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A USER'S GUIDE FOR THE REBUS-3 FUEL-CYCLE-ANALYSIS CAPABILITY

by

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REBUS-3 FUEL CYCLE ANALYSIS CAPABILITY

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ABSTRACT

REBUS-3 is a system of programs designed for the fuel-cycle analysis of fast reactors. This new capability is an extension and refinement of the REBUS-2 code system and complies with the standard code practices and interface dataset specifications of the Committee on Computer Code Coordination (CCCC). The new code is hence divorced from the earlier ARC System. In addition, the coding has been designed to enhance code exportability.

Major new capabilities not available in the REBUS-2 code system include a search on burn cycle time to achieve a specified value for the multiplication constant at the end of the burn step; a general non-repetitive fuel-management capability including temporary out-of-core fuel storage, loading of fresh fuel, and subsequent retrieval and reloading of fuel; significantly expanded user input checking; expanded output edits; provision of prestored burnup chains to simplify user input; option of fixed or free field BCD input formats; and, choice of finite difference, nodal or spatial flux synthesis neutronics in one-, two-, or three-dimensions.

Information is presented which is useful to the REBUS-3 production user, and to the user who will be implementing REBUS-3 at another installation.

1. INTRODUCTION

REBUS-3 is a system of programs designed for the analysis of fast reactor fuel cycles. The code is an extension and refinement of the REBUS-2 code.[1] As in the case of REBUS-2, REBUS-3 solves two basic types of analysis problems:

1. the infinite-time, or equilibrium, conditions of a reactor operating under a fixed fuel management scheme; and

2. the explicit cycle-by-cycle, or non-equilibrium, operation of a reactor under a specified repetitive or non-repetitive fuel management program.

Only the repetitive type of fuel management scheme is available in REBUS-2 for the non-equilibrium problems. The addition of the general non-repetitive fuel management capability represents a significant enhancement in REBUS-3 as compared to REBUS-2. This new capability also provides for temporary out-of-core storage, loading of fresh fuel, and subsequent retrieval and reloading of the fuel.

Again, as is the case for REBUS-2, for the equilibrium type problems, the code uses specified external fuel supplies to load the reactor. Optionally, reprocessing may be included in the specifications of the external fuel cycle and discharged fuel may be recycled back into the reactor. For non-equilibrium problems, the initial composition of the reactor core may be explicitly specified or the core may be loaded from external feeds as in equilibrium problems.

Four types of search procedures may be carried out in order to satisfy user-supplied constraints:

1. adjustment of the reactor burn cycle time to achieve a specified discharge burnup;

2. adjustment of the fresh fuel enrichment to achieve a specified multiplication constant at a specified point during the burn cycle;

3. adjustment of the control poison density to maintain a specified value of the multiplication constant throughout the reactor burn cycle; and

4. adjustment of the reactor burn cycle time to achieve a specified value of the multiplication constant at the end of the burn step.

Only the first three types of searches are available in REBUS-2.

The user has full control over which of the searches is involved for a particular problem and also may control the precision for a particular search. The BCD input dataset A.BURN is used to specify which of the searches are to be included, and the convergence criteria for the searches are supplied in the BCD input datasets A.BURN and A.NIP3.

A problem must be fully specified initially. Although restarts are possible to permit running cases in segments (to check progress or to get adequate turnaround), there is no present provision for redirecting the calculation once it has been initiated. This limitation is planned to be addressed in future code modifications.

The REBUS-3 System is logically as well as operationally separated into two major segments as in the case of REBUS-2. These are a neutronics code and a fuel cycle code. Each of these major code blocks form a separate module and hence are compatible with execution in a modular environment such as that provided by the ARC System.[2] The REBUS-3 System is comprised of these two major computational modules as well as a number of other modules which perform such tasks as cross-section homogenization, dataset conversion, input processing and checking, etc. It is the REBUS-3 System which provides the complete fuel cycle computational package. The REBUS-3 fuel cycle modules, on the other hand, are those program packages which deal explicitly with the fuel cycle model and related functions. Since there is no geometric information inherent to this fuel cycle model, any neutronics code or module may be used (one-, two-, or three-dimensional diffusion or transport theory, direct or flux synthesis solution, etc.) to provide the region average fluxes required by the fuel cycle modules as long as the interface datasets are compatible.

Whereas REBUS-2 used various ARC System[2] datasets and utilized the DIF1D[3] and DIF2D[4] codes to provide the neutronics solution, REBUS-3 uses only the datasets as specified by the Committee on Computer Code Coordination (CCCC),[5] and has available various neutronics solution algorithms. In particular, finite difference,[6] spatial flux synthesis,[7] or nodal diffusion-theory[8-10] methods are optionally available in the REBUS-3 code System to provide the flux solution in one-, two-, or three-dimensions. In addition, a fast running flux renormalization option is available for scoping studies which avoids the expense of the neutronics calculation at intermediate burn step intervals.

Whereas this document will frequently refer to code modules, the standalone export version of the code has been assembled into a single overlayed code module. Also, several of the sections will refer to modules which are not implemented in the export version of the code. For example, the SUBSET, SUMMARY, CSEC10, and COPYDS modules described in the Programming Information chapter are not included in the export code package. These references are included here for completeness of documentation of the modular version of the code system in use at ANL. Similarly, although the A.SUMMAR dataset is included in the Appendices, this dataset is not pertinent for the standalone export version of the code.

The following chapters and appendices will concentrate on information useful to the user who desires to use REBUS-3 for solution of burnup problems, or to the user who will be implementing the REBUS-3 code.

Chapter 2, which is essentially a copy of most of Chapter II of Ref. 1, is included to provide a review of the physical model used in REBUS-3. It is repeated here for the convenience of the user who is not familiar with the REBUS-2 code. The mathematical formulation and method of solution presented in Ref. 1 will not be repeated here, however. The reader is referred to Chapter III of Ref. 1 for details on the mathematical formulation, method of solution, and acceleration techniques.

Chapter 3 is addressed to the code user and concentrates on new capabilities. A sample problem input is provided which illustrates the new general fuel management capability in REBUS-3. The sample problems discussed in Ref. 1 are not repeated here, so that the user should see Ref. 1 for an example of a typical equilibrium problem and for a discussion of the output formats.

The last chapter addresses programming information which would normally not be of interest to the code user, but is intended rather for the user who will be implementing REBUS-3. There, emphasis is placed on descriptions of code and array usage, array storage considerations, and interface dataset usage.

The appendices provide the specifications for the BCD input datasets used by REBUS-3 and also present a description of the free format input processing routine FFORM.

2. DESCRIPTION OF THE FUEL CYCLE PHYSICAL MODEL

The fuel cycle model used in REBUS-3 may be subdivided into an in-reactor cycle and an ex-reactor or external cycle. The in-reactor cycle is concerned with the location of each discrete "fuel bundle" (or "composition") in space over the period during which it resides in the reactor. For example, a bundle may be loaded at a particular position, then irradiated for some specified time in a flux which is determined by the reactor composition as well as the control and power requirements. After this initial burn, the bundle may or may not be repositioned in space. In any case, if any of the fuel bundles in the reactor are altered, the irradiation rate will undergoe a discontinuous change at this so-called "fuel management time." After several burn/shuffle sequences, the bundle is discharged from the reactor. Spatial movement of any given bundle is, of course, constrained by the requirement of volume preservation. In-reactor movement of a single bundle requires movement of at least two other bundles. One bundle must be moved from its position and inserted in another location, or discharged from the reactor to make room for the original transfer. The space vacated by the original bundle must be filled by fresh fuel, or by a bundle moved from a fourth location. This linked sequence of fuel bundle motions is referred to as a "fuel management path" since it describes the path a specific bundle takes through the reactor as a function of time.

The fuel cycle module of the REBUS-3 System (FCC004) uses a three-level indexing system to identify and locate each of the fuel bundles in the in-reactor cycle. These indices are termed "material type," "stage," and "region." A given material type identifies all of those fuel bundles, or compositions in the reactor which are following a specific fuel management path or sequence. Note that this sequence involves motion in both space and time; a composition which is moved into a position at a particular time may be moved at a later time and replaced by another. A composition which is placed in a specific spatial position at some time is at a particular stage of its in-reactor history. This stage number is a running total of the number of burn cycles which that particular composition has gone through. By convention, stage 1 represents the most recently charged fuel ("fresh" or unburned fuel if it is at the start of a burn cycle) while the composition with the highest stage number represents the composition which has been in the reactor the longest and therefore will be the one discharged at the next fuel management step. The two indices "material type" and "stage" therefore, identify a fuel bundle with respect to its in-reactor history. The two ends of the stage index sequence provide the link with the external cycle. As a specific illustrative example, suppose material type 7 consisted of four stages. There are therefore, four different compositions, which may or may not be in different regions of the reactor, which comprise material type 7. The first stage is the freshly charged fuel, the second represents a fuel bundle which has gone through one burn cycle and therefore is characterized by a differenct set of atomic densities from stage 1. Similarly, stages 3 and 4 have gone through 2 and 3 burn cycles, respectively. The stage 4 composition will be discharged at the fuel management step following the next burn cycle.

The final index, "region," physically locates the specific fuel bundle in the reactor. A region is a closed volume over which the average group fluxes are calculated by the neutronics module being used. These space-dependent group fluxes are used in the isotopic transmutation or burnup equations. A region may be as small as one neutronics mesh cell. If there are several different fuel bundles to be placed within the same region, their compositions will be homogenized into a single region-composition or region-density for the neutronics calculation. In order to treat this case, the indexing system permits any number of compositions to be placed in a single region provided that the total volume of all compositions in a given region equals the physical region volume.

If the as-charged compositions of all material types are held constant and the burn/refuel process is repeated, the composition of the discharged fuel bundles will approach constant values as time increases, assuming that control and criticality constraints are not violated. This reactor condition is actually calculated (or approximated) as one step in obtaining the solution to the equilibrium recycle problem, as detailed in Chapter III of Ref. 1.

Two possibilities arise in the case that fuel management procedures change after a burn cycle. The first is when a particular move sequence is to be carried out only once. Each fuel bundle in the reactor must be accounted for separately at the end of each burn cycle. The second possibility is the case in which a number of burn cycles elapse without any fuel movement within a particular material type, then one discharge-charge move is made, and so on with a fixed repetition factor. Clearly no equilibrium condition can be defined for the first of these possibilities. The second one however, is repetitive and thus may admit of an equilibrium condition. The amount of numerical work required for each pass toward the solution is equal to that for a single burn cycle multiplied by the least common multiple of the repetition factors of all the material types in the reactor. It is for this reason that the equilibrium search procedure is limited to problems with a repetition factor of one, i.e. those in which the same fuel management procedure is carried out at the end of every burn cycle.

It should be noted that the above indexing system is most convenient for describing repetitive partial refueling schemes such as the scatter-reloading scheme often considered for fast reactors. Individual fuel bundles however, can be accounted for separately at the end of each burn cycle through direct reference to the index triplet (material type, stage, region). The stage index is redundant in a simple non-equilibrium problem in which a different fuel management procedure is carried out after each burn cycle. In an equilibrium problem, however, this stage index has a definite value. Since by definition the fuel management procedure is held fixed, the sequence of stages of a material type present in the reactor at any time represent different phases in the burnup history of a fuel bundle. Hence the equilibrium solution can be obtained by calculating only one burn cycle explicitly.

The external cycle model used in REBUS-3 is intended to represent the actual course of events following the discharge of fuel from the reactor. Hence this ex-reactor model consists of the following successive steps: cooling, delivery to a reprocessing plant, refabrication using both reprocessed and external feed supplies, preloading storage, and reactor charge. Each of these phases will be described in more detail in the following sections.

Appendix A contains a complete description of the A.BURN BCD input dataset which is the user-specified input data for the fuel cycle model. In the following discussion, the specification of the in-reactor and external cycle models will be described and related to the corresponding BCD card types of dataset A.BURN. This will serve to aid the user in preparing the data to correctly represent a particular fuel cycle problem.

2.1 SPECIFICATION OF THE IN-REACTOR CYCLE

The simplest type of problem is the non-equilibrium type problem in which the user specifies a fully-loaded reactor (with no information about the external cycle) to be operated at a specified power level for the specified burn cycle time. Optionally, one can specify a fuel management program to follow after any number of burn/shutdown/shuffle cycles. The calculation can be performed with or without the use of time subintervals. The shutdown time and length of each burn cycle are specified on card type 03 of dataset A.BURN, modified as appropriate using the type 36 card data. The number of subintervals into which the total burn cycle time is to be divided is also specified on the type 03 card. For non-equilibrium problems there is no limit to this number, while for equilibrium problems it is limited to a maximum of four subintervals. The total number of fuel management operations is also specified on the type 03 card. The last fuel management operation is then followed by a final burn step, so that the total number of burn cycles to be computed is always one more than the number of fuel management operations specified.

The isotopic transmutation matrix used in REBUS-3 may contain beta minus, beta plus, and alpha decay terms as well as (n,gamma), (n,p), (n,alpha), (n,2n), and (n,f) reactions. Additionally, any number of fission products are permitted with fractional yields that may be fissioning isotope dependent. For decay reactions, isomeric-state branching factors are also permitted for each decaying isotope. Which isotopes appear in a calculation, and the reactions which they undergo, are specified on the type 09 and 25 cards. All parent isotopes listed on the type 09 cards are termed "active" isotopes in that their atomic densities will change as a function of time as the reactor is operated. Additionally, at least one of the active isotopes must appear on the type 24 cards. It should be noted that the computer core storage required by REBUS-3 depends on the square of the number of active isotopes specified.

Each unique fuel management path or fuel shuffling scheme is defined on the type 11 or type 35 cards and given a unique "path label." The fuel bundle to be moved is identified on the type 11 cards by the sub-zone label and the location of this fuel in the reactor is given by the zone label, or alternatively by the region label. If the type 35 cards are being used instead, the fuel bundle is identified by the zone or sub-zone label, and the location by the region or zone label, respectively. There are two different types of fuel management paths: those which move fuel to different regions or to out-of-core storage, and those which do not. If a particular zone is specified for each of N stages in a path, then 1/N of the fuel will be removed at each fuel management step in each region to which the zone was assigned (via the dataset A.NIP3 type 15 cards). For example, suppose zone A1 has been assigned to the reactor regions CORE1, CORE2, and CORE5. If this composition is specified in a fuel management path which has three stages, then in an equilibrium problem, 1/3 of the fuel in regions CORE1, CORE2, and CORE5 will be discharged at the end of each burn cycle and fresh fuel, as specified by the external cycle will be reloaded. Hence at the start of any burn cycle, the fuel in each of these regions will be of three different composition: fresh fuel, once burned fuel, and twice burned fuel corresponding to stages 1 through 3, respectively. For the neutronics calculation, each of these regions will, of course, contain a single composition obtained from homogenizing the three separate stages. Note that in this type of fuel management path (typical for equilibrium problems) there is no movement of fuel from one region to another.

A number of optional card types may be provided to complete the specification of the problem. These are card types 01, 02, and 10. In the absence of type 10 cards, the active isotope labels used to specify the isotopic chain data on the type 09 cards must be contained in the ISOTXS microscopic cross section library. Since it is often desirable to use different cross sections for the same isotope in different regions of the reactor due to varying spectra, one often uses a number of different names for the same physical isotope in a cross section set. Card type 10 enables one to equate a single local active isotope label to many different isotope labels on the cross section file. For example, one may use U235 as the active isotope label for uranium 235, but have labels U235I, U235O, and U235B on the cross section set referring perhaps to uranium 235 in the inner and outer core regions and in the radial blanket of a reactor.

These cards complete the specification of the in-reactor model and since there is no external cycle, serve to specify a straightforward non-equilibrium burnup problem. A description of the external cycle is given in the following sections with a discussion of the associated BCD input data cards needed to specify each aspect of the cycle. In supplying an external cycle, whether it is for an equilibrium or for a non-equilibrium problem, the user is thereby specifying how the empty reactor is to be loaded from the external cycle materials and subsequently refueled over the course of the burn cycles with these same materials. If one were to use only the basic cards described above for a non-equilibrium problem, then one is not specifying how the reactor is to be loaded but rather the actual initial atomic densities of the loaded reactor. This specification is accomplished using the type 13, 14, and 15 cards of dataset A.NIP3 described in Appendix E.

2.2 REACTOR CHARGE SPECIFICATIONS

The type 12 cards are used to describe the fabricated fuel which is to be loaded into the reactor at the fuel management time. For each fuel management path described on the type 11 or 35 cards, one specifies the fabrication time and the pre-loading storage on the type 12 cards. The user also specifies the initial "enrichment" (some of which may be 0.0) of the fuel as well as an "enrichment modification factor" to be used in adjusting the initial enrichment in those problems in which there is a charge-enrichment search.

The enrichment of a fuel is actually a volume fraction representing the fraction of the total fresh charge volume which is to be made up from the high reactivity feed fuel stream, conventionally termed CLASS 1 feed. In other words, it is defined as the ratio of the CLASS 1 fuel volume to the total (CLASS 1+CLASS 2) volume of the charge fuel. The specification of CLASS 1 and CLASS 2 fuel is arbitrary and is described below in the section on refabrication. The only basic requirement is that the reactor multiplication constant be sensitive to variations in the fuel enrichments. The fraction of the total volume of fuel required for each fresh charge which is not made up from CLASS 1 feed will be made up from the low-reactivity feed stream CLASS 2. The required volume of fuel to be fabricated is determined by the "active" volume of each charge material, i.e., the volume occupied by the active isotopes in each material. A fuel fabrication label, specified on the type 13 cards, is used to identify a particular set of atomic densities for the active isotopes. These are as-fabricated fuel densities and may, for example, correspond to an oxide at some percentage of its theoretical density. The active isotope label must be an actual active isotope label specified on a type 09 card. As mentioned earlier, the use of different cross section library labels associated with each type of fuel permits the use of microscopic cross sections which are self-shielded for each material type which is fabricated. At present, REBUS-3 does not permit these microscopic cross sections to vary over a burn cycle. However, a selection of different library isotope labels for each fuel isotope permits approximate corrections for energy and spatial self-shielding as well as for fuel temperature in a particular material type.

2.3 REACTOR DISCHARGE SPECIFICATIONS

The normal procedure following the discharge of a fuel bundle from the reactor is assumed to be storage in a cooling pond followed by transfer to one or more reprocessing plants. Each discharged label (see the discussion of the data set A.BURN type 11 cards) has a cooling time associated with it which is specified on the type 14 cards. This cooling time may logically also include the time required for delivery to the reprocessing plants specified on the type 15 cards. For each discharge label, any number of reprocessing plants may be specified as destinations. One also specifies here the fraction of the discharge to be delivered to each plant. All of the reactor discharge material not delivered to a reprocessing plant will be considered to be sold.

Provision is made for sale of discharged fuel both directly after cooling and following reprocessing. The discharged fuel material of each type may be cooled for a different period, then divided before dispatch to several different reprocessing plants. Discharged fuel of several different material types may be mixed as input to a single reprocessing plant. Radioactive decay processes are accounted for in each material over the specified cooling and/or fuel transfer times according to the isotopic decay schemes specified on the type 09 and 25 cards. Note should be taken of the fact that when an isotope has been discharged from the reactor and fed into a reprocessing plant, the specific identification of that isotope with its particular self-shielded microscopic cross section is lost. Hence, all atoms of that isotope from all of the various materials are counted together.

2.4 REPROCESSING

As mentioned above, the cooled fuel may be divided and/or combined for input to one or more reprocessing plants. Each of these plants has an associated reprocessing time which is specified on the type 16 cards. Each reprocessing plant is assigned a set of "recovery fractions" for each active isotope being processed. These sets of recovery fractions are given a recovery-factor specification label and specified on the type 17 cards. Also associated with each reprocessing plant is a "process separation fraction" for the high-reactivity output. The process separation fraction is the fraction of the atoms of each isotope recovered which are put in the CLASS 1 output stream; the remainder is assigned to the CLASS 2 stream. A given set of isotope labels and associated fractions is assigned a class separation specification label and are defined on the type 18 cards. Note that each reprocessing plant is assumed to operate on a batch process. This approximation was made in order to simplify the calculation of fuel availability for refabrication. The real continuous process can be simulated by splitting a single reprocessing plant input batch into several parts, and then assigning a different reprocessing time to each part.

Optionally, one may also specify an initial batch volume for each reprocessing plant on the type 16 cards and the composition of the output is specified on the type 23 cards. As noted previously, by specifying an external cycle for a particular problem, one is in fact specifying how the initially empty reactor is to be loaded in order to start the burn cycles. Normally this initial fabrication to load the empty reactor is made from fuel supplied exclusively from external feeds. There is no material available from the reprocessing plants due to the simple fact that no material has been discharged from the reactor as yet and sent to these plants. However, by the use of card type 13, this initial fabrication may also include material from the reprocessing plants.

Figure II.1 in Ref. 1 shows a schematic description of the REBUS-3 external cycle model. It includes all the steps which have been discussed thus far, as well as the refabrication phase to be presented in the next section.

2.5 REFABRICATION AND EXTERNAL FEED

The refabrication phase is difficult to arrange into a fully determined yet flexible scheme which is easy for the user to specify in terms of input data requirements. The correct enrichment ratio of each charge material is unknown at problem preparation time, so that specific high- and low-reactivity fuel requirements are unknown. Since the model is of a recycle system, the discharged fuel, and therefore part of the refabrication fuel inventory, is undefined until the reactor performance is known. The method adopted in REBUS-3 is a priority ordering scheme which is relatively easy to specify and is not unduly restrictive in scope. The basis of the model is as follows. At some minimum time before the refueling date, a choice of fuel for refabrication is made. Fuel is available in the form of high-reactivity (CLASS 1) and low-reactivity (CLASS 2) batches, each with fixed isotopic ratios. There may be a number of each of these, some of which represent reprocessed fuel and some of which come from external feeds. In each particular application there are, of course, preferences for one type of fuel mixture over others, but one may be forced to use some second-choice material because of the limited volumes available. There is probably a preference between externally available feeds with different isotopic densities but again there may be a limited amount available. There must, of course, be enough fuel of some type available to complete the makeup of all charge materials.

There is also a choice in distributing the available fuel among the several charge materials which must be fabricated. There may be a preference for one type of feed for use in a particular fuel, and a preference for use of any surplus in the fabrication of another material. There may be a commitment to sell some fraction of reprocessed fuel from some of the plants. The following is a description of the priority scheme which has been devised to express these options of choice in fabrication of fresh fuel. While the scheme cannot treat all conceivable possibilities, it is simple to specify and to calculate and is applied in the same manner for CLASS 1 and CLASS 2 feed streams though the specifications may be different for each.

The first part of the scheme is an absolute order of preference, given for each charge material, of the choice of sources to be used in fabricating that material. A "priority level" of 1 (the highest priority level) for use of fuel from a reprocessing plant or external feed implies that all atoms of that fuel will be used for fabrication of the charge material if they are needed. This is modified by a "distribution fraction" as discussed below. Any surplus material will be made available for use in lower priority fabrication requests. If one material shows priority 1 for more than one type of fuel, those fuels will be used in fabrication in proportion to the number of atoms available from each storage or feed.

If two or more materials have priority 1 for the same fuel source, the total available atoms will be distributed according to a "distribution fraction," which is input along with each priority number. A default value of 1.0 is assumed. If after such a distribution there are still atoms of fuel available (if one or more of the fabricated materials is completed), the surplus is distributed at priority level 1 in proportion to the original distribution fractions of those materials which are not yet complete. When all operations at priority level 1 are completed, the calculation proceeds to priority level 2, and so on until fabrication is completed. Note that bred fuel sale is also treated by the priority system. This is done to permit some of the desired sell-off options described above to be treated by the model.

The priority levels and distribution fractions of each source (reprocessing plant or external feed) to be used in the fabrication of a material are specified for CLASS 1 fuel on the type 19 cards. The same type of priority system is specified for the CLASS 2 fuel supply on the type 20 cards.

The external feed supplies provide an independent source of fuel for fabrication. The name of each external feed and its associated volume are given on the type 21 cards. The type 18 cards are used to describe how the feed supply is to be divided into the CLASS 1 and CLASS 2 fuel streams. The volume of the external feeds must be large enough to insure that there will always be enough fuel to fabricate all required materials. The specific isotopic composition of each feed is specified on the type 22 cards. These atomic densities, when combined with the total feed volumes specified on the type 21 cards, determine the total number of atoms of each isotope available from each external feed.

Some of the capabilities of this system are illustrated by the following example. Consider a plutonium-uranium fueled fast breeder reactor. Assume that it has two different enrichments in the core, and a single blanket composition. The core and blanket discharge fuels are to be reprocessed separately in plants A and B respectively. It is desired to sell 1/4 of the reprocessed blanket plutonium (CLASS 1 fuel) and to distribute the remainder in a 2 to 1 volume ratio into the two core charge compositions. If there is insufficient material from reprocessing plant B to complete the fabrication of the core charges, the remainder needed is to be taken from plant A. On the other hand, if there is more than enough material to fabricate the core charges, the excess will be added to the volume sold. All reprocessed low-reactivity fuel (CLASS 2) is to be used preferentially for blanket charge fabrication, then for the core charges. Any external feed required to complete a fabrication will be obtained first from a limited volume feed (external feed A) and then from a second feed of unlimited volume (external feed B). The priority table and set of distribution fractions needed to specify this program is shown in Table 1. Note that the CLASS 2 fabrication scheme differs from that for the CLASS 1 feed stream.

TABLE 1

Example of Priority System for Selection of Fuel Charge Batches

Path Label or Sale Label	Priority Level/Distribution Fraction							
	Class 1 Fuel				Class 2 Fuel			
	Reprocessing Plant		External Feed		Reprocessing Plant		External Feed	
	A	B	A	B	A	B	A	B
Core Charge 1	2/1.0	1/0.5	3/1.0	4/1.0	2/1.0	2/1.0	3/1.0	4/1.0
Core Charge 2	2/1.0	1/.25	3/1.0	4/1.0	2/1.0	2/1.0	3/1.0	4/1.0
Blanket	-----	-----	-----	-----	1/1.0	1/1.0	2/1.0	3/1.0
Sale	3/1.0	1/.25	-----	-----	-----	-----	-----	-----

3. REBUS-3 USER INFORMATION

REBUS-3 provides a number of enhancements and extensions as compared to the REBUS-2 capability.[1] These include:

1. complete compatibility with the coding practices and interface datasets of the Committee on Computer Code Coordination (CCCC);[5]
2. significantly expanded user input checking capability;
3. expanded output edits including mass balance and neutron balance edits;
4. simplification of user problem specification;
5. optional fixed or free field BCD input formats;
6. provision of optional prestored burnup chains to simplify user BCD input;
7. provision of a search on the reactor burn cycle time for a specified end-of-cycle k_{eff};
8. provision of a completely general non-repetitive fuel management capability including temporary out-of-core storage, loading of fresh fuel, and subsequent retrieval and reloading of fuel;
9. one-, two-, or three-dimensional capability including slab, cylindrical, XY, XYZ, RZ, THETA-R-Z, triangular-Z, and hexagonal-Z geometries, but excluding spherical;
10. optional diffusion theory neutronics solutions available using finite difference, nodal, or spatial flux synthesis algorithms; and,
11. provision for saving the CCCC datasets PWDINT, RTFLUX, RZFLUX, and ZNATDN at each time node for use in later static neutronics.

The following sections will address these new capabilities from the point of view of the code user.

3.1 REBUS-3 BCD Input

As in the case of REBUS-2, the input data for REBUS-3 are of two types: 1) a binary cross-section dataset on disk or tape, and 2) BCD input data normally via punched cards or card images. The cross-section file contains the microscopic cross-sections to be used and is in the ISOTXS format as specified by the CCCC[5]. At ANL, the older ARC System XS.ISO[2] dataset may also be used.

REBUS-3 includes the option of permitting the user to provide the cross section data by means of BCD card input rather than by using the binary dataset ISOTXS. This is accomplished by specifying the cross sections according to the BCD formats given in Ref. 5 for datset ISOTXS and including these in the input data stream in the block[11] NOSORT=A.ISO.

REBUS-3 uses standard ANL conventions[11] regarding the structure of the BCD input data. Thus a typical BCD input deck involving the input BCD datasets A.STP027, A.BURN, A.DIF3D, and A.NIP3 would appear as below, where only the dataset ISOTXS is declared as being an old dataset which is provided by the user for this run.

```
BLOCK=OLD
DATASET=ISOTXS
BLOCK=STP027
DATASET=A.STP027
.
.
DATASET=A.BURN
.
.
DATASET=A.DIF3D
.
.
DATASET=A.NIP3
.
.
```

The dots correspond to the various user supplied card types for the datasets as described in the Appendices. This same input deck using the optional free field input format capability would appear as

```
BLOCK=OLD
DATASET=ISOTXS
BLOCK=STP027
UNFORM=A.STP027
.
.
UNFORM=A.BURN
.
.
UNFORM=A.DIF3D
.
.
UNFORM=A.NIP3
.
.
```

Since the free format option has been specified by means of the UNFORM keyword, in this case the dots would correspond to any free field equivalent[11] of the formats specified in the Appendices for the various BCD datasets. For convenience, the section on the free format input processor from Ref. 11 is presented in Appendix I.

It should be noted that it is permissible to specify some of the input BCD datasets using the free format option (UNFORM=) and others using the fixed format option (DATASET=) within the same job.

The BCD input data consists of the BCD datasets listed in Table 2.

TABLE 2

BCD Input Datasets for REBUS-3

Dataset Name[+]	Comments
A.BURN	Must be present if the problem is not a restart.
A.DIF3D	Need not be present if defaults are acceptable. Not pertinent if the neutronics is provided by the spatial flux synthesis module SYN3D.[7]
A.HMG4C	Need not be present if defaults are acceptable. Some of the data provided in A.HMG4C can be alternatively supplied in dataset A.NIP3.
A.MASFLO	Must be present if a standalone mass flow calculation is to be run.
A.NIP3	Must be present if old datasets GEODST, NDXSRF, and ZNATDN are not supplied. A.NIP3 need not be supplied if the problem is a restart, and dataset ISOTXS is not to be condensed.
A.STP027	Need not be present if defaults are acceptable.
A.SUMMAR	Need not be present if defaults are acceptable.
A.SYN3D	Must be present if the neutronics is provided by the spatial flux synthesis module SYN3D.[7] The presence of dataset A.SYN3D is used to indicate that the neutronics is to be provided by the flux synthesis module SYN3D rather than by the finite difference or nodal neutronics module DIF3D.[6]

[+] Complete descriptions of these input datasets are contained in the Appendices.

3.1.1 Extensions and Modifications to Dataset A.BURN

Dataset A.BURN in REBUS-2 involved card types 01 through 25. These same card types are present in REBUS-3 but new capability has been added to the code as reflected in the new card types 27 through 37. Card type 26 specified in the dataset description for A.BURN to treat the burnup-dependent cross-section capability has not yet been implemented for REBUS-3. It is the lack of this capability which limits the present version of the code to fast reactor analysis.

The code now provides prestored burnup chains which the user may specify rather than the normal procedure of using the type 09 cards to indicate the components of the chains. As indicated in the description of the type 09 and 25 cards, the privileged names PUUCH1, PUUCH2, THUCH1, and THUCH2 refer to these prestored chains. These correspond to simple and complex plutonium-uranium and thorium-uranium chains, respectively.

Figure 1 lists the components of these prestored chains in terms of the type 09 and type 25 card input (using free field format) which would have to be supplied by the user if the prestored chains were not invoked, but the same detail was desired. The isotope names (U-235, PU239, etc.) would have to be related to the corresponding isotope naming in the ISOTXS library using the dataset A.BURN type 10 cards. The user may easily add to or delete parts from the prestored chains as indicated on the card type 09 and 25 descriptions.

Card type 28 permits the user to specify the value to be used for Avogadro's number. This flexibility is useful when running REBUS-3 to compare with calculations performed using other burnup codes which may have a somewhat different value for this quantity. The default value for this constant is 6.022054E+23.

New summary edits concerned with mass balance and mass flows are provided in REBUS-3, and the new card types 29 through 34 are used to provide the necessary user input data. The input processor provides default isotope classifications according to the isotope names as specified in Figure 2. However, the actual labels of the isotopes in the problem should be provided using the type 31 cards since the summary neutron balance will omit isotopes which do not follow the default naming conventions.

REBUS-2 provided a fuel management capability which assumed a repetitive strategy. The user specifies this management using the type 11 cards of dataset A.BURN. REBUS-3 has been expanded to also provide a general non-repetitive fuel management capability which the user specifies using the new card types 35, 36, and 37. The new card type 36 may also be used with the repetitive fuel management strategy specified using the type 11 cards and hence provides more flexibility then was available in REBUS-2.

A description of dataset A.BURN is given in Appendix A. The descriptions of the card types have been expanded to provide the user with guidance as to their use. In particular, users should read the notes provided at the end of each of the card types for details on the use of the particular card type. An example of use of the new card types is given in Section 3.3 below.

```
    PUUCH1                       PUUCH2
=================            =================

09 U-235 1 U-236             09 U-234 1 U-235
09 U-236 1 DUMP1             09 U-234 2 LFPP3
09 U-236 2 LFPP3             09 U-235 1 U-236
09 U-238 1 PU239             09 U-235 2 LFPP5
09 PU238 1 PU239             09 U-236 1 NP237
09 PU239 5 PU238             09 U-236 2 LFPP3
09 PU239 1 PU240             09 U-238 1 PU239
09 PU240 1 PU241             09 U-238 2 LFPP9
09 PU241 6 DUMP1             09 U-238 5 NP237
09 PU241 1 PU242             09 PU238 1 PU239
09 PU242 1 DUMP1             09 PU238 2 LFPP9
09 U-235 2 LFPP5             09 PU238 8 U-234
09 U-238 2 LFPP9             09 NP237 2 LFPPA
09 PU238 2 LFPP9             09 NP237 1 PU238
09 PU239 2 LFPP9             09 NP237 5 PU236 0.36 U-236 0.36 DUMP1 0.28
09 PU240 2 LFPP9             09 PU236 2 LFPPA
09 PU241 2 LFPP9             09 PU236 8 DUMP1
09 PU242 2 LFPP9             09 PU239 1 PU240
09 DUMP1 0                   09 PU239 2 LFPP9
09 LFPP3 0                   09 PU239 5 PU238
09 LFPP5 0                   09 PU240 1 PU241
09 LFPP9 0                   09 PU240 2 LFPP9
                             09 PU241 1 PU242
25 PU241 6 DUMP1 1.4952-09   09 PU241 2 LFPP9
                             09 PU241 6 AM241
                             09 PU242 1 AM243
                             09 PU242 2 LFPP9
                             09 AM241 1 CM242 0.66 AM242 0.20 PU242 0.14
                             09 AM241 2 LFPPA
                             09 AM242 1 AM243
                             09 AM242 2 LFPPA
                             09 AM243 1 CM244
                             09 AM243 2 LFPPA
                             09 CM242 1 CM243
                             09 CM242 2 LFPPA
                             09 CM242 8 PU238
                             09 CM243 1 CM244
                             09 CM243 2 LFPPA
                             09 CM243 8 PU239
                             09 CM244 1 CM245
                             09 CM244 2 LFPPA
                             09 CM244 8 PU240
                             09 CM245 1 CM246
                             09 CM245 2 LFPPA
                             09 CM246 1 DUMP2
                             09 CM246 2 LFPPA
```

Figure 1. Prestored Burnup Chains

```
                           PUUCH2
                           ================

                           09 LFPP3 0
                           09 LFPP5 0
                           09 LFPP9 0
                           09 LFPPA 0
                           09 DUMP1 0
                           09 DUMP2 0

                           25  PU238 8 U-234 2.5022-10
                           25  PU236 8 DUMP1 7.7121-09
                           25  PU241 6 AM241 1.4952-09
                           25  CM242 8 PU238 4.9278-08
                           25  CM243 8 PU239 7.86433-10
                           25  CM244 8 PU240 1.23018-09


     THUCH1                     THUCH2
================           ================

09 TH232 1 PA233           09 TH232 1 PA233
09 TH232 2 LFPP3           09 TH232 2 LFPP3
09 PA233 1 U-234           09 PA233 1 U-234
09 PA233 2 LFPP3           09 PA233 2 LFPP3
09 PA233 6 U-233           09 PA233 6 U-233
09 U-233 1 U-234           09 U-233 1 U-234
09 U-233 2 LFPP3           09 U-233 2 LFPP3
09 U-234 1 U-235           09 U-234 1 U-235
09 U-234 2 LFPP3           09 U-234 2 LFPP3
09 U-235 1 U-236           09 U-235 1 U-236
09 U-235 2 LFPP5           09 U-235 2 LFPP5
09 U-236 1 DUMP1           09 U-236 1 NP237
09 U-236 2 LFPP3           09 U-236 2 LFPP3
09 U-238 1 PU239           09 U-238 1 PU239
09 U-238 2 LFPP9           09 U-238 2 LFPP9
09 PU238 1 PU239           09 U-238 5 NP237
09 PU238 2 LFPP9           09 PU238 1 PU239
09 PU239 1 PU240           09 PU238 2 LFPP9
09 PU239 2 LFPP9           09 PU238 8 U-234
09 PU239 5 PU238           09 NP237 2 LFPPA
09 PU240 1 PU241           09 NP237 1 PU238
09 PU240 2 LFPP9           09 NP237 5 PU236 0.36 U-236 0.36 DUMP1 0.28
09 PU241 1 PU242           09 PU236 2 LFPPA
09 PU241 2 LFPP9           09 PU236 8 DUMP1
09 PU241 6 DUMP1           09 PU239 1 PU240
09 PU242 1 DUMP1           09 PU239 2 LFPP9
09 LFPP3 0                 09 PU239 5 PU238
09 LFPP5 0                 09 PU240 1 PU241
```

Figure 1. Prestored Burnup Chains (cont'd.)

```
     THUCH1                      THUCH2
=================           =================

09 LFPP9 0                  09 PU240 2 LFPP9
09 DUMP1 0                  09 PU241 1 PU242
                            09 PU241 2 LFPP9
25  PA233 6 U-233 2.9713-07 09 PU241 6 AM241
25  PU241 6 DUMP1 1.4952-09 09 PU242 1 AM243
                            09 PU242 2 LFPP9
                            09 AM241 1 CM242 0.66 AM242 0.20 PU242 0.14
                            09 AM241 2 LFPPA
                            09 AM242 1 AM243
                            09 AM242 2 LFPPA
                            09 AM243 1 CM244
                            09 AM243 2 LFPPA
                            09 CM242 1 CM243
                            09 CM242 2 LFPPA
                            09 CM242 8 PU238
                            09 CM243 1 CM244
                            09 CM243 2 LFPPA
                            09 CM243 8 PU239
                            09 CM244 1 CM245
                            09 CM244 2 LFPPA
                            09 CM244 8 PU240
                            09 CM245 1 CM246
                            09 CM245 2 LFPPA
                            09 CM246 1 DUMP2
                            09 CM246 2 LFPPA
                            09 LFPP3 0
                            09 LFPP5 0
                            09 LFPP9 0
                            09 LFPPA 0
                            09 DUMP1 0
                            09 DUMP2 0

                            25  PA233 6 U-233 2.9713-07
                            25  PU238 8 U-234 2.5022-10
                            25  PU236 8 DUMP1 7.7121-09
                            25  PU241 6 AM241 1.4952-09
                            25  CM242 8 PU238 4.9278-08
                            25  CM243 8 PU239 7.86433-10
                            25  CM244 8 PU240 1.23018-09
```

Figure 1. Prestored Burnup Chains (cont'd.)

