EUR 3882 e

ADDENDUM 1

EUROPEAN ATOMIC ENERGY COMMUNITY - EURATOM

SQUID - 360
A MULTIGROUP DIFFUSION PROGRAM
WITH CRITICALITY SEARCHES FOR THE IBM-360

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A B S T R A C T

This Addendum is presenting the latest features embodied in the program SQUID-360 running on the IBM-360/65 at CETIS, CCR EURATOM, Ispra.

1. Enlargement of the maximum dimensions: two standard versions of SQUID-360 are available, allowing up to 15,000 and 20,000 mesh points respectively.
   Also the maximum number of groups, compositions, and other items is increased.

2. Inclusion of a new option, for testing and printing the input data only, without performing the calculation.

3. The first guess of the dilution factor θ (1) which was formerly calculated by the program, in the criticality searches by uniform variation of a control isotope, must now be supplied as an input datum.

4. Some remarks are given about using the fluxes saved in preceding runs.

5. An "ERRATA CORRIGE" to the reports FN-E-86 (and EUR 3882 e) is supplied.

KEYWORDS

PROGRAMMING	EIGENVALUES
DILUTION	NEUTRON FLUX
CRITICALITY	CONTROL
MULTI-GROUP THEORY	ISOTOPES
DIFFUSION	STANDARDS
IBM 360	MULTIPLICATION FACTORS

1. NEW VERSIONS OF THE PROGRAM SQUID-360 *)

Two new versions of the program SQUID-360 are now working
(March 1968). The first version, with the main program named
SQ15K, requires at least 300,000 bytes of main storage. The
second version, with the main program named SQ20K, requires
400,000 bytes of main storage.
The new maximum dimensions for both versions are as follows:

ITEM	VERS.1	VERS. 2
- Maximum number of groups	KGD = 40	60
- Maximum number of compositions	KCD = 300	300
- Maximum number of rows	KXD = 200	300
- Maximum number of columns	KYD = 200	300
- Maximum number of mesh-points	KPD = 15,000	20,000
- Maximum number of control banks	KLIST = 100	100
- Maximum number of elements in the control list	KTRL = 400	400
- Maximum number of control areas	KROD = 100	100

From now on APPENDIX-A of the report FN-E-86 (and of the report
EUR 3882 e), giving the maximum dimensions for a temporary ver-
sion of the code, must be regarded as obsolete.
The chapters 2 , 3 , 4 and 5 which follow hold for both ver-
sions of the program.

2. A NEW OPTION FOR TESTING INPUT DATA

In order to have the input data only tested and printed by
the program, punch -1 in Col. 38-39 of card no. 2 of the input
deck. The program therefore will stop automatically after com-
pleting the print-out of all input data, reactor picture in-
cluded.

3. THE FIRST GUESS OF THE DILUTION FACTOR

In a criticality search by uniform variation of a control iso-
tope the program follows a strategy slightly different from that
described in references (1) and (2), Chapter II-D.
We remind this is the search of a prefixed multiplication factor
λc by means of a uniform variation of a control isotope number
densities.
The number densities of the control isotope are specified in
input per composition except for a multiplicative factor θ,
called dilution factor, unique for the whole reactor, which is
calculated by the program.

Besides minimum and maximum values of θ (θ_{max} and θ_{min}) a
first approximation $\theta^{(1)}$ ($\theta_{min} \leq \theta^{(1)} \leq \theta_{max}$) is to be input.
The program first determines the eiyenvalue $\lambda^{(1)}$ corresponding
to $\theta^{(1)}$. The second estimate $\theta^{(2)}$ is θ_{max} or θ_{min} according
on whether $\lambda^{(1)} - \lambda_c$ is positive or negative.
Also of this estimate the program calculates the correspondent
eigenvalue $\lambda^{(2)}$

