06**.12
1110.13**.84.1122.42**.04.1139.13**.41.1150.83**.7.1156.7**.03.1194.2**.16
1204.47**.03.1227.76**.62.1243.26**.42.1248.69*.2.1.1269.55**.47.1292.21*1.7
1301.83**.98.1334.68**.07.1345.46**.02.1354.99.1.5.1359.8**.1.1377.88**.95
1387.05**.04.1397.75.2.1416.59**.02.1426.9*.1.65.1433.56**.85.1509.51**.06
1518.4.2.85.1524.11.2.7.1555.63**.12.1581.21**.25.1589.01.5.2.1603.02**.95
1630.69.7.5.1640.68*1.1666.94*1.9.1672.3**.04.1677.79**.46.1705.5**.12
1720.09**.72.1728.2**.04.1739.85**.15.1746.85**.62.1763.1.85.1803.31.1.5
1811.75**.95.1823.46*1.7.1848.6**.05.1853.76**.8.1861.46**.68.1900.66.2.2
1930.59**.42.1950.54.1.8.1970.81.3.5.1987.73.1.2.2004.87**.56.2015.2**.05
2034.79**.08.2051.27**.35.2061.51**.90.2073.1**.15.2078.32**.36.2116.56.1.45
2147.65*1.5.2162.76.1.8.2178.03*1.5.2196.29*1.1.2216.2**.25.2221.95*1.4
2270.18**.2.2276.13**.85.2286.6*4.6.2321.52**.12.2335.41*1.8.2352.55**.6
2362.6**1.2374.6.1.05.2381.6**.15.2389.6**.04.2418.12*1.4.2439.4**1
2456.11*.2.9.2491.59**.04.2508.75*5.2526.09*1.2563.1*4.2568.45*1.2611.89
1.15.2622.9**1.2634.02*2.5.2654.56**.06.2663.97*3.2677.23**.2.2688.68*.2.8
2713.74*1.15.2721.52**.12.2733.25*.5.8.2747.04**.15.2763.8**.06.2772.92**.98
2793.08*.2.25.2815.5**.4.2831.99**.5.2852.79*2.7.2882.31**.24.2895.1**.25
291*.44**.16.2947.12*1.4.2955.92**.58.2964.77**.38.2978.11**.2.2989.3**.6
3006.2**.15.3016.41**.43.3027.82*3.15.3039.29**.7.3049.7**.18.3060.1**.55
3081.12**.85.3102.4**.05.3109.4**.6.3147.9*.6.3152.79.6.5.3163.8**.32.3187.1
1.25.3206.95*1.8.3229.51**.2.3242.15**.2.3252.3*1.1.3267.65**.6.3296.04*.6
3316.92**.05.3330.08*1.3340.65*2.5.3371.4**.05.3383.48*1.7.3410.66**.5
3421.63**.15.3428.6**.17.3443.72**.8.3471.03**.5.3491.37**.2.3519.87*1.75
3566.2**.04.3574.99**.2.3592.66**.36.3610.47*1.35.3622.41**.5.3637.42**.3
3649.5*1.3673.8**.32.3692.25**.5.3707**.48.3723.25**.4.3732.62*1.3745**.26
3757.8**.3.3786.43**.4.3818.62**.28.3825.11**.3.5.3847.95**.4.3867.68**.65
3884.25**.3.3904.27**.4.3931.2*1.31.6.9*-5.1.95*-4.17.5.4.5.8*6.1.5.14*-5
7.45.1
0
232.30.23.32
                                        1.24.6*2.29.9*3.23.2*4.21.2*5.20.1*6.20.7*8.21.4
11*22.2*12*1.9.6*14*1.9.9*15*20.3*16*21.1*17*17.9*18*21.8*19*24.2*20*22.7
21*20.5*22*22.5*23*26.24*40*27*21.5*28*19.2*33*19.3*37*29.39*33.5*42*28
43*21.6*45*20.5.47*23.2.53*24

                                                488.107109.365**.5.107.88.6.134
0
1.0.0
                                                                5.19.5.53
*.365*16.3*2.87**.1283*30.4*1.32**.365*40.1**.78**.365*41.5**.92**.385*44.8**.54
*.1283*51.3*3.4**.385*55.6*4.3**.1217*70.6*3.27**.365*83.5**.004**.243*87.4
*67**.368*106.3**.02**.243*110.9**.011**.243*128.1**.01**.25*133.9*6.9**.365
139.7**.19**.243*144.2*1.6**.1283*162.4**.02**.25*169.8**.03**.243*173.1*1.3.7
*.365*202.5**.9*1.**.385*209.6*1.6**.365*218.2**.012**.25*251.3**.8**.365*259**.19
*.25*264.7**.22**.243*272.4**.12**.243*290.9*2.1**.1217*293**.017**.25*300.6**.1
*.25*310.9*6.59**.385*316.4*9.5**.365*327.8**.4**.243*347.3**.03**.25*356.2**.02
*.25*361.8*1.16**.385*387.2.13**.365*392**.01**.25*398.1*1**.365*404.4*9.2
*.1217*428.4**.83**.243*444.6*1.8**.257*461.4*1.08**.257*466.8**.6**.257*469.6
2.8**.243*472.2**.08**.25*479.6**.1**.25*487.7*1.14**.243*495.2**.04**.25*500.6
10**.243*512.3**.75**.243*515.5*4.4**.257*526.6**.1**.25*532.2**.06**.25*554.4
```

to be continued

Continuation (table 6)