LFPMO	4	ZR91	4	ZR92	4	ZR94	4	KR83	4	KR84	4	XE124	4	KR86	4
ZR96	4	CM241	3	CM242	3	CM247	3	XE126	4	XE128	4	XE129	4	XE130	4
CM248	3	BK249	3	CF249	3	CF250	3	XE131	4	XE132	4	XE134	4	XE136	4
CF251	3	CF252	3	CF253	3	ES253	3	EU151	4	EU153	4	RE187	4	CL	8
Y89	4	Y90	4	Y91	4	ZR93	4	K	8	MO	5	CR	5	NI	5
ZR95	4	NB94	4	NB95	4	MO92	4	LI-7	8	N-14	8	O-16	8	H-2	8
MO94	4	MO95	4	MO96	4	MO97	4	N-15	8	O-17	8	RE185	4	F-19	8
MO98	4	MO99	4	MO100	4	RU96	4	P-31	8	S-32	8	GD152	4	GD154	4
RU98	4	RU99	4	RU100	4	RU101	4	GD155	4	GD156	4	GD157	4	GD158	4
RU102	4	RU103	4	RU104	4	RU105	4	GD160	4	PU240	2	PU241	1	PU239	1
RU106	4	RH105	4	SN126	4	SB121	4	HE3	8	LI-6	8	B-10	7	C	8
SB123	4	SB124	4	SB125	4	SB126	4	AU197	4	U-235	1	DY164	4	B-11	7
TE120	4	TE122	4	TE123	4	TE124	4	H-3	8	HE4	8	CD	8	CO59	4
TE125	4	TE126	4	TE127	4	TE128	4	HF	8	HF174	4	HF176	4	HF177	4
TE129	4	TE130	4	TE132	4	I-127	4	HF178	4	HF179	4	HF180	4	ZR90	4
I-129	4	I-130	4	I-131	4	I-135	4	TH232	2	U-233	1	TH230	3	PA231	3
XE133	4	CS134	4	CS135	4	CS136	4	U-232	3	U-237	3	NP238	3	PU236	3
CS137	4	BA134	4	BA135	4	BA136	4	PU237	3	PU243	3	PU244	3	AM242	3
BA137	4	BA140	4	LA139	4	LA140	4	NP237	3	PU238	2	PU242	2	CM243	3
CE140	4	CE141	4	CE142	4	CE143	4	CM244	3	CM245	3	CM246	3	AM241	3
CE144	4	PR141	4	PR142	4	PR143	4	AM243	3	PA233	3	U-234	3	U-236	3
ND142	4	ND143	4	ND144	4	ND145	4	NB93	4	TC99	4	RH103	4	CD113	4
ND146	4	ND147	4	ND148	4	ND150	4	SM149	4	CS133	4	AG107	4	AG109	4
PM147	4	PM148	4	PM149	4	PM151	4	U-238	2	U3FP13	4	U5FP13	4	P9FP13	4
SM144	4	SM147	4	SM148	4	SM150	4	U3FP23	4	U3FP33	4	U5FP23	4	U5FP33	4
SM151	4	SM152	4	SM153	4	SM154	4	P9FP23	4	P9FP33	4	BE-9	8	HYDRGN	8
EU155	4	EU156	4	EU157	4	TB159	4	CD108	4	CD110	4	CD111	4	CD112	4
TB160	4	DY160	4	DY161	4	DY162	4	CD114	4	CD115	4	CD116	4	IN113	4
DY163	4	HO165	4	ER166	4	ER167	4	IN115	4	SN112	4	SN114	4	SN115	4
GE72	4	GE73	4	GE74	4	GE76	4	SN116	4	SN117	4	SN118	4	SN119	4
AS75	4	SE74	4	SE76	4	SE77	4	SN120	4	SN122	4	SN123	4	SN124	4
SE78	4	SE80	4	SE82	4	BR79	4	SN125	4	FE	5	NA23	6	LU175	4
BR81	4	KR85	4	RB85	4	RB86	4	LU176	4	TA182	7	W-182	4	W-183	4
RB87	4	SR84	4	SR86	4	SR87	4	W-184	4	W-186	4	TA181	7	MG	8
SR88	4	SR89	4	SR90	4	PD102	4	AL27	8	SI	8	CA	8	TI	8
PD104	4	PD105	4	PD106	4	PD107	4	V	8	MN55	5	CU	8	ZR	5
PD108	4	PD110	4	AG111	4	CD106	4	BA138	4	PB	8	EU152	4	EU154	4
XE135	4	KR78	4	KR80	4	KR82	4								

2...FERTILE
3...OTHER ACTINIDE
4...FISSION PRODUCT
5...STRUCTURE
6...COOLANT
7...CONTROL
8...UNDEFINED
9...SPECIAL

Figure 2. Default Isotope Classifications in REBUS-3

3.1.2 New Dataset A.STP027

Dataset A.STP027 corresponds to the BCD dataset A.STP004 used by REBUS-2, but has been expanded relative to that dataset. The description of A.STP027 given in Appendix F specifies several new options not available in REBUS-2.

On card type 01, cols. 7-12, 37-42, and 55-72 have no analogy in dataset A.STP004. These data refer to trapping errors, creating a condensed version of dataset ISOTXS, invoking a standalone mass flow summary edit, setting the available problem time, and flagging the problem as a high-burnup problem. Similarly, cols. 13-18, 31-36, and 43-60 on card type 02 correspond to new capability not available in REBUS-2, related to invoking reaction summary and mass flow edits, punching mass flow summary edit data, and invoking user supplied modules. Some of these options have been disabled in the standalone export version of the code, but are included here for completeness of documentation of the version of the code used at ANL in its modular form. In particular, cols. 7-12 and 37-42 on card type 01 are not pertinent for the export version of the code. Also, on card type 02, cols. 13-18 and 31-36 are not implemented.

The UDOIT1 and UDOIT3 modules referred to in cols. 49-60 on card type 02 are user supplied codes which the standard path invokes following the execution of the fuel cycle module and after the execution of the neutronics module, repectively. UDOIT1 and UDOIT3 are dummy modules in both the modular and standalone versions of the code. User supplied versions of these modules typically manipulate interface datasets and edit specific items of interest to the user. An example of the use of the UDOIT capability would be to specify new control rod positions at various points in the burn cycle and modify dataset GEODST, e.g. The standard path and catalogued procedure provide the user with an unspecified BCD dataset named A.UDOIT which is available for the user supplied modules.

As in the case of the description of dataset A.BURN, the expanded notes given for the specification of A.STP027 in Appendix F are intended to provide the necessary documentation for the user.

3.2 JCL - THE CATALOGUED PROCEDURE ARCSP027

Figure 3 lists the IBM catalogued procedure ARCSP027 used at ANL to specify the characteristics of the various datasets used during the execution of REBUS-3. This procedure would of course not be appropriate for a non-IBM computer. The correspondences between the datasets and the dataset reference numbers is provided in the DSNAME array as specified in the path driver STP027.

The symbolic parameters contained in the procedure are tabulated in Figure 3 as is a brief description of the contents of each of the datasets involved. The parameters &PRELIB1-&PRELIB3 and &POSTLIB permit the user to easily modify the STEPLIB DD card when using special code libraries. The STEPLIB DD card in Figure 3 references a library containing the standalone export version of the code at ANL.

```
//ARCSP027 PROC DEST=A,DEST2=F,DMPDEST=F,
//             DMY1CYL=21,DMY2CYL=7,DMY5CYL=4,
//             FDCCYL=20,FLXCYL=1,HALFTRK=6136,
//             ISOCYL=1,ISODSP=SHR,
//             ISOTXS=NULLFILE,MODEDCB='RECFM=U',
//             PATH='STP027',POSTLIB='SYS1.DUMMYLIB',
//             PRELIB1='SYS1.DUMMYLIB',PRELIB2='SYS1.DUMMYLIB',
//             PRELIB3='SYS1.DUMMYLIB',
//             PSICYL=5,PSUCYL=3,QRTRTRK=3064,REGN=1000K,
//             RFDSP='(,DELETE)',RFILES='&RFILES',RFVOL=,
//             RTCYL=5,RTDSP='(,DELETE)',RTFLUX='&RTFLUX',
//             RTVOL=,SRFCYL=12,TIMLIM='(600,0)',TRIAL1=NULLFILE,
//             TRIAL2=NULLFILE,TRIAL3=NULLFILE,TRIAL4=NULLFILE,
//             TRIAL5=NULLFILE,TRIAL6=NULLFILE,TRIAL7=NULLFILE,
//             TRIAL8=NULLFILE,TWELTRK=1016,
//             UNITS=BATCHDSK,UNITSCR=SASCR,XSDSP=SHR,
//             XSISO=NULLFILE,XSISO2=NULLFILE,
//             ZONCYL=1
//*
//*    ****************************************************************
//*    *                                                              *
//*    *             CATALOGED PROCEDURE FOR REBUS-3                  *
//*    *             LAST MODIFIED  02/24/83 AT ANL                   *
//*    *                                                              *
//*    ****************************************************************
//*
//*  *******************************************************************
//*
//*  PARAMETER    DEFAULT VALUE              USAGE              FTNNF001
//*  =========    =============              =====              ========
//*
//*   PATH         STP027          PROGRAM NAME                   EXEC
//*   TIMLIM       (600,0)         STEP TIME LIMIT                EXEC
//*   REGN         1000K           STEP REGION SIZE               EXEC
//*   PRELIB1      SYS1.DUMMYLIB   FIRST STEP LIBRARY             STEPLIB
//*   PRELIB2      SYS1.DUMMYLIB   SECOND STEP LIBRARY            STEPLIB
//*   PRELIB3      SYS1.DUMMYLIB   THIRD STEP LIBRARY             STEPLIB
//*   POSTLIB      SYS1.DUMMYLIB   LAST STEP LIBRARY              STEPLIB
//*   DEST         A               OUTPUT DEST. (PRINTER)         06
//*   DEST2        F               OUTPUT DESTINATION FICHE       10
//*   DMPDEST      F               ROUTE DUMP TO FICHE            SYSUDUMP
//*   ISOCYL       1               NO. CYL. FOR TEMPORARY ISOTXS  30
//*   ISODSP       SHR             DISPOSITION OF ISOTXS          35
//*   ISOTXS       NULLFILE        DSN FOR DATASET ISOTXS         35
//*   RFDSP        (,DELETE)       DISPOSITION FOR FILE RFILES    27
//*   RFILES       &RFILES         DSN FOR DATASET RFILES         27
//*   RFVOL        ------          VOLUME FOR RFILES              27
//*   RTCYL        5               NO. OF CYL. FOR RTFLUX         22
//*   RTDSP        (,DELETE)       DISPOSITION OF RTFLUX          22
```

Figure 3. IBM Catalogued Procedure ARCSP027

```
//*    RTFLUX       &RTFLUX         DSN FOR DATASET RTFLUX         22
//*    RTVOL        ------          VOLUME FOR RTFLUX              22
//*    SRFCYL       12              NO. OF CYL. FOR SURF. FLUXES   63,64
//*    TRIAL1       NULLFILE        DSN FOR FIRST TRIAL FUNCTION   70
//*    TRIAL2       NULLFILE        DSN FOR SECOND TRIAL FUNCTION  71
//*    TRIAL3       NULLFILE        DSN FOR THIRD TRIAL FUNCTION   72
//*    TRIAL4       NULLFILE        DSN FOR FOURTH TRIAL FUNCTION  73
//*    TRIAL5       NULLFILE        DSN FOR FIFTH TRIAL FUNCTION   74
//*    TRIAL6       NULLFILE        DSN FOR SIXTH TRIAL FUNCTION   75
//*    TRIAL7       NULLFILE        DSN FOR SEVENTH TRIAL FUNCTION 76
//*    TRIAL8       NULLFILE        DSN FOR EIGHTH TRIAL FUNCTION  77
//*    XSDSP        SHR             DISP. FOR FILES XS.ISO,XS.ISO2 31
//*    XSISO        NULLFILE        DSN FOR DATASET XS.ISO FILE 1  31
//*    XSISO2       NULLFILE        DSN FOR DATASET XS.ISO FILE 2  31
//*
//*    THE FOLLOWING SIX PARAMETERS DEFINE CYLINDER ALLOCATION
//*    AND THE DCB FOR AUXILIARY FLUX, FDCOEF AND ZONMAP DATASETS
//*
//*    FDCCYL       20              NO. OF CYL. FOR FDCOEF DATASET 51
//*    FLXCYL       1               NO. CYL. FOR 1 GROUP FLUX FILES52-59,
//*    MODEDCB      RECFM=U         DCB FOR MAJOR IO DATASETS      48-61,
//*    PSICYL       5               NO. CYL. FOR FLUX DATASETS     48-49,
//*    PSUCYL       3               NO. CYL. FOR ADJ. UPSCAT FLUX  50
//*    ZONCYL       1               NO. CYL FOR ZONMAP             61
//*
//*    THE FOLLOWING THREE PARAMETERS DEFINE CYLINDER ALLOCATION
//*    FOR DUMMY FILES WHICH ALLOCATE CONTIGUOUS BLOCKS OF SPACE
//*    TO BE SUBALLOCATED TO VARIOUS SCRATCH DATA SETS.
//*
//*    DMY1CYL      21              NO. OF CYL. FOR FDCOEF, ZONMAP 51,61
//*    DMY2CYL       7              NO. OF CYL. FOR FLUX DATASETS (48,52,
//*                                                                58)
//*    DMY5CYL       4              NO. OF CYL. FOR FLUX DATASETS (50,56)
//*
//*    THE FOLLOWING FIVE PARAMETERS DEFINE UNIT AND BLKSIZE FOR
//*    A VARIETY OF DATASETS
//*
//*    HALFTRK      6136            HALF TRACK BLOCKING
//*    QRTRTRK      3064            QUARTER TRACK BLOCKING
//*    TWELTRK      1016            TWELFTH TRACK BLOCKING
//*    UNITS        BATCHDSK        GENERIC UNIT NAME
//*    UNITSCR      SASCR           GENERIC UNIT NAME
//*
//*   ******************************************************************
//*
//STP027 EXEC PGM=&PATH,TIME=&TIMLIM,REGION=&REGN
//STEPLIB  DD DSN=&PRELIB1,DISP=SHR
//         DD DSN=&PRELIB2,DISP=SHR
//         DD DSN=&PRELIB3,DISP=SHR
```

Figure 3. IBM Catalogued Procedure ARCSP027 (cont'd.)

```
//         DD DSN=C116.B05317.REBUS3.STANDALO.MODLIB,DISP=SHR
//         DD DSN=&POSTLIB,DISP=SHR
//DUMMY1 DD DSN=&DUMMY1,SPACE=(CYL,(&DMY1CYL,1),,CONTIG),
//             UNIT=&UNITSCR
//*            SHARED BY FDCOEF(51),ZONMAP(61)
//DUMMY2 DD DSN=&DUMMY2,SPACE=(CYL,(&DMY2CYL,1),,CONTIG),
//             UNIT=(&UNITSCR,SEP=(DUMMY1))
//*            SHARED BY PSIOLD(48),FRNOLD(52),PSIGO(58)
//DUMMY3 DD DSN=&DUMMY3,SPACE=(CYL,(&DMY2CYL,1),,CONTIG),
//             UNIT=(&UNITSCR,SEP=(DUMMY1,DUMMY2))
//*            SHARED BY PSINEW(49),FRNNEW(53),PSIGN(59)
//DUMMY4 DD DSN=&DUMMY4,SPACE=(CYL,(&DMY2CYL,1),,CONTIG),
//             UNIT=(&UNITSCR,SEP=(DUMMY1,DUMMY2,DUMMY3))
//*            SHARED BY FRNM1(55),SRCNEW(57),FSRC(60)
//             UNIT=(&UNITSCR,SEP=(DUMMY1,DUMMY2,DUMMY3,DUMMY4))
//*            SHARED BY PSIUP(50), AND FRNM2(56)
//FT04F001 DD UNIT=&UNITSCR,SPACE=(TRK,(10,10))
//*            DISSPLA SCRATCH FILE
//FT05F001 DD DDNAME=SYSIN
//*            BCD INPUT.
//FT06F001 DD SYSOUT=&DEST,DCB=(RECFM=FBA,LRECL=133,BLKSIZE=1596)
//*            PRINTED OUTPUT.
//FT07F001 DD SYSOUT=B,DCB=(RECFM=F,BLKSIZE=80)
//*            PUNCHED OUTPUT
//FT08F001 DD DSN=SYS1.DISSPLA.DATA,DISP=SHR
//*            DISSPLA FONT FILE
//FT09F001 DD UNIT=&UNITSCR,SPACE=(CYL,(1,0)),
//             DCB=(RECFM=VBS,LRECL=84,BLKSIZE=&QRTRTRK)
//*            ARC SYSTEM SPOOLED OUTPUT.
//FT10F001 DD DCB=(RECFM=FBA,LRECL=133,BLKSIZE=1596),SYSOUT=&DEST2
//*            ALTERNATE PRINT FILE.
//FT11F001 DD DSN=&ADIF3D,UNIT=&UNITSCR,SPACE=(TRK,(1,0)),
//             DCB=(RECFM=VBS,LRECL=84,BLKSIZE=&TWELTRK)
//*            1,2 OR 3D DIFFUSION MODULE DEPENDENT BCD DATASET.
//FT12F001 DD DSN=&ANIP3,UNIT=&UNITSCR,SPACE=(TRK,(4,1)),
//             DCB=(RECFM=VBS,LRECL=84,BLKSIZE=&QRTRTRK)
//*            THE ARC SYSTEM GENERAL NEUTRONICS BCD DATASET.
//FT13F001 DD DSN=&AHMG4C,UNIT=&UNITSCR,SPACE=(TRK,(1,0)),
//             DCB=(RECFM=VBS,LRECL=84,BLKSIZE=&TWELTRK)
//*            CCCC HOMOGENIZATION MODULE DEPENDENT BCD DATASET.
//FT14F001 DD DSN=&AISO,UNIT=&UNITSCR,SPACE=(CYL,(1,0)),
//             DCB=(RECFM=VBS,LRECL=84,BLKSIZE=&QRTRTRK)
//*            THE ISOTXS BCD DATASET.
//FT15F001 DD DSN=&AUDOIT,UNIT=&UNITSCR,SPACE=(TRK,(3,1)),
//             DCB=(RECFM=VBS,LRECL=84,BLKSIZE=&QRTRTRK)
//*            BCD INPUT DATASET FOR UDOIT MODULES.
//FT16F001 DD DSN=&JONPLOT,UNIT=&UNITSCR,SPACE=(TRK,(10,3)),
//             DCB=(RECFM=VBS,LRECL=84,BLKSIZE=844),DISP=(MOD,PASS)
//*            BEITEL'S SUMMERY WORKING DATA SET.
```

Figure 3. IBM Catalogued Procedure ARCSP027 (cont'd.)

```
//FT17F001 DD DSN=&LASIP3,UNIT=&UNITSCR,SPACE=(TRK,(1,1)),
//             DCB=(RECFM=VBS,LRECL=84,BLKSIZE=&QRTRTRK)
//*            THE LASIP3 BCD INPUT DATASET A.LASIP3
//FT18F001 DD DSN=&ABURN,UNIT=&UNITSCR,SPACE=(TRK,(4,1)),
//             DCB=(RECFM=VBS,LRECL=84,BLKSIZE=&QRTRTRK)
//*            THE REBUS-3 BCD INPUT DATASET A.BURN.
//FT19F001 DD DSN=&ASTP027,UNIT=&UNITSCR,SPACE=(TRK,(1,1)),
//             DCB=(RECFM=VBS,LRECL=84,BLKSIZE=&TWELTRK)
//*            THE REBUS-3 MODULE DEPENDENT BCD INPUT DATASET.
//FT20F001 DD DSN=&VOLINT,UNIT=&UNITSCR,SPACE=(CYL,(01,1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            SYN3D VOLUME INTEGRAL FILE
//FT21F001 DD SYSOUT=B,DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)
//*            LASIP3 PUNCHED OUTPUT DATA SET BCDSOB
//FT22F001 DD DSN=&RTFLUX,DISP=&RTDSP,SPACE=(CYL,(&RTCYL,1)),
//             UNIT=&UNITS,VOL=SER=&RTVOL,
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            CCCC REAL FLUX INTERFACE DATASET RTFLUX AT FIRST TIME
//*            TIME POINT (BOC).
//FT23F001 DD DSN=&COMPXS,UNIT=&UNITSCR,SPACE=(CYL,(1,1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            COMPOSITION MACROSCOPIC CROSS-SECTION DATASET.
//FT24F001 DD DSN=&LABELS,UNIT=&UNITSCR,SPACE=(TRK,(3,0)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&TWELTRK)
//*            A.NIP3 LABELS AND AREA DEFINITIONS.
//FT25F001 DD DSN=&D3EDIT,UNIT=&UNITSCR,SPACE=(CYL,(1,1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            DIF3D EDITS INTERFACE DATASET.
//FT26F001 DD DSN=&AMASFLO,UNIT=&UNITSCR,SPACE=(TRK,(1,1)),
//             DCB=(RECFM=VBS,LRECL=84,BLKSIZE=&QRTRTRK)
//*            THE REBUS-3 BCD INPUT DATASET A.MASFLO
//FT27F001 DD DSN=&RFILES,UNIT=&UNITS,SPACE=(CYL,(04,1)),
//             VOL=SER=&RFVOL,DISP=&RFDSP,
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            RFILES RESTART/WRAPUP DATA SET.
//FT30F001 DD DSN=&DUMISO,DISP=(,DELETE),UNIT=&UNITS,
//             SPACE=(CYL,(&ISOCYL.1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=6136)
//*            TEMPORARY DATA SET FOR ISOTXS CREATED FROM XS.ISO
//FT31F001 DD DSN=&XSISO,DISP=&XSDSP
//*            ARC MICROSCOPIC ISOTOPE CROSS SECTION XS.ISO FILE 1
//FT31F002 DD DSN=&XSISO2,DISP=&XSDSP
//*            ARC MICROSCOPIC ISOTOPE CROSS SECTION XS.ISO FILE 2
//FT32F001 DD DSN=&INTTOC,UNIT=&UNITSCR,SPACE=(CYL,(01,1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            SYN3D INTEGRAL TABLE OF CONTENTS
//FT33F001 DD DSN=&SEARCH,UNIT=&UNITSCR,SPACE=(CYL,(01,1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            CCCC CRITICALITY SEARCH SPECIFICATION DATASET SEARCH.
```

Figure 3. IBM Catalogued Procedure ARCSP027 (cont'd.)

```
//FT34F001 DD DSN=&GEODST,UNIT=&UNITSCR,SPACE=(CYL,(01,1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            CCCC GEOMETRY DESCRIPTION DATASET GEODST.
//FT35F001 DD DSN=&ISOTXS,DISP=&ISODSP
//*            CCCC MICROSCOPIC CROSS SECTIONS DATASET ISOTXS.
//FT36F001 DD DSN=&ZADBOC,UNIT=&UNITSCR,SPACE=(TRK,(10,1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            CCCC ZONE NUCLIDE ATOM DENSITIES DATASET ZNATDN AT BOC
//FT37F001 DD DSN=&NDXSRF,UNIT=&UNITSCR,SPACE=(TRK,(03,0)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            CCCC NUCLIDE/CROSS SECTION REFERENCING DATASET NDXSRF.
//FT38F001 DD DSN=&ZNATDN,UNIT=&UNITSCR,SPACE=(TRK,(10,1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            CCCC ZONE NUCLIDE ATOM DENSITIES DATASET ZNATDN.
//FT39F001 DD DSN=&DIF3D,UNIT=&UNITSCR,SPACE=(TRK,(1,0)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&QRTRTRK)
//*            1, 2 OR 3D DIFFUSION MODULE DEPENDENT BINARY DATASET.
//FT42F001 DD DSN=&RZFLUX,UNIT=&UNITS,SPACE=(TRK,(01,1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            CCCC ZONE AVERAGED FLUX INTERFACE DATASET RZFLUX.
//FT43F001 DD DSN=&PWDINT,UNIT=&UNITS,SPACE=(CYL,(01,1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            CCCC POWER DENSITY INTERFACE DATASET PWDINT.
//FT44F001 DD DSN=&ISNTXS,UNIT=&UNITS,SPACE=(CYL,(04,1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            CCCC (ISOTXS) TYPE FILE PRODUCED BY CSE010
//FT45F001 DD DSN=&ISOTX1,UNIT=&UNITS,SPACE=(CYL,(04,0)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            CCCC (ISOTXS) TYPE FILE USED FOR MERGING IN CSE010
//FT46F001 DD DSN=&ISOTXS2,DISP=(,DELETE),
//             UNIT=(&UNITSCR,SEP=(FT30F001,FT35F001)),
//             SPACE=(CYL,(&ISOCYL,1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=6136)
//*            VERSION 2 OF CCCC DATA SET ISOTXS
//FT47F001 DD DSN=&SNCONS,UNIT=&UNITSCR,SPACE=(TRK,(01,1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            CCCC SN CONSTANTS DATASET SNCONS.
//FT48F001 DD DSN=&PSIOLD,SUBALLOC=(CYL,(&PSICYL,1),DUMMY2),
//             DCB=&MODEDCB
//*            FLUX ITERATE SCRATCH DATASET.
//FT49F001 DD DSN=&PSINEW,SUBALLOC=(CYL,(&PSICYL,1),DUMMY3),
//             DCB=&MODEDCB
//*            FLUX ITERATE SCRATCH DATASET.
//FT50F001 DD DSN=&PSIUP,SUBALLOC=(CYL,(&PSUCYL,1),DUMMY5),
//             DCB=&MODEDCB
//*            AUXILIARY FLUX DATASET FOR ADJOINT UPSCATTER ITERATIONS
//FT51F001 DD DSN=&FDCOEF,SUBALLOC=(CYL,(&FDCCYL,5),DUMMY1),
//             DCB=&MODEDCB
//*            FINITE DIFFERENCE COEFFICIENTS SCRATCH DATASET.
```

Figure 3. IBM Catalogued Procedure ARCSP027 (cont'd.)

```
//FT52F001 DD DSN=&FRNOLD,SUBALLOC=(CYL,(&FLXCYL,1),DUMMY2),
//             DCB=&MODEDCB
//*            FISSION SOURCE SCRATCH DATASET
//FT53F001 DD DSN=&FRNNEW,SUBALLOC=(CYL,(&FLXCYL,1),DUMMY3),
//             DCB=&MODEDCB
//*            FISSION SOURCE SCRATCH DATASET
//FT54F001 DD DSN=&NDXSRF2,UNIT=&UNITSCR,SPACE=(TRK,(03,0)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            VERSION 2 OF CCCC DATA SET NDXSRF
//FT55F001 DD DSN=&FRNM1,SUBALLOC=(CYL,(&FLXCYL,1),DUMMY4),
//             DCB=&MODEDCB
//*            FISSION SOURCE SCRATCH DATASET.
//FT56F001 DD DSN=&FRNM2,SUBALLOC=(CYL,(&FLXCYL,1),DUMMY5),
//             DCB=&MODEDCB
//*            FISSION SOURCE SCRATCH DATASET.
//FT57F001 DD DSN=&SRCNEW,SUBALLOC=(CYL,(&FLXCYL,1),DUMMY4),
//             DCB=&MODEDCB
//*            TOTAL SOURCE SCRATCH DATASET.
//FT58F001 DD DSN=&PSIGO,SUBALLOC=(CYL,(&FLXCYL,1),DUMMY2),
//             DCB=&MODEDCB
//*            FLUX ITERATE SCRATCH DATASET ONE GROUP.
//FT59F001 DD DSN=&PSIGN,SUBALLOC=(CYL,(&FLXCYL,1),DUMMY3),
//             DCB=&MODEDCB
//*            FLUX ITERATE SCRATCH DATASET ONE GROUP.
//FT60F001 DD DSN=&FSRC,SUBALLOC=(CYL,(&PSICYL,1),DUMMY4),
//             DCB=&MODEDCB
//*            FIXED SOURCE SCRATCH DATASET.
//FT61F001 DD DSN=&ZONMAP,SUBALLOC=(CYL,(&ZONCYL,1),DUMMY1),
//             DCB=&MODEDCB
//*            ZONE MAP SCRATCH DATASET.
//FT62F001 DD DSN=&CXSECT,UNIT=&UNITSCR,SPACE=(CYL,(01,1)),
//             DCB=&MODEDCB
//*            COMPOSITION CROSS SECTIONS SCRATCH DATASET.
//FT63F001 DD DSN=&SCR001,UNIT=&UNITSCR,SPACE=(CYL,(&SRFCYL,2)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            SCRATCH FILE 1.
//FT64F001 DD DSN=&SCR002,UNIT=&UNITSCR,SPACE=(CYL,(&SRFCYL,2)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            SCRATCH FILE 2.
//FT65F001 DD DSN=&SCR003,UNIT=&UNITSCR,SPACE=(CYL,(01,1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            SCRATCH FILE 3.
//FT66F001 DD DSN=&SCR004,UNIT=&UNITSCR,SPACE=(CYL,(01,1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            SCRATCH FILE 4.
//FT67F001 DD DSN=&SCR005,UNIT=&UNITSCR,SPACE=(CYL,(01,1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            SCRATCH FILE 5.
//FT68F001 DD DSN=&SCR006,UNIT=&UNITSCR,SPACE=(CYL,(01,1)),
```

Figure 3. IBM Catalogued Procedure ARCSP027 (cont'd.)

```
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            SCRATCH FILE 6.
//FT69F001 DD DSN=&SCR007,UNIT=&UNITSCR,SPACE=(CYL,(01,1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            SCRATCH FILE 7.
//FT70F001 DD DSN=&TRIAL1,DISP=SHR
//*            SYNTHESIS TRIAL FUNCTION 1
//FT71F001 DD DSN=&TRIAL2,DISP=SHR
//*            SYNTHESIS TRIAL FUNCTION 2
//FT72F001 DD DSN=&TRIAL3,DISP=SHR
//*            SYNTHESIS TRIAL FUNCTION 3
//FT73F001 DD DSN=&TRIAL4,DISP=SHR
//*            SYNTHESIS TRIAL FUNCTION 4
//FT74F001 DD DSN=&TRIAL5,DISP=SHR
//*            SYNTHESIS TRIAL FUNCTION 5
//FT75F001 DD DSN=&TRIAL6,DISP=SHR
//*            SYNTHESIS TRIAL FUNCTION 6
//FT76F001 DD DSN=&TRIAL7,DISP=SHR
//*            SYNTHESIS TRAIL FUNCTION 7
//FT77F001 DD DSN=&TRIAL8,DISP=SHR
//*            SYNTHESIS TRIAL FUNCTION 8
//FT78F001 DD DSN=&UDOIT1,UNIT=&UNITSCR,SPACE=(CYL,(01,1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            UDOIT INTERFACE FILE VERSION 1.
//FT79F001 DD DSN=&UDOIT2,UNIT=&UNITSCR,SPACE=(CYL,(01,1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            UDOIT INTERFACE FILE VERSION 2.
//FT80F001 DD DSN=&UDOIT3,UNIT=&UNITSCR,SPACE=(CYL,(01,1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            UDOIT INTERFACE FILE VERSION 3.
//FT81F001 DD DSN=&ASUMMAR,UNIT=&UNITSCR,SPACE=(TRK,(3,1)),
//             DCB=(RECFM=VBS,LRECL=84,BLKSIZE=&QRTRTRK)
//*            BCD INPUT DATASET FOR SUMMARY MODULE.
//FT82F001 DD DSN=&EOCRF,UNIT=&UNITSCR,
//             SPACE=(CYL,(1,1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            REAL FLUX DATA SET AT EOC.
//FT83F001 DD DSN=&SCRCH1,UNIT=&UNITSCR,SPACE=(CYL,(1,1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            REAL FLUX DATA SET AT SECOND TIME POINT.
//FT84F001 DD DSN=&SCRCH2,UNIT=&UNITSCR,SPACE=(CYL,(1,1)),
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*            REAL FLUX DATA SET AT THIRD TIME POINT.
//FT85F001 DD DSN=&SCRCH3,DISP=(NEW,DELETE),UNIT=&UNITSCR,
//             SPACE=(CYL,(1,1)),
//*            REAL FLUX DATA SET AT FOURTH TIME POINT.
//             DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//FT87F001 DD DISP=(NEW,PASS),UNIT=TAPE6250,
//             LABEL=(1,SL),VOL=SER=,
```

Figure 3. IBM Catalogued Procedure ARCSP027 (cont'd.)

```
//               DSN=NULLFILE,
//               DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//FT89F001 DD DSN=&BRN,UNIT=&UNITSCR,SPACE=(CYL,(1,1)),
//               DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*              DATA DUMP FOR BURNUP MODULE-TO-MODULE TRANSMISSION.
//FT90F001 DD DSN=&POINTR,UNIT=&UNITSCR,SPACE=(CYL,(3,1)),
//               DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*              POINTR DATA DUMP FOR BURNUP MODULE-TO-MODULE TRANSMISSION
//FT91F001 DD DSN=&SCRCH4,DISP=(NEW,DELETE),UNIT=&UNITSCR,
//               SPACE=(CYL,(1,1)),
//               DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*              REAL FLUX DATA SET FOR 2ND DENSITY ITERATION IN
//*              PRELIMINARY SEARCH AND UNPOISONED KEFF IN INTERMEDIATE
//*              AND FINAL SEARCHES.
//FT93F001 DD DSN=&NDS1,UNIT=&UNITSCR,SPACE=(CYL,(1,1)),
//               DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*              A1 MATRIX AND B MATRIX.
//FT94F001 DD DSN=&NDS2,UNIT=(&UNITSCR,SEP=FT93F001),SPACE=(CYL,(1,1)),
//               DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*              AVERAGE A1 MATRIX, AA.
//FT95F001 DD DSN=&NDS3,UNIT=(&UNITSCR,SEP=(FT93F001,FT94F001)),
//               SPACE=(CYL,(1,1)),
//               DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*              DN MATRIX.
//FT96F001 DD DSN=&NDSCR,UNIT=&UNITSCR,SPACE=(CYL,(3,1),RLSE),
//               DCB=(RECFM=VBS,BLKSIZE=&HALFTRK)
//*              N-1 (OR N-2) FLUX ITERATE.
//FT97F001 DD DSN=&NDS4,UNIT=&UNITSCR,SPACE=(CYL,(1,1)),
//               DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*              STAGE DENSITIES AT THE BEGINNING OF CYCLE.
//FT98F001 DD DSN=&NDS5,UNIT=(&UNITSCR,SEP=FT96F001),
//               SPACE=(CYL,(1,1)),
//               DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*              STAGE DENSITIES AT THE CURRENT TIME NODE.
//FT99F001 DD DSN=&NBHAT,UNIT=&UNITSCR,SPACE=(CYL,(1,1)),
//               DCB=(RECFM=VBS,LRECL=X,BLKSIZE=&HALFTRK)
//*              BHAT MATRIX.
//SYSUDUMP DD SYSOUT=&DMPDEST
//*              SYSTEM DUMP DATASET FOR ABNORMAL JOB TERMINATION.
//GRAPHICS DD PLOTTER=G1DATA,DISP=(MOD,KEEP),DSN=&G1DATA,
//               SPACE=(CYL,(20,3)),UNIT=SASCR
//*              GRAPHICS OUTPUT DATASET
//*
```

Figure 3. IBM Catalogued Procedure ARCSP027 (cont'd.)

Normally, the dataset name as specified in the the array DSNAME in the path driver STP027 is used as a temporary dataset name in the procedure. Thus for example, logical unit number 42 as specified by FT42F001 contains the dataset &RZFLUX which corresponds to the CCCC[5] dataset RZFLUX.