If $\lambda^{(1)} - \lambda_c$ and $\lambda^{(2)} - \lambda_c$ have different signs, the iterative
procedure is continued by successive linear interpolations bet-
ween two consecutive couples of values of λ and θ :

$$\theta^{(i)} = \theta^{(i-1)} + \left[\theta^{(i-2)} - \theta^{(i-1)}\right] \frac{\lambda_c - \lambda^{(i-1)}}{\lambda^{(i-2)} - \lambda^{(i-1)}}$$

until a factor $\theta^{(\tau)}$ is found such that:

$$\left| \lambda^{(\tau)} - \lambda_c \right| < \eta$$

Then θ_c is set equal to $\theta^{(\tau)}$ and the search is terminated.
If the reactivity λ does not change sign going from $\theta^{(1)}$ to
$\theta^{(2)}$, the criticality search is interrupted and the pro-
blem ends with the final edits of a normal problem (average
and point source fluxes and compositions integrals), correspon-
ding to $\theta^{(2)}$ (i.d. θ_{max} or θ_{min}).

The new datum $\theta^{(1)}$ must be specified on the first card (7E10.5)
of SPECIFICATION OF DATA FOR UNIFORM SEARCH (1-V), so that the
contents of this card begins:

Col. 1-10   DILMIN   = θ_{min} = minimum permissible
                                                  value of the dilution
                                                  factor

Col. 11-20   DILMAX   = θ_{max} = maximum permissible
                                                  value of the dilution
                                                  factor

Col. 21-30   DIL   = $\theta^{(1)}$ = first approximation
                                                  of the dilution factor
                                                  ($\theta_{min} \leq \theta^{(1)} \leq \theta_{max}$)

The same datum must be added after θ_{min} and θ_{max} in **Sheet 2
of SQUID 360 INPUT FORM.**

4. SOME REMARKS ON USING THE FLUXES SAVED IN PRECEDING RUNS.

4.1. We remember that the program, if required (IFG=1 on CARD
no. 2), reads the initial flux approximations from the
L.U. (=logical unit) 11.
If the program has stopped with the more up-to-dated fluxes
on the logical unit 9, one should replace on the DD cards
the logical number 09 with the logical number 11 and vice-
versa. Therefore if the restart of an interrupted problem
is desired, we advise to use, as flux units, nine track
tapes with standard label and corresponding DD cards of
the type:

$$FT\left\{\begin{array}{c} 09 \\ 11 \end{array}\right\} F001 \ DD \ UNIT \ = \ L91,LABEL=(,SL),DISP=(NEW,DELETE) \quad C$$

$$VOLUME \ = \ (PRIVATE,SER \ = \ XXXXXX),DSNAME \ = \ ZZZZZZ$$

and then, when required, to exchange the first of the L.U.9
DD cards with the first of the L.U.11 DD cards.
Anyhow an effort has been made to safeguard, at the beginning
of the run, both flux units. So, even in the case of oblivion
or mistake in applying these rules, it is again possible to
restart the problem with the correct flux tape.

4.2. When, in a multicase run, a problem requires, as initial
guess, the converged fluxes of the proceding one, tape units
are not necessary for saving the fluxes but the transmission
of the point fluxes from a problem to the following one can
take place automatically even if disk units are used to store
the fluxes.

4.3. We advise to use the option I$\emptyset$M=1 (Spectral radii read from
the flux tape. See e.g. columns 31-33 of card no.2) only in
a continuation of the same problem or, if a criticality
search is dealt with, in a continuation of the same search
iteration.

5. ERRATA CORRIGE

The factor $\frac{1}{\lambda}$ in formulae 5.3 and 5.4, page 13 of FN-E-86 (or
page 17 of EUR 3882 e) must be canceled.

REFERENCES:
(1) "SQUID-360 - A Multigroup Diffusion Program with Criticality
Searches for the IBM-360", A.Daneri, B.Gabutti, E.Salina,
FN-E-86 (September 1967)
(2) Same Title and Authors, EUR 3882e (1968)