```
10•.243•560•7•6•.243•565•.•8•.243•570•7•1•75•.257•587•5•6•4•.257•605•1
.6•.25•607•93•2•4•.243•622•2•5•6•.243•625•6•6•.25•648•2•.04•.25•653•5
.09•.25•669•5•1•7•.25•674•5•3•.25•681•5•.16•.25•687•4•.08•.25•696•1•.25
704•.25•.25•713•9•.07•.25•726•1•.25•730•39•.07•.25•747•49•5•2•.25•752•57
4•.25•764•.13•.25•779•94•.8•.25•784•74•11•6•.25•792•65•2•.25•803•8•1•8
.25•813•.24•.25•822•.16•.25•831•39•.2•.25•844•04•.24•.25•848•78•1•.25
861•83•.52•.25•872•34•.64•.25•878•75•.52•.25•882•33•4•.25•886•67•.4•.25
902•84•.6•.25•908•82•.52•.25•914•87•.24•.25•923•29•.32•.25•933•39•18•25
945•24•2•.25•949•.25•.36•.25•960•59•.2•.25•975•48•3•2•.25•981•4•.02•.25
989•86•4•.25•1008•94•4•.25•1016•91•.52•.25•1036•79•.84•.25•1047•87•2•8
.25•1056•31•1•6•.25•1061•.4•1•6•.25•1067•71•3•2•.25•1078•33•.07•.25•1087
.04•.25•1092•.05•.25•1102•.05•.25•1115•23•2•16•.25•1134•91•2•2•.25
1147•62•1•.32•.25•1159•.45•.14•.25•1173•6•.24•.25•1178•1•5•6•.25•1203•3
6•8•.25•1218•9•7•6•.25•1226•.2•.25•1235•5•3•8•.25•1254•2•1•.25•1270•8
.24•.25•1276•4•.76•.25•1283•3•.2•.25•1299•3•3•2•.25•1303•1•.16•.25
1310•3•.72•.25•1341•.12•.25•1346•5•.92•.25•1352•.32•.25•1363•.08•.25
1371•.6•.25•1373•.6•.25•1382•5•2•.2•.25•1398•5•.48•.25•1410•.08•.25
1414•5•10•.25•1423•.18•.25•1438•5•1•.28•.25•1446•5•2•.25•1461•1•44•.25
1473•5•.63•.25•1483•1•.28•.25•1496••56•.25•1504•.46•.25•1511•3•6•.25•1519
.36•.25•1529•.5•.28•.25•1542•.24•.25•1553•.04•.25•1561•.24•.25•1566•.04
.25•1568•.5•.44•.25•1577•.•2•.25•1586•10•4•.25•1613•5•.08•.25•1621•.8•.25
1626•.5•3•2•.25•1634•.08•.25•1638•.•.25•1642•2•.8•.25•1655•.5•.12•.25•1677
3•.25•1686•.04•.25•1695•.16•.25•1705•.32•.25•1713•.2•.25•1718•3•6•.25
1726•1•4•.25•1740•.08•.25•1745•.2•.25•1754•.48•.25•1767•.12•.25•1772•.04
.25•1776•.5•.72•.25•1806•.72•.25•1818•.12•.25•1831•.8•.25•1835•.92•.25
1841•.5•.2•.25•1853•1•.6•.25•1863•.5•.08•.25•1870•.12•.25•1874•.5•.2•.25
1881•.5•.4•.25•1904•.5•.8•.25•1913•.8•.•.25•1926•.28•.25•1934•.5•.8•.25•1937
12•.25•1945•.08•.25•1957•1•.32•.25•1968•2•.52•.25•1987•3•2•.25•2022•2•.25
2026•.8•.25•2036•.2•.25•2045•.8•.25•2059•.08•.25•2067•.16•.25•2072•.4•.25
2080•.08•.25•2090•3•.6•.25•2093•.2•.25•2099•.08•.25•2103•.64•.25•2110•.64
.25•2114•.16•.25•2128•7•.2•.25•2139•.56•.25•2150•1•.52•.25•2156•.16•.25
2163•.24•.25•2167•.6•.25•2174•7•.2•.25•2185•.08•.25•2190•.24•.25•2197•.16
.25•2216•.12•.25•2225•.2•.25•2244•.08•.25•2253•.6•.25•2262•.08•.25•2269
.08•.25•2273•.24•.25•2290•.08•.25•2300•.2•.25•2311•3•.8•.25•2317•2•.25
2326•2•.25•2338•.4•.25•2349•1•.24•.25•2369•.6•.25•2378•.12•.25•2390•14
.25•2431•2•2•.25•2441•.4•.25•2454•1•.6•.25•2464•.4•.25•2470•.2•.25•2479
.2•.25•2495•1•6•.25•2505•7•2•.25•2522•2•.8•.25•2536•.8•.25•2543•.08•.25
2554•.64•.25•2558•.4•.25•2574•6•.4•.25•2595•.08•.25•2608•1•.25•2617•.48
.25•2628•.2•.25•2636•.8•.25•2645•.12•.25•2658•10•.25•2677•1•.25•2683•1•2
.25•2698•.96•.25•2711•2•.8•.25•2724•1•6•.25•2731•.24•.25•2739•.08•.25
2749•.8•.25•2753•.8•.25•2767•.08•.25•2777•6•4•.25•2791•.08•.25•2805•.6
.25•2813•.2•.25•2824•2•.8•.25•2831•2•.8•.25•2846•4•4•.25•2860•.08•.25•2869
1•6•.25•2875•.08•.25•2887•.08•.25•2901•1•2•.25•2915•2•.8•.25•2937•.2•.25
2944•2•.25•2958•.•.25•2978•.08•.25•2989•.08•.25•3000•.08•.25•3016•1•.25
3028•4•.8•.25•3039•.08•.25•3048•6•.8•.25•3058•.2•.25•3079•6•.25•3100•2•.25
3112•4•.8•.25•3120•.08•.25•3131•2•.4•.25•3148•1•2•.25•3153•.6•.25•3160•.4
.25•3175•.6•.25•3185•.2•.25•3192•.2•.25•3192•4•4•.25•3207•.4•.25•3214
5•2•.25•3224•.2•.25•3234•.4•.25•3242•9•2•.25•3260•.08•.25•3265•.08•.25
3273•2•.8•.25•3280•.4•.25•3301•.8•.25•3306•.08•.25•3311•.08•.25•3324•.6
.25•3332•.2•.25•3349•.08•.25•3365•5•2•.25•3378•.6•.25•3391•2•.25•3405•.4
.25•3423•1•2•.25•3432•.6•.25•3444•.08•.25•3457•.4•.25•3471•.2•.25•3485
4•4•.25•3505•2•.2•.25•3511•.08•.25•3522•6•.25•3540•2•4•.25•3562•.2•.25
3578•.8•.25•3586•.4•.25•3610•20•.25•3620•.08•.25•3643•5•2•.25•3658•.4
.25•3664•6•4•.25•3676•.08•.25•3692•12•.25•3714•.2•.25•3726•2•.25•3733•6
.25•3751•.4•.25•3757•.2•.25•3780•1•.25•3790•2•8•.25•3815•2•4•.25•3832
6•4•.25•3848•.2•.25•3855•.08•.25•3864•.8•.25•3870•.08•.25•3887•14•.25
3904•17•2•.25•3917•.2•.25•3942•.08•.25•3958•.4•.25•3972•.2•.25•3989•14
.25•3996•.4•.25•,48•••4•4•••4•16,8,7•1•6•8•6•••6,63,6•.5