The last DD card relates to the graphics capability at ANL, and would probably have to be modified at other installations, whether IBM or not. Modules GNIP4C[6] and SUMMARY have graphics capabilities which make use of this DD card for the generated output.

The minimum JCL required if the catalogued procedure is used as given in Figure 3, would be

```
//ANYNAME JOB
// EXEC ARCSP027,
// ISOTXS='CXYZ.TEST.ISOTXS'
//SYSIN DD *
         .
         .
         .
/*
```

In this example, it is assumed that the binary cross section dataset ISOTXS was previously created and saved using the dataset name CXYZ.TEST.ISOTXS.

3.3 EXAMPLES OF BCD INPUT

Examples of BCD input data for both equilibrium and non-equilibrium problems are given in Ref. 1. These will not be repeated since, as mentioned earlier, the user will be assumed to have access to that document. The following sections will address the new REBUS-3 capabilities.

3.3.1 General Fuel Management

One of the major new capabilities available in REBUS-3 is the ability to specify a general non-repetitive fuel management scheme for non-equilibrium problems. The sample problem discussed below is an example of the use of this new capability of the code and includes temporary out-of-core fuel storage, loading of fresh fuel into the second burn step, and subsequent retrieval and reloading of the fuel.

Figure 4 lists the BCD input for a typical non-equilibrium calculation. All of the BCD datasets make use of the free field format option[11] as indicated by the use of the keyword UNFORM=.

```
BLOCK=OLD
DATASET=ISOTXS
BLOCK=STP027
UNFORM=A.STP027
01 1 0 0 1 0 0 0 0 0 480
02 1 0 0 1
UNFORM=A.DIF3D
01      NON-EQUILIBRIUM, XY, FUEL SHUFFLE WITH OUT-OF-CORE STORAGE
02 1500 30000
03 0 0 0 0 50
04 1 0 0 00 000 10 100 0 1 3
06 0.0 .001 .005 250.0000000+6
UNFORM=A.SUMMAR
01 0 30000 1 1 1
04 2 A9238 B9238 C9238 D9238 E9238 F9238 G9238 P9238
04 1 A9235 B9235 C9235 D9235 E9235 F9235 G9235 P9235
04 4 A9999 B9999 C9999 D9999 E9999 F9999 G9999
05 U-238 FERT 238.050 A9238 B9238 C9238 D9238 E9238 F9238 G9238 P9238
05 U-235 SPEC 235.050 A9235 B9235 C9235 D9235 E9235 F9235 G9235 P9235
05 PU239 FISS 239.040 A9439 B9439 C9439 D9439 E9439 F9439 G9439 P9439
05 PU240 FERT 240.050 A9440 B9440 C9440 D9440 E9440 F9440 G9440 P9440
05 PU241 FISS 241.040 A9441 B9441 C9441 D9441 E9441 F9441 G9441 P9441
05 PU242 SPEC 242.040 A9442 B9442 C9442 D9442 E9442 F9442 G9442 P9442
07 REG1 REG2 REG3 REG4 REG5 REG6 REG7 REG8 REG9
UNFORM=A.NIP3
01      NON-EQUILIBRIUM, XY, FUEL SHUFFLE WITH OUT-OF-CORE STORAGE
02 0 1 13500 0 25000 0 0 0 1 1
03 40
04 3 2 3 2
06 REFL 0.0 80.0 0 0 0.0 80.0
06 BREG1 0.0 12.0 0 0 36.0 48.0
06 BREG2 12.0 24.0 0 0 36.0 48.0
06 BREG3 24.0 36.0 0 0 36.0 48.0
06 BREG4 36.0 48.0 0 0 36.0 48.0
06 BREG5 36.0 48.0 0 0 24.0 36.0
06 BREG6 36.0 48.0 0 0 12.0 24.0
06 BREG7 36.0 48.0 0 0 0.0 12.0
06 REG1 0.0 12.0 0 0 24.0 36.0
06 REG2 12.0 24.0 0 0 24.0 36.0
06 REG3 24.0 36.0 0 0 24.0 36.0
06 REG4 0.0 12.0 0 0 12.0 24.0
06 REG5 12.0 24.0 0 0 12.0 24.0
06 REG6 24.0 36.0 0 0 12.0 24.0
06 REG7 0.0 12.0 0 0 0.0 12.0
06 REG8 12.0 24.0 0 0 0.0 12.0
06 REG9 24.0 36.0 0 0 0.0 12.0
07 AREAC REG1 REG2 REG3 REG4 REG5 REG6 REG7 REG8 REG9
07 AREAB BREG1 BREG2 BREG3 BREG4 BREG5 BREG6 BREG7
09 X 20 48.0 10 80.0
```

Figure 4. Sample Problem BCD Input

```
09 Y 20 48.0 10 80.0
12 REFL 60.0 20.0
12 AREAC 60.0 20.0
12 AREAB 60.0 20.0
13 IB1 A9235 3.1000-5 A9238 1.3558-2 A9439 0.0
13 IB1 A9440 0.0 A9441 0.0 A9442 0.0
13 IB1 A9999 0.0 DUMP1 0.0 DUMP2 0.0
13 IB1 DUMP3 0.0 A2400 2.3756-3 A2600 8.1994-3
13 IB1 A2800 1.6266-3 A4200 1.8431-4 A2555 2.2528-4
13 IB1 A1123 6.2401-3 A0816 2.7176-2
13 IB2 C9235 3.2000-5 C9238 1.3558-2 C9439 0.0
13 IB2 C9440 0.0 C9441 0.0 C9442 0.0
13 IB2 C9999 0.0 DUMP1 0.0 DUMP2 0.0
13 IB2 DUMP3 0.0 C2400 2.3756-3 C2600 8.1994-3
13 IB2 C2800 1.6266-3 C4200 1.8431-4 C2555 2.2528-4
13 IB2 C1123 6.2401-3 C0816 2.7176-2
13 IB3 E9235 3.3000-5 E9238 1.3558-2 E9439 0.0
13 IB3 E9440 0.0 E9441 0.0 E9442 0.0
13 IB3 E9999 0.0 DUMP1 0.0 DUMP2 0.0
13 IB3 DUMP3 0.0 E2400 2.3756-3 E2600 8.1994-3
13 IB3 E2800 1.6266-3 E4200 1.8431-4 E2555 2.2528-4
13 IB3 E1123 6.2401-3 E0816 2.7176-2
13 IB4 G9235 3.4000-5 G9238 1.3558-2 G9439 0.0
13 IB4 G9440 0.0 G9441 0.0 G9442 0.0
13 IB4 G9999 0.0 DUMP1 0.0 DUMP2 0.0
13 IB4 DUMP3 0.0 G2400 2.3756-3 G2600 8.1994-3
13 IB4 G2800 1.6266-3 G4200 1.8431-4 G2555 2.2528-4
13 IB4 G1123 6.2401-3 G0816 2.7176-2
13 IB5 A9235 3.5000-5 A9238 1.3558-2 A9439 0.0
13 IB5 A9440 0.0 A9441 0.0 A9442 0.0
13 IB5 A9999 0.0 DUMP1 0.0 DUMP2 0.0
13 IB5 DUMP3 0.0 A2400 2.3756-3 A2600 8.1994-3
13 IB5 A2800 1.6266-3 A4200 1.8431-4 A2555 2.2528-4
13 IB5 A1123 6.2401-3 A0816 2.7176-2
13 IB6 C9235 3.6000-5 C9238 1.3558-2 C9439 0.0
13 IB6 C9440 0.0 C9441 0.0 C9442 0.0
13 IB6 C9999 0.0 DUMP1 0.0 DUMP2 0.0
13 IB6 DUMP3 0.0 C2400 2.3756-3 C2600 8.1994-3
13 IB6 C2800 1.6266-3 C4200 1.8431-4 C2555 2.2528-4
13 IB6 C1123 6.2401-3 C0816 2.7176-2
13 IB7 E9235 3.7000-5 E9238 1.3558-2 E9439 0.0
13 IB7 E9440 0.0 E9441 0.0 E9442 0.0
13 IB7 E9999 0.0 DUMP1 0.0 DUMP2 0.0
13 IB7 DUMP3 0.0 E2400 2.3756-3 E2600 8.1994-3
13 IB7 E2800 1.6266-3 E4200 1.8431-4 E2555 2.2528-4
13 IB7 E1123 6.2401-3 E0816 2.7176-2
13 IC1 B9235 1.9168-5 B9238 8.6912-3 B9439 1.2000-3
13 IC1 B9440 4.0789-4 B9441 2.0392-4 B9442 4.8481-5
13 IC1 B9999 0.0 DUMP1 0.0 DUMP2 0.0
```

Figure 4. Sample Problem BCD Input (cont'd.)

```
13 IC1 DUMP3 0.0 B2400 2.8111-3 B2600 9.6814-3
13 IC1 B2800 1.9207-3 B4200 2.1764-4 B2555 2.6609-4
13 IC1 B1123 8.2217-3 B0816 2.1460-2
13 IC2 D9235 1.9168-5 D9238 8.6912-3 D9439 1.2500-3
13 IC2 D9440 4.0789-4 D9441 2.0392-4 D9442 4.8481-5
13 IC2 D9999 0.0 DUMP1 0.0 DUMP2 0.0
13 IC2 DUMP3 0.0 D2400 2.8111-3 D2600 9.6814-3
13 IC2 D2800 1.9207-3 D4200 2.1764-4 D2555 2.6609-4
13 IC2 D1123 8.2217-3 D0816 2.1460-2
13 IC3 F9235 1.9168-5 F9238 8.6912-3 F9439 1.3000-3
13 IC3 F9440 4.0789-4 F9441 2.0392-4 F9442 4.8481-5
13 IC3 F9999 0.0 DUMP1 0.0 DUMP2 0.0
13 IC3 DUMP3 0.0 F2400 2.8111-3 F2600 9.6814-3
13 IC3 F2800 1.9207-3 F4200 2.1764-4 F2555 2.6609-4
13 IC3 F1123 8.2217-3 F0816 2.1460-2
13 IC4 B9235 1.9168-5 B9238 8.6912-3 B9439 1.3500-3
13 IC4 B9440 4.0789-4 B9441 2.0392-4 B9442 4.8481-5
13 IC4 B9999 0.0 DUMP1 0.0 DUMP2 0.0
13 IC4 DUMP3 0.0 B2400 2.8111-3 B2600 9.6814-3
13 IC4 B2800 1.9207-3 B4200 2.1764-4 B2555 2.6609-4
13 IC4 B1123 8.2217-3 B0816 2.1460-2
13 IC5 D9235 1.9168-5 D9238 8.6912-3 D9439 1.4000-3
13 IC5 D9440 4.0789-4 D9441 2.0392-4 D9442 4.8481-5
13 IC5 D9999 0.0 DUMP1 0.0 DUMP2 0.0
13 IC5 DUMP3 0.0 D2400 2.8111-3 D2600 9.6814-3
13 IC5 D2800 1.9207-3 D4200 2.1764-4 D2555 2.6609-4
13 IC5 D1123 8.2217-3 D0816 2.1460-2
13 IC6 F9235 1.9168-5 F9238 8.6912-3 F9439 1.4500-3
13 IC6 F9440 4.0789-4 F9441 2.0392-4 F9442 4.8481-5
13 IC6 F9999 0.0 DUMP1 0.0 DUMP2 0.0
13 IC6 DUMP3 0.0 F2400 2.8111-3 F2600 9.6814-3
13 IC6 F2800 1.9207-3 F4200 2.1764-4 F2555 2.6609-4
13 IC6 F1123 8.2217-3 F0816 2.1460-2
13 IC7 B9235 1.9168-5 B9238 8.6912-3 B9439 1.5000-3
13 IC7 B9440 4.0789-4 B9441 2.0392-4 B9442 4.8481-5
13 IC7 B9999 0.0 DUMP1 0.0 DUMP2 0.0
13 IC7 DUMP3 0.0 B2400 2.8111-3 B2600 9.6814-3
13 IC7 B2800 1.9207-3 B4200 2.1764-4 B2555 2.6609-4
13 IC7 B1123 8.2217-3 B0816 2.1460-2
13 IC8 D9235 1.9168-5 D9238 8.6912-3 D9439 1.5500-3
13 IC8 D9440 4.0789-4 D9441 2.0392-4 D9442 4.8481-5
13 IC8 D9999 0.0 DUMP1 0.0 DUMP2 0.0
13 IC8 DUMP3 0.0 D2400 2.8111-3 D2600 9.6814-3
13 IC8 D2800 1.9207-3 D4200 2.1764-4 D2555 2.6609-4
13 IC8 D1123 8.2217-3 D0816 2.1460-2
13 IC9 F9235 1.9168-5 F9238 8.6912-3 F9439 1.6000-3
13 IC9 F9440 4.0789-4 F9441 2.0392-4 F9442 4.8481-5
13 IC9 F9999 0.0 DUMP1 0.0 DUMP2 0.0
13 IC9 DUMP3 0.0 F2400 2.8111-3 F2600 9.6814-3
```

Figure 4. Sample Problem BCD Input (cont'd.)

```
13 IC9 F2800 1.9207-3 F4200 2.1764-4 F2555 2.6609-4
13 IC9 F1123 8.2217-3 F0816 2.1460-2
13 RS8 H2400 1.3180-2 H2600 4.5410-2 H2800 9.0060-3
13 RS8 H4200 1.0210-3 H2555 1.2480-3 H1123 2.2370-3
14 IBL1 IB1 1.0
14 IBL2 IB2 1.0
14 IBL3 IB3 1.0
14 IBL4 IB4 1.0
14 IBL5 IB5 1.0
14 IBL6 IB6 1.0
14 IBL7 IB7 1.0
14 IC01 IC1 1.0
14 IC02 IC2 1.0
14 IC03 IC3 1.0
14 IC04 IC4 1.0
14 IC05 IC5 1.0
14 IC06 IC6 1.0
14 IC07 IC7 1.0
14 IC08 IC8 1.0
14 IC09 IC9 1.0
14 IBLK1 IBL1 1.0
14 FRESH1 IBL1 1.0
14 IBLK2 IBL2 1.0
14 IBLK3 IBL3 1.0
14 IBLK4 IBL4 1.0
14 IBLK5 IBL5 1.0
14 FRESH5 IBL5 1.0
14 IBLK6 IBL6 1.0
14 IBLK7 IBL7 1.0
14 ICOR1 IC01 1.0
14 ICOR2 IC02 1.0
14 ICOR3 IC03 1.0
14 ICOR4 IC04 1.0
14 ICOR5 IC05 1.0
14 ICOR6 IC06 1.0
14 ICOR7 IC07 1.0
14 ICOR8 IC08 1.0
14 ICOR9 IC09 1.0
14 RSHD8 RSH8 1.0
14 RSH8 RS8 1.0
15 ICOR1 REG1
15 ICOR2 REG2
15 ICOR3 REG3
15 ICOR4 REG4
15 ICOR5 REG5
15 ICOR6 REG6
15 ICOR7 REG7
15 ICOR8 REG8
15 ICOR9 REG9
```

Figure 4. Sample Problem BCD Input (cont'd.)

```
15 IBLK1 BREG1
15 IBLK2 BREG2
15 IBLK3 BREG3
15 IBLK4 BREG4
15 IBLK5 BREG5
15 IBLK6 BREG6
15 IBLK7 BREG7
15 RSHD8 REFL
37 '' 2.9721222+10
UNFORM=A.BURN
01      NON-EQUILIBRIUM, XY, FUEL SHUFFLE WITH OUT-OF-CORE STORAGE
02 0 27600 0 0.001 0.001 0.0001 1 1
03 0 30.0 0.0 40.0 1.0 1 2
09 U235 1 DUMP1
09 U238 1 PU239
09 PU239 1 PU240
09 PU240 1 PU241
09 PU241 1 PU242
09 PU242 1 DUMP2
09 FP 0
09 DUMP1 0
09 DUMP2 0
09 DUMP3 0
09 U235 2 FP
09 U238 2 FP
09 PU239 2 FP
09 PU240 2 FP
09 PU241 2 FP
09 PU242 2 FP
09 PU241 6 DUMP3
10 U235 A9235 B9235 C9235 D9235 E9235 F9235 G9235
10 U238 A9238 B9238 C9238 D9238 E9238 F9238 G9238
10 PU239 A9439 B9439 C9439 D9439 E9439 F9439 G9439
10 PU240 A9440 B9440 C9440 D9440 E9440 F9440 G9440
10 PU241 A9441 B9441 C9441 D9441 E9441 F9441 G9441
10 PU242 A9442 B9442 C9442 D9442 E9442 F9442 G9442
10 FP A9999 B9999 C9999 D9999 E9999 F9999 G9999
24 U235 0 235.139368 U238 0 238.150641
24 PU239 1 239.151063 PU240 0 240.151486
24 PU241 1 241.161913 PU242 0 242.162336
24 FP 0 237.0 DUMP1 0 236.0
24 DUMP2 0 236.0 DUMP3 0 236.0
25 PU241 6 DUMP3 1.4930556E-9
28 0.602472E+24
30 5 U235 6 U236 7 U238
31 1 U235
31 2 U238
31 4 FP
35 APATH1 IBLK1 BREG1 1 1 ' ' 2 2 BREG1 3 3
```

Figure 4. Sample Problem BCD Input (cont'd.)

```
35 APATH2 IBLK2 BREG2 1 1 ' ' 2 2 BREG2 3 3
35 APATH3 IBLK3 BREG3 1 1 ' ' 2 2 BREG3 3 3
35 APATH4 IBLK4 BREG4 1 1 ' ' 2 2 REG7 3 3
35 APATH5 IBLK5 BREG5 1 1 ' ' 2 2 BREG5 3 3
35 APATH6 IBLK6 BREG6 1 1 ' ' 2 2 BREG6 3 3
35 APATH7 IBLK7 BREG7 1 1 ' ' 2 2 BREG7 3 3
35 PATH1 FRESH1 BREG1 2 2
35 PATH2 IBLK2 BREG2 2 2
35 PATH3 IBLK3 BREG3 2 2
35 PATH4 IBLK4 BREG4 2 2
35 PATH5 FRESH5 BREG5 2 2
35 PATH6 IBLK6 BREG6 2 2
35 PATH7 IBLK7 BREG7 2 2
35 PATH1C ICOR1 REG1 1 1 REG2 2 2 REG3 3 3
35 PATH2C ICOR2 REG2 1 1 REG3 2 2 REG4 3 3
35 PATH3C ICOR3 REG3 1 1 REG4 2 2 REG5 3 3
35 PATH4C ICOR4 REG4 1 1 REG5 2 2 REG6 3 3
35 PATH5C ICOR5 REG5 1 1 REG6 2 2 BREG4 3 3
35 PATH6C ICOR6 REG6 1 1 REG7 2 2 REG8 3 3
35 PATH7C ICOR7 REG7 1 1 REG8 2 2 REG9 3 3
35 PATH8C ICOR8 REG8 1 1 REG9 2 2 REG1 3 3
35 PATH9C ICOR9 REG9 1 1 REG1 2 2 REG2 3 3
36 45.0 25.0 1.0 2 3
```

Figure 4. Sample Problem BCD Input (cont'd.)

A simple XY geometry is specified on the card types 03, 04, 06, and 09 of dataset A.NIP3. The type 37 card of data set A.NIP3 specifies the energy conversion factor which will replace the values given in the ISOTXS dataset being used. The reactor power level is specified on the type 06 card of dataset A.DIF3D.

The type 02 card of dataset A.BURN indicates that only one density iteration[1] is to be allowed, and the type 03 card specifies a 30 day shutdown period between burn cycles, a burn cycle length of 40 days, no subdivision of the burn steps, and that two fuel management operations will be performed.

The burnup chains are specified (without making use of the prestored burnup chains) using the type 09 and 25 cards of dataset A.BURN. Avogadro's number is set using the type 28 card instead of using the default value of 6.022054E+23 supplied by the input processor.

The type 30 card specifies the naming conventions for the uranium-235, uranium-236, and uranium-238 isotopes in the particular ISOTXS dataset being used, and the type 31 cards indicate the classifications of three of the isotopes in the cross section set.

The new card types 35 and 36 specify the fuel management scheme to be used. Out-of-core storage is specified in the paths APATH1-APATH7 by means of the blank destination label fields. Fresh fuel is loaded for the second burn step for these paths as indicated in paths PATH1-PATH7. Note that two of the fresh compositions (FRESH1 and FRESH5) were not originally used to specify the reactor composition on the type 15 cards of data set A.NIP3. In anticipation of their use in the fuel management scheme however, these compositions were specified on the dataset A.NIP3 type 14 cards. The out-of-core fuel is retrieved for the third burn cycle and shuffled into the regions specified on the type 35 cards.

The new capability which permits loading fresh fuel during the burn steps provides the the user with the flexibility of modifying the type of fuel in the reactor. Thus a core initially loaded with oxide fuel could be reloaded during the course of the problem with carbide fuel, for example. The general fuel management capability also provides the user with the ability to specify a programmed control rod movement scheme. This could be accomplished, for example, by putting one of the active isotopes into control rod and rod follower regions at zero atomic density (so that these regions will be treated as "burnup regions"), and then using the type 35 cards to shuffle the rod and follower compositions at each burn step into the desired reactor locations.

It should be noted again that the fuel management example given in Figure 4 could not have been specified with the capability available in the REBUS-2 code.

The type 36 card indicates that the burn cycle length for stages 2 and 3 is to be 45 days rather than the originally specified 40 days, and that the shutdown period between these burn cycles is to be 25 days rather than 30 days.

3.3.2 Nodal Option for DIF3D

The nodal option[10] of DIF3D is invoked simply by indicating any of the hexagonal geometry options on the type 03 card of dataset A.NIP3 and specifying the corresponding boundary conditions on the type 04 card. Since the nodal option currently treats only rotational (periodic) symmetry as opposed to reflectional symmetry in the plane, when geometry types 114, 116, 124, or 126 are specified on card type 03 of dataset A.NIP3, boundary condition type 7 must be specified in cols. 13-18 of card type 04. If boundary condition 7 was already being used for one of the triangular geometry options with the finite difference option of DIF3D[6], then in fact it is only the geometry type which the user must change on the type 03 card.

Thus, for the finite difference option, the card types 03 and 04 of dataset A.NIP3 for a particular problem might contain (in free format)

```
03 90
04 3 4 3 4 4 4
```

whereas for the nodal option of the same problem, these cards would contain

```
03 124
04 7 4 3 4 4 4
```

Note that the field containing the 3 on the type 04 card is ignored when boundary condition 7 is being used, so that one could just as well have provided the cards

```
03 124
04 7 4 0 4 4 4
```

Since studies[10] have shown that the higher-order axial approximation provided by the nodal scheme permits the use of an axial mesh which is at least four times coarser than that of the typical finite difference problem, for most REBUS-3 calculations, the axial mesh should coincide with the axial region assignments given on the dataset A.NIP3 type 30 cards. Thus, the data on the type 09 cards of dataset A.NIP3 would normally also be changed in going from a finite difference to a nodal version of DIF3D in order to take full advantage of the speed afforded by the nodal option.

All of the other BCD input data are unchanged as compared with the finite difference version of DIF3D, except possibly the BPOINTER allocation on the type 02 card of dataset A.DIF3D and the region size specified on the JOB card. These trivial modifications permit the user to readily change from the finite difference to the nodal options without extensive changes in the input deck. This is particularly important with regard to the geometric specifications since the same type 30 cards, which may be quite extensive for a large problem, are used for both the triangular finite difference option and the corresponding hexagonal nodal option.

The user should be aware of a possible problem however, when converting from a finite difference to a nodal problem for some geometries. Hexagons are assigned to regions via the A.NIP3 type 30 cards described in Appendix E. The hexagonal-geometry solution domains for sixth and third core symmetries are rotated 30 degrees counterclockwise from the respective domains used in the DIF3D triangular-geometry models in compliance with the CCCC specifications[5]. A special procedure has been implemented in the input processor GNIP4C[6] to facilitate conversion of existing type 30 cards for most (but not all) finite difference models to those required for the nodal option. When hexagonal geometry and periodic boundary conditions are specified, GNIP4C will use the periodicity (rotational symmetry) to assign hexagons not referenced on type 30 cards (but included in the hexagonal-geometry solution domain) to appropriate regions. This procedure requires that the user assure that the hexagons bisected by the triangular-geometry fractional-core symmetry lines are assigned to regions in a manner consistent with rotationally symmetric boundary conditions. Thus, if the original triangular-geometry model was constructed using type 3 boundary conditions (reflectional symmetry) on A.NIP3 card type 04, the user must make certain that the region assignments are also consistent with the rotational symmetry assumed in mapping the triangular-geometry model to the hexagonal-geometry model. If the region assignments are not so specified, regions with zero volumes may be created, causing a fatal error to be generated by the REBUS-3 input processor FCI002.

Continuing the example given above, if the following type 30 cards

```
30 REG1 3  2  2 60.8 87.9
30 REG2 3 12 12 60.8 87.9
```

were in the geometric specification, upon rotation of the geometry for the nodal calculation, the region labelled REG2 would have a zero volume. If instead these type 30 cards had contained

```
30 REG1 3  2  2 60.8 87.9
30 REG1 3 12 12 60.8 87.9
```

a consistent geometrical representation would be generated for the equivalent nodal option.

The user is referred to Ref. 10 for further details as to the use of the nodal option of DIF3D and to Ref. 6 for details on the use of the finite difference version of the code and dataset A.NIP3.

3.3.3 Spatial Synthesis Option for the Neutronics

The spatial synthesis neutronics module is invoked by including the BCD input dataset A.SYN3D in the problem specifications. It should be noted that since SYN3D predates the FFORM free format input processor[11], the user must provide the A.SYN3D data using the formatted version as given in Appendix H.

Typically, pre-calculated flux trial functions will have been generated and saved by the user for use in the synthesis neutronics calculation. However, in all other respects, the problem specifications for the spatial flux synthesis calculation are identical to those for the finite difference

DIF3D calculation. Thus, the same advantages accrue as those discussed above for the nodal option with respect to the ease of problem specification and modification when going from one neutronics option to another.

The user is referred to Ref. 7 for details as to the use of the SYN3D code and dataset A.SYN3D.

3.4 INPUT ERROR CHECKING

Table 3 lists the input error checking performed in the various subroutines of the REBUS-3 input processor FCIO02. The code issues self-explanatory error messages to assist the user in correcting his input. In general, a detected error will not stop execution until the input processing has been completed so that as many of the input errors as possible can be detected at one time.

Input checking of a new problem is frequently accomplished by setting cols. 13-18 on card type 01 of dataset A.STP027 to 1 so that only the input processor will be executed. This procedure permits inexpensive checking of input and eliminates the chance of executing a problem containing non-fatal input errors. Fatal errors will of course terminate execution after the input processor has completed.

3.5 INITIAL FLUX GUESSES

The flux file in REBUS-3 is RTFLUX[5]. REBUS-3 uses the same strategy as REBUS-2[1] to insure that the flux file which the neutronics module uses is the most appropriate for the time node involved. In REBUS-3, the module INITFL provides the initialization of RTFLUX and sets all values to the constant 1.0. As indicated in Figure 3, the beginning-of-cycle RTFLUX is stored on FT22F001 and the end-of-cycle RTFLUX on FT82F001.

In some situations, problem efficiency may be enhanced by providing an RTFLUX dataset that was saved from a previous problem to initiate a new case, rather than using the flat flux guess provided by INITFL. In this case, the user would declare DATASET=RTFLUX under the BLOCK=OLD[11] in the BCD input, and indicate the name of the saved dataset in the JCL. Symbolic parameters RTCYL, RTDSP, RTFLUX, and RTVOL are provided in the catalogued procedure for the FT22F001 dataset.

TABLE 3

REBUS-3 BCD Input Error Checking

SUBROUTINE	CHECKS PERFORMED
BRN09	1. Only one prestored burnup chain may be specified on the type 09 cards.
BRN30	1. Blank isotope labels are not allowed on the type 30 cards.
CHKCDS	1. The number of zones in datasets GEODST and NDXSRF must agree. 2. The number of zones+sub-zones in dataset LABELS must agree with datasets GEODST and NDXSRF. 3. The number of regions in datasets GEODST and LABELS must agree. 4. The number of zones+sub-zones in datasets LABELS and ZNATDN must agree. 5. The maximum number of nuclides in any set in data sets ZNATDN and NDXSRF must agree. 6. The coarse mesh structure in datasets SEARCH and GEODST must agree.
CHK12	1. Reactor charge labels on the type 12 cards must appear on the type 11 cards. 2. Path labels on the type 11 cards must appear on the type 12 cards. 3. If the enrichment ENR on a type 12 card is greater than 0.0, the path label of that type 12 card must appear on both a type 19 and 20 card. 4. If ENR on a type 12 card is 0.0, the path label of that type 12 card must appears on a type 20 card.
CHK13	1. Chemical composition labels on the type 13 cards must appear on the type 12 cards. 2. Active isotopes on the type 13 cards must have valid labels.
CHK15	1. Reactor discharge labels on the type 14 cards must also appear on the type 15 cards. 2. Reactor discharge labels on the type 15 cards must appear on the type 11 cards.
CHK16	1. Reprocessing plant labels on the type 16 cards must appear on the type 15 cards.
CHK17	1. Recovery factor specification labels on the type 17 cards must appear on the type 16 cards. 2. Active isotopes on the type 17 cards must have valid labels.

TABLE 3

REBUS-3 BCD Input Error Checking (cont'd.)

SUBROUTINE	CHECKS PERFORMED
CHK18	1. Class separation specification labels on the type 18 cards must appear on the type 16 cards (if there are type 16 cards present). 2. Active isotopes on the type 18 cards must have valid labels.
CHK21	1. Reprocessing plant or external feed labels on the type 19 and 20 cards must appear on a type 16 or 21 card, but not on both.
CHK22	1. External feed labels on type 22 cards must appear on type 21 cards. 2. Active isotopes on the type 22 cards must have valid labels.
CHK23	1. Reprocessing plant labels on the type 23 cards must appear on the type 16 cards. 2. Volumes of reprocessing plant outputs on the type 16 cards must be greater than 0.0 for reprocessing plants referenced on the type 23 cards. 3. Active isotopes on the type 23 cards must have valid labels.
CHK37	1. Path labels must agree between the type 35 and 37 cards. 2. Region labels may not be repeated for different paths in the same cycle. 3. The same regions must be referenced in all cycles.
CHKTST	Note: The following errors are fatal if EPSG is less than 1.0 and are non-fatal if EPSG is greater than or equal to 1.0 1. Path labels on the type 05 cards must match path labels on the type 11 cards. 2. Labels on the type 06 cards must correspond to a path label on the type 11 cards or to a test group label on the type 05 cards. 3. Labels on the type 07 and 08 cards must correspond to path labels on the type 11 cards or to test group labels on the type 05 cards.
CTLCDS	1. Every problem has dataset A.BURN card types 03, 09, 11 (or 35), and 24. 2. If type 35 cards are supplied, type 14, 15, 16, 17, and 23 cards are not supplied. 3. If the burnup convergence criterion EPSG is less than

TABLE 3

REBUS-3 BCD Input Error Checking (cont'd.)

SUBROUTINE	CHECKS PERFORMED
CTLCDS	1.0, card types 06 are present.
	4. If any card types 04, 12, 13, or 18-22 are present, they are all present.
	5. If any card types 15, 16, or 17 are present, they are all present.
	6. If a type 27 card is present, EPSF and EPSG are 1.0 or larger, and type 04, 12, 13, and 18-22 cards are all supplied.
DIST	1. Labels on type 19 and 20 cards must correspond to reprocessing plant or external feed labels.
	2. Priority levels are not defined more than once.
EXTCYC	1. Reprocessing plant labels must agree between the type 15 and 16 cards.
ICHKR1	1. Presence of type 25 cards if reaction types 6-8 are present on the type 09 cards.
	2. A fission product isotope created by more than one reaction type from the same parent isotope.
	3. Yield fractions differing from 1.0 by more than one percent.
	4. Invalid reaction types specified on the type 09 cards.
	5. Isotope labels on the type 10 cards must match isotope labels on the type 09 cards.
ICHKR2	1. Active isotopes on the type 24 cards must have valid labels.
	2. Every active isotope on the type 09 cards having a reaction type greater than or equal to 6 must also appear on a type 25 card.
	3. Active isotopes on the type 25 cards must have valid labels.
ISOLST	1. Active isotopes on card types 10 and 9 must agree.
LDSDEN	1. Every material contains some active isotopes
NFB	1. Isotopes on type 24 cards are defined on type 09 or 10 cards.
PATHS	NOTE: The following errors apply if the fuel management was specified using the dataset A.BURN type 11 cards
	1. Stage 1 sub-zone/zone correspondences on type 11

TABLE 3

REBUS-3 BCD Input Error Checking (cont'd.)

SUBROUTINE	CHECKS PERFORMED
PATHS	cards must agree with dataset A.NIP3 type 14 cards. Note: The following errors apply if the fuel management was specified using the dataset A.BURN type 35 cards 1. All stages must have been specified considering all of the paths. 2. Stage 1 zone/region or sub-zone/zone correspondences on the type 35 cards must agree with dataset A.NIP3 type 14 and 15 cards.
PROLIF	1. NZNR is greater than zero for all regions. 2. All regions contain some composition.
RDTXS	1. File wide chi matrices are not permitted in dataset ISOTXS.
SCANER	1. All active isotopes are present in the cross section data. 2. All active isotopes are present in any zone which contains any active isotopes. 3. Modifier sub-zones may not contain active isotopes. 4. Zones may contain only one sub-zone.
SIZE	Note: The following errors apply if the fuel management was specified using the dataset A.BURN type 11 cards 1. For equilibrium problems, stage numbers are monotonically increasing if a secondary composition resides in a primary composition for more than one stage. 2. All stages involve the same secondary composition. 3. All stages must have been specified. 4. Data in cols. 31-36 and 49-54 on type 11 cards must correspond to region or zone labels. 5. Data in cols. 25-30 and 43-48 on type 11 cards must correspond to sub-zone labels. 6. A path is defined either in terms of regions or zones, but not both. 7. Region or zone labels specifying a path may not be blank, except for a discharge label. Note: The following errors apply if the fuel management was specified using the dataset A.BURN type

TABLE 3

REBUS-3 BCD Input Error Checking (cont'd.)

SUBROUTINE	CHECKS PERFORMED
SIZE	35 cards 1. Data in cols. 13-18 on type 35 cards must correspond to primary composition (zone) or secondary composition (sub-zone) labels. 2. Data in cols. 19-24, 37-42, and 55-60 on type 35 cards must correspond to region or primary composition (zone) labels. 3. Stages may not be multiply defined. 4. All stages between the smallest and largest for a given path must have been specified. 5. Data in cols. 19-24, 37-42, and 55-60 on type 35 cards for a given path must either all be region labels or all be primary composition (zone) labels. 6. Cols. 13-18 must contain a secondary composition (sub-zone) label if the path is being defined in terms of primary compositions (zones). 7. If the path is being defined in terms of primary compositions (zones), cols. 19-24, 37-42, and 55-60 must specify the same zone or be blank. 8. If the path is being defined in terms of primary compositions (zones) and loads fresh fuel into a cycle number greater than 1, the sub-zone specified in cols. 13-18 may not be assigned to a region via the dataset A.NIP3 type 14 and 15 cards. 9. If the smallest stage number for a given path is greater than 1, the path must be defined in terms of regions.
STAGE	1. For non-equilibrium problems, cycle 1 volumes must be not 0.0 2. For non-equilibrium problems, fuel may not be multiply assigned to a region. 3. For non-equilibrium problems, all volumes in a path must have the same volume to within 0.1 per cent.

3.6 WRAPUP-RESTART FACILITY

REBUS-3 provides the wrapup-restart capability specified for REBUS-2, although the code has of course been expanded as necessary to accommodate the new datasets involved in REBUS-3. Automatic wrapup is performed based on available remaining time, and the user may also specify a periodic wrapup or force a wrapup using cols. 43-48 and 49-54 on card type 01 of dataset A.STP027.

The user should generally save a restart file for every REBUS-3 run to insure against the possibility of exceeding the time limit, so that the problem may be continued without wasting the time and money spent on the problem which was not completed. The restart dataset (RFILES) is contained on the FT27F001 DD card as indicated in Figure 3. Symbolic parameters RFDSP, RFILES, and RFVOL are provided in the catalogued procedure listed in Figure 3 for the convenience of the user in specifying the disposition, name, and volume for the the wrapup-restart dataset.

Typically a wrapup is performed if insufficient time remains to execute another complete neutronics calculation during a burnup sequence. However, a wrapup will also be automatically performed if time is exceeded during a DIF3D calculation. The DIF3D iterations will continue from the point of interuption upon a restart of the problem.

The user indicates a problem restart by specifying DATASET=RFILES in the BLOCK=OLD portion of the BCD input[11], and indicating the dataset on which the restart data was saved in the previous REBUS-3 run which performed the wrapup.

The datasets saved on RFILES are indicated in Table 6 in Chapter 4 for module FCC005.

3.7 FLUX RENORMALIZATION OPTION

As for REBUS-2, for non-equilibrium problems, the option exists for renormalizing the time zero flux shape at each time node to maintain the specified reactor power instead of recomputing the flux using the neutronics module. The renormalization is accomplished by module NUC018, and the option is invoked by setting cols. 31-36 on card type 01 of dataset A.STP027 to 1. Users should read the note concerning this option in the description of the A.STP027 dataset in Appendix F.

For REBUS-3, it is the RZFLUX[5] dataset which is renormalized by NUC018. Also, as in REBUS-2, the end-of-cycle calculation is always performed using a full neutronics solution rather than the flux renormalization.

3.8 CONVERGENCE CRITERION FOR EOC KEFF SEARCHES

An automatic search capability is available in REBUS-3 which enables the user to achieve a specified end-of-cycle eigenvalue, keff(EOC), by adjustment of the reactor burn cycle time. This search is invoked using the dataset A.BURN type 27 card. As in the case of the discharge burnup search[1], the burn cycle time T is adjusted until the ratio

$$\left| \frac{\mathrm{keff(EOC)-keff(T)}}{\mathrm{keff(EOC)}} \right|$$

is less than or equal to EPSD, or until five different estimates of the burn cycle time have been made. Keff(EOC) and EPSD are specified in cols. 13-24 and 25-36 respectively on card type 27 of dataset A.BURN. Since a search for an end-of-cycle keff cannot be carried out simultaneously with a conventional burnup or enrichment search, the user must have set EPSG and EPSF to at least 1.0 on card types 03 and 04 of dataset A.BURN, respectively, or a fatal error will be flagged by the input processor FCI002. In addition, the user must disable any poison enrichment search by setting cols. 19-24 on card type 01 of dataset A.STP027 to 1.

Users should note that the performance of this new search is strongly dependent upon the degree of burnup occuring in the reactor under consideration. Problems with low discharge burnups such as are normally encountered in fast reactors pose no difficulty and will typically show rapid convergence. However, burnups greater than about 20 a/o (atom per cent) can exhibit very poor convergence due to difficulty in obtaining a well converged end-of-cycle eigenvalue. Such problems will require two cyclic mode iterations[1] to obtain accurate end-of-cycle eigenvalues. Discharge burnups greater than about 40 a/o may require more than two cyclic mode iterations to achieve convergence. Test problems of up to 60 a/o discharge burnup have been successfully run by giving sufficient attention to the need for more than the normal number of cyclic mode iterations.

3.9 HIGH BURNUP APPLICATIONS

As mentioned above, experience has shown that enrichment and burn-time searches exhibit extremely slow convergence or even non-convergence when performed on equilibrium problems with very high discharge burnups (greater than about 30 a/o). The problem convergence is greatly improved by performing additional cyclic mode iterations[1] at various stages during the calulation. The user may invoke this high burnup mode by setting cols. 66-72 on card type 01 of dataset A.STP027 to 1.

REBUS-3 permits two definitions of the discharge burnup. The standard definition of the burnup is the ratio of atoms of fissionable isotopes destroyed by fission in the discharge fuel to the total atoms initially present in the fuel. If the number in cols. 49-60 on card type 03 of dataset A.BURN is negative the code will compute the burnup as the ratio of atoms of fissionable isotopes destroyed by all processes in the discharged fuel to the total atoms initially present in the fuel.

3.10 STACKING OF CCCC DATASETS FOR LATER USE

The dataset on the FT87F001 DD card in Figure 3 is intended for "stacking" the CCCC datasets[5] PWDINT, RTFLUX, RZFLUX, AND ZNATDN at each time node in the problem. In addition to these datasets which vary throughout the course of the problem, the datasets which are normally saved at a problem wrapup are put at the beginning of the file on FT87F001. The datasets saved in a wrapup are indicated in Table 6 in Chapter 4 for module FCC005. For an equilibrium problem, these data correspond to the configuration at the beginning of the final search pass with full edits[1]. For a large equilibrium problem, a considerable time may have been spent in the preliminary, intermediate, and final searches[1], and this saving of datasets permits the reconstructing of a problem which may have failed due to a computer malfunction at an advanced stage in the calculation.

These data saved on FT87F001 may be read later and used for static neutronics or perturbation calculations, for example. Normally the dataset should be saved on a magnetic tape unless the problem is not very large.

The stacking capability (which uses module COPYDS) is not implemented in the standalone export version of the code.

3.11 EXECUTION TIMES FOR SAMPLE PROBLEM

The sample problem specified in Figure 4 was executed on the IBM 3033 using a region size of 820 K bytes. Table 4 lists the CPU times in seconds for the various parts of the computation, and lists the percentage represented by each.

As was the case for REBUS-2, Table 4 shows that the major portion of the time spent in REBUS-3 is devoted to the neutronics calculations. Due to the higher speed of the IBM 195 computer for floating point arithmetic operations, this particular problem on the IBM 195 requires 22.3 seconds for the neutronics calculations, corresponding to 41.2 per cent of the total calculation for that area of the code.

TABLE 4

CPU Execution Times for Sample Problem on the IBM 3033

Program Area	CPU Time, sec.	Per Cent
SCAN and STUFF Processing[11]	1.6	2.5
Neutronics Input Processing (GNIP4C)	2.1	3.2
Cross Section Condensation[+] (SUBSET)	0.3	0.4
Fuel Cycle Input Processing (FCI002)	1.4	2.2
Fuel Cycle Calculations (FCC004)	10.7	16.3
Cross Section Homogenization (HMG4C)	1.9	2.8
Neutronics Calculations (DIF3D)	36.1	55.3
SUMMARY Processing[+] (AJC013)	6.8	10.4
Overhead for Standard Path STP027	4.5	6.9
Totals	65.3	100.0

[+] Not executed in the standalone export code.

4. PROGRAMMING INFORMATION

This chapter contains information for users who will be implementing REBUS-3 at other installations and would not normally be of interest to the production user.

4.1 REBUS-3 MODULES

The standard path driver STP027 calls a number of modules to guide the REBUS-3 System in the calculation of a fuel cycle problem. In the standalone export version of the code, the various modules have been linked into a single large overlay program. In this document, the code sections are refered to as modules, and for completeness of documentation of the ANL modular version of the code system, modules which are not implemented in the export version will be referenced as well. Normally, those modules which are not part of the export version of the code system are so indicated.

Table 5 lists the various modules invoked by the standard path driver with a brief comment as to the function of each. Each of the modules in Table 5 consists of a number of subroutines.

Table 6 lists the functions of the various subroutines in modules STP027, MASSFL, INITFL, MODDIF, NUC018, COPYDS, SUBSET, FCC004, FCI002, AND FCC005. For the standalone code, these groupings would correspond to major overlays. Also, for the standalone version of the code, the SUBSET and COPYDS overlays are not pertinent.

4.2 REBUS-3 ARRAY USAGE

The arrays used in REBUS-3 make use of the dynamic storage capability provided by the BPOINTER[11,2] facility. Pointers to these arrays are stored in common blocks POINTS and PNTSA to be described later. The arrays referenced in COMMON/POINTS/ are permanent arrays used in the modules FCC004 and FCC005, whereas the arrays referenced in COMMON/PNTSA/ are temporary arrays used only by the input processor module FCI002.

Figure 5 shows the array arguments for the subroutines in modules FCI002, FCC004, NUC018, and SUBSET, and lists the subroutines issuing various POINTR calls for each of these arrays. The pointer references are also given where the IP pointers correspond to the permanent arrays and the IT pointers to the temporary arrays. A number of temporary arrays not referenced in the PNTSA common block are also involved, in which case their pointers are the FORTRAN variables used at the time the array was allocated.

Figure 6 shows the arrays referenced in common blocks POINTS and PNTSA and indicates the subroutines which alter the contents of these arrays. Local temporary arrays are also listed.

TABLE 5

Modules Invoked by Standard Path Driver STP027

MODULE	FUNCTION
AJC013+	The SUMMARY module which provides summary edits of reaction rates and isotopic masses.
BCDINP	Processes the A.DIF3D BCD input dataset.
COPYDS+	Copies the CCCC interface files RTFLUX, RZFLUX, PWDINT, and ZNATDN to the file STACK.
CSE010+	Microscopic cross section converter from the ARC System XS.ISO format to the CCCC ISOTXS format.
DIF3D	DIF3D diffusion theory neutronics solution,
FCI002	Processes the A.BURN BCD dataset and sets up arrays for module FCC004.
FCC004	The REBUS-3 computational module.
FCC005	The REBUS-3 wrapup-restart module.
INITFL	Creates a beginning RTFLUX or NHFLUX dataset.
MASSFL	Provides a standalone mass flow summary edit.
MODCXS	Processes the directional diffusion coefficients and modifies the energy conversion factors in dataset COMPXS based on the user input supplied on the dataset A.NIP3 card type 37.
MODDIF	Modifies the dataset DIF3D to control edits from module DIF3D.
NUC016	The HMG4C module which homogenizes microscopic cross sections to prepare the dataset COMPXS.
NUC018	Provides a flux renormalization capability in place of an actual neutronics solution.
NUI009	The GNIP4C module to process the BCD dataset A.NIP3.
RESNDX	Saves the CCCC interface file NDXSRF and restores NDXSRF after poison searches.
SCAN	Reads the entire card-image input file and spools the card images onto a single file.
STUFF	Processes the input data associated with the next unprocessed data block named STP027 and creates the BCD datasets.
SRCH4C	Performs the neutronics searches in conjunction with module DIF3D.
SUBSET+	Condenses dataset ISOTXS and creates datasets ISOTXS version 2 and NDXSRF version 2.
SYN3D	SYN3D spatial flux synthesis neutronics solution.
UDOIT1	User supplied module for manipulative operations.
UDOIT3	User supplied module for manipulative operations.

+Not implemented in the standalone export code.

TABLE 6

Subroutine Functions in REBUS-3 Modules

Module	Subroutine	Function
COPYDS	COPYDS	Copies the CCCC files RTFLUX, RZFLUX, PWDINT, and ZNATDN to the file STACK. The program is intended for use with the REBUS-3 depletion capability for saving the BOEC and EOEC cycle.
	PACKIT	Loads data for the first record of dataset STACK.
	PWFILE	Copies the data from the 1D and 2D records of dataset PWDINT to dataset STACK.
	RTFILE	Copies the data from the 1D, 2D, and 3D records of dataset RTFLUX to dataset STACK.
	RZFILE	Copies the data from the 1D and 2D records of dataset RZFLUX to dataset STACK.
	ZNFILE	Copies the data from the 1D and 2D records of dataset ZNATDN to dataset STACK.
FCI002	ACT	Generates the arrays ACTF and VOL.
	ARMAKE	Initializes the arrays to be used in the fuel cycle burnup module, FCC004.
	ARSIZE	Computes the variables NBREG and NLOC.
	ARSTOR	Finishes setting up the arrays used in the FCC004 module.
	BRNCDS	The driver routine which allocates arrays and calls the subroutines needed to read the various card types of dataset A.BURN.
	BRNIN	Generates the array BURUP.
	BRN09	Reads the type 09 cards of dataset A.BURN and loads arrays to define the burnup chains. BRN09 has prestored burnup chains available if the user chooses not to specify the details of the burnup chain.
	BRN10	Reads the type 10 cards of dataset A.BURN.
	BRN11	Reads the type 11 cards of dataset A.BURN.
	BRN12	Reads the type 12 cards of dataset A.BURN.
	BRN13	Reads the type 13 cards of dataset A.BURN.
	BRN14	Reads the type 14 cards of dataset A.BURN.
	BRN15	Reads the type 15 cards of dataset A.BURN.
	BRN16	Reads the type 16 cards of dataset A.BURN.
	BRN17	Reads the type 17 cards of dataset A.BURN.
	BRN18	Reads the type 18 cards of dataset A.BURN.
	B1920	Reads the type 19 and 20 cards of dataset A.BURN.
	BRN21	Reads the type 21 cards of dataset A.BURN.
	BRN22	Reads the type 22 cards of dataset A.BURN.
	BRN23	Reads the type 23 cards of dataset A.BURN.
	BRN24	Reads the type 24 cards of dataset A.BURN.

TABLE 6

Subroutine Functions in REBUS-3 Modules (cont'd.)

Module	Subroutine	Function
FCI002	BRN25	Reads the type 25 cards of dataset A.BURN. BRN25 has stored decay constant data to be used with the prestored burnup chains specified on the type 09 cards.
	BRN27	Reads the type 27 cards of dataset A.BURN.
	BRN28	Reads the type 28 cards of dataset A.BURN and sets the default value for Avogadro's number.
	BRN29	Reads the type 29 cards of dataset A.BURN and sets default values for the edit areas for the summary edits.
	BRN30	Reads the type 30 cards of dataset A.BURN and sets default values for the edit isotopes for the summary edits
	BRN31	Reads the type 31 cards of dataset A.BURN and sets values for the classifications for problem isotopes. If no type 31 cards are supplied, subroutine BRN31 will read the type 04 cards from dataset A.SUMMAR instead if they are provided.
	BRN32	Reads the type 32 cards of dataset A.BURN.
	BRN33	Reads the type 33 cards of dataset A.BURN.
	BRN34	Reads the type 34 cards of dataset A.BURN.
	BRN35	Reads the type 35 cards of dataset A.BURN and sets array MFRESH.
	BRN36	Reads the type 36 cards of dataset A.BURN.
	BRN37	Reads the type 37 cards of dataset A.BURN.
	BUDCDS	The driver routine for reading the type 05 through type 08 cards of the A.BURN dataset.
	CHKCDS	The driver routine for checking the A.BURN type 09 through 37 cards for errors and/or inconsistencies. Certain arrays are also generated by routines called here.
	CHKTST	Checks the dataset A.BURN card types 05, 06, 07, 08, and 11 data for consistency.
	CHK12	Checks the dataset A.BURN type 11 and 12 cards and the type 12, 19, and 20 cards for consistency.
	CHK13	Checks the dataset A.BURN type 13 cards.
	CHK15	Checks the dataset A.BURN type 14 and 15 cards.
	CHK16	Checks the dataset A.BURN.type 16 cards.
	CHK17	Checks the dataset A.BURN.type 17 cards.
	CHK18	Checks the dataset A.BURN type 18 cards.
	CHK21	Checks the dataset A.BURN type 21 cards.
	CHK22	Checks the dataset A.BURN type 22 cards.
	CHK23	Checks the dataset A.BURN type 23 cards.

TABLE 6

Subroutine Functions in REBUS-3 Modules (cont'd.)

Module	Subroutine	Function
FCI002	CHK37	Checks the type 35 and 37 cards of A.BURN and sets arrays NUMREP and LREPF.
	CLASS	Generates the array CS.
	CMPENR	Generates the arrays ARHO, DELTA, and E.
	CTLCDS	Reads the type 01 through 04 cards of dataset A.BURN. CTLCDS also makes macroscopic checks to verify that valid card types are present from dataset A.BURN. In particular, card types 03, 09, 11, (or 35) and 24 are always required for every problem. Also, if any of card types 04, 12, 13, or 18-22 are present, they must all be present. This is also true for card types 15, 16, and 17. CTLCDS also checks to assure that if a type 27 card is present, EPSG and EPSF were specified as 1.0 or more, and that type 04, 12, 13, 18-22 cards have been supplied.
	CVOL	Generates the VOLF and VOLM arrays.
	DIST	Generates the arrays IDEM and SUP.
	ECLASS	Edits the isotope classifications for the isotopes in the problem and sets array ISOCLA.
	ELIM	Eliminates unnecessary arrays from the BPOINTER container array.
	EXCYCL	The driver which generates arrays related to the external cycle.
	EXTCYC	Generates the arrays ANV, DELIV, DSALE, and RECOV.
	FCI002	The driver program for the REBUS-3 fuel cycle input proccessor. Called from the path driver STP027.
	FEED	Generates the arrays DENF and VOF.
	FIMSO	Fills the arrays MISO and MISOF.
	FISPRO	Generates the NFPS array.
	FIVE	Reads type 05 cards of dataset A.BURN.
	GETMS	Computes the value of the variable MS.
	ICHKR1	Checks the type 09 and type 10 card data, computes the variables NDEC, INFP, NACI, and NEQ, and generates the array LOI9.
	ICHKR2	Checks the type 24 and 25 cards of A.BURN.
	INCYCL	Generates arrays and variables concerning in-core definitions.
	ISO	Generates the ISONAM array.
	ISOLST	Generates the LISTEQ and NAC arrays.
	LDSDEN	Loads the initial stage densities in the SDEN array and the charge densities in the DEN array. The SDEN array is written on LUN NDS4.

TABLE 6

Subroutine Functions in REBUS-3 Modules (cont'd.)

Module	Subroutine	Function
FCI002	LDSDEN	LDSDEN also sets arrays ISOEQ, LOCATR, SDENF, LOCTRF, and ISOEQF.
	MATRIX	Manipulates and generates arrays used in the construction of the A matrix. Also, the capture, fission, and nu*fission microscopic cross sections for all of the isotopes in the problem are stored in array SIGMAS.
	NEWLSG	Rewrites datasets LABELS, SEARCH, and GEODST after proliferation of zones and elimination of non-modifier sub-zones. NEWLSG also sets arrays AREA, NRA, and NREGA.
	NEWNDX	NEWNDX condenses array NOS so that the first dimension is NNSNEW rather than LOTS, loads arrays HNNAME and NOR, and rewrites dataset NDXSRF.
	NFB	Generates the NFBR array.
	ONE	Reads the type 01 cards of dataset A.BURN.
	PATHS	Computes the contents of the following arrays concerning the fuel management paths: LPATH, PCL, PLB, SCL, IPATYP, SN, and KRZONE. PATHS verifies that for stage 1, the sub-zone/region correspondences specified on the dataset A.BURN type 11 cards agree with those specified on the dataset A.NIP3 card types 14 and 15. If the fuel managment is specified on the dataset A.BURN type 35 cards, PATHS computes the contents of arrays LPATH, SCL, PCL, PLB, FRESH, LKSF, LPATHF, IPATYP, SN, KFRESH, and KRZONE and verifies that for stage 1, the zone-region correspondences specified on the dataset A.BURN type 35 cards agree with those specified on the dataset A.NIP3 type 15 cards. PATHS also verifies that all stages have been specified for some path.
	PROLIF	Proliferates zones into regions, rewrites dataset ZNATDN, and loads arrays CMPNAM, REGNAM, ADEN, VLSA, NSSA, NZNR, NZSZ, VOLZ, VFPA, NSPA, and VOLR.
	REACT	Generates arrays used in building the A matrix.
	RDTXS	Reads the first three records of dataset ISOTXS.
	SCANER	Reads record 2D of dataset ZNATDN to load the original atom densities into array ADENO. Subroutine SCANER checks zones to assure that

TABLE 6

Subroutine Functions in REBUS-3 Modules (cont'd.)

Module	Subroutine	Function
FCI002	SCANER	all of the active isotopes are present in any zone which contains any active isotopes. SCANER also verifies that there are no active isotopes in any of the modifier sub-zones, and that all active isotopes are present in the cross section data. SCANER homogenizes the non-modifier sub-zones into the zones to which they are assigned. SCANER also sets array ISOANL and verifies that each zone containing active isotopes contains only one sub-zone.
	SEVEIT	Reads type 07 and type 08 cards of dataset A.BURN.
	SIX	Reads type 06 cards of dataset A.BURN.
	SIZE	SIZE computes the value of NMAT, the number of materials (paths) which load fresh fuel at stage 1, and checks the dataset A.BURN card type 11 or 35 data. SIZE also sets the variable MFRESH, the number of materials (paths) which load fresh fuel at a stage number greater than 1.
	STAGE	Generates the MA, MPATH, MPATHF, LKS, and NKS arrays.
	TIMES	Generates the array TEX.
	TRNSF	Generates the ISONME and LOCA arrays and reads the 4D records of dataset ISOTXS to generate the SETMAS array.
FCC004	ACON	Generates the ABX matrix on dataset NDS.
	ADJX1	Used in control poison searches. ADJX1 computes a new initial poison control parameter (X1) and its derivative (DKDX) for the current time node based on the previously computed values. The dataset SEARCH is then rewritten with these new variables.
	BINIT	Initializes the B matrix to the identity matrix.
	BRAT	Computes the numerator and denominator of the breeding ratio for the reactor.
	BUMP	Eliminates storage space for fuel properties following the retrieval of fuel from temporary out-of-core storage to make space available for possible later out-of-core storage.
	BURNP	Calculates the burnup for each test group and for each material with a burnup limit.

TABLE 6

Subroutine Functions in REBUS-3 Modules (cont'd.)

Module	Subroutine	Function
FCC004	CHNGEQ	Adjusts the SEEK tables and the DSRN array so that the proper flux guess is used for the neutronics at each time node. On the initial entry (IGFLUX=-2) the initial BOC flux guess (whether user supplied or generated by the module INITFL) is copied to the datasets for the other time nodes. For equilibrium problems, the BOC and EOC fluxes are stored on DSRN(1) and DSRN(2), respectively. IF there are subintervals in the problem (a maximum of four are permitted), the fluxes at the end of each are stored on DSRN(3) through DSRN(5). In the preliminary search procedure the 2nd flux-density iteration at the EOC is stored on NDSRN(6). In the intermediate and final search, the unpoisoned keff flux (if any) is stored on NDSRN(6). In the case of the nodal option for the neutronics solution, the dataset NHFLUX is managed instead of dataset RTFLUX.
	CHNGNE	A version of subroutine CHNGEQ. It is called in non-equilibrium problems only. CHNGNE adjusts the SEEK tables and DSRN array so that the proper flux guess is used for the neutronics at each time node. On the initial entry (IGFLUX=-2) the initial BOC flux guess (whether user supplied or generated by the module INITFL is copied to the datasets for the other time nodes. Since an arbitrary number of sub-intervals may be used in a non-equilibrium problem two different cases are provided for. If the number of sub-intervals is .le. 4, then the flux at each time node is saved. If the number of sub-intervals is .GT. 4, then only the BOC and EOC fluxes are saved (on DSRN(1) and DSRN(2)) and all the other intermediate time nodes are put on a single dataset (DSRN(3)). In the case of the nodal option for the neutronics solution, dataset NHFLUX is managed instead of RTFLUX.
	CPFLUX	Copies fluxes from unit NI to unit NO (files assumed to be in RTFLUX format). If the neutronics is being done using the nodal option, the files are assumed to be in NHFLUX format.
	CYCLIC	Directs the cyclic mode iterations to obtain the converged B matrix.

TABLE 6

Subroutine Functions in REBUS-3 Modules (cont'd.)

Module	Subroutine	Function
FCC004	DENEXT	Computes stage densities and region densities, then extrapolates region densities. Convergence of cyclic mode iterations is checked here.
	DENOM	Calculates the denominator of the burnup for material MLBL.
	ENRICH	Generates the next guess for the feed enrichment, E(3), and the burn time, T(3). Used in obtaining the convergence of the constrained equilibrium mode.
	EXTED	Edits the external cycle model.
	FCC004	The fuel cycle calculational module driver. Called from the path driver STP027.
	GENSDN	Computes stage densities (SDEN array) during the external cycle calculations.
	INDAT	Reads the dataset BRN and obtains the eigenvalue and power normalized zone-averaged flux from dataset RZFLUX. INDAT also reads record 5 of dataset COMPXS to obtain the fissions per watt-second for each zone. If this is the first entry to INDAT, flags are set for the preliminary search procedure. The power normalized zone-averaged fluxes are renormalized here also.
	MARCH	Computes the B matrix, averages the A matrix, and computes the densities at each time node. Check for convergence of region density iterations is made here.
	MASFLO	Computes and edits the mass flow for equilibrium problems.
	MSREGN	Calculates the density for each material in a region and depletes using the DN matrix.
	MSP1	Prints the data in array AMASS.
	MSP2	Prints the data in array D.
	MSP3	Prints the data in array SDEN.
	MSSG	A debugging aid which prints the contents of arrays INT(150), FLT(150), and IP(150) and the location of array BLK. The variable ANAME is also printed, which is the name of the subroutine which called MSSG. MSSG is called by nearly all subprograms.
	NUMER	Calculates the numerator of the burnup and the extrapolation factor for material label MLBL.
	OUTDAT	Produces and reads output interfaces to cross-section homogenization and neutronics

TABLE 6

Subroutine Functions in REBUS-3 Modules (cont'd.)

Module	Subroutine	Function
FCC004	OUTDAT	modules. The SEARCH dataset is modified (by subroutine ADJX1) and atom density data is written (by subroutine ZONEAD).
	PSUB	Generates the data printed at each time node. The stage densities, conversion and breeding ratios, burnup, power, and fissile masses are computed. The cumulative edits of burnups and average powers printed at the end of a run are also computed here. Also summary edits of masses, fissile and fertile captures and fissions, the British definition breeding gain, and the neutron balance are edited here.
	REACTN	Computes the BOC and EOC reaction rates for each of the isotopes in the various edit areas for capture, fission, and nu*fission and sets arrays BOCRAC, EOCRAC, FISSIL, and FERTIL.
	REFAB	Contains the model for the refabrication of fuel from the external feeds and the reprocessing plant output. REFAB also computes the fabrication matrices Q and QP.
	REPROC	Contains the model for the external cycle. Fuel is followed from discharge to refabrication. The external cycle iterations to obtain the unconstrained equilibrium mode are done here. The test for convergence is made here also.
	SAVPRG	Has entry points SAVE and INITL. The entry SAVE writes the BPOINTER common blocks and data to a file LUN. The entry INITL reads this file and initializes the BPOINTER tables and data blocks. The entry SAVPRG differs from SAVE in that it first purges the BPOINTER tables and then writes the file LUN.
	SEARCH	Guides the calculation from beginning to completion. The selection and specification of the search level (preliminary, intermediate, or final) is made here. Convergence to the desired burnup and unpoisoned multiplication constant is checked here.
	SHUFDR	Invokes subroutine SHUFF which performs the fuel shuffling in non-equilibrium problems.
	SHUFF	Performs the fuel shuffling between burn steps (non-equilibrium problems only) and accounts for decay processes during the down time for refueling. Decay in temporary

TABLE 6

Subroutine Functions in REBUS-3 Modules (cont'd.)

Module	Subroutine	Function
FCC004	SHUFF	storage is calculated upon retrieval of the fuel, prior to core use. Subroutine LDSDEN of module FCI002 writes the SDEN array on unit NDS4. Module FCC004 also writes SDEN on NDS4 following the external cycle loop in subroutines REFAB, REPROC, and GENSDN. Non-equilibrium problems begin with SDEN on NDS4, but after the first entry into PSUB the SDEN values are copied from NDS4 to NDS5. SHUFF restores new SDEN values to NDS4 following fuel shuffling.
	SRCHDR	Invokes subroutine SEARCH to guide the calculation from beginning to completion.
	SRCHI	Reads the CCCC dataset SEARCH.
	SRCHO	Writes the CCCC dataset SEARCH.
	SPLBRN	Used to obtain a direct burnup search without additional neutronics solutions during the preliminary search procedure (only). SPLBRN computes a new transmutation matrix (DN) from the existing average A matrix (AA) and the new burn cycle time, T(3). New stage densities (SDEN array) and region densities (DEN1 and DEN4 arrays) are then computed based on the revised transmutation matrix.
	SWITCH	Interchanges the flux datasets associated with time node NU1 and time node NU2 by both the SEEK tables and the DSRN array.
	TDECAY	Calculates the exponential of the matrix AA*T. Reference--B. Duane, "Transmutation Logic for SN Transport Analysis", Proc. Conf. on Application of Computing Methods to Reactor Problems, ANL-7050 (1965).
	ZONEAD	Rewrites the ZNATDN file with the current atom densities.
FCC005	CPYFLX	Copies fluxes from unit NI to unit NO for the CCCC file RTFLUX or NHFLUX, starting at record number IREC on LUN NI and JREC on LUN NO. RTFLUX may be 1, 2, or 3-dimensional.
	FCC005	The driver for the wrapup/restart module, FCC005. If LFLAG=0, this is a wrapup run. If LFLAG=1, this a restart. If LFLAG=0, datasets must be saved for a future restart. In this case the following datasets are copied to the dataset RFILES in the following order -

TABLE 6

Subroutine Functions in REBUS-3 Modules (cont'd.)

Module	Subroutine	Function
FCC005	FCC005	

File	Conditions for Copying
BRN	Always
POINTR	Always
ZNATDN	If ZNATDN exists. Otherwise, dataset ZADBOC is copied to the place where ZNATDN is normally copied. This could occur if DIF3D does not converge at the beginning of cycle and ZNATDN has never been written.
ZADBOC	Always
GEODST	Always
NDXSRF	Always
RTFLUX	If the nodal option of the neutronics solution is not involved.
NHFLUX	If the nodal option of the neutronics solution is involved.

(RTFLUX, NHFLUX, EOCRF, SCRCH1-SCRCH4 are not saved if this is a REBUS-3/SYN3D problem).

(The following 5 datasets are versions of RTFLUX).

	Equilibrium	Non-Equilibrium	
		(NSTEP.LE.4)	(NSTEP.GT.4)
EOCRF	Always	Always	Always
SCRCH1	INT(11).GE.2	INT(11).GE.2	Always
SCRCH2	INT(11).GE.3	INT(11).GE.3	
SCRCH3	INT(11).EQ.4	INT(11).EQ.4	
SCRCH4	Always	Never	

NDS1	Always
NDS2	Always
NDS4	Always
NDS5	Always
SEARCH	If the problem involves a poison search. In this case, INT(31) is set to 1 as a flag to RESTAR.
RZFLUX	Always
GEODST	Always
LABELS	Always
DIF3D	If the problem uses module DIF3D. In this case, INT(33) is set to 1 as

TABLE 6

Subroutine Functions in REBUS-3 Modules (cont'd.)

Module	Subroutine	Function
FCC005	FCC005	a flag to RESTAR. If LFLAG=1 these same datasets are copied from RFILES back to their appropriate volumes with the one exception of RFFLUZ which is not recreated if INEUT=0.
	RESTAR	Restores all datasets contained on file RFILES.
	TRACIT	Edits the record number and number of words transferred during the WRAPUP and RESTAR executions.
	WRAPUP	Performs the data wrapup, building a new file, RFILES.
INITFL	INITFL	The driver for creation of a beginning RTFLUX or NHFLUX dataset.
	RTFLOX	Writes a starting flux guess on the RTFLUX or NHFLUX file if one does not already exist. The guess is a flat 1.0.
MASSFL	MASSED	Computes and edits the mass flow for equilibrium problems.
	MASSFL	The driver for the standalone mass flow edits.
MODDIF	MODDIF	Modifies array IEDF in record 2D of dataset DIF3D to control the edits for module DIF3D. Also assures that datasets PWDINT and RZFLUX will be written by DIF3D, and sets the eigenvalue EFFK to 0.0 so that module DIF3D will obtain the eigenvalue from the dataset RTFLUX.
NUC018	NORM1	Renormalizes the region-averaged fluxes to correspond to the power specified in COMMON/RZSPEC/ and rewrites dataset RZFLUX if necessary. The region energy conversion factors of record type 4 of dataset COMPXS are used to compute the power.
	NUC018	The driver for module NUC018 which renormalizes the fluxes in dataset RZFLUX to a specified power.
RESNDX	RESNDX	Saves dataset NDXSRF and restores NDXSRF after a poison search.
STP027	ABERT	Rewinds dataset 6 and calls ABEND so as to clear the output buffer if ERRSET is called

TABLE 6

Subroutine Functions in REBUS-3 Modules (cont'd.)

Module	Subroutine	Function
STP027	ABERT	for a fatal error.
	MAIN	The REBUS-3 standard path driver.
	PRCLOZ	Edits the logical unit numbers of open datasets.
SUBSET	CREAX2	Creates the new 2D record for dataset ISOTXS version 2 and writes dataset ISOTXS version 2. CREAX2 calls SEEK to interchange the logical unit numbers of datasets ISOTXS and ISOTXS version 2.
	LODSCT	Called by CREAX2 to save the scattering cross sections into one group for an isotope into the appropriate full scattering matrix for that isotope.
	NDXCON	Creates the new 2D record for dataset NDXSRF version 2 consistent with dataset ISOTXS version 2 and writes NDXSRF version 2.
	REVERS	A utility routine which stores (N2-N1+1) words from the single precision vector B, starting at B(NSTRT-N1), in LODSCT order into the ITO-th row of the single precision doubly subscripted array A, starting at A(ITO,N1).
	SKIMER	The executive driver for reading and condensing dataset ISOTXS and writing the new datasets ISOTXS version 2 and NDXSRF version 2 to be consistent with ISOTXS version 2.
	SUBSET	The main driver for the module which creates a working version of dataset ISOTXS (ISOTXS version 2) containing only those isotopes which are contained in the problem at hand. SUBSET also combines the ISOTXS scattering matrices and preserves only the total scattering matrix. SUBSET modifies dataset NDXSRF to be consistent with dataset ISOTXS version 2 and creates a working version of dataset NDXSRF (NDXSRF version 2).

| Module FCI002 |

			Subroutines Issuing	POINTR CALLS			
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
ACTF	IT(3)	ACT	EXCYCL	ELIM			
DEN	IP(14)		CHKCDS		CHKCDS, INDAT	CHKCDS	
VOL	IP(7)		EXCYCL		INDAT		
VOLM	IP(65)		INCYCL		INDAT		
PCL	IT(47)	ARSIZE	CHKCDS	ELIM	CHKCDS		
LISTEQ	IT(8)		CHKCDS	ELIM	ARMAKE		
IR	IT(32)		BRNCDS	ELIM	ARMAKE		BRNCDS
PRISO	IT(34)		BRNCDS	ELIM	ARMAKE		
LOISO	IT(31)		BRNCDS	ELIM	ARMAKE		
NAC	IT(9)		CHKCDS	ELIM	ARMAKE		
IPATYP	IT(10)		CHKCDS	ELIM	CHKCDS		
BURUP	IP(99)	BRNIN	ARMAKE		INDAT		
MBLAB	IT(28)		BUDCDS	ELIM	ARMAKE		
MBLIM	IT(29)		BUDCDS	ELIM	ARMAKE		
BTLAB	IP(100)		BUDCDS		ARMAKE, INDAT		
BTLIM	IT(30)		BUDCDS	ELIM	ARMAKE		
PLB	IP(96)		CHKCDS		ARMAKE, CHKCDS, INDAT		
LOISO	IT(31)	BRN09	BRNCDS	ELIM	ARMAKE		
IR	IT(32)		BRNCDS	ELIM	ARMAKE		BRNCDS
PRISO	IT(34)		BRNCDS	ELIM	ARMAKE		
YF	IT(33)		BRNCDS	ELIM	ARMAKE		
DUMISO	IT(34)		BRNCDS	ELIM	ARMAKE		
DUMYF	IT(33)		BRNCDS	ELIM	ARMAKE		
LOI10	IT(35)	BRN10	BRNCDS	ELIM			
LISO	IT(36)		BRNCDS	ELIM			
PLBLT	IT(40)	BRN11	BRNCDS	ELIM			
NPREV	IPNT4		BRNCDS	ELIM	CHKCDS		
SNT	IT(41)		BRNCDS	ELIM			
SCLT	IT(42)		BRNCDS	ELIM			
PCLT	IT(43)		BRNCDS	ELIM			

Figure 5. Array Arguments of REBUS-3 Subroutines

| Module FCI002 |

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
RCLBL	IT(48)	BRN12	BRNCDS	ELIM			
CCLBL	IT(50)		BRNCDS	ELIM			
RFABT	IT(51)		BRNCDS	ELIM			
PLOAD	IT(52)		BRNCDS	ELIM			
ENR	IT(53)		BRNCDS	ELIM			
DEL	IT(62)		BRNCDS	ELIM			
CCOML	IT(55)	BRN13	BRNCDS	ELIM			
AIL	IT(56)		BRNCDS	ELIM			
FAD	IT(57)		BRNCDS	ELIM			
RDL	IT(58)	BRN14	BRNCDS	ELIM			
COOLT	IT(59)		BRNCDS	ELIM			
RDLBL	IT(66)	BRN15	BRNCDS	ELIM			
RPL	IT(64)		BRNCDS	ELIM			
FDL	IT(65)		BRNCDS	ELIM			
RPLBL	IP(107)	BRN16	BRNCDS		INDAT		
RFSL	IT(67)		BRNCDS	ELIM			
CSSL	IT(68)		BRNCDS	ELIM			
RPT	IT(69)		BRNCDS	ELIM			
VRP	IT(70)		BRNCDS	ELIM			
RFSLBL	IT(71)	BRN17	BRNCDS	ELIM			
RFISO	IT(72)		BRNCDS	ELIM			
RECFR	IT(73)		BRNCDS	ELIM			
CSSLBL	IT(74)	BRN18	BRNCDS	ELIM			
CSISO	IT(75)		BRNCDS	ELIM			
CSFR	IT(76)		BRNCDS	ELIM			
FSRCL	IT(77)	B1920	BRNCDS	ELIM			
FSRPL	IT(78)		BRNCDS	ELIM			
FSPL	IT(79)		BRNCDS	ELIM			
FSDF	IT(80)		BRNCDS	ELIM			
EFL	IP(108)	BRN21	BRNCDS		INDAT		