0

                                                    107109,37,134
                                                                  1
136•2•146•3•150•4•151•5•157•6•147,7•133,8,139,9,120•10•120•11•130,12•125
```


to be continued

Continuation (table 6)


```
13•130•15•120•16•133•17•130•19•130•20•140•21•154•22•133•24•120•26•150•27
130•31•134•36•175•37•130•40•146•41•130•42•136•45•130•48•130•50•130•51
130•57,130•58,127•61•140•62•130

                                        488•113115•18,4,5,114,8,6•80
0
1,0,0
                                                                1•456•2,52
.526•1•8•.04•.021•3,86•.15••432•4,7•.048•.021•9,12•.52••526•12•1•.032
.479•14•6•2•1•.021•21•6•.66•.021•23•.246•.479•25•2•1,9•.021•32•4•1•5
.021•39,9•.57•.479•45•6•.69•.021•46 3•.063•.479•48•6•.093•.479•63,2•.14
.479•83,5•1,2•.479•95•.27•.479•.45••4•3,0••4•9•.0•7•31••6•.89••5•19•.921

                                                                      0
113115•11•80
                1•72•3•81•5•00•6•140•7•60•9•78•10•110•14•78•16•78•17•78•18
78

488•110246,-16,0,112,8,5,112
0
1,0,0
                                        29,3••0078••104•66,7•1•23••329•83,3••083
.329•89,6•12,7••171•120•5,47••396•226••12••396•226•6•1•66••329•394•1
38•3••396•444•3•2,85••329•673•8,5••396•743•6•6••329•756•5•1••396•935•7•2
.329•970••1••396•1107•45••396•1125•17,9••329••93••4•3,5••4•178•5,91••6
.88••5,••1••.3054

0
                                110246,3•112
                                                2•90,4,130,5,150

488•111113,42••5,111,9•5,112
0
1,0,0
                                        18,35••.0467•.3675•27,5••.98••.3825•56,3••.014
.245•63,7••.39••.3675•69,5••.016••255••84,9•3,15••.3675•86,3••.43••.255••99,6
1•3••.3825•103,2••.14••255•108,4•1,15••.3675•115••.061••255•138,2••.79••.3825
144•5••.56••.245•158,9•1,51••.245•164•2••4,6••.3825•193•5•15,5••.1225•216•2•24
.3675•225,5•3•34••.255•233,8•15••.1275•261,5•2,78••.3675•270•3•89••.1225
275,8•2,05••.255•292,2••.66••.245•314••.305••.255•332,2••.66••.255•356,5•2,6
.3825•389•6•28••.1275•415•6,85••.3675•433•1,73••.3675•439•1•14••.255•480••64
.255•503•3,55••.3675•527•1,91••.3675•541•5•41••.255•552•5,83••.3675•578•12•3
.1275•606•3•65••.245•625•4•16••.255•025•01•3•2••.245•675•7•3••.245•724•1•97
.3675•858,22•5••.3675••.54••4•3,5••4•35,6,96••6••.88••-5,••1••.5