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

| Module FCI002 |

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
EFCSSL	IT(81)	BRN21	BRNCDS	ELIM			
EFV	IT(82)		BRNCDS	ELIM			
EFLBL	IT(83)	BRN22	BRNCDS	ELIM			
EFISO	IT(84)		BRNCDS	ELIM			
EFDEN	IT(85)		BRNCDS	ELIM			
RPLI	IT(86)	BRN23	BRNCDS	ELIM			
RPISO	IT(87)		BRNCDS	ELIM			
RPIAD	IT(88)		BRNCDS	ELIM			
LOI24	IT(37)	BRN24	BRNCDS	ELIM	ARMAKE		
IFIS	IT(54)		BRNCDS	ELIM			
AM	IT(38)		BRNCDS	ELIM	ARMAKE		
ISODEC	IT(90)	BRN25	BRNCDS	ELIM	ARMAKE		
IDR	IT(91)		BRNCDS	ELIM	ARMAKE		
ISOPR	IT(92)		BRNCDS	ELIM	ARMAKE		
ISOCON	IT(93)		BRNCDS	ELIM	ARMAKE		
DUMISO	IT(92)		BRNCDS	ELIM	ARMAKE		
DUMCON	IT(93)		BRNCDS	ELIM	ARMAKE		
ENDFNM	IT(60)	BRN31	BRNCDS	ELIM			
ICLASS	IT(61)		BRNCDS	ELIM			
PLBLT	IT(40)	BRN35	BRNCDS	ELIM			
NOSTAG	IT(41)		BRNCDS	ELIM			
PRIMAR	IT(42)		BRNCDS	ELIM			
REGION	IT(43)		BRNCDS	ELIM			
BURTIM	IT(14)	BRN36	BRNCDS	ELIM			
SHUTDO	IT(15)		BRNCDS	ELIM			
RELPOW	IT(16)		BRNCDS	ELIM			
NUMSTA	IT(17)		BRNCDS	ELIM			
PATHLB	IT(18)	BRN37	BRNCDS	ELIM			
NOREP	IT(19)		BRNCDS	ELIM			
BTLAB	IP(100)	CHKTST	BUDCDS		ARMAKE, INDAT		

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

Module FCI002

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
MTLAB	IP(102)	CHKTST	BUDCDS		ARMAKE, INDAT		
PLBLT	IT(40)		BRNCDS	ELIM			
SMLAB	IP(103)		BUDCDS		INDAT		
EMLAB	IP(105)		BUDCDS		INDAT		
LAB	ILAB		BUDCDS	ELIM	CHKDRV		
PLBLT	IT(40)	CHK12	BRNCDS	ELIM			
RCLBL	IT(48)		BRNCDS	ELIM			
FSRCL	IT(77)		BRNCDS	ELIM			
ENR	IT(53)		BRNCDS	ELIM			
CCLBL	IT(50)	CHK13	BRNCDS	ELIM			
LISTEQ	IT(8)		CHKCDS	ELIM	ARMAKE INDAT		
CCOML	IT(55)		BRNCDS	ELIM			
AIL	IT(56)		BRNCDS	ELIM			
RDLBL	IT(66)	CHK15	BRNCDS	ELIM			
RDL	IT(58)		BRNCDS	ELIM			
SCLT	IT(42)		BRNCDS	ELIM			
RPLBL	IP(107)	CHK16	BRNCDS		INDAT		
RPL	IT(64)		BRNCDS	ELIM			
RFSL	IT(67)	CHK17	BRNCDS	ELIM			
RFSLBL	IT(71)		BRNCDS	ELIM			
LOI9	IT(63)		CHKCDS	ELIM			
RFISO	IT(72)		BRNCDS	ELIM			
CSSL	IT(68)	CHK18	BRNCDS	ELIM			
CSSLBL	IT(74)		BRNCDS	ELIM			
LOI9	IT(63)		CHKCDS	ELIM			
CSISO	IT(75)		BRNCDS	ELIM			
FSRPL	IT(78)	CHK21	BRNCDS	ELIM			
RPLBL	IP(107)		BRNCDS		INDAT		
EFL	IP(108)		BRNCDS		INDAT		
EFL	IP(108)	CHK22	BRNCDS		INDAT		

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

| Module FCI002 |

Array	Pointer	Subroutine	Subroutines Issuing POINTR CALLS				
			PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
EFLBL	IT(83)	CHK22	BRNCDS	ELIM			
LOI9	IT(63)		CHKCDS	ELIM			
EFISO	IT(84)		BRNCDS	ELIM			
RPLBL	IP(107)	CHK23	BRNCDS		INDAT		
RPLI	IT(86)		BRNCDS	ELIM			
LOI9	IT(63)		CHKCDS	ELIM			
RPISO	IT(87)		BRNCDS	ELIM			
VRP	IT(70)		BRNCDS	ELIM			
PLBLT	IT(40)	CHK37	BRNCDS	ELIM			
PATHLB	IT(18)		BRNCDS	ELIM			
PLB	IP(96)		CHKCDS		ARMAKE, CHKCDS, INDAT		
NUMREP	IP(117)		CHKCDS		INDAT		
NOREP	IT(19)		BRNCDS	ELIM			
LREPF	IP(144)		CHKCDS		INDAT		
IPATYP	IT(10)		CHKCDS	ELIM	CHKCDS		
PCL	IT(47)		CHKCDS	ELIM	CHKCDS		
SN	IT(45)		CHKCDS	ELIM	CHKCDS		CHKCDS
LPATHF	IP(74)		CHKCDS		CHKCDS, INDAT		
CSSL	IT(68)	CLASS	BRNCDS	ELIM			
CSSLBL	IT(74)		BRNCDS	ELIM			
CSISO	IT(75)		BRNCDS	ELIM			
CSFR	IT(76)		BRNCDS	ELIM			
EFCSSL	IT(81)		BRNCDS	ELIM			
ISONAM	IP(61)		INCYCL		ARMAKE, INDAT		
CS	IP(8)		EXCYCL		INDAT		
PLB	IP(96)	CMPENR	CHKCDS		ARMAKE, CHKCDS, INDAT		
RCLBL	IT(48)		BRNCDS	ELIM			
CCLBL	IT(50)		BRNCDS	ELIM			
ENR	IT(53)		BRNCDS	ELIM			
DEL	IT(62)		BRNCDS	ELIM			

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

Module FCI002

Array	Pointer	Subroutine	Subroutines Issuing POINTR CALLS				
			PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
CCOML	IT(55)	CMPENR	BRNCDS	ELIM			
AIL	IT(56)		BRNCDS	ELIM			
FAD	IT(57)		BRNCDS	ELIM			
ARHO	IP(9)		EXCYCL		INDAT		
DELTA	IP(12)		EXCYCL		INDAT		
E	IP(46)		EXCYCL		INDAT		
ISONAM	IP(61)		INCYCL		ARMAKE, INDAT		
VOLF	IP(55)	CVOL	INCYCL		INCYCL, INDAT	INCYCL	
VOLM	IP(65)		INCYCL		INDAT		
VOLR	IP(72)		CHKCDS		CHKCDS, INDAT		
MPATH	IP(1)		INCYCL		ARMAKE, INDAT		
CMPNAM	IT(13)		CHKCDS	ELIM	CHKCDS	CHKCDS	
SN	IT(45)		CHKCDS	ELIM	CHKCDS		CHKCDS
PCL	IT(47)		CHKCDS	ELIM	CHKCDS		
IHIT	IT(7)		INCYCL	ELIM			
IPATYP	IT(10)		CHKCDS	ELIM	CHKCDS		
PLB	IP(96)	DIST	CHKCDS		ARMAKE, CHKCDS, INDAT		
FSRCL	IT(77)		BRNCDS	ELIM			
FSRPL	IT(78)		BRNCDS	ELIM			
FSPL	IT(79)		BRNCDS	ELIM			
FSDF	IT(80)		BRNCDS	ELIM			
RPLBL	IP(107)		BRNCDS		INDAT		
EFL	IP(108)		BRNCDS		INDAT		
IDEM	IP(10)		EXCYCL		INDAT		DIST
SUP	IP(11)		EXCYCL		INDAT		
ENDFNM	IT(60)	ECLASS	BRNCDS	ELIM			
ICLASS	IT(61)		BRNCDS	ELIM			
NOS	IP(122)		CHKCDS		CHKCDS, INDAT	CHKCDS	
HANAME	IHANPT		CHKCDS	CHKCDS	CHKCDS	CHKCDS	
HNNAME	IP(120)		CHKCDS		CHKCDS,		

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

| Module FCI002 |

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
					INDAT		
ISOCLA	IP(118)	ECLASS	CHKCDS		CHKCDS, INDAT		
WORK	IWORK		CHKCDS	CHKCDS			
FISISO	IP(66)		CHKCDS		CHKCDS, INDAT		
FERISO	IP(68)		CHKCDS		CHKCDS, INDAT		
ISOCOR	IP(126)		CHKCDS		CHKCDS, INDAT		
RDLBL	IT(66)	EXTCYC	BRNCDS	ELIM			
RPL	IT(64)		BRNCDS	ELIM			
FDL	IT(65)		BRNCDS	ELIM			
SCL	IT(46)		CHKCDS	ELIM	CHKCDS		
PCL	IT(47)		CHKCDS	ELIM	CHKCDS		
RFSL	IT(67)		BRNCDS	ELIM			
RFSLBL	IT(71)		BRNCDS	ELIM			
RFISO	IT(72)		BRNCDS	ELIM			
RECFR	IT(73)		BRNCDS	ELIM			
RPLBL	IP(107)		BRNCDS		INDAT		
DELIV	IP(5)		EXCYCL		INDAT		
DSALE	IP(4)		EXCYCL		INDAT		
RECOV	IP(6)		EXCYCL		INDAT		
ISONAM	IP(61)		INCYCL		ARMAKE, INDAT		
ANV	IP(47)		EXCYCL		INDAT		
RPLI	IT(86)		BRNCDS	ELIM			
RPISO	IT(87)		BRNCDS	ELIM			
RPIAD	IT(88)		BRNCDS	ELIM			
VRP	IT(70)		BRNCDS	ELIM			
VOF	IT(5)	FEED	EXCYCL	ELIM			
DENF	IT(4)		EXCYCL	ELIM			
EFL	IP(108)		BRNCDS		INDAT		
EFV	IT(82)		BRNCDS	ELIM			
EFLBL	IT(83)		BRNCDS	ELIM			
EFISO	IT(84)		BRNCDS	ELIM			
EFDEN	IT(85)		BRNCDS	ELIM			
ISONAM	IP(61)		INCYCL		ARMAKE,		

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

Module FCI002

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
					INDAT		
ANV	IP(47)	FEED	EXCYCL		INDAT		
LISTEQ	IT(8)	FIMSO	CHKCDS	ELIM	ARMAKE		
LISTLO	IT(89)		ARMAKE	ELIM	ARMAKE		
LOCATR	IT(6)		CHKCDS	ELIM	CHKCDS		
LOCTRF	IT(20)		CHKCDS	ELIM	CHKCDS		
MISOF	IP(142)		ARMAKE		INDAT		ARMAKE
NAC	IT(9)		CHKCDS	ELIM	ARMAKE		
MISO	IP(97)		ARMAKE		INDAT		ARMAKE
ISONAM	IP(61)	FISPRO	INCYCL		ARMAKE, INDAT		
IR	IT(32)		BRNCDS	ELIM	ARMAKE		BRNCDS
PRISO	IT(34)		BRNCDS	ELIM	ARMAKE		
NFPS	IP(71)		INCYCL		INDAT		
BTLAB	IP(100)	FIVE	BUDCDS		ARMAKE, INDAT		
NMBT	IP(101)		BUDCDS		ARMAKE, INDAT		
MTLAB	IP(102)		BUDCDS		ARMAKE, INDAT		
SNT	IT(41)	GETMS	BRNCDS	ELIM			
NOSTAG	IT(41)		BRNCDS	ELIM			
LOISO	IT(31)	ICHKR1	BRNCDS	ELIM	ARMAKE		
IR	IT(32)		BRNCDS	ELIM	ARMAKE		BRNCDS
PRISO	IT(34)		BRNCDS	ELIM	ARMAKE		
YF	IT(33)		BRNCDS	ELIM	ARMAKE		
LOI9	IT(63)		CHKCDS	ELIM			
LOI10	IT(35)		BRNCDS	ELIM			
LISO	IT(36)		BRNCDS	ELIM			
LOI24	IT(37)	ICHKR2	BRNCDS	ELIM	ARMAKE		
LOISO	IT(31)		BRNCDS	ELIM	ARMAKE		
ISODEC	IT(90)		BRNCDS	ELIM	ARMAKE		
IR	IT(32)		BRNCDS	ELIM	ARMAKE		BRNCDS

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

| Module FCI002 |

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
ISOPR	IT(92)	ICHKR2	BRNCDS	ELIM	ARMAKE		
ISONAM	IP(61)	ISO	INCYCL		ARMAKE, INDAT		
LISTEQ	IT(8)		CHKCDS	ELIM	ARMAKE		
LISTEQ	IT(8)	ISOLST	CHKCDS	ELIM	ARMAKE		
NAC	IT(9)		CHKCDS	ELIM	ARMAKE		
LOI10	IT(35)		BRNCDS	ELIM			
LISO	IT(36)		BRNCDS	ELIM			
LOI9	IT(63)		CHKCDS	ELIM			
SCL	IT(46)	LDSDEN	CHKCDS	ELIM	CHKCDS		
LISTEQ	IT(8)		CHKCDS	ELIM	ARMAKE		
SDEN	IP(51)		CHKCDS		CHKCDS, INDAT	CHKCDS	
DEN	IP(14)		CHKCDS		CHKCDS, INDAT	CHKCDS	
PCL	IT(47)		CHKCDS	ELIM	CHKCDS		
CMPNMO	ICMPPT		CHKCDS	CHKCDS			
ADENO	IZNA2D		CHKCDS	CHKCDS			
HNNAME	IHNNPT		CHKCDS	CHKCDS	CHKCDS	CHKCDS	
NDXS	INDXPT		CHKCDS	CHKCDS		CHKCDS	
NOS	IP(122)		CHKCDS		CHKCDS, INDAT	CHKCDS	
NZSZO	INZSPT		CHKCDS	ELIM			
NSPAO	INSPPT		CHKCDS	ELIM			
ISOEQ	IP(119)		CHKCDS		CHKCDS, INDAT		
LOCATR	IT(6)		CHKCDS	ELIM	CHKCDS		
SDENF	IP(116)		CHKCDS		CHKCDS, INDAT		
LOCTRF	IT(20)		CHKCDS	ELIM	CHKCDS		
ISOEQF	IP(136)		CHKCDS		CHKCDS, INDAT		
IPATYP	IT(10)		CHKCDS	ELIM	CHKCDS		
SN	IT(45)		CHKCDS	ELIM	CHKCDS		CHKCDS
NOA	IP(69)	MATRIX	ARMAKE		INDAT		
NREC	IP(39)		ARMAKE		INDAT		

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

| Module FCI002 |

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
FSYLDF	IP(49)	MATRIX	ARMAKE		INDAT		
DEKAY	IPNT5		ARMAKE	ELIM			
MSPOT	IP(17)		ARMAKE		INDAT		ARMAKE
LAB	IP(40)		ARMAKE		INDAT		
CSEC	IP(16)		ARMAKE		INDAT		
DECAY	IP(41)		ARMAKE		INDAT		
ISONME	IT(11)		ARMAKE	ELIM			
LOCA	IPNT3		ARMAKE	ELIM			
IR	IT(32)		BRNCDS	ELIM	ARMAKE		BRNCDS
AWP	IT(1)		ARMAKE	ELIM			
LISTLO	IT(89)		ARMAKE	ELIM	ARMAKE		
LISTEQ	IT(8)		CHKCDS	ELIM	ARMAKE		
NAC	IT(9)		CHKCDS	ELIM	ARMAKE		
YFT	IPNT7		ARMAKE	ELIM			
TXS4	IPNT8		ARMAKE	ELIM			
TXS5	IPNT9		ARMAKE	ELIM			
SNGAM	IPNT10		ARMAKE	ELIM			
SNALF	IPNT11		ARMAKE	ELIM			
SNP	IPNT12		ARMAKE	ELIM			
SFIS	IPNT13		ARMAKE	ELIM			
SN2N	IPNT14		ARMAKE	ELIM			
SIGMAS	IP(94)		ARMAKE		INDAT		
NDXS	IT(12)		CHKCDS	ELIM	CHKCDS		
NOS	IP(122)		CHKCDS		CHKCDS, INDAT	CHKCDS	
NOR	IP(121)		CHKCDS		CHKCDS, INDAT		
CMPNMO	ICMPP5	NEWLSG	CHKCDS	CHKCDS			
ARANMO	IARAPT		CHKCDS	CHKCDS			
NRAO	INRAPT		CHKCDS	CHKCDS			
CMPNAM	IT(13)		CHKCDS	ELIM	CHKCDS	CHKCDS	
REGNME	IREGPP		CHKCDS	CHKCDS			
ARANAM	IARAPP		CHKCDS	CHKCDS			
NRAP	INRAPP		CHKCDS	CHKCDS			
LAB3D	ILAB3D		CHKCDS	CHKCDS			
LAB4D	ILAB4D		CHKCDS	CHKCDS			
NSHZ1	INZ1PT		CHKCDS	CHKCDS			
NSHZ2	INZ2PT		CHKCDS	CHKCDS			
GOD345	IGD345		CHKCDS	CHKCDS			

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

| Module FCI002 |

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
GEOD5D	IGOD5D	NEWLSG	CHKCDS	ELIM			
NZHBBO	INZWPT		CHKCDS	ELIM			
NZCO	INZCPT		CHKCDS	ELIM			
NZNRO	INZNPT		CHKCDS	ELIM			
NZHBB	INZHBB		CHKCDS	CHKCDS			
NZC	INZC		CHKCDS	CHKCDS			
GEOD78	IGOD78		CHKCDS	CHKCDS			
NZNR	IP(124)		CHKCDS		CHKCDS, INDAT		
NWORK	IBSQPT		CHKCDS	ELIM			
AREA	IP(86)		CHKCDS		CHKCDS, INDAT		
NRA	IP(85)		CHKCDS		CHKCDS, INDAT		
NREGA	IP(84)		CHKCDS		CHKCDS, INDAT		
ALIAS	IALIAS		CHKCDS	ELIM	CHKCDS		
REGLB6	IP(62)		CHKCDS		ARMAKE, CHKCDS, INDAT		
NRASAV	INRASV		CHKCDS	CHKCDS			
BSQO	IBSQPT		CHKCDS	ELIM			
BSQ	IBSQ		CHKCDS	CHKCDS			
WORK	IBSQPT		CHKCDS	ELIM			
BOUND	IBOUND		CHKCDS	CHKCDS			
BNDC	IBNDPT		CHKCDS	ELIM			
SCL	IT(46)		CHKCDS	ELIM	CHKCDS		
IPATYP	IT(10)		CHKCDS	ELIM	CHKCDS		
NDX2D	INDX2D	NEWNDX	CHKCDS	CHKCDS	CHKCDS	CHKCDS	
NDUM	INOSPT		CHKCDS	CHKCDS	CHKCDS	CHKCDS	
NORO	INROPT		CHKCDS	CHKCDS			
NDX3D	INDX3D		CHKCDS	ELIM	CHKCDS		
FNDX3D	INDX3D		CHKCDS	ELIM	CHKCDS		
HNNAME	IP(120)		CHKCDS		CHKCDS, INDAT		
NOR	IP(121)		CHKCDS		CHKCDS, INDAT		
NOS	IP(122)		CHKCDS		CHKCDS, INDAT	CHKCDS	

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

Module FCI002

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
VOLZ	IP(56)	NEWNDX	CHKCDS		CHKCDS,		
VFPA	IP(57)		CHKCDS		CHKCDS, INDAT		
VLSA	IP(58)		CHKCDS		CHKCDS, INDAT		
NSPA	IP(123)		CHKCDS		CHKCDS, INDAT		
NSSA	IP(67)		CHKCDS		CHKCDS, INDAT		
NZSZ	IP(59)		CHKCDS		CHKCDS, INDAT		
NFBR	IP(70)	NFB	INCYCL		INDAT		
IFIS	IT(54)		BRNCDS	ELIM			
LOI24	IT(37)		BRNCDS	ELIM	ARMAKE		
ISONAM	IP(61)		INCYCL		ARMAKE, INDAT		
TITLE	IP(73)	ONE	CTLCDS		INDAT		
PLBLT	IT(40)	PATHS	BRNCDS	ELIM			
SCLT	IT(42)		BRNCDS	ELIM			
TPCL	IPNT1		CHKCDS	ELIM			
PCLT	IT(43)		BRNCDS	ELIM			
TSCL	IPNT2		CHKCDS	ELIM			
TSN	IPNT3		CHKCDS	ELIM			
SNT	IT(41)		BRNCDS	ELIM			
REGNMO	IREGPT		CHKCDS	CHKCDS			
CMPNMO	ICMPPT		CHKCDS	CHKCDS			
PLB	IP(96)		CHKCDS		ARMAKE, CHKCDS, INDAT		
SN	IT(45)		CHKCDS	ELIM	CHKCDS		CHKCDS
SCL	IT(46)		CHKCDS	ELIM	CHKCDS		
PCL	IT(47)		CHKCDS	ELIM	CHKCDS		
LPATH	IP(113)		CHKCDS		ARMAKE, CHKCDS, INCYCL, INDAT		

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

Module FCI002

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
NPREV	IPNT4	PATHS	BRNCDS	ELIM	CHKCDS		
NZNRO	INZNPT		CHKCDS	ELIM			
NZSZO	INZSPT		CHKCDS	ELIM			
NOSTAG	IT(41)		BRNCDS	ELIM			
PRIMAR	IT(42)		BRNCDS	ELIM			
REGION	IT(43)		BRNCDS	ELIM			
TSN35	IPNT3		CHKCDS	ELIM			
FRESH	IP(95)		CHKCDS		CHKCDS, INDAT		
LKSF	IP(63)		CHKCDS		CHKCDS, INDAT		
LPATHF	IP(74)		CHKCDS		CHKCDS, INDAT		
IPATYP	IT(10)		CHKCDS	ELIM	CHKCDS		
KRZONE	IP(147)		CHKCDS		CHKCDS, INDAT		
KFRESH	IP(148)		CHKCDS		CHKCDS, INDAT		
CMPNMO	ICMPPT	PROLIF	CHKCDS	CHKCDS			
REGNMO	IREGPT		CHKCDS	CHKCDS			
NZNRO	INZNPT		CHKCDS	ELIM			
ADENO	IZNA2D		CHKCDS	CHKCDS			
NZSZO	INZSPT		CHKCDS	ELIM			
VLSAO	IVLSPT		CHKCDS	ELIM			
NSSAO	INSSPT		CHKCDS	ELIM			
CMPNAM	IT(13)		CHKCDS	ELIM	CHKCDS	CHKCDS	
ADEN	IP(13)		CHKCDS		CHKCDS, INDAT		
NZNR	IP(124)		CHKCDS		CHKCDS, INDAT		
NZSZ	IP(59)		CHKCDS		CHKCDS, INDAT		
VLSA	IP(58)		CHKCDS		CHKCDS, INDAT		
NSSA	IP(67)		CHKCDS		CHKCDS, INDAT		
VFPAO	IVFPPT		CHKCDS	ELIM			
NSPAO	INSPPT		CHKCDS	ELIM			
VOLZ	IP(56)		CHKCDS		CHKCDS,		

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

| Module FCI002 |

Array	Pointer	Subroutine	Subroutines Issuing POINTR CALLS				
			PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
					INDAT		
VFPA	IP(57)	PROLIF	CHKCDS		CHKCDS, INDAT		
NSPA	IP(123)		CHKCDS		CHKCDS, INDAT		
REGNAM	IP(62)		CHKCDS		ARMAKE, CHKCDS, INDAT		
TEMVOL	IGOD5D		CHKCDS	ELIM			
VOLR	IP(72)		CHKCDS		CHKCDS, INDAT		
SCL	IT(46)		CHKCDS	ELIM	CHKCDS		
IPATYP	IT(10)		CHKCDS	ELIM	CHKCDS		
NOA	IP(69)	REACT	ARMAKE		INDAT		
NREC	IP(39)		ARMAKE		INDAT		
FSYLDF	IP(49)		ARMAKE		INDAT		
DEKAY	IPNT5		ARMAKE	ELIM			
AWP	IT(1)		ARMAKE	ELIM			
LOI24	IT(37)		BRNCDS	ELIM	ARMAKE		
AM	IT(38)		BRNCDS	ELIM	ARMAKE		
LOISO	IT(31)		BRNCDS	ELIM	ARMAKE		
IR	IT(32)		BRNCDS	ELIM	ARMAKE		BRNCDS
YF	IT(33)		BRNCDS	ELIM	ARMAKE		
PRISO	IT(34)		BRNCDS	ELIM	ARMAKE		
ISONAM	IP(61)		INCYCL		ARMAKE, INDAT		
NF	IP(54)		ARMAKE		ARMAKE, INDAT		
ISODEC	IT(90)		BRNCDS	ELIM	ARMAKE		
IDR	IT(91)		BRNCDS	ELIM	ARMAKE		
ISOPR	IT(92)		BRNCDS	ELIM	ARMAKE		
ISOCON	IT(93)		BRNCDS	ELIM	ARMAKE		
SETMAS	IMASS		ARMAKE	ELIM			
ISONME	IT(11)		ARMAKE	ELIM			
LISTEQ	IT(8)		CHKCDS	ELIM	ARMAKE		
NAC	IT(9)		CHKCDS	ELIM	ARMAKE		
IFIS	IT(54)		BRNCDS	ELIM			
INPMAS	IINPMS		ARMAKE	ELIM			

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

| Module FCI002 |

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
TXS4	IPNT8	RDPXS	ARMAKE	ELIM			
TXS5	IPNT9		ARMAKE	ELIM			
SNGAM	IPNT10		ARMAKE	ELIM			
SFIS	IPNT13		ARMAKE	ELIM			
SNALF	IPNT11		ARMAKE	ELIM			
SNP	IPNT12		ARMAKE	ELIM			
SN2N	IPNT14		ARMAKE	ELIM			
SIGMAS	IP(94)		ARMAKE		INDAT		
HNNAME	IHNNPT	SCANER	CHKCDS	CHKCDS	CHKCDS	CHKCDS	
NDXS	INDXPT		CHKCDS	CHKCDS		CHKCDS	
NOSO	INOSPT		CHKCDS	CHKCDS	CHKCDS	CHKCDS	
NOR	INORPT		CHKCDS	CHKCDS	CHKCDS	CHKCDS	
NAC	IT(9)		CHKCDS	ELIM	ARMAKE		
LISTEQ	IT(8)		CHKCDS	ELIM	ARMAKE		
NSPAO	INSPPT		CHKCDS	ELIM	CHKCDS		
NSSAO	INSSPT		CHKCDS	ELIM			
NZSZO	INZSPT		CHKCDS	ELIM			
HOLDER	IHOLDR		CHKCDS	CHKCDS			
NSHZ1	INZ1PT		CHKCDS	CHKCDS			
NSHZ2	INZ2PT		CHKCDS	CHKCDS			
CMPNMO	ICMPPT		CHKCDS	CHKCDS			
WORK	IZNA2D		CHKCDS	CHKCDS			
NOS	IP(122)		CHKCDS		CHKCDS, INDAT	CHKCDS	
ADENO	IZNA2D		CHKCDS	CHKCDS			
VFPAO	IVFPPT		CHKCDS	ELIM			
VLSAO	IVLSPT		CHKCDS	ELIM			
VOLZO	IVOLPT		CHKCDS	ELIM			
ABSNAM	IHANPT		CHKCDS	CHKCDS	CHKCDS	CHKCDS	
HANAME	IP(83)		CHKCDS		CHKCDS, INDAT		
BRNTIM	IP(137)	SETPAR	CHKCDS		CHKCDS, INDAT		
DOWNTI	IP(138)		CHKCDS		CHKCDS, INDAT		
POWFAC	IP(139)		CHKCDS		CHKCDS, INDAT		
NUMSTA	IT(17)		BRNCDS	ELIM			

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

| Module FCI002 |

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
BURTIM	IT(14)	SETPAR	BRNCDS	ELIM			
SHUTDO	IT(15)		BRNCDS	ELIM			
RELPOW	IT(16)		BRNCDS	ELIM			
SMLAB	IP(103)	SEVEIT	BUDCDS		INDAT		
SILAB	IP(104)		BUDCDS		INDAT		
EMLAB	IP(105)		BUDCDS		INDAT		
EILAB	IP(106)		BUDCDS		INDAT		
MBLAB	IT(28)	SIX	BUDCDS	ELIM	ARMAKE		
BTLAB	IP(100)		BUDCDS		ARMAKE, INDAT		
MBLIM	IT(29)		BUDCDS	ELIM	ARMAKE		
BTLIM	IT(30)		BUDCDS	ELIM	ARMAKE		
LAB	ILAB		BUDCDS	ELIM	CHKDRV		
LIM	ILIM		BUDCDS	ELIM			
PLBLT	IT(40)	SIZE	BRNCDS	ELIM			
SCLT	IT(42)		BRNCDS	ELIM			
TPCL	IPNT1		CHKCDS	ELIM			
TSCL	IPNT2		CHKCDS	ELIM			
PCLT	IT(43)		BRNCDS	ELIM			
TSN	IPNT3		CHKCDS	ELIM			
SNT	IT(41)		BRNCDS	ELIM			
REGNMO	IREGPT		CHKCDS	CHKCDS			
CMPNMO	ICMPPT		CHKCDS	CHKCDS			
NZNRO	INZNPT		CHKCDS	ELIM			
NOSTAG	IT(41)		BRNCDS	ELIM			
PRIMAR	IT(42)		BRNCDS	ELIM			
REGION	IT(43)		BRNCDS	ELIM			
TSN35	IPNT3		CHKCDS	ELIM			
NZSZO	INZSPT		CHKCDS	ELIM	CHKCDS		
NKS	IP(2)	STAGE	INCYCL		ARMAKE, INDAT		
SN	IT(45)		CHKCDS	ELIM	CHKCDS		CHKCDS
MPATH	IP(1)		INCYCL		ARMAKE, INDAT		
PCL	IT(47)		CHKCDS	ELIM	CHKCDS		
REGLB6	IP(62)		CHKCDS		ARMAKE,		

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

| Module FCI002 |

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
		STAGE			CHKCDS, INDAT		
MA	IP(98)		INCYCL		INDAT		
LKS	IP(114)		INCYCL		INDAT		
LPATH	ILPATH		CHKCDS		CHKCDS, INCYCL, INDAT		
VOLR	IP(72)		CHKCDS		CHKCDS, INDAT		
MPATHF	IP(140)		INCYCL		INDAT		
IPATYP	IT(10)		CHKCDS	ELIM	CHKCDS		
LPATHF	IP(74)		CHKCDS		CHKCDS, INDAT		
PLB	IP(96)	TIMES	CHKCDS		ARMAKE, CHKCDS, INDAT		
RCLBL	IT(48)		BRNCDS	ELIM			
RFABT	IT(51)		BRNCDS	ELIM			
PLOAD	IT(52)		BRNCDS	ELIM			
SCL	IT(46)		CHKCDS	ELIM	CHKCDS		
PCL	IT(47)		CHKCDS	ELIM	CHKCDS		
RDL	IT(58)		BRNCDS	ELIM			
COOLT	IT(59)		BRNCDS	ELIM			
RPT	IT(69)		BRNCDS	ELIM			
TEX	IP(3)		EXCYCL		INDAT		
ISONME	IT(11)	TRNSF	ARMAKE	ELIM			
LOCA	IPNT3		ARMAKE	ELIM			
SETMAS	IMASS		ARMAKE	ELIM			

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

|Module FCC004|

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
AA/A1	IP(36/42)	ACON	ARSTOR		INDAT		
NREC	IP(39)		ARMAKE		INDAT		
MSPOT	IP(17)		ARMAKE		INDAT		ARMAKE
CSEC	IP(16)		ARMAKE		INDAT		
LAB	IP(40)		ARMAKE		INDAT		
DECAY	IP(41)		ARMAKE		INDAT		
PHI	IP(22)		ARSTOR		INDAT		
FSYLDF	IP(49)		ARMAKE		INDAT		
NFPS	IP(71)		INCYCL		INDAT		
MISO	IP(97)		ARMAKE		INDAT		ARMAKE
NKS	IP(2)		INCYCL		ARMAKE, INDAT		
MPATH	IP(1)		INCYCL		ARMAKE, INDAT		
B	IP(50)	BINIT	ARSTOR		INDAT		
NKS	IP(2)	BRAT	INCYCL		ARMAKE, INDAT		
MPATH	IP(1)		INCYCL		ARMAKE, INDAT		
VOLF	IP(55)		INCYCL		INCYCL, INDAT	INCYCL	
BRN	IP(76)		ARMAKE		INDAT		
BRD	IP(75)		ARMAKE		INDAT		
VOLR	IP(72)		CHKCDS		CHKCDS, INDAT		
SDEN	IP(51)		CHKCDS		CHKCDS, INDAT	CHKCDS	
AA/A1	IP(36/42)		ARSTOR		INDAT		
NFBR	IP(70)		INCYCL		INDAT		
MA	IP(98)		INCYCL		INDAT		
REGLB6	IP(62)		CHKCDS		ARMAKE, CHKCDS, INDAT		
AREAN	IP(87)		ARSTOR		INDAT		
AREAD	IP(88)		ARSTOR		INDAT		
NREGA	IP(84)		CHKCDS		CHKCDS,		

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

| Module FCC004 |

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
		BRAT			INDAT		
NRA	IP(85)		CHKCDS		CHKCDS, INDAT		
AREA	IP(86)		CHKCDS		CHKCDS, INDAT		
BREED	IP(127)		ARSTOR		INDAT		
LKST	IP(133)	BUMP	ARSTOR		INDAT		
LPATHT	IP(134)		ARSTOR		INDAT		
LEPT	IP(132)		ARSTOR		INDAT		
MPATHT	IP(135)		ARSTOR		INDAT		
SDENT	IP(125)		ARSTOR		INDAT		
TSTOR	IP(131)		ARSTOR		INDAT		
KRZONT	IP(149)		ARSTOR		INDAT		
MISOT	IP(146)		ARSTOR		INDAT		
ISOEQT	IP(145)		ARSTOR		INDAT		
PLB	IP(96)	BURNP	CHKCDS		ARMAKE, CHKCDS, INDAT		
NKS	IP(2)		INCYCL		ARMAKE, INDAT		
BTLAB	IP(100)		BUDCDS		ARMAKE, INDAT		
NMBT	IP(101)		BUDCDS		ARMAKE, INDAT		
MTLAB	IP(102)		BUDCDS		ARMAKE, INDAT		
BURUP	IP(99)		ARMAKE		INDAT		
NKS	IP(2)	DENEXT	INCYCL		ARMAKE, INDAT		
ERROR	IP(38)		ARMAKE		INDAT		
B	IP(50)		ARSTOR		INDAT		
SDEN	IP(51)		CHKCDS		CHKCDS, INDAT	CHKCDS	

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

| Module FCC004 |

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
RD	IP(19)	DENEXT	ARSTOR		INDAT		
RN	IP(18)		ARSTOR		INDAT		
DEN1	IP(23)		ARSTOR		INDAT		
DEN2	IP(24)		ARSTOR		INDAT		
Z	IP(35)		ARSTOR		INDAT		
VOLF	IP(55)		INCYCL		INCYCL, INDAT	INCYCL	
MA	IP(98)		INCYCL		INDAT		
BHAT	IP(52)		ARSTOR		INDAT		
BURUP	IP(99)	DENOM	ARMAKE		INDAT		
EMLAB	IP(105)		BUDCDS		INDAT		
EILAB	IP(106)		BUDCDS		INDAT		
ISONAM	IP(61)		INCYCL		ARMAKE, INDAT		
DEN	IP(14)		CHKCDS		CHKCDS, INDAT	CHKCDS	
VOLM	IP(65)		INCYCL		INDAT		
NF	IP(54)		ARMAKE		ARMAKE, INDAT		
T	FIXED DIM.	ENRICH	SEARCH		INDAT		
E	FIXED DIM.		SEARCH		INDAT		
F	FIXED DIM.		SEARCH		INDAT		
ISONAM	IP(61)	EXTED	INCYCL		ARMAKE, INDAT		
EDIT	IP(109)		ARSTOR		INDAT		
EDITF	IP(110)		ARSTOR		INDAT		
EDITRP	IP(111)		ARSTOR		INDAT		
MPATH	IP(1)		INCYCL		ARMAKE, INDAT		
PLB	IP(96)		CHKCDS		ARMAKE, CHKCDS, INDAT		
REGLB6	IP(62)		CHKCDS		ARMAKE, CHKCDS, INDAT		
TEX	IP(3)		EXCYCL		INDAT		

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

| Module FCC004 |

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
NOA	IP(69)	EXTED	ARMAKE		INDAT		
RPLBL	IP(107)		BRNCDS		INDAT		
EFL	IP(108)		BRNCDS		INDAT		
CFD	IP(130)		ARSTOR		INDAT		
NKS	IP(2)	GENSDN	INCYCL		ARMAKE, INDAT		
DEN	IP(14)		CHKCDS		CHKCDS, INDAT	CHKCDS	
B	IP(50)		ARSTOR		INDAT		
SDEN	IP(51)		CHKCDS		CHKCDS, INDAT	CHKCDS	
MA	IP(98)		INCYCL		INDAT		
A1	IP(42)	MARCH	ARSTOR		INDAT		
AA	IP(36)		ARSTOR		INDAT		
DN	IP(37)		ARSTOR		INDAT		
RDM	IP(20)		ARSTOR		INDAT		
RNM	IP(21)		ARSTOR		INDAT		
DEN4	IP(26)		ARSTOR		INDAT		
DEN1	IP(23)		ARSTOR		INDAT		
ERROR	IP(38)		ARMAKE		INDAT		
DEN3	IP(25)		ARSTOR		INDAT		
B	IP(50)		ARSTOR		INDAT		
Z	IP(35)		ARSTOR		INDAT		
BHAT	IP(52)		ARSTOR		INDAT		
BRNTIM	IP(137)		CHKCDS		CHKCDS, INDAT		
BR	IP(127)	MASFLO	ARSTOR		INDAT		
POWER	IP(128)		ARSTOR		INDAT		
HM	IP(129)		ARSTOR		INDAT		
CFEED	IP(130)		ARSTOR		INDAT		
BOC	IP(15)		ARSTOR		INDAT		
EOC	IEDTMA		ARSTOR		INDAT		
DEN1	IP(23)	MSREGN	ARSTOR		INDAT		
SDEN	IP(51)		CHKCDS		CHKCDS,	CHKCDS	

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

Module FCC004

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
		MSREGN			INDAT		
NKS	IP(2)		INCYCL		ARMAKE, INDAT		
VOLF	IP(55)		INCYCL		INCYCL, INDAT	INCYCL	
MA	IP(98)		INCYCL		INDAT		
RDM	IP(20)		ARSTOR		INDAT		
RNM	IP(21)		ARSTOR		INDAT		
DN	IP(37)		ARSTOR		INDAT		
DEN4	IP(26)		ARSTOR		INDAT		
DEN3	IP(25)		ARSTOR		INDAT		
AMASS	IP(80)	MSP1	ARMAKE		INDAT		
ISONAM	IP(61)		INCYCL		ARMAKE, INDAT		
REGLB6	IP(62)		CHKCDS		ARMAKE, CHKCDS, INDAT		
NKS	IP(2)	MSP2	INCYCL		ARMAKE, INDAT		
MPATH	IP(1)		INCYCL		ARMAKE, INDAT		
D	VARIABLE		VARIES		INDAT		
REGLB6	IP(62)		CHKCDS		ARMAKE, CHKCDS, INDAT		
MPATH	IP(1)	MSP3	INCYCL		ARMAKE, INDAT		
ISONAM	IP(61)		INCYCL		ARMAKE, INDAT		
REGLB6	IP(62)		CHKCDS		ARMAKE, CHKCDS, INDAT		
SDEN	IP(51)		CHKCDS		CHKCDS, INDAT	CHKCDS	
BURUP	IP(99)	NUMER	ARMAKE		INDAT		

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

| Module FCC004 |

Array	Pointer	Subroutine	Subroutines Issuing POINTR CALLS				
			PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
SMLAB	IP(103)	NUMER	BUDCDS		INDAT		
SILAB	IP(104)		BUDCDS		INDAT		
ISONAM	IP(61)		INCYCL		ARMAKE, INDAT		
MPATH	IP(1)		INCYCL		ARMAKE, INDAT		
NFPS	IP(71)		INCYCL		INDAT		
SDEN	IP(51)		CHKCDS		CHKCDS, INDAT	CHKCDS	
AA	IP(36)		ARSTOR		INDAT		
B	IP(50)		ARSTOR		INDAT		
FSYLDF	IP(49)		ARMAKE		INDAT		
VOLM	IP(65)		INCYCL		INDAT		
NF	IP(54)		ARMAKE		ARMAKE, INDAT		
MA	IP(98)		INCYCL		INDAT		
DEN	IP(14)		CHKCDS		CHKCDS, INDAT	CHKCDS	
NKS	IP(2)	PSUB	INCYCL		ARMAKE, INDAT		
MPATH	IP(1)		INCYCL		ARMAKE, INDAT		
AA/A1	IP(36/42)		ARSTOR		INDAT		
DN	IP(37)		ARSTOR		INDAT		
SDEN	IP(51)		CHKCDS		CHKCDS, INDAT	CHKCDS	
NFBR	IP(70)		INCYCL		INDAT		
NFPS	IP(71)		INCYCL		INDAT		
NF	IP(54)		ARMAKE		ARMAKE, INDAT		
VOLF	IP(55)		INCYCL		INCYCL, INDAT	INCYCL	
VOLR	IP(72)		CHKCDS		CHKCDS, INDAT		
F	IP(34)		ARSTOR		INDAT		
Z	IP(35)		ARSTOR		INDAT		
BRD	IP(75)		ARMAKE		INDAT		

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

Module FCC004

Array	Pointer	Subroutine	Subroutines Issuing POINTR CALLS				
			PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
BRN	IP(76)	PSUB	ARMAKE		INDAT		
BUN	IP(77)		ARMAKE		INDAT		
BUD	IP(78)		ARMAKE		INDAT		
DMASS	IP(79)		ARMAKE		INDAT		
NOA	IP(69)		ARMAKE		INDAT		
AMASS	IP(80)		ARMAKE		INDAT		
MA	IP(98)		INCYCL		INDAT		
PLB	IP(96)		CHKCDS		ARMAKE, CHKCDS, INDAT		
AREAN	IP(87)		ARSTOR		INDAT		
NREGA	IP(84)		CHKCDS		CHKCDS, INDAT		
NRA	IP(85)		CHKCDS		CHKCDS, INDAT		
AREA	IP(86)		CHKCDS		CHKCDS, INDAT		
FPWS	IP(60)		ARSTOR		INDAT		
FSYLDF	IP(49)		ARMAKE		INDAT		
ISONAM	IP(61)		INCYCL		ARMAKE, INDAT		
POWER	IP(112)		ARMAKE		INDAT		
BURN	IP(115)		ARSTOR		INDAT		
EDTMAS	IP(15)		ARSTOR		INDAT		
FISSIL	IP(91)		ARSTOR		INDAT		
FERTIL	IP(92)		ARSTOR		INDAT		
FISISO	IP(66)		CHKCDS		CHKCDS, INDAT		
FERISO	IP(68)		CHKCDS		CHKCDS, INDAT		
EDTBRG	IP(53)		ARSTOR		INDAT		
BOCRAC	IP(89)		ARSTOR		INDAT		
EOCRAC	IP(90)		ARSTOR		INDAT		
ISOCOR	IP(126)		CHKCDS		CHKCDS, INDAT		
EDTBAL	IP(64)		ARSTOR		INDAT		
ISOCLA	IP(118)		CHKCDS		CHKCDS, INDAT		
NOS	IP(122)		CHKCDS		CHKCDS, INDAT	CHKCDS	

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

| Module FCC004 |

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
BREED	IP(127)	PSUB	ARSTOR		INDAT		
POWUR	IP(128)		ARSTOR		INDAT		
HM	IP(129)		ARSTOR		INDAT		
PHI	IP(22)	REACTN	ARSTOR		INDAT		
ADEN	IP(13)		CHKCDS		CHKCDS, INDAT		
NOS	IP(122)		CHKCDS		CHKCDS, INDAT	CHKCDS	
NSPA	IP(123)		CHKCDS		CHKCDS, INDAT		
NZNR	IP(124)		CHKCDS		CHKCDS, INDAT		
SIGMAS	IP(94)		ARMAKE		INDAT		
BOCRAC	IP(89)		ARSTOR		INDAT		
EOCRAC	IP(90)		ARSTOR		INDAT		
NREGA	IP(84)		CHKCDS		CHKCDS, INDAT		
NRA	IP(85)		CHKCDS		CHKCDS, INDAT		
AREA	IP(86)		CHKCDS		CHKCDS, INDAT		
NZSZ	IP(59)		CHKCDS		CHKCDS, INDAT		
VOLZ	IP(56)		CHKCDS		CHKCDS, INDAT		
NSSA	IP(67)		CHKCDS		CHKCDS, INDAT		
VLSA	IP(58)		CHKCDS		CHKCDS, INDAT		
VFPA	IP(57)		CHKCDS		CHKCDS, INDAT		
ISOCLA	IP(118)		CHKCDS		CHKCDS, INDAT		
FISSIL	IP(91)		ARSTOR		INDAT		
FERTIL	IP(92)		ARSTOR		INDAT		
FISISO	IP(66)		CHKCDS		CHKCDS, INDAT		
FERISO	IP(68)		CHKCDS		CHKCDS, INDAT		

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

| Module FCC004 |

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
HANAME	IP(83)	REACTN	CHKCDS		CHKCDS, INDAT		
EN	IP(81)	REFAB	ARSTOR		INDAT		
ANV	IP(47)		EXCYCL		INDAT		
Q	IP(44)		ARSTOR		INDAT		
QP	IP(45)		ARSTOR		INDAT		
SUP	IP(11)		EXCYCL		INDAT		
IDEM	IP(10)		EXCYCL		INDAT		DIST
VOL	IP(7)		EXCYCL		INDAT		
CS	IP(8)		EXCYCL		INDAT		
ARHO	IP(9)		EXCYCL		INDAT		
AN	IP(27)		ARSTOR		INDAT		
VP	IP(28)		ARSTOR		INDAT		
VU	IP(29)		ARSTOR		INDAT		
AFAB	IP(30)		ARSTOR		INDAT		
DL	IP(31)		ARSTOR		INDAT		
DL1	IP(32)		ARSTOR		INDAT		
FU	IP(33)		ARSTOR		INDAT		
DENR	IP(48)		ARSTOR		INDAT		
E	IP(46)	REPROC	EXCYCL		INDAT		
DELTA	IP(12)		EXCYCL		INDAT		
DSALE	IP(4)		EXCYCL		INDAT		
ANV	IP(47)		EXCYCL		INDAT		
DELIV	IP(5)		EXCYCL		INDAT		
RECOV	IP(6)		EXCYCL		INDAT		
DENR	IP(48)		ARSTOR		INDAT		
DENF1	IP(82)		ARSTOR		INDAT		
Q	IP(44)		ARSTOR		INDAT		
QP	IP(45)		ARSTOR		INDAT		
NKS	IP(2)		INCYCL		ARMAKE, INDAT		
ERROR	IP(38)		ARMAKE		INDAT		
DEN	IP(14)		CHKCDS		CHKCDS, INDAT	CHKCDS	
SDEN	IP(51)		CHKCDS		CHKCDS, INDAT	CHKCDS	
NREC	IP(39)		ARMAKE		INDAT		
LAB	IP(40)		ARMAKE		INDAT		

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

| Module FCC004 |

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
DECAY	IP(41)	REPROC	ARMAKE		INDAT		
AA	IP(36)		ARSTOR		INDAT		
DN	IP(37)		ARSTOR		INDAT		
F	IP(34)		ARSTOR		INDAT		
Z	IP(35)		ARSTOR		INDAT		
VOLM	IP(65)		INCYCL		INDAT		
TEX	IP(3)		EXCYCL		INDAT		
EN	IP(81)		ARSTOR		INDAT		
EDIT	IP(109)		ARSTOR		INDAT		
EDITF	IP(110)		ARSTOR		INDAT		
EDITRP	IP(111)		ARSTOR		INDAT		
FSYLDF	IP(49)		ARMAKE		INDAT		
CFD	IP(130)		ARSTOR		INDAT		
B	IP(50)	SEARCH	ARSTOR		INDAT		
MPATH	IP(1)	SHUFF	INCYCL		ARMAKE, INDAT		
LPATH	IP(113)		CHKCDS		CHKCDS, INCYCL, INDAT		
LKS	IP(114)		INCYCL		INDAT		
SDEN	IP(51)		CHKCDS		CHKCDS, INDAT	CHKCDS	
AMASS	IP(80)		ARMAKE		INDAT		
NOA	IP(69)		ARMAKE		INDAT		
VOLF	IP(55)		INCYCL		INCYCL, INDAT	INCYCL	
VOLR	IP(72)		CHKCDS		CHKCDS, INDAT		
ISONAM	IP(61)		INCYCL		ARMAKE, INDAT		
REGLB6	IP(62)		CHKCDS		ARMAKE, CHKCDS, INDAT		
BURN	IP(115)		ARSTOR		INDAT		
DMASS	IP(79)		ARMAKE		INDAT		
MA	IP(98)		INCYCL		INDAT		
AA	IP(36)		ARSTOR		INDAT		
NREC	IP(39)		ARMAKE		INDAT		

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

LAB	IP(40)		ARMAKE		INDAT		

Module FCC004

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
DECAY	IP(41)	SHUFF	ARMAKE		INDAT		
FSYLDF	IP(49)		ARMAKE		INDAT		
DN	IP(37)		ARSTOR		INDAT		
W	IP(43)		ARSTOR		INDAT		
F	IP(34)		ARSTOR		INDAT		
Z	IP(35)		ARSTOR		INDAT		
LKSF	IP(63)		CHKCDS		CHKCDS, INDAT		
LREP	IP(143)		ARSTOR		INDAT		
NUMREP	IP(117)		CHKCDS		INDAT		
LREPF	IP(144)		CHKCDS		INDAT		
SDENF	IP(116)		CHKCDS		CHKCDS, INDAT		
LPATHF	IP(74)		CHKCDS		CHKCDS, INDAT		
MPATHF	IP(140)		INCYCL		INDAT		
DOWNTI	IP(138)		CHKCDS		CHKCDS, INDAT		
DNT	IP(141)		ARSTOR		INDAT		
SDENT	IP(125)		ARSTOR		INDAT		
MPATHT	IP(135)		ARSTOR		INDAT		
TSTOR	IP(131)		ARSTOR		INDAT		
LREPT	IP(132)		ARSTOR		INDAT		
LKST	IP(133)		ARSTOR		INDAT		
LPATHT	IP(134)		ARSTOR		INDAT		
MISO	IP(97)		ARMAKE		INDAT		ARMAKE
MISOF	IP(142)		ARMAKE		INDAT		ARMAKE
ISOEQ	IP(119)		CHKCDS		CHKCDS, INDAT		
ISOEQF	IP(136)		CHKCDS		CHKCDS, INDAT		
MISOT	IP(146)		ARSTOR		INDAT		
ISOEQT	IP(145)		ARSTOR		INDAT		
KRZONE	IP(147)		CHKCDS		CHKCDS, INDAT		
KFRESH	IP(148)		CHKCDS		CHKCDS, INDAT		

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

| Module FCC004 |

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
KRZONT	IP(149)	SHUFF	ARSTOR		INDAT		
POWFAC	IP(139)		CHKCDS		CHKCDS, INDAT		
AA	IP(36)	SPLBRN	ARSTOR		INDAT		
DN	IP(37)		ARSTOR		INDAT		
B	IP(50)		ARSTOR		INDAT		
BHAT	IP(52)		ARSTOR		INDAT		
MA	IP(98)		INCYCL		INDAT		
NKS	IP(2)		INCYCL		ARMAKE, INDAT		
SDEN	IP(51)		CHKCDS		CHKCDS, INDAT	CHKCDS	
VOLF	IP(55)		INCYCL		INCYCL, INDAT	INCYCL	
DEN1	IP(23)		ARSTOR		INDAT		
DEN3	IP(25)		ARSTOR		INDAT		
DEN4	IP(26)		ARSTOR		INDAT		
ERROR	IP(38)		ARMAKE		INDAT		
AA	IP(36)	TDECAY	ARSTOR		INDAT		
DN	IP(37)		ARSTOR		INDAT		
W	IP(43)		ARSTOR		INDAT		
F	IP(34)		ARSTOR		INDAT		
Z	IP(35)		ARSTOR		INDAT		
DNSR	IP(23/26)	ZONEAD	ARSTOR		INDAT		
EDTISO	IP(93)		CHKCDS		INDAT		
ISOEQ	IP(119)		CHKCDS		CHKCDS, INDAT		
HNNAME	IP(120)		CHKCDS		CHKCDS, INDAT		
MA	IP(98)		INCYCL		INDAT		
MPATH	IP(1)		INCYCL		ARMAKE, INDAT		
NKS	IP(2)		INCYCL		ARMAKE, INDAT		
NOR	IP(121)		CHKCDS		CHKCDS, INDAT		

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

| Module FCC004 |

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
NOS	IP(122)	ZONEAD	CHKCDS		CHKCDS, INDAT	CHKCDS	
NSPA	IP(123)		CHKCDS		CHKCDS, INDAT		
NZNR	IP(124)		CHKCDS		CHKCDS, INDAT		
REGLBL	IP(62)		CHKCDS		ARMAKE, CHKCDS, INDAT CHKCDS,		
ZDEN	IP(13)		CHKCDS		CHKCDS,		
KRZONE	IP(147)		CHKCDS		CHKCDS, INDAT		

| Module NUC018 |

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
ZGF	IZGF	NORM1	NUC018				
IHOLD	IHOLD1		NUC018				
NUP	INUPPT		NUC018				
NDN	INDNPT		NUC018				
WORK	IHOLD2		NUC018				
VOLR	IHOLD3		NUC018				
NZNR	INZNPT		NUC018				
PC	IPC		NUC018				
RZFLX	IRZFLU		NUC018				

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

Module SUBSET

			Subroutines Issuing POINTR CALLS				
Array	Pointer	Subroutine	PUTM	WIPOUT	GETPNT, IGET	REDEF	CLEAR
HSETI2	IISO22	CREAX2	SKIMER				
HISON2	IHISPT		SKIMER				
CHI2	ICHIPT		SKIMER				
VEL2	IVELPT		SKIMER				
EMAX2	IEMAPT		SKIMER				
LOCA2	ILOCPT		SKIMER				
HSETID	IISO2D		SUBSET				
HISONM	IHISPT		SUBSET				
CHI	ICHIPT		SUBSET				
VEL	IVELPT		SUBSET				
EMAX	TEMAPT		SUBSET				
LOCA	ILOCPT		SUBSET				
NISO2	INISO2		SUBSET				
ISET4D	IISO4D		SUBSET				
IDSCT	IDSCPT		SUBSET				
LORD	ILORPT		SUBSET				
JBAND	IJBAPT		SUBSET				
IJJ	IIJJPT		SUBSET				
WORK5D	IISO5D		SUBSET				
WORK7D	IISO7D		SUBSET				
IIJ2	IIJJ2		SKIMER				
SCT27D	ISSCPT		SKIMER				CREAX2
SSCAT	IISCAT		SKIMER				
NDDMAX	INDDMX		SKIMER				
N1MIN	IN1MIN		SKIMER				
N1MIN	IN1MIN		SKIMER				
SSCAT	ISSCAT	LODSCT	SUBSET				CREAX2
SSCAT	ISSCAT		SUBSET				CREAX2
HNNAMC	IND2DC	NDXCON	SKIMER	SKIMER			
HANAMC	IHANPT		SKIMER	SKIMER			
ATWTC	IATWPT		SKIMER	SKIMER			
NCLCN	INCLPT		SKIMER	SKIMER			
NDXSC	INDXPT		SKIMER	SKIMER			
NOSC	INOSPT		SKIMER	SKIMER			
NORC	INORPT		SKIMER	SKIMER			
HNNAME	INDX2D		SUBSET				
HANAME	IHANPT		SUBSET				

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

Module SUBSET

			Subroutines Issuing	POINTR CALLS			
					GETPNT,		
Array	Pointer	Subroutine	PUTM	WIPOUT	IGET	REDEF	CLEAR
ATWT	IATWPT	NDXCON	SUBSET				
NCLN	INCLPT		SUBSET				
NDXS	INDXPT		SUBSET				
NOS	INOSPT		SUBSET				
NOR	INORPT		SUBSET				
WORK3D	INDX3D		SUBSET				
HNNAME	INDX2D	SKIMER	SUBSET				
HANAME	IHANPT		SUBSET				
ATWT	IATWPT		SUBSET				
NCLN	INCLPT		SUBSET				
NDXS	INDXPT		SUBSET				
NOS	INOSPT		SUBSET				
NOR	INORPT		SUBSET				
WORK3D	INDX3D		SUBSET				
HSETID	IISO2D		SUBSET				
HISONM	IHISPT		SUBSET				
CHI	ICHIPT		SUBSET				
VEL	IVELPT		SUBSET				
EMAX	IEMAPT		SUBSET				
LOCA	ILOCPT		SUBSET				
IDSCT	IDSCPT		SUBSET				
LORD	ILORPT		SUBSET				
JBAND2	IJBAPT		SUBSET				
IJJ	IIJJPT		SUBSET				
NISO2	INISO2		SUBSET				
WORK4D	IISO4D		SUBSET				
WORK5D	IISO5D		SUBSET				
WORK7D	IISO7D		SUBSET				

Figure 5. Array Arguments of REBUS-3 Subroutines (cont'd.)

Contents of Common Block /POINTS/

Array Name	Pointer	Set in Subroutine
AA	IP(36)	ACON,MARCH,REPROC,SHUFF
ADEN	IP(13)	PROLIF,ZONEAD
AFAB	IP(30)	REFAB
AMASS	IP(80)	PSUB,SHUFF
AN	IP(27)	REFAB
ANV	IP(47)	EXTCYC,FEED,REPROC
AREA	IP(86)	NEWLSG
AREAD	IP(88)	BRAT
AREAN	IP(87)	BRAT,PSUB
ARHO	IP(9)	CMPENR
A1	IP(42)	ACON,MARCH
BB	IP(50)	BINIT,MARCH,SEARCH,SPLBRN
BHAT	IP(52)	DENEXT,MARCH,SPLBRN
BOCRAC	IP(89)	REACTN
BREED	IP(127)	BRAT
BRD	IP(75)	BRAT,PSUB
BRN	IP(76)	BRAT,PSUB
BRNTIM	IP(137)	SETPAR
BTLAB	IP(100)	FIVE
BUD	IP(78)	PSUB
BUN	IP(77)	PSUB
BURN	IP(115)	PSUB,SHUFF
BURUP	IP(99)	BRNIN,BURNP,DENOM,NUMER
CFD	IP(130)	EXTED,MASFLO,REPROC
CS	IP(8)	CLASS
CSEC	IP(16)	MATRIX
DECAY	IP(41)	MATRIX
DELIV	IP(5)	EXTCYC
DELTA	IP(12)	CMPENR
DEN	IP(14)	LDSDEN,REPROC
DENF1	IP(82)	REPROC
DENR	IP(48)	REFAB,REPROC
DEN1	IP(23)	DENEXT,MARCH,MSREGN,SPLBRN
DEN2	IP(24)	DENEXT
DEN3	IP(25)	MARCH,MSREGN,SPLBRN
DEN4	IP(26)	MARCH,MSREGN,SPLBRN
DL	IP(31)	REFAB
DL1	IP(32)	REFAB
DMASS	IP(79)	PSUB
DN	IP(37)	TDECAY
DNT	IP(141)	TDECAY
DOWNTI	IP(138)	SETPAR
DSALE	IP(4)	EXTCYC

Figure 6. Subroutines Setting Arrays

Contents of Common Block /POINTS/

Array Name	Pointer	Set in Subroutine
E	IP(46)	CMPENR
EDIT	IP(109)	EXTED,REPROC
EDITF	IP(110)	EXTED,REPROC
EDITRP	IP(111)	EXTED,REPROC
EDTBAL	IP(64)	PSUB
EDTBRG	IP(53)	PSUB
EDTISO	IP(93)	MASFLO,ZONEAD
EDTMAS	IP(15)	PSUB
EFL	IP(108)	BRN21
EILAB	IP(106)	SEVEIT
EMLAB	IP(105)	SEVEIT
EN	IP(81)	REPROC
EOCRAC	IP(90)	REACTN
ERROR	IP(38)	DENEXT,MARCH,REPROC,SPLBRN
F	IP(34)	PSUB,REPROC,TDECAY
FERISO	IP(68)	ECLASS
FERTIL	IP(92)	REACTN
FISISO	IP(66)	ECLASS
FISSIL	IP(91)	REACTN
FPWS	IP(60)	INDAT
FRESH	IP(95)	PATHS
FSYLDF	IP(49)	REACT
FU	IP(33)	REFAB
HANAME	IP(83)	SCANER
HM	IP(129)	PSUB
HNNAME	IP(120)	NEWNDX
IDEM	IP(10)	DIST
ISOCLA	IP(118)	ECLASS
ISOCOR	IP(126)	ECLASS
ISOEQ	IP(119)	LDSDEN,SHUFF
ISOEQF	IP(136)	LDSDEN
ISOEQT	IP(145)	BUMP,SHUFF
ISONAM	IP(61)	ISO
KFRESH	IP(148)	PATHS
KRZONE	IP(147)	PATHS,SHUFF
KRZONT	IP(149)	BUMP,SHUFF
LAB	IP(40)	MATRIX
LKS	IP(114)	SHUFF,STAGE
LKSF	IP(63)	PATHS
LKST	IP(133)	BUMP,SHUFF
LPATH	IP(113)	PATHS,SHUFF
LPATHF	IP(74)	PATHS,SHUFF
LPATHT	IP(134)	BUMP,SHUFF

Figure 6. Subroutines Setting Arrays (cont'd.)

Contents of Common Block /POINTS/

Array Name	Pointer	Set in Subroutine
LREP	IP(143)	SHUFF
LREPF	IP(144)	CHK37
LREPT	IP(132)	BUMP,SHUFF
MA	IP(98)	SHUFF,STAGE
MISO	IP(97)	FIMSO,SHUFF
MISOF	IP(142)	FIMSO
MISOT	IP(146)	BUMP,SHUFF
MPATH	IP(1)	SHUFF,STAGE
MPATHF	IP(140)	STAGE
MPATHT	IP(135)	BUMP,SHUFF
MSPOT	IP(17)	MATRIX
MTLAB	IP(102)	FIVE
NF	IP(54)	REACT
NFBR	IP(70)	NFB
NFPS	IP(71)	FISPRO
NKS	IP(2)	STAGE
NMBT	IP(101)	FIVE
NOA	IP(69)	REACT
NOR	IP(121)	NEWNDX,SCANER
NOS	IP(122)	NEWNDX,SCANER
NRA	IP(85)	NEWLSG
NREC	IP(39)	MATRIX,REACT
NREGA	IP(84)	NEWLSG
NSPA	IP(123)	PROLIF
NSSA	IP(67)	PROLIF
NUMREP	IP(117)	CHK37,SHUFF
NZNR	IP(124)	PROLIF
NZSZ	IP(59)	PROLIF
PHI	IP(22)	INDAT
PLB	IP(96)	PATHS
POWER	IP(112)	PSUB
POWFAC	IP(139)	SETPAR
POWUR	IP(128)	MASFLO,PSUB
Q	IP(44)	REFAB
QP	IP(45)	REFAB
RD	IP(19)	DENEXT
RDM	IP(20)	MARCH,MSREGN
RECOV	IP(6)	EXTCYC
REGLB6	IP(62)	PROLIF
RN	IP(18)	DENEXT
RNM	IP(21)	MARCH,MSREGN
RPLBL	IP(107)	BRN16
SDEN	IP(51)	DENEXT,GENSDN,LDSDEN,PSUB,SHUFF,SPLBRN

Figure 6. Subroutines Setting Arrays (cont'd.)

Contents of Common Block /POINTS/

Array Name	Pointer	Set in Subroutine
SDENF	IP(116)	LDSDEN
SDENT	IP(125)	BUMP,SHUFF
SIGMAS	IP(94)	MATRIX,RDPXS
SILAB	IP(104)	SEVEIT
SMLAB	IP(103)	SEVEIT
SUP	IP(11)	DIST
TEX	IP(3)	TIMES
TITLE	IP(73)	INDAT,ONE
TSTOR	IP(131)	BUMP,SHUFF
VFPA	IP(57)	PROLIF
VLSA	IP(58)	PROLIF
VOL	IP(7)	ACT
VOLF	IP(55)	CVOL
VOLM	IP(65)	CVOL
VOLR	IP(72)	PROLIF
VOLZ	IP(56)	PROLIF
VP	IP(28)	REFAB
VU	IP(29)	REFAB
W	IP(43)	TDECAY
Z	IP(35)	ADJXI,DENEXT,PSUB,REPROC,SHUFF,TDECAY

Contents of Common Block /PNTSA/

Array Name	Pointer	Set in Subroutine
ACTF	IT(3)	ACT
AIL	IT(56)	BRN13
AM	IT(38)	BRN24
AWP	IT(1)	REACT
BTLIM	IT(30)	SIX
BURTIM	IT(14)	BRN36
CCLBL	IT(50)	BRN12
CCOML	IT(55)	BRN13
CMPNAM	IT(13)	PROLIF
COOLT	IT(59)	BRN14
CSFR	IT(76)	BRN18
CSISO	IT(75)	BRN18
CSSL	IT(68)	BRN16
CSSLBL	IT(74)	BRN18
DEL	IT(62)	BRN12

Figure 6. Subroutines Setting Arrays (cont'd.)

Contents of Common Block /PNTSA/

Array Name	Pointer	Setin Subroutine
DENF	IT(4)	FEED
EFCSSL	IT(81)	BRN21
EFDEN	IT(85)	BRN22
EFISO	IT(84)	BRN22
EFLBL	IT(83)	BRN22
EFV	IT(82)	BRN21
ENDFNM	IT(60)	BRN31
ENR	IT(53)	BRN12
FAD	IT(57)	BRN13
FDL	IT(65)	BRN15
FSDF	IT(80)	B1920
FSPL	IT(79)	B1920
FSRCL	IT(77)	B1920
FSRPL	IT(78)	B1920
ICLASS	IT(61)	BRN31
IDR	IT(91)	BRN25
IFIS	IT(54)	BRN24
IHIT	IT(7)	CVOL
IPATYP	IT(10)	PATHS
IR	IT(32)	BRN09,ICHKR1,MATRIX
ISOCON	IT(93)	BRN25
ISODEC	IT(90)	BRN25
ISONME	IT(11)	TRNSF
ISOPR	IT(92)	BRN25
LISO	IT(36)	BRN10
LISTEQ	IT(8)	ISOLST
LISTLO	IT(89)	MATRIX
LOCATR	IT(6)	LDSDEN
LOCTRF	IT(20)	LDSDEN
LOISO	IT(31)	BRN09
LOI9	IT(63)	ICHKR1
LOI10	IT(35)	BRN10
LOI24	IT(37)	BRN24
MBLAB	IT(28)	SIX
MBLIM	IT(29)	SIX
NAC	IT(9)	ISOLST
NDXS	IT(12)	CHKCDS
NOREP	IT(19)	BRN37
NUMSTA	IT(17)	BRN36
PATHLB	IT(18)	BRN37
PCL	IT(47)	CHK37,PATHS
PCLT	IT(43)	BRN11,BRN35
PLBLT	IT(40)	BRN11,BRN35

Figure 6. Subroutines Setting Arrays (cont'd.)

Contents of Common Block /PNTSA/

Array Name	Pointer	Setin Subroutine
PLOAD	IT(52)	BRN12
PRISO	IT(34)	BRN09
RCLBL	IT(48)	BRN12
RDL	IT(58)	BRN14
RDLBL	IT(66)	BRN15
RECFR	IT(73)	BRN17
RELPOW	IT(16)	BRN36
RFABT	IT(51)	BRN12
RFISO	IT(72)	BRN17
RFSL	IT(67)	BRN16
RFSLBL	IT(71)	BRN17
RPIAD	IT(88)	BRN23
RPISO	IT(87)	BRN23
RPL	IT(64)	BRN15
RPLI	IT(86)	BRN23
RPT	IT(69)	BRN16
SCL	IT(46)	PATHS
SCLT	IT(42)	BRN11,BRN35
SHUTDO	IT(15)	BRN36
SN	IT(45)	CHK37,PATHS
SNT	IT(41)	BRN11,BRN35
VOF	IT(5)	FEED
VRP	IT(70)	BRN16
YF	IT(33)	BRN09,ICHKR1

Local Temporary Arrays

Array Name	Pointer	Set in Subroutine
ALIAS	IALIAS	NEWLSG
BOUND	IBOUND	NEWLSG
BSQ	IBSQ	NEWLSG
DEKAY	IPNT5	REACT
GEOD5D	IGOD5D	NEWLSG,PROLIF
GOD345	IGD345	NEWLSG
GOD78	IGOD78	NEWLSG
HOLDER	IHOLDR	SCANER
INPMAS	IINPMS	REACT
LAB	ILAB	SIX
LAB2D	ILAB2D	CHKCDS,NEWLSG

Figure 6. Subroutines Setting Arrays (cont'd.)

Local Temporary Arrays

Array Name	Pointer	Set in Subroutine
LAB3D	ILAB3D	NEWLSG
LAB4D	ILAB4D	NEWLSG
LIM	ILIM	SIX
LOCA	IPNT3	TRNSF
NDX2D	INDX2D	CHKCDS,NEWNDX,SCANER
NDX3D	INDX3D	CHKCDS,NEWNDX,SCANER
NPREV	IPNT4	BRN11
NRASAV	INRASV	NEWLSG
NSHZ1	INSHZ1	NEWLSG
NSHZ2	INSHZ2	NEWLSG
NZC	INZC	NEWLSG
NZHBB	INZHBB	NEWLSG
REC4	N4	SRCHI
SER4D	ISER4D	CHKCDS,NEWLSG
SETMAS	IMASS	TRNSF
SFIS	IPNT13	RPDXS
SNALF	IPNT11	RDPXS
SNGAM	IPNT10	RDPXS
SNP	IPNT12	RDPXS
SN2N	IPNT14	RDPXS
TPCL	IPNT1	PATHS,SIZE
TSCL	IPNT2	PATHS,SIZE
TSN	IPNT3	PATHS,SIZE
TXS3	IPNT2	RDTXS ELIM
TXS4	IPNT8	RDTXS
TXS5	IPNT9	RDPXS
WORK	IWORK	ECLASS
YFT	IPNT7	MATRIX
ZNAT2D	IZNA2D	LDSDEN,SCANER

Figure 6. Subroutines Setting Arrays (cont'd.)

4.3 BINARY INTERFACE DATASET USAGE

Communication between the various modules of REBUS-3 is accomplished by means of interface datasets. This is true in the case of the standalone export version as well, although in that case, the code could have been set up to provide communication between the various code areas using common blocks, for example. The CCCC[5] interface datasets as well as a number of datasets pertinent to the REBUS-3 code system are used. All of the possible datasets which may be involved are included in the catalogued procedure ARCSP027 listed in Figure 3. For any given problem, not all of the datasets will be involved however. For example, if the neutronics is being provided by the DIF3D code, all of the datasets related to the spatial flux synthesis code SYN3D are not pertinent.

Figure 7 lists the interface datasets (files) which are read, written, or rewound in the various subroutines of REBUS-3.

Appendix J indicates the main logical flow of REBUS-3 along with the interface datasets involved.

4.4 REBUS-3 COMMON BLOCK USAGE

As in the case of REBUS-2, REBUS-3 uses three major common blocks. These are:

```
COMMON SINGLE/FLT(150),INT(150)
COMMON POINTS/IP(150)
COMMON PNTSA/IT(125)
```

The dimensions of the various arrays involved are all larger than was the case for the REBUS-2 code. The arrays referenced in the common blocks POINTS and PNTSA have been indicated earlier in Figure 6

Common block SINGLE contains two arrays, the floating point array FLT and the integer array INT, each dimensioned 150. These arrays contain various floating point and integer quantities used throughout the code. The contents of the common block is contained in the binary interface dataset BRN which is written by the input processor, FCI002 and read by the computational module FCC004. BRN is also read by the path driver STP027, and is read and written by the wrapup-restart module FCC005 as one of the datasets on the RFILES wrapup-restart dataset. As shown in Figure 3, BRN is contained on the DD card FT89F001.

A complete description of the contents of arrays FLT and INT is given in Figure 8.

Module COPYDS

	Binary Files		
Subroutine	Read	Written	Rewound
COPYDS	PWDINT		PWDINT
	RTFLUX		RTFLUX
	RZFLUX		RZFLUX
	ZNATDN		ZNATDN
	STACK	STACK	STACK
PWFILE	PWDINT	STACK	
RTFILE	RTFLUX	STACK	
RZFILE	RZFLUX	STACK	
ZNFILE	ZNATDN	STACK	

Module INITFL

	Binary Files		
Subroutine	Read	Written	Rewound
RTFLOX	GEODST		GEODST
	ISOTXS		ISOTXS
		NHFLUX	NHFLUX
		RTFLUX	RTFLUX

Module FCI002

	Binary Files		
Subroutine	Read	Written	Rewound
ARMAKE			ISOTXS
CHKCDS	GEODST		
	LABELS		
	NDXSRF		
	SEARCH		
	ZNATDN		
FCI002		BRN	BRN
			POINTR

Figure 7. Binary File Manipulation

Module FCI002

Subroutine		Binary Files	
	Read	Written	Rewound
LDSDEN		NDS4	NDS4
NEWLSG	GEODST	GEODST	GEODST
	LABELS	LABELS	LABELS
	SEARCH	SEARCH	SEARCH
		SCR001	SCR001
NEWNDX	NDXSRF	NDXSRF	NDXSRF
PROLIF		ZADBOC	ZADBOC
	ZNATDN		ZNATDN
RDPXS	ISOTXS		
RDTXS	ISOTXS		
SAVE		POINTR	
SCANER	ZNATDN		
TRNSF	ISOTXS		

Module FCC004

Subroutine		Binary Files	
	Read	Written	Rewound
ACON		NDS1	NDS1
		NDS2	NDS2
BRAT	NDS1		NDS1
	NDS5		NDS5
BURNP	NDS4		NDS4
CHNGEQ			EOCRF
			NHFLUX
			RTFLUX
			SCRCH1
			SCRCH2
			SCRCH3
			SCRCH4
CPFLUX	NHFLUX	NHFLUX	NHFLUX
	RTFLUX	RTFLUX	RTFLUX
			EOCRF
			SCRCH1
			SCRCH2
			SCRCH3

Figure 7. Binary File Manipulation (cont'd.)