0
111113,18,112
    4•110,6•121,8,72•10•128•15•104•16•112•17•114•19•160•20•106•21,124•26
93•27,90•28•116•29•110•32•95•33•100•35•110•36•150
488,235,194•3,5•235,117••••11,7••47,9
10
••0,95,89,546,1
                                                .273••.00563,99••.5•1•14••.0185•124,6
.437•2•035••.00477•12••.563•2,84••.002•157,5•.5•3•14••.0202•155••.437•3,6
.0286•47••.437•4,84••.027•3,8••.5•5,45••.0099•24••.5•5,83••.005•76,5••.5,6•2
.013•68••.5•6,39••.0915•12••.563•7••.09••.0537•28••.437•8•78••.457•82••.437•9,28
.0755•95••.437•9,74••.015•103••.5•10,18••.0229•56••.437•10,7••.0075•95,7••.5
11•1••.0076•24••.5•11,66••.1538•3,5••.563•12,39••.327•24••.563•12,85••.0111•60
••5•13•28••.016•51••.5•13•69••.011••8,1••.9••.5•13,98••.09••2••0••.5•14•53••.033•23••.5
15•42••.0732•49••.437•16,08••.092•19••.5•16,66••.0783•86••.437•16,9••.013•16••.5
18,06••.0972•90••.437•18,6••.017•71,9••.5•18,98••.019•81••.5•19,29••.626•52
.563•20,16••.029•68,7••.5•20,65••.042•33••.5•21•12••.385•21••.437•22••.0036
155,5••.5•22,45••.0036•112••.5•22,96••.1073•42••.437•23•43••.142•8••.5•23,66
.206•86••.437•24•25••.07•36,8••.5•24,33••.028•47,9••.5•24,55••.028•116,5••.5
```


to be continued

Continuation (table 6)

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28.7,.019.35.5..5,29.67,.033,28,.5,30.59..038,77..5,30.86..094,17..5
32.06..312,58..5,33.53..332,20..5,34.38..375,34..5,34.85..15,49..5,35.21
.76,107..5,38.33..089.86.6..5,39.41..4,47..5,39.9..073,32.2..5,40.54..07
105..5,41.3..078.37.3..5,41.54..062,22.7..5,41.86..224,38..5,42.2..07
38.3..5,42.7..044,22..5,43.42..103,26..5,43.95..096,54..5,44.65..176,80
.5,45..074,34.2..5,45.8..034,27.5..5,46.81..083,65.6..5,47..235,77.3..5
48..121,23..5,48.3..158.44.5..5,48.8..136.43..5,49.43..106,24..5,50.15
.035,21..5,50.48..16,78..5,51.28..525,58.9..5,51.65..038.67.5..5,52.29
.336,142..5,53.49..088,114..5,54.15..035,83.7..5,55.1..44,60..5,55.9..31
79..5,56.51..65,94..5,57.75..15,133..5,58.08..178,35.4..5,58.72..185
91.5..5,59.75..03,240..5,60.18..165,43..5,60.86..065,110..5,61.14..058
91.2..5,62.45..02,92.2..5,63.63..158,42.2..5,64.29..156,16..5,65.78..038
30..5,66.4..045,28..5,67.22..011.65.3..5,68.51..016,46.9..5,69.29..089
88..5,70.43..346.72.6..5,70.75..267,80..5,71.52..055,171..5,72.37..376
75..5,72.91..03,122.8..5,74.54..343,61..5,75.18..15,66.6..5,75.53..142
37.1..5,76.77..0078,45.9..5,77.5..116,55..5,78.1..115,99..5,78.47..015
38.3..5,79.67..077,75..5,80.34..082,113..5,81.42..099,70..5,82.1..0055
129.4..5,82.64..242,14.8..5,83.61..128.72.1..5,84.05..164,65.6..5,84.28
.207,81.2..5,85..11,62.1..5,85.63..065,88.6..5,86.25..0054,111.2..5
86.79..077,92.2..5,87.6..079,102.2..5,88.78..35,96.7..5,89.1..019,92.2
.5,89.8..07,97.6..5,90.34..51,14.4..5,91.26..31,59.9..5,92.06..075,92.2
.5,92.58..263,41.2..5,93.24..034.85..5,94.08..41,14.6..5,94.34..072,7..5
.5.56..162,104..5,96.41..105,111.2..5,98.11..281,81.2..5,99.53..062
106.5..5,100.29..066,87.8..5,100.98..099,44.5..5,101.85..036,51.3..5
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73.7..5,105.55..03,38.3..5,106.09..113,57.7..5,106.72..0107,72.6..5
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24.2..5,110.18..055,13.4..5,111.13..046,43.4..5,111.66..107,29.1..5
113.54..135,44..5,115.08..041,171..5,115.92..266,67.5..5,118.3..14,99.8
.5,118.62..28,59.2..5,121.9..51,64.7..5,122.89..054,66.6..5,123.59..036
88.6..5,123.96..01,122.6..5,124.75..195,85.5..5,125.62..37,35.2..5
126.01..18,38.3..5,126.45..35,37.1..5,127.74..057,81.2..5,128.14..13
51.5..5,129.54..06,32.3..5,129.92..15,51.5..5,131.23..19,208..5,131.64
.09,217.5..5,132.11..19,78.6..5,132.68..1,40.9..5,133.04..1,63..5,133.62
.38,40.2..5,135.15..34,92.2..5,135.47..34,48.4..5,136.29..27,35.7..5
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0
235,80,47.9
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49,89,58,91,49,93,28.2,94,67,97,59.5,98,81.3,101,43,102,30,103,39,104
77,1,110,52,112,54,115,29,116,65,117,40,119,45,120,56,121,39,124,44.7
134,39.7,135,43.8,137,42.1,138,54.3,139,77.7,140,56.4,146,46.5,147,46.5
148,55.3,156,50.7,158,64.6,159,73.7,161,59.1,162,67.8
0.45,101.3
1.8,101.3,5,101.3,10,101.3,20.5,101.3,41,101.3,60,101.3,100,101.3,300
101.3,@9,97.476
582,632,64,578,68,676.05,751.09,791.35,679.28,753.62,831.11,567.82

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9
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.75,10.93,.572586,143.3,.75,11.89,.297838,24,.75,14.31,.160461,67,.75
14.68,.746454,30,.5,15.46,.498484,650,.25,17.66,.434754,34,.75,22.29
.564895,62,.75,23.94,.026569,55,.5,26.24,.429478,44,.5,27.24,.022992,8

to be continued

Continuation (table 6)

.5.32.31..147778.110..25.35.5..04016-.5..75.41.42..96335.3..5.41.66
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.25,50.04..428580,12..75,52.6,1.4432,9,9..75,55.63..294953,22..5,57.44
.857642,451.9..25,55.54..717012,1052.9..25,59.22,1.087655,133..75,60.94
1.921498,5760..25,63.08..15109,111..75,65.71,1.498488,74..75,66.57
.15443,103.04..75,74.05..268932,32..75,74.95,2.556551,84..75,78.95
.018007,138.24..5,81.76..063561,1750..25,82.68..082482,24.05..75,83.52
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49
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71,42,73,41,74,56,75,36,76,46,77,33,80,43.6,84,39,86,33,90,28,91,27,93
45,94,47,95,32,97,41,98,41

4.65,289.4,10,289.4,21.5,289.4,45.5,289.4,100,289.4,215,289.4,465
289.4,1000,289.4,@9,252.7
742,598.6,712.70,741.61,731.36,701.40,815.65,661.25,598.6

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1.056,2.24,0.006,1
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0,1,320.7,1.08,0,1,330.4,.31,0,1,346,.89,0,1,363.7,1.7,0,1,372,.72,0,1
405,5.39,0,1,419,.3,0,1,445.8,.075,0,1,449.8,.78,0,1,466.5,.14,0,1,473.3

to be continued

Continuation (table 6)

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,03,0,1,546.4,1,33,0,1,553.2,,79,0,1,566,3,1,32,0,1,584,1,,05,0,1,596.8
2.35,0,1,608,1,,92,0,1,632.5,,53,0,1,637,5,,46,0,1,665,1,7.64,0,1,678.6
1,0,1,712,1,,05,0,1,743.3,,037,0,1,750,2,49,7.8,1,758.9,,22,0,1,778.3
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845.6,,35,0,1,854.9,1.64,0,1,876.5,,47,0,1,891.5,3.16,0,1,903.9,,73,0,1
908.9,2.62,0,1,915.3,1.19,0,1,943.5,,4,0,1,958.4,2.31,0,1,971.3,2.58,0,1
979.2,,23,0,1,1001.8,3.1,0,1,102,,1,,16,0,1,1041.6,,39,0,1,1045.7,,12,0
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,2,0,1,1142.7,1.2,0,1,1159.6,,65,0,1,1185.5,4.57,0,1,1190.8,3.33,0,1
1208.9,1.81,0,1,1228,,29,0,1,1236.5,,32,0,1,1254.7,2.17,0,1,1281.4,,12,0
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,97,4,1,1429,,4,0,1,1450.2,1.67,0,1,1462.9,,55,0,1,1481.2,,24,0,1,1540.7
2.57,0,1,1549.5,3.98,0,1,1563.7,2.9,0,1,1575.3,3.18,0,1,1609.6,,87,0,1
1621.4,,71,0,1,1643.2.65,0,1,1662.6,1.59,0,1,1687.9,,8,0,1,1724.1,2.01,0
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2.57,0,1,1998.3,,12,0,1,2016.7,1.17,0,1,2022.9,1.23,0,1,2033.4,2.25,7.2
1,2055.6,1.51,1.9,1,2082.8,2.16,0,1,1.05E-4,1.75E-4,14.7,4.91E6,1.54E-5
282,1
      0.0.0.0.0.0.0.0.0.0.0.0.-1

0
  240,33,23,2
              1,31,3,20,4,21,8,5,23,5,6,21,7,19,5,9,26,10,21,5,12,24,5
13,21,5,14,20,15,22,16,22,19,21,5,20,24,21,26,24,21,26,21,5,27,25,28
21,5,29,26,32,26,5,36,21,5,37,25,5,40,25,41,24,5,42,21,5,44,25,45,21,46
25,47,22,48,26,5,49,26

488,14761,16,3.5,147.0,10,73.4375,0
                              -1.80,102,08170,1,1.04,0.0054
0.5,5.36,15.5,0.5,6.57,0.75,0.5,6.92,1.81,0.5,15.1,0.37,0.5,19.6,0.96
0.5,29.2,0.44,0.5,35.2,0.07,0.5,38.1,4.3,0.5,45.6,3.8,0.5,48.2,3.2,0.5
52.4,0.26,0.5,55.8,0.18,0.5,65.4,5.7,0.5,85.5,3.8,0.5,115.7,5.0,0.5,3.1E-4
1.7E-4,6.8,6.0E6,6.31E-6,230,1
0
                                    14761,16,73.4375
                                                  1,80,2,67,3,84,4,68
5,73
6,73,7,73,8,73,9,73,10,73,11,73,12,73,13,73,14,73,15,73,16,73
-1,-1,-1,-1,-1,-1,-1,-1
```


Table 7

SDP input tapes of general character 1/1 1972

AEK tape no.	DFN	Temp. (K)	Energy interval (eV)	Number of groups	Materials and kind of data (the symbolism is explained in table 8 below)
026	238120	1200	0.024-4000	2497	^{238}U(00), s-wave resonances
031	859120	"1200"	0.025-4000	3739	^{238}U(00), s-wave. ^{235}U(11). ^{239}Pu(11)*
032	859300	300	0.025-4000	4066	do.
033	238300	300	0.024-4000	2828	^{238}U(00), s-wave resonances
035	859861	"861"	0.025-4000	3820	^{238}U(00), s-wave. ^{235}U(11). ^{239}Pu(11)*
037	859024	"1026"	0.025-4000	3790	do.

* At present all UKNDL data are evaluated at 300°K.

Table 8

Explanation of the symbols used in the last column of table 7

Source of group structure / Source of cross section	RESAB resonance parameter library	UKNDL
RESAB resonance parameter library	(00)	(10)
UKNDL	(01)	(11)

Table 9

Input data for job 1 (RESABFILE1 test examples)

```
2,
14,
0,

RESAB LIBRARY

238
FF
1,
15,11,1971,
238,
2,14,
                                                    1.35463E3,2.03864E3
1.23410E3,7.4851E+2,4.5390E2,2.7536E+2,1.6701E+2
1.01301E2,4.7851E+1,2.9023E+1,1.7635E+1,1.0677E+1
5.04348,2.38237,1.455
861,
0.1,
0.3734,0.4318,0.4047,4,1,2,1,
238.125,-2.186E-2,10.64,
239.11,-5.406E-5,11.7,
235.11,-6.857E-4,11.7,
16,-4.544E-2,3.8,
1,1,20,
8-4,
1,2,20.4,
16,1,3.8,
0.771,
2,1,1
FF
-1,
-1,
FF
2,
15,11,1971,
-1,1,
-3,
3,
-14,
2,1,1,1,4,1,2,
239.125,-2.186E-2,10.64,
239.11,-5.405E-5,11.7,
235.11,-6.857E-4,11.7,
16,-4.544E-2,3.8,
55.02,1,11.97,
7.03,
1,2,20.4,
16,1,3.8,
0.771,
0.3734,0.4318,0.4047,
35.859861,
FF
-1
12,
0,
-10,
```

to be continued

Continuation (table 9)

```
238,232,107109,113115,110246,111113,235,239,240,14761,-1,
238
FF
3,
15,11,1971,
238,
2,8,
1,11090E5,8,5517 E4,6,73795E4,4,08677E4,2,47875E4
1,50344E4,9,11882E3,5,53004E3,3,35463E3
861,
0,1
0,3734,0,4318,0,6047,4,1,2,1,
238,125,-2,1868-2,10,64,
239,11,-5,406E-5,11,7,
235,11,-6,857E-4,11,7,
16,-4,544E-2,3,8,
55,02,1,11,97,
7,03,
1,2,20,4,
16,1,3,8,
0,771,
1,1,1
FF
-1,
-1,
2,
14,
0,
-10,
238,232,107109,113115,110246,111113,235,239,240,14761,-1,
238
FF
4,
15,11,1971,
238,
3,14,
                                        3,35463E3,2,03468E3
1,23410E3,7,48518E2,4,53999E2,2,75364E2,1,67017E2
1,01301E2,4,78512E1,2,90232E1,1,76035E1,1,06770E1
5,04348,2,38237,1,855
861,
16,
7,6,9,
FF
-1,
-1,
FF
5,
15,11,1971,
-1,1,
-1,
-3,
1,
-14,
1,1,1,5,
2,
238,125,100,10,64,
235,117,1,5,11,7,
239,059,0,25,11,7,
16,203,5,3,8,
2,100,9,
10,
10,
35,859861,
FF
-1,
-10,
```