Module FCC004

	Binary Files		
Subroutine	Read	Written	Rewound
CPFLUX			SCRCH4
DENEXT	NBHAT	NBHAT	NBHAT
	NDSCR	NDSCR	NDSCR
	NDS1	NDS1	NDS1
	NDS4	NDS4	NDS4
	NDS5	NDS5	NDS5
GENSDN	NDS1		NDS1
		NDS4	NDS4
INDAT	BRN		BRN
	COMPXS		COMPXS
	RZFLUX		RZFLUX
		NDS1	NDS1
			POINTR
INITL	POINTR		
MARCH		NBHAT	NBHAT
	NDSCR	NDSCR	NDSCR
	NDS1	NDS1	NDS1
	NDS2	NDS2	NDS2
	NDS3	NDS3	NDS3
MSREGN	NDS3		NDS3
	NDS4		NDS4
NUMER	NDS1		NDS1
	NDS2		NDS2
OUTDAT		BRN	BRN
OUTDAT	POINTR		
PSUB	NDSCR	NDSCR	NDSCR
	NDS1		NDS1
	NDS2		NDS2
	NDS4	NDS4	NDS4
	NDS5	NDS5	NDS5
REACTN	ZNATDN		
REPROC	NDS4		NDS4
SAVE		POINTR	
SEARCH		NDS1	NDS1
SHUFF		NDS4	NDS4
	NDS5		NDS5
SPLBRN		NBHAT	NBHAT
	NDS1	NDS1	NDS1
	NDS2		NDS2
	NDS3	NDS3	NDS3
	NDS4		NDS4

Figure 7. Binary File Manipulation (cont'd.)

Module FCC004

	Binary Files		
Subroutine	Read	Written	Rewound
SPLBRN	NDS5		NDS5
SRCHI	SEARCH	SEARCH	SEARCH
SRCHO		SEARCH	SEARCH
ZONEAD	ZADBOC		ZADBOC
	ZNATDN	ZNATDN	ZNATDN

Module FCC005

	Binary Files		
Subroutine	Read	Written	Rewound
CPYFLX	NHFLUX	NHFLUX	
	RTFLUX	RTFLUX	
FCC005	BRN		BRN
	RFILES		
RESTAR	RFILES		
		BRN	BRN
		LABELS	LABELS
		NDS1	NDS1
		NDS2	NDS2
		NDS4	NDS4
		NDS5	NDS5
		NDXSRF	NDXSRF
		NHFLUX	NHFLUX
		RTFLUX	RTFLUX
		RZFLUX	RZFLUX
		SEARCH	SEARCH
		SRCH1	SCRCH1
		SRCH2	SCRCH2
		SRCH3	SCRCH3
		SRCH4	SCRCH4
		ZADBOC	ZADBOC
		ZNATDN	ZNATDN
			POINTR
			RFILES
WRAPUP		RFILES	

Figure 7. Binary File Manipulation (cont'd.)

Module FCC005

Subroutine	Binary Files Read	Written	Rewound
WRAPUP	DIF3D		DIF3D
	EOCRF		EOCRF
	GEODST		GEODST
	LABELS		LABELS
	NDS1		NDS1
	NDS2		NDS2
	NDS4		NDS4
	NDS5		NDS5
	NDXSRF		NDXSRF
	NHFLUX		NHFLUX
	POINTR		POINTR
	RTFLUX		RTFLUX
	RZFLUX		RZFLUX
	SEARCH		SEARCH
	SRCH1		SRCH1
	SRCH2		SRCH2
	SRCH3		SRCH3
	SRCH4		SRCH4
	ZADBOC		ZADBOC
	ZNATDN		ZNATDN
			POINTR
			RFILES

Module MODDIF

Subroutine	Binary Files Read	Written	Rewound
MODDIF	DIF3D	DIF3D	DIF3D

Figure 7. Binary File Manipulation (cont'd.)

Module NUC018

Subroutine	Binary Files Read	 Written	 Rewound
NUC018	COMPXS		COMPXS
	GEODST		GEODST
	RZFLUX	RZFLUX	RZFLUX

Module RESNDX

Subroutine	Binary Files Read	 Written	 Rewound
RESNDX	NDXSRF	NDXSRF	NDXSRF

Path Driver STP027

Subroutine	Binary Files Read	 Written	 Rewound
STP027	BRN		BRN
	DIF3D		DIF3D
	SEARCH		SEARCH
	RTFLUX		RTFLUX

Module SUBSET

Subroutine	Binary Files Read	 Written	 Rewound
SUBSET	ISOTXS		ISOTXS
	NDXSRF		NDXSRF
		ISOTXS-2	ISOTXS-2
		NDXSRF-2	NDXSRF-2

Figure 7. Binary File Manipulation (cont'd.)

Contents of Array INT in COMMON/SINGLE/ FLT(150),INT(150)

Name	Local Name	Definition and Comments
INT(1)	NACI	The number of active isotopes. Active isotopes are those whose atom densities are changing as a function of time.
INT(2)	NMAT	The number of material types which contain active isotopes.
INT(3)	NBREG	The number of burn regions.
INT(4)	NGP	The number of neutron energy groups in the cross section library.
INT(5)	NORP	The number of reprocessing plants.
INT(6)	NOF	The number of external feed supplies.
INT(7)	NSTEP	The number of substeps per burn cycle, at each of which the neutronics solution will be obtained.
INT(8)	LMAX	Maximum number of region density iterations to be carried out at any time node. Set to 2 in the preliminary (set to 1 at the start of preliminary, then changed to 2) and in the intermediate searches, and to LMAXS for the final search.
INT(9)	MMAX	Maximum number of cyclic mode iterations. Set to 2 (in INDAT, other values set in SEARCH), 1, and MMAXS in the preliminary, intermediate, and final search levels, respectively (set to 2 at the start of the preliminary search, then set to 1). For non-equilibrium problems, MMAX is whatever value is set by the user, that is, MMAXS.
INT(10)	NFIS	The number of active isotopes which are fissionable. This subset of the NACI active isotopes are used to calculate the intial actinide element inventory for burnup.
INT(11)	NSTEPS	Save area for NSTEP (INT(7)) during the preliminary search procedure.
INT(12)	IFPT	Flag controlling calls to subroutine PSUB in MARCH. If IFPT.LT.1, PSUB is not called. If IFPT.GE.1, PSUB is called. IFPT is set to 1 in SEARCH for the final edit pass after completion of the final search. IFPT is set to 2 for non-equilibrium problems during the final search.
INT(13)	IALF	Normally set to zero. Subroutine SEARCH sets IALF to -1 to indicate the need for an unpoisoned keff calculation at time node ALPHA.
INT(14)	IMAIN	Main core container array length in module FCC004.
INT(15)	IBULK	Bulk core container array length in module FCC004.
INT(16)	IPRINT	BPOINTER debugging print flag. Also controls

Figure 8. Contents of Arrays INT and FLT

Contents of Array INT in COMMON/SINGLE/ FLT(150),INT(150)

Name	Local Name	Definition and Comments
INT(16)	IPRINT	other debugging prints in FCI002, FCC004, and FCC005. In particular, if IPRINT.NE.0, the FLT and INT arrays are printed from COMMON/SINGLE/.
INT(17)		INT(17) is set to 1 on the first entry to INDAT as a sentinel to avoid reading dataset COMPXS after that first entry.
INT(18)	IPR5	Mass balance punch flag. 0, do n t punch the mass balance data. 1, punch the mass balance data.
INT(19)	NTGRP	Number of test groups (each containing one or more material types) for which the burnup constraint is to be tested.
INT(20)	ISF	Search procedure flag which indicates the problem status. 2 in the preliminary search, set in INDAT. -1 in the intermediate search, set in SEARCH (also set to 1 for non-equilibrium problems). 0 in the final search for equilibrium or non-equilibrium problems. Control searches during the neutronics solutions are possible only if ISF=0. ISF is reset after a fuel shuffling in subroutine SEARCH.
INT(21)	NREG	The number of regions.
INT(22)	IO10	The maximum number of equivalent isotope names assigned to an absolute isotope name, plus 1, as specified on dataset A.BURN type 10 cards.
INT(23)	NTOT	The number of material types plus the number of test groups having a burnup limit.
INT(24)	N5	The number of type 05 cards in dataset A.BURN. N5 is .GE. the number of burnup test groups.
INT(25)	N6	The number of type 06 cards in dataset A.BURN.
INT(26)	N7	The number of type 07 cards in dataset A.BURN.
INT(27)	N8	The number of type 08 cards in dataset A.BURN.
INT(28)	NFISBR	The number of isotopes identified as fissile for breeding ratio calculations. NFISBR is specified via the dataset A.BURN type 24 cards.
INT(29)	NFP	The number of active isotopes which are fission products.
INT(30)	MMAXS	Save area for MMAX (INT(9)) during the preliminary and intermediate search procedures.
INT(31)		0 if no poison searches are involved (i.e., data set SEARCH does not exist). 1 if dataset SEARCH does exist. This is set in WRAPUP as a flag

Figure 8. Contents of Arrays INT and FLT (cont'd.)

Contents of Array INT in COMMON/SINGLE/ FLT(150),INT(150)

Name	Local Name	Definition and Comments
INT(31)		to RESTAR.
INT(32)	NZONE	The number of zones (primary compositions).
INT(33)		0 if module DIF3D is not involved (i.e., dataset DIF3D does not exist). 1 if dataset DIF3D does exist. Set in WRAPUP as a flag to RESTAR
INT(34)	MU	Index of the cyclic mode iterations, used in subroutine DENEXT. MU is set to 0 in subroutine GENSDN.
INT(35)	LMAXS	SAVE area for LMAX (INT(8)) during the preliminary and intermediate search procedures.
INT(36)	NMREG	Maximum number of burnup matrices stored in a single record on scratch files. If no scratch files are needed, NMREG=NMMAX.
INT(37)	NMMAX	The total number of different burnup matrices (material-regions). This is the sum over all regions of the number of materials which have at least one stage of irradiation in that region. For non-equilibrium problems, NMMAX=NMAT.
INT(38)	NU	The time node number. NU=0,1,2,...,NSTEP. Beginning of cycle corresponds to NU=0. Incremented in MARCH. NU is set equal to ALPHA in subroutine SEARCH when doing unpoisoned keff calculations.
INT(39)	LFD	The region-density iteration count at the current time node. Set to 0 at the beginning of cycle in subroutine DENEXT (reset to 0 in MARCH and INDAT). If LFD=N, then the A matrix has been averaged N times and N neutronics solutions have been made.
INT(40)	NMLAB	The number of material types which have burnup limits.
INT(41)	IGFLUX	Control flag for switching flux dataset reference numbers in subroutines CHNGEQ and CHNGNE. Initially set to -2 in INDAT, reset to -1 on first entry to CHNGEQ or CHNGNE. Set to 0 at the start of the intermediate search. Set to 2 if an unpoisoned keff calculation is next. Reset back to 1 if it is 2.
INT(42)	MCUE	Region-density iteration flag, which is set to 0 in CYCLIC and in MARCH at the end of region-density iterations, and to 1 in MARCH or DENEXT during region-density iterations in order for subroutine CYCLIC to go on to a neutronics calculation and stop calling DENEXT and MARCH.

Figure 8. Contents of Arrays INT and FLT (cont'd.)

Name	Local Name	Definition and Comments
INT(43)	NINTI	The number of first dimension intervals in the RTFLUX flux dataset.
INT(44)	ITER	Set to 1 (in MARCH after NU=NSTEP) to indicate that a flux solution has previously been obtained at the current time node. Set to 0 at the start of calculations for the next time node to indicate no flux for this node exists (and therefore one must be copied from elsewhere). Set to 1 for the start of an intermediate search, but set to 0 if NSTEP.GT.1.
INT(45)	NBLK	Number of records on scratch files used for saving any burnup matrix. If burnup matrices are all held in core, NBLK=0. (For logical unit numbers NDS1, NDS2, NDS3, NDSCR, and NBHAT).
INT(46)	NWDBLK	Number of single precision words in each record of burnup scratch files for arrays AA, DN, A1, B, and BHAT. NWDS=MULT*NMREG*NACI*NACI. (For LUN NDS1, NDS2, NDS3, NDSCR, and NBHAT).
INT(47)	JPNT	Pointer controlling selection of array DEN1 for B.O.C. and DEN4 otherwise, in creating homogenized atomic densities for use in the neutronics solution. Used in DENEXT (where it is set to DEN1) and in OUTDAT (which calls ZONEAD to write a new ZNATDN dataset). Set to DEN4 in MARCH.
INT(48)	MULT	Word length multiplier for block data transfer. Set to 2 for double precision words on short word length computers or 1 otherwise.
INT(49)	NINTJ	Number of second dimension intervals in the RTFLUX flux dataset.
INT(50)	NDIM	Number of space dimensions in the flux dataset.
INT(51)	NBHAT	Data set reference number of the scratch file used to store the transmutation matrix B at time node ALPHA*NSTEP.
INT(52)	NDSCR	Data set reference number of a file used for scratch storage, used in MARCH and DENEXT.
INT(53)	NDS5	Data set reference number of the scratch file used to store array SDEN..
INT(54)	NDS4	Data set reference number of the scratch file used to store the array SDEN (MWDS single precision words long) in records 1,2,...,NMAT , and array BRN at time node NU in record NMAT+NU for 1.LE.NU.LE.NSTEP (each record is NMAT*(MS-1)

Figure 8. Contents of Arrays INT and FLT (cont'd.)

Contents of Array INT in COMMON/SINGLE/ FLT(150),INT(150)

Name	Local Name	Definition and Comments
INT(54)	NDS4	double words (or NMAT for non-equilibrium problems).
INT(55)	NDS3	Data set reference number of the scratch file used to store the AA matrix.
INT(56)	NDS2	Data set reference number of the scratch file used to store the AA matrix. Subroutine FCI002 initially sets NDS2 to the negative of its proper value as a flag to subroutines WRAPUP and RESTAR that the data set has not yet been written. Subroutine MARCH sets NDS2=-NDS2 before the first write to the data set.
INT(57)	NDS1	Data set reference number of the scratch file used to store the A1 matrix in record 1,2,...,NBLK, and the B matrix in records NBLK+1, NBLK+2, ..., 2*NBLK.
INT(58)	IMP	Original main core storage allocation used by module FCI002.
INT(59)	IBP	original bulk core storage allocation used by module FCI002.
INT(60)	MWDS	The number of single precision words in each record of the array SDEN. MWDS=MULT*NACI*MS.
INT(61)	NOFISS	Number of fissile isotopes in the balance edits.
INT(62)	NAREA	The number of areas.
INT(63)	NOFERT	Number of fertile isotopes in the balance edits.
INT(64)	NSTEP1	NSTEP+1, set on the first entry to subroutine CHNGEQ or CHNGNE. If NSTEP.GT.5 in CHNGNE, it is set to 3.
INT(65)	MS	The number of stages in the SDEN array. (Set to 2 if IPTYPE=1). MS is one plus the maximum number of stages in any path.
INT(66)	KFLAG	Problem status flag. Set to 0 at the start of a burn cycle in MARCH, and also at the end to denote the problem is completed, in SEARCH. Set to 1 in SEARCH to request a neutronics solution with control search. Set to 2 in SEARCH to request a neutronics solution without control search. Set to 3 in PSUB to request fuel shuffling.
INT(67)	JPRE	The number of the prestored burnup chain as specified by dataset A.BURN card type 09. JPRE=1 for PUUCH1, JPRE=2 for PUUCH2, JPRE=3 for THUCH1, and JPRE=4 for THUCH2.
INT(68)	KB	Burnup test flag used in subroutine REPROC. Set to 2 at the start of the problem in INDAT. Set to

Figure 8. Contents of Arrays INT and FLT (cont'd.)

Contents of Array INT in COMMON/SINGLE/ FLT(150),INT(150)

Name	Local Name	Definition and Comments
INT(68)	KB	1 prior to an unpoisoned keff calculation in order to perform external cycle iterations. Normally 0 (set to 0 in subroutine SEARCH) and only one pass is made through REPROC, i.e., no iterations are done and no check for convergence is made.
INT(69)	NREG	The number of regions.
INT(70)	IPTYPE	Problem type flag. 0 for equilibrium, 1 for non-equilibrium.
INT(71)	NUPREV	Time node number of previous neutronics solution. Used in subroutine CHNGNE for non-equilibrium problems only to adjust the SEEK tables.
INT(72)	I0	Data constant 0.
INT(73)	I1	Data constant 1.
INT(74)	I2	Data constant 2.
INT(75)	I3	Data constant 3.
INT(76)	I4	Data constant 4.
INT(77)	MODE	MODE parameter for subroutines REED and RITE.
INT(78)	IE	Data constant set to MULT*I4.
INT(79)	MLSTSV	Size of the main storage container actually used in module FCI002.
	NDT	Number of estimates of required burn-time which have been made in module FCC004.
INT(80)	INFP	The number of active isotopes which are fission products.
INT(81)	NDEC	The number of radioactive decay processes specified on the dataset A.BURN type 09 cards. That is, the number of type 09 cards with reaction type .GE. 6.
INT(82)	NLOC	The number of neutron reactions specified via the dataset A.BURN type 09 cards.
INT(83)	NFM	The number of fuel management operations remaining to be performed in a non-equilibrium problem. Initially set to the value specified on the dataset A.BURN type 03 card and decremented by 1 in SEARCH.
INT(84)	NASYN3	Logical unit number of dataset A.SYN3D. If NASYN3 .GT. 0, this is presumed to be a REBUS-3/ SYN3D problem so that module FCC004 will not be concerned with dataset RTFLUX.
INT(85)	NDSRN(1)	Data set reference number of scratch flux file at time node 0.
INT(86)	NDSRN(2)	Data set reference number of scratch flux file at

Figure 8. Contents of Arrays INT and FLT (cont'd.)

Contents of Array INT in COMMON/SINGLE/ FLT(150),INT(150)

Name	Local Name	Definition and Comments
INT(86)	NDSRN(2)	time node 1.
INT(87)	NDSRN(3)	Data set reference number of scratch flux file at time node 2.
INT(88)	NDSRN(4)	Data set reference number of scratch flux file at time node 3.
INT(89)	NDSRN(5)	Data set reference number of scratch flux file at time node 4.
INT(90)	NDSRN(6)	Data set reference number of scratch flux file for the second density iteration at the E.O.C. in the preliminary search, and the unpoisoned keff in the intermediate and final search procedures (used in equilibrium problems only).
INT(91)	N4REC	The number of records (each containing array BRN(M,K) at a given time node) written to data set reference number NDS4 by subroutine PSUB. The maximum value of N4REC is NSTEP.
INT(92)	NSTEP1	Save area for NSTEP (INT(7)) for non-equilibrium problems.
INT(93)	NCYCLE	Number of previous burn cycles + 1, for non-equilibrium problems. Incremented by 1 on each entry to subroutine SHUFF.
INT(94)	ISHUFF	Flag used in subroutine PSUB to control the calculation of array DMASS for used in the burnup denominator. It is first set to 0, permitting the calculation. Then after fuel is shuffled, it is set to 1 to be sure that DMASS is not recalculated using atom density data of irradiated fuel. Incremented by 1 on each entry to subroutine SHUFF.
INT(95)	NEOC	Data set reference number of the E.O.C. flux guess. if NEOC=0, a flux guess does not exist. If NEOC=-1, dataset EOCRF does not exist in the DSNAME list.
INT(96)	LTL	Length of array TITLE, the problem title from dataset A.BURN type 01 cards.
INT(97)	NINTK	The number of third dimension intervals in the RTFLUX flux dataset.
INT(98)	NISO	The number of isotopes in dataset ISOTXS.
INT(99)	NESRCH	Non-equilibrium enrichment-burn time search flag. Normally 0, but set to 1 in subroutine SEARCH to indicate completion of the search and start of the final search procedure. Reset to 0 in

Figure 8. Contents of Arrays INT and FLT (cont'd.)

Contents of Array INT in COMMON/SINGLE/ FLT(150),INT(150)

Name	Local Name	Definition and Comments
INT(99)	NESRCH	subroutine SEARCH after a fuel shuffling. NESRCH is set to 1 in CTLCDS if there are no data set A.BURN card types 4, 12, 13, or 18-22 supplied.
INT(100)	NOENDF	The number of isotopes classified for summary neutron balance edits.
INT(101)	NON	The number of nuclides in the cross section data.
INT(102)	NSN	The number of nuclide cross section sets.
INT(103)	NNS	The maximum number of nuclides in any set.
INT(104)	ISOANL(1)	The active isotope number corresponding to the nuclide Th232.
INT(105)	ISOANL(2)	The active isotope number corresponding to the nuclide Pa233.
INT(106)	ISOANL(3)	The active isotope number corresponding to the nuclide U-233.
INT(107)	ISOANL(4)	The active isotope number corresponding to the nuclide U-234.
INT(108)	ISOANL(5)	The active isotope number corresponding to the nuclide U-235.
INT(109)	ISOANL(6)	The active isotope number corresponding to the nuclide U-236.
INT(110)	ISOANL(7)	The active isotope number corresponding to the nuclide U-238.
INT(111)	ISOANL(8)	The active isotope number corresponding to the nuclide Np237.
INT(112)	ISOANL(9)	The active isotope number corresponding to the nuclide Pu236.
INT(113)	ISOANL(10)	The active isotope number corresponding to the nuclide Pu238.
INT(114)	ISOANL(11)	The active isotope number corresponding to the nuclide Pu239.
INT(115)	ISOANL(12)	The active isotope number corresponding to the nuclide Pu240.
INT(116)	ISOANL(13)	The active isotope number corresponding to the nuclide Pu241.
INT(117)	ISOANL(14)	The active isotope number corresponding to the nuclide Pu242.
INT(118)	ISOANL(15)	The active isotope number corresponding to the nuclide Am241.
INT(119)	ISOANL(16)	The active isotope number corresponding to the nuclide Am242.
INT(120)	ISOANL(17)	The active isotope number corresponding to the nuclide Am243.

Figure 8. Contents of Arrays INT and FLT (cont'd.)

Contents of Array INT in COMMON/SINGLE/ FLT(150),INT(150)

Name	Local Name	Definition and Comments
INT(121)	ISOANL(18)	The active isotope number corresponding to the nuclide Cm242.
INT(122)	ISOANL(19)	The active isotope number corresponding to the nuclide Cm243.
INT(123)	ISOANL(20)	The active isotope number corresponding to the nuclide Cm244.
INT(124)	ISOANL(21)	The active isotope number corresponding to the nuclide Cm245.
INT(125)	ISOANL(22)	The active isotope number corresponding to the nuclide Cm246.
INT(126)	NPOW	Ratio of actual power to power used for mass flow summary edits.
INT(127)	NZONE	3 if there are no internal blankets, 4 if there are internal blankets. For mass flow summary edits.
INT(128)	NFIS	0 if U-235 is not included in the fissile definition 1 if U-235 is included in the fissile definition. For mass flow summary edits.
INT(129)	NC	Core residence in number of cycles for mass flow summary edits.
INT(130)	NRB	Radial blanket residence in number of cycles for mass flow summary edits.
INT(131)	NIB	Internal blanket residence in number of cycles for mass flow summary edits.
INT(132)	NFERAB	Fertile material type in axial blanket, 0...uranium, 1...thorium. For mass flow summary edits.
INT(133)	NFERRB	Fertile material type in radial blanket, 0...uranium 1...thorium. For mass flow summary edits.
INT(134)	NFERIB	Fertile material type in internal blankets, 0...uranium, 1...thorium. For mass flow summary edits.
INT(135)	MFLAG	Error flag set in INDAT and SHUFF.
INT(136)	IBUDEF	0...define burnup as the ratio of atoms destroyed by fission in the discharge fuel to atoms originally present in the fuel 1...define burnup as the ratio of atoms destroyed by all processes in the discharge fuel to atoms originally present in the fuel Set in CTLCDS.
INT(137)	NNHFLU	Logical unit number of dataset NHFLUX. If NNHFLU .GT. 0, this is presumed to be a nodal option for the neutronics solution so that dataset NHFLUX is to be managed rather than RTFLUX.

Figure 8. Contents of Arrays INT and FLT (cont'd.)

Contents of Array INT in COMMON/SINGLE/ FLT(150),INT(150)

Name	Local Name	Definition and Comments
INT(138)	J27	Number of dataset A.BURN type 27 cards.
INT(139)	J35	Number of dataset A.BURN type 35 cards.
INT(140)	MFRESH	Number of paths for which fresh fuel is introduced at a stage number greater than 1.
INT(141)	J36	Number of dataset A.BURN type 36 cards.
INT(142)	NSTOR	Number of temporary out of core storage locations.
INT(143)	NOTSET	Number of zones which are not originally assigned to any region.
INT(144)		0, provide full edits. 1, suppress edits from module FCC004 until in the final pass with full edits.
INT(145-150)		Reserved

Contents of Array FLT in COMMON/SINGLE/ FLT(150),INT(150)

Name	Local Name	Definition and Comments
FLT(1)	AKUP	The desired unpoisoned eigenvalue, at time ALPHA*T(3) from dataset A.BURN card type 04. In the preliminary search this is the B.O.C. keff predicted from the formula k-sub d=k-sub O(ALPHA*T)+(delta k/T)*ALPHA*T.
FLT(2)	ALPHA	Read in as the fraction of the burn time T(3) at which AKUP is to be reached. ALPHA=1/NSTEP where 0.LE.1.LE.NSTEP.
FLT(3)	ATK	The unpoisoned eigenvalue obtained at time ALPHA*T(3). In the preliminary search it is the actual B.O.C. keff.
FLT(4)	EPSE	The convergence criterion for the maximum allowable relative error in any isotope charge density, used for the convergence of the unconstrained equilibrium mode. Supplied on dataset A.BURN card type 02.
FLT(5)	EPSC	Convergence criterion for the maximum allowable relative error in any isotope discharge density, used for the convergence of the cyclic mode. Supplied on dataset A.BURN card type 02.
FLT(6)	EPSN	Convergence criterion for the maximum allowable

Figure 8. Contents of Arrays INT and FLT (cont'd.)

Contents of Array FLT in COMMON/SINGLE/ FLT(150),INT(150)

Name	Local Name	Definition and Comments
FLT(6)	EPSN	relative error in the region-isotope density. Supplied on dataset A.BURN card type 02.
FLT(8)	EPSG	Convergence criterion for the error allowable in the burnup. EPSG is used to establish the burn step length. Supplied on dataset A.BURN card type 03.
FLT(9)	EPSF	Convergence criterion for the allowable relative error in the desired upoisoned eigenvalue AKUP. Supplied on dataset A.BURN card type 04.
FLT(10)	T(1)	The third-last burn cycle time in days.
FLT(11)	T(2)	The second-last burn cycle time in days.
FLT(12)	T(3)	The burn-time guess in days from dataset A.BURN card type 03. T(3) is also the latest burn time during the course of a calculation.
FLT(13)	F(1)	ATK-AKUP for the third-last unpoisoned eigenvalue.
FLT(14)	F(2)	ATK-AKUP for the second-last unpoisoned eigenvalue.
FLT(15)	F(3)	ATK-AKUP for the last unpoisoned eigenvalue.
FLT(16)	E(1)	The second value for the reactor charge-enrichment search, supplied on the dataset A.BURN card type 04. E(1) is also the third-last enrichment during a search.
FLT(17)	E(2)	Second-last enrichment during a search.
FLT(18)	E(3)	Initial value for the reactor charge-enrichment search. Supplied on dataset A.BURN card type 04. E(3) is also the latest value during a search.
FLT(19)	EK(1)	The previous burn step time.
FLT(20)	EK(2)	T(3), the current burn step time.
FLT(21)		Reserved
FLT(22)	EG(1)	The previous limiting burnup error.
FLT(23)	EG(2)	The current limiting burnup error, BRN=burnup desired-burnup computed.
FLT(24)	AVOGAD	Avogadro's number used in REBUS-3.
FLT(25)		Reserved
FLT(26)	BB	The total atoms charged (as accounted in the burnup denominator) for the burnup-limiting path, from BURUP(J,5)).
FLT(27)	EMW	Megawatts electric for mass flow summary edits.
FLT(28)	THMW	Megawatts thermal for mass flow summary edits.
FLT(29)	CF	Capacity factor for mass flow summary edits.
FLT(30)	FPD	Cycle length in full power days for mass flow summary edits.
FLT(31)	GO	Most recent computed converged control search

Figure 8. Contents of Arrays INT and FLT (cont'd.)

Contents of Array FLT in COMMON/SINGLE/ FLT(150),INT(150)

Name	Local Name	Definition and Comments
FLT(31)	G0	parameter from dataset SEARCH, for NU=0.
FLT(32)	G1	Previous converged control search paramter, for NU=0.
FLT(33)	DG0	DK/DX, the derivative of keff with respect to the search parameter X from dataset SEARCH, for NU=0.
FLT(34)	DG1	Previous value of DG0.
FLT(35)	EXT	External cycle time in calendar years for mass flow summary edits.
FLT(36)	FLOSS	Fractional loss in reprocessing for mass flow summary edits.
FLT(37)	TDOWN	Shutdown time in days for refueling between burn steps (for non-equilibrium problems only) used in subroutine SHUFF. Supplied on dataset A.BURN card type 03.
FLT(38)	H	Length of the burn substep in days. Initialized to 0.0 and set after the first entry to MARCH. Reset to 0.0 in DENEXT.
FLT(39)	TNU	H*NU.
FLT(40)	TOLD	Time in days at which the problem begins. Supplied on dataset A.BURN card type 03. TOLD is incremented by TDOWN in SHUFF and TNU in OUTDAT.
FLT(41)	BNOLD	Cumulative total kWd summed over all fuel discharged, over all previous cycles. Computed in subroutine SHUFF.
FLT(42)	BDOLD	Cumulative total mass (kg) of fissile and fertile material discharged, over all previous cycles. Computed in subroutine SHUFF.
FLT(43)	BMAX	The cumulative peak discharge burnup, over all previous cycles, i.e. the global peak discharge burnup. Computed in subroutine SHUFF.
FLT(44)	FISTOT(1)	Total B.O.C. fission rate for all the areas specified on the dataset A.NIP3 type 07 cards.
FLT(45)	FISTOT(2)	Total E.O.C. fission rate for all the areas specified on the dataset A.NIP3 type 07 cards.
FLT(46)	EU235	U-235 fraction in fertile uranium for mass flow summary edits.
FLT(47)	CFEED	Label of external feed supplying the core.
FLT(48)	BUVAL	Maximum discharge burnup.
FLT(49)		Reserved
FLT(50)	G(1,1)	Final control search value at time node 1 for the current cyclic mode iteration (i.e. the value after all region-density iterations are completed).

Figure 8. Contents of Arrays INT and FLT (cont'd.)

Contents of Array FLT in COMMON/SINGLE/ FLT(150),INT(150)

Name	Local Name	Definition and Comments
FLT(51)	G(2,1)	First control search value at time node 2.
FLT(52)	G(3,1)	First control search vlaue at time node 3.
FLT(53)	G(4,1)	First control search vlaue at time node 4.
FLT(54)	G(5,1)	Not used.
FLT(55)	G(1,2)	DK/DX for control search at time node 1.
FLT(56)	G(2,2)	DK/DX for control search at time node 2.
FLT(57)	G(3,2)	DK/DX for control search at time node 3.
FLT(58)	G(4,2)	DK/DX for control search at time node 4.
FLT(59)	G(5,2)	Not used.
FLT(60)	Z(1)	Final control search value for region-density iteration 1 at the current time node.
FLT(61)	Z(2)	As Z(1) for iteration 2.
FLT(62)	Z(3)	As Z(1) for iteration 3.
FLT(63)	Z(4)	As Z(1) for iteration 4.
FLT(64)	Z(5)	As Z(1) for iteration 5.
FLT(65)	Z(6)	As Z(1) for iteration 6.
FLT(66)	Z(7)	As Z(1) for iteration 7.
FLT(67)	Z(8)	As Z(1) for iteration 8.
FLT(68)	Z(9)	As Z(1) for iteration 9.
FLT(69)	Z(10)	As Z(1) for iteration 10.
FLT(70)	GOX1	GO-X1, where GO is FLT(31) and X1 is the converged search value from the latest neutronics solution at NU=0. GOX1 is used to adjust X1 for all NU on the second and subsequent cyclic mode iterations.
FLT(71)	EOCK	Desired E.O.C. keff supplied on dataset A.BURN card type 27.
FLT(72)	EPSD	The convergence criterion for the E.O.C. keff search, supplied on dataset A.BURN card type 27.
FLT(73)	TIME2	The second burn cycle guess for the E.O.C. keff search, supplied on dataset A.BURN card type 27.
FLT(74)		Reserved
FLT(75)	KDIF(1)	The previous error in the E.O.C keff.
FLT(76)	KDIF(2)	The current error in the E.O.C keff. KDIF(2)= EOCK-CURRK.
FLT(77)	DKDT	Most recent derivative of the E.O.C keff with respect to the burn cycle time.
FLT(78)	CYCL(1)	The last burn cycle time.
FLT(79)	CYCL(2)	The current burn cycle time (=T(3)).
FLT(80)	SK1	Keff at the beginning of cycle.
FLT(81)	SK2	Keff at the end of cycle.
FLT(82)	SKDIF	SK1-SK2, the change in keff over the cycle. SKDIF is computed in SEARCH.

Figure 8. Contents of Arrays INT and FLT (cont'd.)

Contents of Array FLT in COMMON/SINGLE/ FLT(150),INT(150)

Name	Local Name	Definition and Comments
FLT(83)	AKUPSV	Desired unpoisoned eigenvalue at time ALPHA*T(3). Supplied on dataset A.BURN card type 04.
FLT(84)	SAVNFM	Save area for user input value of NFM.
FLT(85)	AREAS(1)	Area label corresponding to the inner core.
FLT(86)	AREAS(2)	Area label corresponding to the middle core.
FLT(87)	AREAS(3)	Area label corresponding to the outer core.
FLT(88)	AREAS(4)	Area label corresponding to the inner blanket.
FLT(89)	AREAS(5)	Area label corresponding to the middle blanket.
FLT(90)	AREAS(6)	Area label corresponding to the outer blanket.
FLT(91)	AREAS(7)	Area label corresponding to the radial blanket.
FLT(92)	AREAS(8)	Area label corresponding to the axial blanket.
FLT(93)	AREAS(9)	Area label corresponding to the control rods.
FLT(94)	SF1	0.0 for the preliminary search, 10.0 for the intermediate and final search. Used in subroutine SEARCH.
FLT(95)	SF2	2.0 for the preliminary search. Set to 1.0 by INDAT for the intermediate and final search. Set to 0.0 in subroutine ENRICH.
FLT(96)	BRN	The value of (burnup limit-burnup obtained) which limits the burn time, from BURUP(J,2)-BURUP(J,3) in subroutine BURNP.
FLT(97)	BOCFIS	The beginning of cycle fissile absorptions.
FLT(98)	EOCFIS	The end of cycle fissile absorptions.
FLT(99)	CURRK	The eigenvalue of the most recent neutronics solution as read from dataset RZFLUX in subroutine INDAT.
FLT(100)		Reserved
FLT(101)	ANLNAM(1)	Absolute isotope label for Thorium 232.
FLT(102)	ANLNAM(2)	Absolute isotope label for Protactinium 233.
FLT(103)	ANLNAM(3)	Absolute isotope label for Uranium 233.
FLT(104)	ANLNAM(4)	Absolute isotope label for Uranium 234.
FLT(105)	ANLNAM(5)	Absolute isotope label for Uranium 235.
FLT(106)	ANLNAM(6)	Absolute isotope label for Uranium 236.
FLT(107)	ANLNAM(7)	Absolute isotope label for Uranium 238.
FLT(108)	ANLNAM(8)	Absolute isotope label for Neptunium 237.
FLT(109)	ANLNAM(9)	Absolute isotope label for Plutonium 236.
FLT(110)	ANLNAM(10)	Absolute isotope label for Plutonium 238.
FLT(111)	ANLNAM(11)	Absolute isotope label for Plutonium 239.
FLT(112)	ANLNAM(12)	Absolute isotope label for Plutonium 240.
FLT(113)	ANLNAM(13)	Absolute isotope label for Plutonium 241.
FLT(114)	ANLNAM(14)	Absolute isotope label for Plutonium 242.
FLT(115)	ANLNAM(15)	Absolute isotope label for Americium 241.

Figure 8. Contents of Arrays INT and FLT (cont'd.)

Contents of Array FLT in COMMON/SINGLE/ FLT(150),INT(150)

Name	Local Name	Definition and Comments
FLT(116)	ANLNAM(16)	Absolute isotope label for Americium 242.
FLT(117)	ANLNAM(17)	Absolute isotope label for Americium 243.
FLT(118)	ANLNAM(18)	Absolute isotope label for Curium 242.
FLT(119)	ANLNAM(19)	Absolute isotope label for Curium 243.
FLT(120)	ANLNAM(20)	Absolute isotope label for Curium 244.
FLT(121)	ANLNAM(21)	Absolute isotope label for Curium 245.
FLT(122)	ANLNAM(22)	Absolute isotope label for Curium 246.

Figure 8. Contents of Arrays INT and FLT (cont'd.)

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Appendix A

BCD DATASET A.BURN

The BCD dataset A.BURN listed in Figure 9 specifies the user general input for the fuel cycle portion of the REBUS-3 code. The type 03 card comments indicate the minimum card types required for various types of fuel cycle problems.

A user oriented approach has been taken in designing the A.BURN dataset specifications. Thus, the novice user may to a large extent accept default values in many areas of the input.