Table 10

Input data for job 2 (RESABFILE1)

```
-2,
0,
FF
1,
14,12,1971,
-3,1,
3,
14,
2,1,2,1,2,
                                        3,35463E3,2,03468E3
1,23410E3,7,48518E2,4,53999E2,2,75364E2,1,67017E2
1,01301E2,4,78512E1,2,90232E1,1,76035E1,1,06770E1
5,04348,2,38237,1,855
238,125,100,10,64,
16,207,14,3,8,
9,87,
55,02,1,11,97,
7,03,
1,2,20,4,
16,1,3,8,
0,771,
0,3734,0,4318,0,6047,
26,238120,
FF
-1
0,
0,
FF
2,
14,12,1971,
-1,2,
3,
14,
2,1,2,1,2,
                                        3,35463E3,2,03468E3
1,23410E3,7,48518E2,4,53999E2,2,75364E2,1,67017E2
1,01301E2,4,78512E1,2,90232E1,1,76035E1,1,06770E1
5,04348,2,38237,1,855
238,125,100,10,64,
16,207,14,3,8,
9,87,
55,02,1,11,97,
7,03,
1,2,20,4,
16,1,3,8,
0,771,
0,3734,0,4318,0,6047,
26,238120,
FF
-1
0,
0,
FF
3,
14,12,1971,
-1,2,
```

to be continued

Continuation (table 10)

```
2,
1,
2,1,-1,1,
8,7,
13.84,0.5,
238.125,100,10.64,
18.8,
12,1,4.65,
1.6,
0.54,0.90,1.05,1.13,1.17,1.188,1.196,1.2,1.35,1.6,1.9,2.5,3.5,5.5,5.5,120
26,238120,
FF
-1,
-10,
```

Table 11

Input data for job 3 (RESABFILE1)

```
11,
0,

RESAB LIBRARY

238
FF
4,
15,11,1971,
238,
2,14,
                                        3.35463E3,2.03468E3
1.23410E3,7.48518E2,4.53999E2,2.75364E2,1.67017E2
1.01301E2,6.78512E1,2.90232E1,1.76035E1,1.06770E1
5.04348,2.38237,1.855
861,
0,1,
0.3734,0.4318,0.6047,2,1,2,1,
238,125,100,10.64,
16,207,14,3.8,
9,87,
1,1,20,
E-4,
1,2,20.4,
16,1,3.8,
0.771,
2,1,1
FF
-1
107109
```

to be continued

Continuation (table 11)

```
FF
5,
15,11,1971,
107109,
2,-1,
1.2E6,0.5,
300,
1,
0,20,
FF
6,
15,11,1971,
107109,
3,1,
1.2E6,-0.5,
300,
1,
0,20,
-1,
20,
E6,0,
FF
7,
15,11,1971,
107109,
2,1,
1.2E6,0.5,
300,
1,
0,E17,
FF
-1,
-1,
12,
0,
-10,
238,232,107109,113115,113246,111113,235,239,240,1.761,-1,
235
FF
8,
15,11,1971,
235,
2,14,
                                        3.35463E3,2.03468E3
1.23410E3,7.48518E2,4.53999E2,2.75364E2,1.67017E2
1.01301E2,6.78512E1,2.90232E1,1.76035E1,1.06770E1
5.04348,2.38237,1.855
300,
0,1,
0.3734,0.4318,0.6047,2,1,2,1,
235.117,3.57,11.7,
16,207,14,3.8,
1.51,
1,1,20,
E-4,
1,2,20.4,
16,1,3.4,
0.771,
2,1,1
FF
```

to be continued

Continuation (table 11)

```
-1,
-1,
4,
2,
14,
0,
-10,
238,232,107109,113115,110286,111113,235,239,240,14761,-1,
238
FF
9,
15,11,1971,
1,3,
238,
2,14,
                                        3.35463@3,2.03466@3
1.23410@3,7.46514@2,4.53299@2,2.75364@2,1.67017@2
1.01301@2,4.78512@1,2.90232@1,1.76035@1,1.06770@1
5.04348,2.38237,1.855
861,
0,1,
0.3734,0.4318,0.6047,2,1,2,1,
238,125,100,10.64,
16,207,14,3.8,
9,87,
1,1,20,
@-4,
1,2,20.4,
16,1,3.8,
0.771,
2,1,1
FF
-1,
-1,
FF
10,
15,11,1971,
-3,1,
3,
-7,
2,1,2,1,2,
238,125,100,10.64,
16,207,14,3.8,
9,87,
55.02,1,11.97,
7.03,
1,2,20.4,
16,1,3.8,
0.771,
0.3734,0.4318,0.6047
FF
-1
-1,
0,
FF
11,
15,11,1971,
-3,1,
3,
7,
```

to be continued

Continuation (table 11)

```
2,1,2,1,2,
1.01301@2,4.78512@1,2.90232@1,1.76035@1,1.06770@1
5.04348,2.38237,1.855
238,125,100,10.64,
16,207,14,3.8,
9,87,
55.02,1,11.97,
7.03,
1,2,20.4,
16,1,3.8,
0.771,
0.3734,0.4318,0.6047
6.68,0.59,23.43,1,1.851
FF
-1,
-10,
```

Table 12

Input data for job 4 (RESABFILE1)

```
0,
0,
FF
11,
14,12,1971,
-1,2,
2,
6,
1,1,-1,1,
8,7,
1200,800,100,51.1,28.85,13.84,5.5,
238,125,100,10.64,
18.8,
-12,1,4.65,
1.6,
0.54,0.90,1.05,1.13,1.17,1.18d,1.196,1.2,1.35,1.6,1.9,2.5,3.5,5.5,5.120
33,238300,
FF
-1,
-10,
```

Table 13

Input data for job 5 (RESABFILE2)

```
2,1,1,1
-300,10000,0.025,3.66,
25,1,
0,
-1,
FF
-1
1,
3,12,
FF
2,
19,11,1971,
2,1,1,1
-300,10000,0.025,20527,65,
25,1,
0,
-1,
FF
-1
2,
3,3,4,12,
FF
3,
19,11,1971,
1,2,1,1
3,66,20527,65,32,235239,4000
0,
-1,
FF
-1
3,
3,12,4,11,5,4,
FF
4,
19,11,1971,
3,1,1,1

RESAB LIBRARY

238
-300,4000,0.025,20527,238300,
0
-1,
-1,
FF
4,
19,11,1971,
1,2,1,1
20527,238300,32,235239,4,859300,10000,
0,
-1,
FF
-1
4,
3,4,2,11,4,12,6,11,
FF
5,
```

to be continued

Continuation (table 13)

```
19,11,1971,
4,1,2,4
-10,
238,232,107109,113115,110246,111113,235,239,240,14761,-1,
238
4,859300,32,92,
U238
300,
859300,32,20527,1,4000,0.001,-300,30,4,0,0,
0,4,0,2,0,-10,
300,20527,859300,4,859300,1,859300,1,
1,859300,32,1,300,
0
-1,
-1,
FF
-1
2,
3,11,6,1,
FF
6,
19,11,1971,
1,1,1,3
300,25,66,32,859300,1,859300,2,
0,
-1,
FF
-1
2,
3,1,6,11,
FF
7,
19,11,1971,
1,1,1,3
300,25,65,1,859300,32,859300,3,
1,
6,2,
1,3,
-1
FF
-1,
-1,
```

Table 14

Input data for job 6 (RESABFILE2)

```
0,
FF
1,
8,12,1971,
3,1,1,1,

RESAB LIBRARY

238,
-1200,4000,0.024,20527,238120,
0,
-1,
-1,
```

to be continued

Continuation (table 14)

```
FF
-1,
2,
6,11,4,12,
FF
2,
8,12,1971,
4,1,2,4,
-10,
238,232,107109,113115,110246,111113,235,239,240,14761,-1,
238,
20527,238120,20528,92,
U238
1200,
238120,20528,20529,1,4000,0.001,-1200,30,4,0,0,
0,4,0,2,0,-10,
1200,20529,238120,20527,238120,20530,238120,1,
20530,238120,26,1,1200,
1,
6,2,
1,1,
-1,
-1,
FF
-1,
-1,
```

Table 15

Input data for job 7 (RESABFILE2)

```
0
FF
1
12,11,1971,
5,1,1,1
2,25,300,
66,65
235U 239Pu
1
2,1
-1
FF
-1
-1
```

Table 16

Input data for job 8 (RESABFILE3)

```
FF
1,
1,3,1972,
4,1,1,4,7,-3,50,
1,2,3,0.01,3,10,218,180,26,215,5,
FF
-1,
```


Table 17

Explanation of procedures in RESABFILE1

All references in the list refer to Risö Report No. 234 (ref. 1)

Procedure	Explanation
FLUXCROSSMIX	Mixing of SDP and LINK ALFA results (pp. 37 and 119)
PRT1GRCRS	Group cross section output
GEO1, GEO2, GEO3	SDP input
SINGL1LEVELADM	Input to SDP single resonance treatment (p. 62)
HOMINPUT	Conversion of LINK ALFA data to SDP input data (p. 37)
SINGLELEVEL	Control af SDP single resonance treatment (p. 62)
GROUPWIDTHS	Single resonance group structure generation (p. 62)
REST	SDP residual terms (pp. 41 and 62)
CROSSPROBCONSTANTS	Determination of fundamental constants for single-level treatment
SDP	Slowing-down procedure
SDPIN1, SDPIN2, SDPIN3	Initial adjustment of SDP parameters
ERFCPL (SA/84/1)	Complex error function (p. 12)
CPM	Calculation of collision probability (p. 25)
SDPOUT	SDP output
SINGL4LEVELOUT	Output from SDP single resonance treatment
SDPCROSSSECTIONTAPE	Control of SDP calculation based on cross section tabulations (p. 61)
SEARCHTAPE (in SDP block)	Initial cross section, group-structure input tape administration
PRETAPE	Transmission of RESAB resonance parameter library from punched cards to disk (pp. 18 and 134)
SEARCHTAPE (in LINK ALFA block)	Administration of library tape with resonance parameters (p. 18)
INITIALLIBR	do.

Continuation (table 17)

Procedue	Explanation
HETERO	Equivalence principles, Dancoff factor determination, LINK ALFA input (pp. 27, 28 and 37)
JUFL3	J-function (p. 42)
FLULNLKLEL2	E_2-function (p. 38)
RLILTLOL	Statistic calculation (pp. 13 and 38)
REHOMOUT	LINK ALFA output, administration of statistic calculation
RUEUSUCUOULUDUEUNUSU	RESCOLDENS (pp. 37 and 50)
HYP(SA/31/2)	Determination of zero of real function
YUOLKLILOL	Determination of λ in the IR method with scatt. int. incl. (pp. 36 and 37, ref. B)

Table 18

Explanation of procedures in RESABFILE2

All references in the list refer to Risø Report No. 234 (ref. 1)

Procedure	Explanation
LIST2	Administration of UKNDL (pp. 10 and 59)
LIST2REST	Control of SDP input cross section, group structure generation (p. 57)
PRETAPE	Transmission of RESAB resonance library from punched cards to disk (pp. 18 and 134)
SEARCHTAPE	Administration of library tape with resonance parameters (p. 18)
INITIALLIBR	do.
FISSILGROUPS	SDP group structure from UKNDL (p. 59)
NOFISSILGROUPS	SDP group structure from RESAB resonance parameter library (p. 57)
TAPEMIX	Mixing of group structures (p. 61)
GROUPSPOINTS	Conversion of SDP input files to DORES input files (groups → points)
DORES	See pp. 12 and 59
TABEL1	Combination of group structure and cross sections
AVSATAPE	Midpoint-group average cross section conversion (p. 59)
TABEL2	Print-out of cross section files (CR-files)
TABEL3	Print-out of SDP cross section, group-structure files (IN-files)

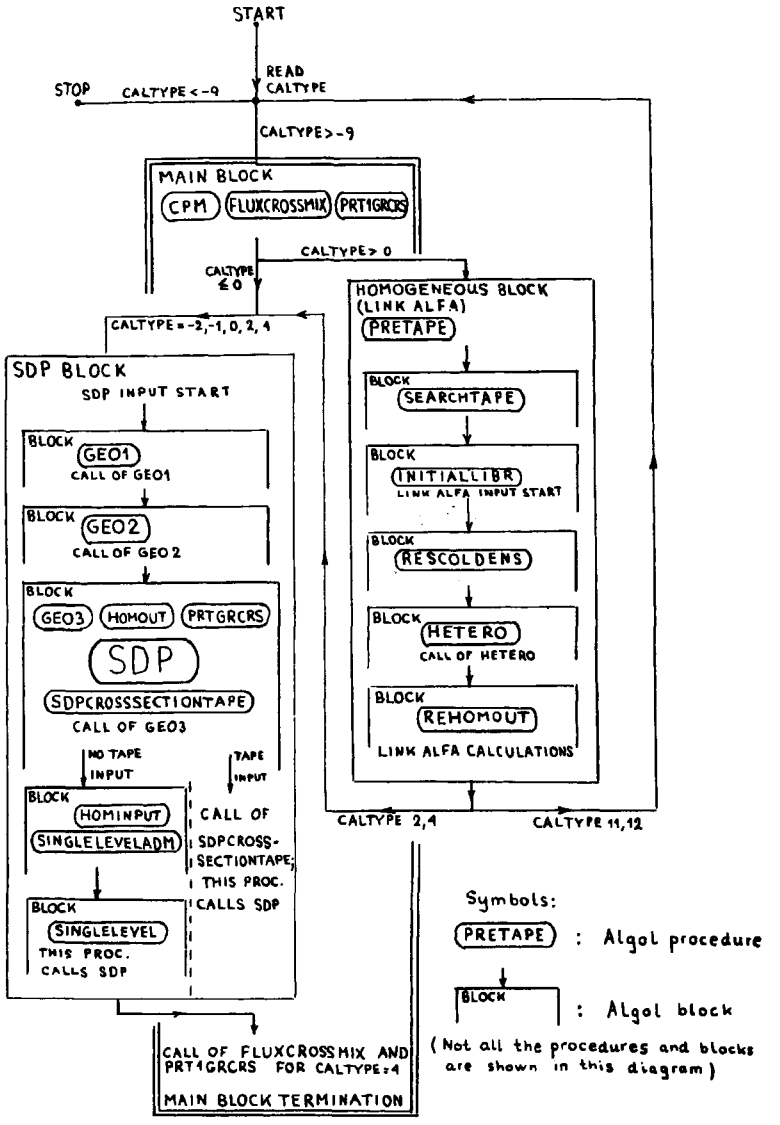

Fig. 1. Coarse structure of RESABFILE1

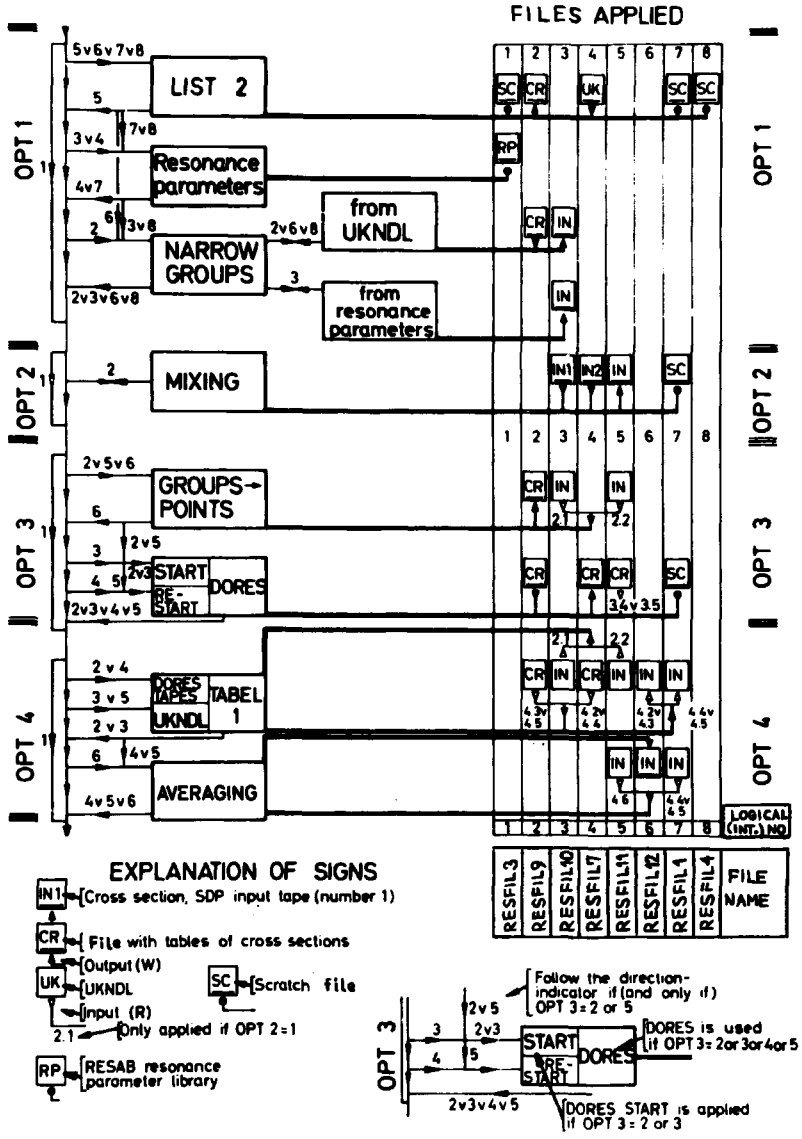

Fig 2 RESABFILE2 job control data and file use