Either the formats specified in Figure 9 or the free format option indicated in Appendix I may be used for dataset A.BURN.

```
C***********************************************************************
C                                                                      -
C                       LAST REVISED 11/10/82 AT ANL                   -
C                                                                      -
CF          A.BURN                                                     -
CE          GENERAL INPUT FOR REBUS-3 FUEL CYCLE MODULES               -
C                                                                      -
CN                      THIS IS A USER-SUPPLIED BCD DATA SET.          -
CN                      THE LIST FOR EACH RECORD IS GIVEN IN TERMS OF  -
CN                      THE BCD FORMAT OF THE DATA CARD. COLUMNS 1-2   -
CN                      NORMALLY CONTAIN THE CARD TYPE NUMBER.         -
CN                      A BLANK FIELD GIVES THE INDICATED DEFAULT      -
CN                      VALUE.                                         -
C                                                                      -
C                                                                      -
CN                 ***  CARD TYPE DIRECTORY  ***                       -
CN                                                                     -
CN    TYPE                     CONTENTS                                -
CN    ====    =====================================================    -
CN     01     PROBLEM TITLE                                            -
CN     02     STORAGE AND CONVERGENCE CRITERIA SPECIFICATIONS          -
CN     03     GENERAL PROBLEM DEFINITION DATA                          -
CN     04     CHARGE ENRICHMENT/CRITICALITY DATA                       -
CN     05     BURNUP TEST GROUP SPECIFICATIONS                         -
CN     06     BURNUP LIMITS                                            -
CN     07     BURNUP NUMERATOR DEFINITION                              -
CN     08     BURNUP DENOMINATOR DEFINITION                            -
CN     09     ISOTOPIC CHAIN DATA                                      -
CN     10     ACTIVE ISOTOPE LABEL EQUIVALENCE LIST                    -
CN     11     REPETITIVE FUEL MANAGEMENT PATH DATA                     -
CN     12     REACTOR CHARGE SPECIFICATIONS                            -
CN     13     FUEL FABRICATION DATA                                    -
CN     14     REACTOR DISCHARGE COOLING TIMES                          -
CN     15     REACTOR DISCHARGE DESTINATION DATA                       -
CN     16     REPROCESSING PLANT SPECIFICATIONS                        -
CN     17     RECOVERY FACTOR DATA                                     -
CN     18     CLASS SEPARATION DATA                                    -
CN     19     CLASS 1 FABRICATION SPECIFICATIONS                       -
CN     20     CLASS 2 FABRICATION SPECIFICATIONS                       -
CN     21     EXTERNAL FEED SPECIFICATIONS                             -
CN     22     EXTERNAL FEED COMPOSITION                                -
CN     23     REPROCESSING PLANT OUPUT INITIAL CONPOSITION             -
CN     24     ACTIVE ISOTOPE DESCRIPTIONS                              -
CN     25     ACTIVE ISOTOPE DECAY CONSTANTS                           -
CN     26     ISOTOPES HAVING BURNUP DEPENDENT CROSS SECTIONS          -
CN     27     END-OF-CYCLE KEFF SEARCH DATA                            -
CN     28     AVOGADRO'S NUMBER                                        -
CN     29     SUMMARY EDITS AREA SPECIFICATIONS                        -
CN     30     SUMMARY MASS BALANCE ISOTOPE SPECIFICATIONS              -
```

Figure 9. BCD Dataset A.BURN

```
CN     31     SUMMARY NEUTRON BALANCE ISOTOPE SPECIFICATIONS          -
CN     32     SUMMARY MASS FLOW SPECIFICATIONS 1                      -
CN     33     SUMMARY MASS FLOW SPECIFICATIONS 2                      -
CN     34     SUMMARY MASS FLOW SPECIFICATIONS 3                      -
CN     35     GENERAL FUEL MANAGEMENT SPECIFICATIONS                  -
CN     36     GENERAL FUEL MANAGEMENT PARAMETERS                      -
CN     37     GENERAL FUEL MANAGEMENT REPETITION FACTORS              -
C                                                                     -
C***********************************************************************


C-----------------------------------------------------------------------
CR          PROBLEM TITLE (TYPE 01)                                    -
C                                                                      -
CL    FORMAT-----(I2,4X,11A6)                                          -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       01                                                     -
CD                                                                     -
CD    7-72      ANY ALPHANUMERIC CHARACTERS.                           -
C                                                                      -
CN              AS MANY TYPE 01 CARDS MAY BE USED AS DESIRED.          -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          STORAGE AND CONVERGENCE CRITERIA SPECIFICATIONS (TYPE 02)  -
C                                                                      -
CL    FORMAT-----(I2,4X,3I6,3E12.5,2I6)                                -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       02                                                     -
CD                                                                     -
CD    7-12      POINTR AND COMMON BLOCK DEBUGGING EDITS.               -
CD             -1...COMMON BLOCKS /SINGLE/ AND /POINTS/ PRINTOUT.      -
CD              0...NO DEBUGGING PRINTOUT (DEFAULT).                   -
CD              1...POINTER DEBUGGING DUMP AND COMMON BLOCKS PRINTOUT. -
CD              2...POINTER DEBUGGING TRACE AND COMMON BLOCKS PRINTOUT.-
CD              3...FULL DEBUGGING PRINTOUT (TRACE + DUMP + COMMON     -
CD                                           BLOCKS PRINTOUT).         -
CD                                                                     -
CD    13-18     POINTR CONTAINER ARRAY SIZE IN SCM IN REAL*8 WORDS.    -
CD              (DEFAULT=20000).                                       -
CD                                                                     -
CD    19-24     POINTR CONTAINER ARRAY SIZE IN LC IN REAL*8 WORDS.     -
CD              (DEFAULT=0).                                           -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CD                                                                  -
CD    25-36     CONVERGENCE CRITERION, EPSN: MAXIMUM ALLOWABLE RELATIVE-
CD              ERROR IN ANY ISOTOPE REGION DENSITY. FOR CONVERGENCE   -
CD              OF REGION-DENSITY ITERATIONS (DEFAULT=0.001).          -
CD                                                                  -
CD    37-48     CONVERGENCE CRITERION, EPSC: MAXIMUM ALLOWABLE RELATIVE-
CD              ERROR IN ANY ISOTOPE STAGE DENSITY. FOR CONVERGENCE OF -
CD              CYCLIC MODE ITERATIONS (DEFAULT=0.001).                -
CD                                                                  -
CD    49-60     CONVERGENCE CRITERION, EPSE: MAXIMUM ALLOWABLE RELATIVE-
CD              ERROR IN ANY ISOTOPE CHARGE DENSITY. FOR CONVERGENCE   -
CD              OF UNCONSTRAINED EQUILIBRIUM MODE (DEFAULT=0.0001).    -
CD                                                                  -
CD    61-66     MAXIMUM NUMBER OF REGION-DENSITY ITERATIONS AT A TIME  -
CD              NODE, LMAX. RECOMMENDED VALUE IS 1. LMAX IS SET TO 5   -
CD              IF INPUT VALUE IS GREATER THAN 5. IF LMAX=N, UP TO N   -
CD              NEUTRONICS SOLUTIONS WILL BE OBTAINED AT EACH TIME     -
CD              NODE (SEE CARD TYPE 03). LMAX=0 MEANS NO AVERAGING OF  -
CD              THE BURN MATRIX WILL BE DONE. THIS VALUE SHOULD NOT BE -
CD              USED FOR EQUILIBRIUM PROBLEMS. IF NO TYPE 02 CARD IS   -
CD              SUPPLIED, OR IF THIS IS AN EQUILIBRIUM PROBLEM, A      -
CD              DEFAULT VALUE OF 1 WILL BE USED.                       -
CD                                                                  -
CD    67-72     MAXIMUM NUMBER OF CYCLIC MODE ITERATIONS, MMAX.        -
CD              (DEFAULT=1).                                           -
C                                                                   -
CN              FOR NONEQUILIBRIUM PROBLEMS, SET EPSC=EPSE=1.000.      -
CN              PROBLEMS INVOLVING HIGH FUEL BURNUP (GREATER THAN      -
CN              ABOUT 20 ATOM PER CENT) SHOULD USE 2 CYCLIC MODE       -
CN              ITERATIONS (COLS 67-72).  VERY HIGH DISCHARGE BURNUP   -
CN              (GREATER THAN ABOUT 50 ATOM PER CENT) MAY REQUIRE MORE -
CN              THAN 2 CYCLIC MODE ITERATIONS.                         -
C                                                                   -
C---------------------------------------------------------------------


C---------------------------------------------------------------------
CR           GENERAL PROBLEM DEFINITION DATA (TYPE 03)                 -
C                                                                   -
CL    FORMAT-----(I2,4X,I6,4E12.5,2I6)                                 -
C                                                                   -
CD    COLUMNS             CONTENTS...IMPLICATIONS, IF ANY              -
CD    =======   ==================================================-
CD    1-2       03                                                     -
CD                                                                  -
CD    7-12      NUMBER OF PREVIOUS BURN CYCLES.                        -
CD                                                                  -
CD    13-24     SHUTDOWN TIME BETWEEN BURN CYCLES (IN DAYS).           -
CD              (NONEQUILIBRIUM PROBLEMS ONLY).                        -
```

Figure 9. BCD Datatset A.BURN (cont'd.)

```
CD                                                                     -
CD    25-36     TIME AT WHICH PROBLEM BEGINS (IN DAYS).                -
CD                                                                     -
CD    37-48     INITIAL TOTAL BURN CYCLE TIME GUESS (IN DAYS).         -
CD                                                                     -
CD    49-60     CONVERGENCE CRITERION, EPSG: ACTUAL ERROR ALLOWABLE    -
CD              IN BURNUP (SEE CARD TYPE 06 AND NOTE BELOW).           -
CD              (DEFAULT=0.001).                                       -
CD                                                                     -
CD    61-66     NUMBER OF SUBINTERVALS INTO WHICH THE TOTAL BURN CYCLE -
CD              TIME IS TO BE DIVIDED.                                 -
CD                                                                     -
CD    67-72     NUMBER OF FUEL MANAGEMENT OPERATIONS, FOR              -
CD              NONEQUILIBRIUM PROBLEMS ONLY. THIS VALUE IS 1 LESS     -
CD              THAN THE TOTAL NUMBER OF BURN CYCLES WHICH WILL BE     -
CD              COMPUTED.                                              -
C                                                                      -
CN              THE DATA CARDS OF A.BURN MAY BE DIVIDED INTO THE       -
CN              FOLLOWING FUNCTIONAL GROUPS:                           -
CN                                                  CARD TYPES         -
CN                      FUNCTION              REQUIRED       OPTIONAL  -
CN              =========================  ================ ===========-
CN              BASIC (NONEQUIL.) PROBLEM  03,09,11(35),24  01,02,10,25-
CN                                                                     -
CN              CHARGE ENRICHMENT SEARCH   04                          -
CN              + REQUIRED EXTERNAL CYCLE  12,13,18-22         --      -
CN                                                                     -
CN              BURNUP LIMITS              06               05,07,08   -
CN                                                                     -
CN              REPROCESSING PLANTS        15,16,17         14,23      -
CN                                                                     -
CN              IF THE FUEL MANAGEMENT IS SPECIFIED USING THE TYPE 35  -
CN              CARDS RATHER THAN THE TYPE 11 CARDS, CARD TYPES        -
CN              14, 15, 16, 17, AND 23 SHOULD NOT BE SUPPLIED.         -
CN                                                                     -
CN              THE TWO BASIC TYPES OF PROBLEMS WHICH MAY BE RUN ARE   -
CN              EQUILIBRIUM AND NONEQUILIBRIUM. AN EQUILIBRIUM PROBLEM -
CN              IS DEFINED AS ONE IN WHICH THE USER WISHES TO FIND THE -
CN              OPERATING CONDITIONS OF THE SPECIFIED REACTOR AFTER AN -
CN              INFINITE NUMBER OF BURN/DISCHARGE/REFUEL STEPS WITH    -
CN              THE CONDITIONS AND CONSTRAINTS AS SUPPLIED. SUCH       -
CN              PROBLEMS REQUIRE THE BASIC PROBLEM CARDS, THE CHARGE   -
CN              ENRICHMENT SEARCH AND EXTERNAL CYCLE CARDS, AND THE    -
CN              SPECIFICATION OF AT LEAST ONE BURNUP LIMIT.            -
CN              OPTIONALLY, ONE MAY INCLUDE REPROCESSING PLANTS IN THE -
CN              EXTERNAL CYCLE. A NONEQUILIBRIUM PROBLEM, ON THE OTHER -
CN              HAND, IS ONE IN WHICH THE BURN/REFUEL STEPS ARE        -
CN              EXPLICITLY COMPUTED IN SUCCESSION USING THE SUPPLIED   -
CN              PARAMETERS AND CONSTRAINTS. SUCH PROBLEMS REQUIRE ONLY -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CN              THE BASIC PROBLEM CARD TYPES LISTED ABOVE. OPTIONALLY, -
CN              ONE MAY SPECIFY AN ENRICHMENT SEARCH BY INCLUDING CARD -
CN              TYPE 04 AND THE REQUIRED EXTERNAL CYCLE CARDS. IF SUCH -
CN              A SEARCH IS SPECIFIED, ONE MAY ALSO SPECIFY DESIRED    -
CN              BURNUP LIMITS BY INCLUDING THE APPROPRIATE CARDS.      -
CN                                                                     -
CN              THE TOTAL BURN CYCLE TIME MAY BE DIVIDED INTO A NUMBER -
CN              OF EQUAL SUBINTERVALS, AS GIVEN IN COLS. 61-66 OF THIS -
CN              CARD. FLUX DISTRIBUTIONS WILL BE COMPUTED AT TIME ZERO -
CN              AND AT THE END OF EACH OF THESE SUBINTERVALS. EACH     -
CN              SUCH POINT IS CALLED A TIME NODE. A PROBLEM WITH N     -
CN              SUBINTERVALS THUS HAS N+1 TIME NODES. IF CONTROL       -
CN              MATERIALS ARE PRESENT, THE APPROPRIATE CONTROL SEARCHES-
CN              MAY BE CARRIED OUT TO MAINTAIN A PRESCRIBED KEFF AT    -
CN              EACH OF THESE TIME NODES. (SEE CARD TYPES 21, 22       -
CN              AND 23 OF DATA SET A.NIP3).                            -
CN                                                                     -
CN              FOR EQUILIBRIUM PROBLEMS, A MAXIMUM OF FOUR            -
CN              SUBINTERVALS IS ALLOWED. THERE IS NO LIMIT FOR         -
CN              NONEQUILIBRIUM PROBLEMS.                               -
CN                                                                     -
CN              NOTE: IF COLS. 49-60 ARE NON-NEGATIVE, THE BURNUP WILL -
CN              BE DEFINED AS THE RATIO OF FISSIONABLE ATOMS DESTROYED -
CN              BY FISSION IN THE DISCHARGED FUEL TO THE TOTAL         -
CN              FISSIONABLE ATOMS INITIALLY PRESENT IN THE FUEL.  IF   -
CN              COLS. 49-60 ARE NEGATIVE, THE BURNUP WILL BE DEFINED   -
CN              AS THE RATIO OF FISSIONABLE ATOMS DESTROYED BY ALL     -
CN              PROCESSES IN THE DISCHARGED FUEL TO THE TOTAL          -
CN              FISSIONABLE ATOMS INITIALLY PRESENT IN THE FUEL, AND   -
CN              THE ABSOLUTE VALUE OF COLS. 49-60 WILL BE USED FOR     -
CN              EPSG.  FISSIONABLE ISOTOPES ARE THOSE ACTIVE ISOTOPES  -
CN              WHICH APPEAR ON A CARD TYPE 09 WITH A 2 IN COLS. 13-18.-
C                                                                      -
C-----------------------------------------------------------------------

C-----------------------------------------------------------------------
CR          CHARGE ENRICHMENT/CRITICALITY DATA (TYPE 04)               -
C                                                                      -
CL    FORMAT-----(I2,10X,5E12.5)                                       -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       04                                                     -
CD                                                                     -
CD    13-24     DESIRED UNPOISONED KEFF(0).                            -
CD                                                                     -
CD    25-36     CONVERGENCE CRITERION, EPSF: RELATIVE ERROR ALLOWABLE  -
CD              IN KEFF(0) DURING CHARGE ENRICHMENT SEARCHES           -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CD                (DEFAULT=0.001).                                     -
CD                                                                     -
CD     37-48      FRACTION OF TOTAL BURN TIME AT WHICH KEFF(0) IS TO BE -
CD                REACHED. THIS MUST BE ONE OF THE END POINTS OF A     -
CD                SUBINTERVAL OF THE BURN STEP, I.E. A TIME NODE.      -
CD                                                                     -
CD     49-60      INITIAL VALUE FOR THE CHARGE ENRICHMENT              -
CD                SEARCH PARAMETER X.                                  -
CD                                                                     -
CD     61-72      SECOND VALUE FOR THE CHARGE ENRICHMENT               -
CD                SEARCH PARAMETER X. (DEFAULT=INITIAL VALUE FROM      -
CD                COLS.49-60 PLUS 0.1).                                -
C                                                                      -
CN                THE ENRICHMENT OF A BATCH OF FRESH FUEL IDENTIFIED   -
CN                AS CHARGE TYPE M IS ADJUSTED ACCORDING TO THE FORMULA -
CN                           E(M)=E(M)(0)(1+(X-1.)*DELTA(M)),          -
CN                WHERE X IS THE CHARGE ENRICHMENT SEARCH PARAMETER    -
CN                WHOSE INITIAL VALUE IS GIVEN IN COLS. 49-60.         -
CN                THE E(M)(0) AND DELTA(M) FOR EACH CHARGE TYPE ARE    -
CN                SPECIFIED ON CARD TYPE 12. RESULTING VALUE OF E(M)   -
CN                MUST ALWAYS LIE BETWEEN 0 AND 1.                     -
CN                                                                     -
CN                IF CARD TYPE 04 IS SUPPLIED, ALL "REQUIRED EXTERNAL  -
CN                CYCLE" CARDS MUST BE INCLUDED (SEE DISCUSSION IN CARD -
CN                TYPE 03).                                            -
CN                                                                     -
CN                IN THE FOLLOWING CARDS, A "LABEL" WILL BE IDENTIFIED -
CN                FROM THE CARD TYPE (E.G., CARD TYPE 21 INDICATES THAT -
CN                EXTERNAL FEED DATA ARE TO FOLLOW). A LABEL IS DEFINED -
CN                AS A SIX-CHARACTER IDENTIFIER THAT REFERENCES THE    -
CN                SPECIFIC OPERATIONS OR DATA THAT FOLLOW. FOR EXAMPLE, -
CN                A "PATH" LABEL DEFINES A SPECIFIC SEQUENCE OF SPATIAL -
CN                POSITIONS AND MOTIONS OF A "CHARGE" IN THE REACTOR   -
CN                AS LISTED ON THE CARD.                               -
CN                                                                     -
CN                THE ISOTOPE LABELING SYSTEM ALLOWS DIFFERENT LIBRARY -
CN                LABELS (I.E., DIFFERENT MICROSCOPIC CROSS SECTIONS) TO -
CN                BE USED IN DIFFERENT FUEL BATCHES. THE INTERNAL, OR  -
CN                RUN-TIME, LABELS FOR "ACTIVE" ISOTOPES (THOSE THAT ARE -
CN                INCLUDED IN THE TRANSMUTATION MATRIX) ARE DEFINED    -
CN                IN THE SPECIFICATION OF THE ISOTOPIC CHAIN (CARD TYPE -
CN                09). THESE RUN-TIME LABELS MAY COINCIDE WITH THE     -
CN                LIBRARY LABELS FOR ALL MATERIALS, IN WHICH CASE NO   -
CN                FUTHER INPUT IS REQUIRED. THE USER MAY, HOWEVER,     -
CN                SPECIFY (SEE CARD TYPE 10) THAT A LIBRARY ISOTOPE    -
CN                LABEL (WHICH DEFINES APPROPRIATE CROSS SECTIONS FOR  -
CN                SOME FUEL BATCH) IS EQUIVALENT TO ONE OF THOSE       -
CN                SPECIFIED ON CARD TYPE 09. ALL LIBRARY ISOTOPES THAT -
CN                ARE EQUIVALENCED TO ONE OF THESE RUN-TIME LABELS ARE -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CN               CONSIDERED IDENTICAL IN THE EXTERNAL CYCLE.           -
CN               APPROPRIATE MICROSCOPIC CROSS SECTIONS FOR THE FRESH  -
CN               CHARGE BATCHES ARE SELECTED THROUGH THE FUEL          -
CN               FABRICATION DATA ON CARD TYPE 13. ACTIVE ISOTOPE      -
CN               LABELS APPEARING ON CARD TYPES OTHER THAN 10 OR 13    -
CN               MUST BE THOSE THAT APPEAR IN COLS. 7-12 OF THE TYPE   -
CN               09 CARDS OR VIA THE PRESTORED BURNUP CHAINS (SEE CARD -
CN               TYPE 09).                                             -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          BURNUP TEST GROUP SPECIFICATIONS (TYPE 05)                 -
C                                                                      -
CL    FORMAT-----(I2,4X,11A6)                                          -
C                                                                      -
CD    COLUMNS             CONTENTS...IMPLICATIONS, IF ANY              -
CD    =======    ======================================================-
CD    1-2        05                                                    -
CD                                                                     -
CD    7-12       LABEL OF BURNUP TEST GROUP (REPEATED ON ADDITIONAL    -
CD               CARDS).                                               -
CD                                                                     -
CD    13-18      PATH LABEL (SEE CARD TYPE 11 OR CARD TYPE 35) TO BE   -
CD               INCLUDED IN TEST GROUP. SEE NOTE FOLLOWING CARD TYPE 06-
CD                                                                     -
CD    19-24      PATH LABEL (SEE CARD TYPE 11 OR CARD TYPE 35) TO BE   -
CD               INCLUDED IN TEST GROUP. SEE NOTE FOLLOWING CARD TYPE 06-
CD                                                                     -
CD    25-30      PATH LABEL (SEE CARD TYPE 11 OR CARD TYPE 35) TO BE   -
CD               INCLUDED IN TEST GROUP. SEE NOTE FOLLOWING CARD TYPE 06-
CD                                                                     -
CD    31-36      PATH LABEL (SEE CARD TYPE 11 OR CARD TYPE 35) TO BE   -
CD               INCLUDED IN TEST GROUP. SEE NOTE FOLLOWING CARD TYPE 06-
CD                                                                     -
CD    37-42      PATH LABEL (SEE CARD TYPE 11 OR CARD TYPE 35) TO BE   -
CD               INCLUDED IN TEST GROUP. SEE NOTE FOLLOWING CARD TYPE 06-
CD                                                                     -
CD    43-48      PATH LABEL (SEE CARD TYPE 11 OR CARD TYPE 35) TO BE   -
CD               INCLUDED IN TEST GROUP. SEE NOTE FOLLOWING CARD TYPE 06-
CD                                                                     -
CD    49-54      PATH LABEL (SEE CARD TYPE 11 OR CARD TYPE 35) TO BE   -
CD               INCLUDED IN TEST GROUP. SEE NOTE FOLLOWING CARD TYPE 06-
CD                                                                     -
CD    55-60      PATH LABEL (SEE CARD TYPE 11 OR CARD TYPE 35) TO BE   -
CD               INCLUDED IN TEST GROUP. SEE NOTE FOLLOWING CARD TYPE 06-
CD                                                                     -
CD    61-66      PATH LABEL (SEE CARD TYPE 11 OR CARD TYPE 35) TO BE   -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CD              INCLUDED IN TEST GROUP. SEE NOTE FOLLOWING CARD TYPE 06-
CD                                                                     -
CD    67-72     PATH LABEL (SEE CARD TYPE 11 OR CARD TYPE 35) TO BE    -
CD              INCLUDED IN TEST GROUP. SEE NOTE FOLLOWING CARD TYPE 06-
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          BURNUP LIMITS (TYPE 06)                                    -
C                                                                      -
CL    FORMAT-----(I2,10X,3(A6,E12.5))                                  -
C                                                                      -
CD    COLUMNS         CONTENTS...IMPLICATIONS, IF ANY                  -
CD    =======   =======================================================-
CD    1-2       06                                                     -
CD                                                                     -
CD    13-18     TEST GROUP OR PATH LABEL.                              -
CD                                                                     -
CD    19-30     DISCHARGE BURNUP LIMIT (AS DECIMAL FRACTION).          -
CD                                                                     -
CD    31-36     TEST GROUP OR PATH LABEL.                              -
CD                                                                     -
CD    37-48     DISCHARGE BURNUP LIMIT (AS DECIMAL FRACTION).          -
CD                                                                     -
CD    49-54     TEST GROUP OR PATH LABEL.                              -
CD                                                                     -
CD    55-66     DISCHARGE BURNUP LIMIT (AS DECIMAL FRACTION).          -
C                                                                      -
CN              EACH BURNUP LIMIT REFERS TO THE RATIO OF THE TOTAL     -
CN              NUMBER OF ATOMS DESTROYED (ACCORDING TO THE SIGN OF    -
CN              THE DATA IN COLS. 49-60 ON CARD TYPE 03) IN THE        -
CN              DISCHARGED FUEL TO THE TOTAL ATOMS INITIALLY PRESENT   -
CN              IN THE FUEL.                                           -
CN              UNLESS SPECIFIED OTHERWISE (SEE CARD TYPES 07 AND 08), -
CN              THE NUMERATOR OF THIS RATIO INCLUDES REACTIONS FOR ALL -
CN              FISSIONABLE ISOTOPES OCCURING OVER THE BURN CYCLE, AND -
CN              THE DENOMINATOR INCLUDES ALL FISSIONABLE ATOMS PRESENT -
CN              AT THE START OF THE BURN CYCLE.                        -
CN                                                                     -
CN              A BURNUP LIMIT MAY BE SPECIFIED FOR A TEST GROUP,      -
CN              CONSISTING OF A COLLECTION OF SEVERAL PATHS AS         -
CN              SPECIFIED ON TYPE 05 CARDS, AND/OR A SINGLE PATH. FOR  -
CN              TEST GROUPS A SINGLE AVERAGE BURNUP IS COMPUTED WHILE  -
CN              FOR A PATH LABEL A SEPARATE BURNUP IS COMPUTED FOR     -
CN              EACH MATERIAL TYPE TO WHICH THAT PATH APPLIES. IF NO   -
CN              BURNUP LIMIT IS GIVEN, NO BURNUP TEST IS MADE FOR THAT -
CN              PATH OR TEST GROUP.                                    -
CN                                                                     -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CN              WE DEFINE THE RELATIVE BURNUP ERROR AS THE VALUE OF    -
CN              THE DIFFERENCE BETWEEN ALLOWABLE AND ACHIEVED BURNUP   -
CN              RELATIVE TO THE ALLOWABLE BURNUP. THAT PATH OR TEST    -
CN              GROUP WHICH COMES CLOSEST TO OR MOST EXCEEDS ITS       -
CN              BURNUP LIMIT IS THE ONE WHICH HAS THE SMALLEST         -
CN              RELATIVE BURNUP, I.E., THE MINIMUM OF                  -
CN                 (BURNUP ALLOWED - BURNUP ACHIEVED)/BURNUP ALLOWED   -
CN              OVER ALL PATHS OR TEST GROUPS. DENOTING THIS LIMITING  -
CN              PATH OR TEST GROUP BY M, THE TOTAL BURN CYCLE TIME     -
CN              WILL BE ADJUSTED UNTIL THE ACTUAL BURNUP OF M IS       -
CN              WITHIN PLUS OR MINUS EPSG OF THE ALLOWABLE BURNUP      -
CN              LIMIT SPECIFIED ON THE TYPE 06 CARD, I.E., UNTIL       -
CN              (BURNUP ALLOWED-BURNUP ACHIEVED)=0 PLUS OR MINUS EPSG. -
CN              THIS WILL GIVE THE LONGEST BURN CYCLE TIME FOR WHICH   -
CN              ALL PATHS AND/OR TEST GROUPS REMAIN WITHIN THEIR       -
CN              RESPECTIVE BURNUP LIMITS.                              -
CN                                                                     -
CN              SETTING EPSG (COLS. 49-60 ON CARD TYPE 03) TO A LARGE  -
CN              NUMBER WILL ALLOW THE BURNUPS TO BE COMPUTED BUT WILL  -
CN              PREVENT ANY ADJUSTMENT OF THE BURN CYCLE TIME.         -
C                                                                      -
C-----------------------------------------------------------------------
```

```
C-----------------------------------------------------------------------
CR          BURNUP NUMERATOR DEFINITION (TYPE 07)                      -
C                                                                      -
CL    FORMAT-----(I2,4X,11A6)                                          -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   ========================================================-
CD    1-2       07                                                     -
CD                                                                     -
CD    7-12      TEST GROUP OR PATH LABEL (REPEATED ON ADDITIONAL       -
CD              CARDS, IF NECESSARY).                                  -
CD                                                                     -
CD    13-18     LABEL OF FISSIONABLE ISOTOPE TO BE INCLUDED IN         -
CD              NUMERATOR OF BURNUP EXPRESSION FOR THE SPECIFIED       -
CD              TEST GROUP OR PATH. (NOTE: THIS IS A LABEL FROM        -
CD              COLS. 7-12 OF THE ACTIVE CHAIN SPECIFIED ON CARD       -
CD              TYPE 09 OR IN A PRESTORED BURNUP CHAIN.)               -
CD                                                                     -
CD    19-24     LABEL OF FISSIONABLE ISOTOPE TO BE INCLUDED IN         -
CD              NUMERATOR OF BURNUP EXPRESSION FOR THE SPECIFIED       -
CD              TEST GROUP OR PATH. (NOTE: THIS IS A LABEL FROM        -
CD              COLS. 7-12 OF THE ACTIVE CHAIN SPECIFIED ON CARD       -
CD              TYPE 09 OR IN A PRESTORED BURNUP CHAIN.)               -
CD                                                                     -
CD    25-30     LABEL OF FISSIONABLE ISOTOPE TO BE INCLUDED IN         -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CD                NUMERATOR OF BURNUP EXPRESSION FOR THE SPECIFIED       -
CD                TEST GROUP OR PATH. (NOTE: THIS IS A LABEL FROM        -
CD                COLS. 7-12 OF THE ACTIVE CHAIN SPECIFIED ON CARD       -
CD                TYPE 09 OR IN A PRESTORED BURNUP CHAIN.)               -
CD                                                                       -
CD     31-36      LABEL OF FISSIONABLE ISOTOPE TO BE INCLUDED IN         -
CD                NUMERATOR OF BURNUP EXPRESSION FOR THE SPECIFIED       -
CD                TEST GROUP OR PATH. (NOTE: THIS IS A LABEL FROM        -
CD                COLS. 7-12 OF THE ACTIVE CHAIN SPECIFIED ON CARD       -
CD                TYPE 09 OR IN A PRESTORED BURNUP CHAIN.)               -
CD                                                                       -
CD     37-42      LABEL OF FISSIONABLE ISOTOPE TO BE INCLUDED IN         -
CD                NUMERATOR OF BURNUP EXPRESSION FOR THE SPECIFIED       -
CD                TEST GROUP OR PATH. (NOTE: THIS IS A LABEL FROM        -
CD                COLS. 7-12 OF THE ACTIVE CHAIN SPECIFIED ON CARD       -
CD                TYPE 09 OR IN A PRESTORED BURNUP CHAIN.)               -
CD                                                                       -
CD     43-48      LABEL OF FISSIONABLE ISOTOPE TO BE INCLUDED IN         -
CD                NUMERATOR OF BURNUP EXPRESSION FOR THE SPECIFIED       -
CD                TEST GROUP OR PATH. (NOTE: THIS IS A LABEL FROM        -
CD                COLS. 7-12 OF THE ACTIVE CHAIN SPECIFIED ON CARD       -
CD                TYPE 09 OR IN A PRESTORED BURNUP CHAIN.)               -
CD                                                                       -
CD     49-54      LABEL OF FISSIONABLE ISOTOPE TO BE INCLUDED IN         -
CD                NUMERATOR OF BURNUP EXPRESSION FOR THE SPECIFIED       -
CD                TEST GROUP OR PATH. (NOTE: THIS IS A LABEL FROM        -
CD                COLS. 7-12 OF THE ACTIVE CHAIN SPECIFIED ON CARD       -
CD                TYPE 09 OR IN A PRESTORED BURNUP CHAIN.)               -
CD                                                                       -
CD     55-60      LABEL OF FISSIONABLE ISOTOPE TO BE INCLUDED IN         -
CD                NUMERATOR OF BURNUP EXPRESSION FOR THE SPECIFIED       -
CD                TEST GROUP OR PATH. (NOTE: THIS IS A LABEL FROM        -
CD                COLS. 7-12 OF THE ACTIVE CHAIN SPECIFIED ON CARD       -
CD                TYPE 09 OR IN A PRESTORED BURNUP CHAIN.)               -
CD                                                                       -
CD     61-66      LABEL OF FISSIONABLE ISOTOPE TO BE INCLUDED IN         -
CD                NUMERATOR OF BURNUP EXPRESSION FOR THE SPECIFIED       -
CD                TEST GROUP OR PATH. (NOTE: THIS IS A LABEL FROM        -
CD                COLS. 7-12 OF THE ACTIVE CHAIN SPECIFIED ON CARD       -
CD                TYPE 09 OR IN A PRESTORED BURNUP CHAIN.)               -
CD                                                                       -
CD     67-72      LABEL OF FISSIONABLE ISOTOPE TO BE INCLUDED IN         -
CD                NUMERATOR OF BURNUP EXPRESSION FOR THE SPECIFIED       -
CD                TEST GROUP OR PATH. (NOTE: THIS IS A LABEL FROM        -
CD                COLS. 7-12 OF THE ACTIVE CHAIN SPECIFIED ON CARD       -
CD                TYPE 09 OR IN A PRESTORED BURNUP CHAIN.)               -
C                                                                        -
CN                IF THIS CARD IS PRESENT, ONLY FISSION REACTIONS OF     -
CN                ISOTOPES APPEARING IN THIS LIST CONTRIBUTE TOWARD      -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CN                THE CALCULATION OF THE BURNUP NUMERATOR OF THE TEST    -
CN                GROUP OR PATH SPECIFIED IN COLS. 7-12.                 -
C                                                                        -
C-------------------------------------------------------------------------


C-------------------------------------------------------------------------
CR            BURNUP DENOMINATOR DEFINITION (TYPE 08)                    -
C                                                                        -
CL    FORMAT-----(I2,4X,11A6)                                            -
C                                                                        -
CD    COLUMNS               CONTENTS...IMPLICATIONS, IF ANY              -
CD    =======     ===========================================================-
CD    1-2         08                                                     -
CD                                                                       -
CD    7-12        TEST GROUP OR PATH LABEL (REPEATED ON ADDITIONAL       -
CD                CARDS, IF NECESSARY).                                  -
CD                                                                       -
CD    13-18       LABEL OF ACTIVE ISOTOPE TO BE INCLUDED IN DENOMINATOR  -
CD                OF BURNUP EXPRESSION FOR THE SPECIFIED TEST GROUP OR   -
CD                PATH. (NOTE: THIS IS A LABEL FROM COLS. 7-12 OF THE    -
CD                ACTIVE CHAIN SPECIFIED ON CARD TYPE 09 OR IN A         -
CD                PRESTORED BURNUP CHAIN.)                               -
CD                                                                       -
CD    19-24       LABEL OF ACTIVE ISOTOPE TO BE INCLUDED IN DENOMINATOR  -
CD                OF BURNUP EXPRESSION FOR THE SPECIFIED TEST GROUP OR   -
CD                PATH. (NOTE: THIS IS A LABEL FROM COLS. 7-12 OF THE    -
CD                ACTIVE CHAIN SPECIFIED ON CARD TYPE 09 OR IN A         -
CD                PRESTORED BURNUP CHAIN.)                               -
CD                                                                       -
CD    25-30       LABEL OF ACTIVE ISOTOPE TO BE INCLUDED IN DENOMINATOR  -
CD                OF BURNUP EXPRESSION FOR THE SPECIFIED TEST GROUP OR   -
CD                PATH. (NOTE: THIS IS A LABEL FROM COLS. 7-12 OF THE    -
CD                ACTIVE CHAIN SPECIFIED ON CARD TYPE 09 OR IN A         -
CD                PRESTORED BURNUP CHAIN.)                               -
CD                                                                       -
CD    31-36       LABEL OF ACTIVE ISOTOPE TO BE INCLUDED IN DENOMINATOR  -
CD                OF BURNUP EXPRESSION FOR THE SPECIFIED TEST GROUP OR   -
CD                PATH. (NOTE: THIS IS A LABEL FROM COLS. 7-12 OF THE    -
CD                ACTIVE CHAIN SPECIFIED ON CARD TYPE 09 OR IN A         -
CD                PRESTORED BURNUP CHAIN.)                               -
CD                                                                       -
CD    37-42       LABEL OF ACTIVE ISOTOPE TO BE INCLUDED IN DENOMINATOR  -
CD                OF BURNUP EXPRESSION FOR THE SPECIFIED TEST GROUP OR   -
CD                PATH. (NOTE: THIS IS A LABEL FROM COLS. 7-12 OF THE    -
CD                ACTIVE CHAIN SPECIFIED ON CARD TYPE 09 OR IN A         -
CD                PRESTORED BURNUP CHAIN.)                               -
CD                                                                       -
CD    43-48       LABEL OF ACTIVE ISOTOPE TO BE INCLUDED IN DENOMINATOR  -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CD              OF BURNUP EXPRESSION FOR THE SPECIFIED TEST GROUP OR   -
CD              PATH. (NOTE: THIS IS A LABEL FROM COLS. 7-12 OF THE    -
CD              ACTIVE CHAIN SPECIFIED ON CARD TYPE 09 OR IN A         -
CD              PRESTORED BURNUP CHAIN.)                               -
CD                                                                     -
CD    49-54     LABEL OF ACTIVE ISOTOPE TO BE INCLUDED IN DENOMINATOR  -
CD              OF BURNUP EXPRESSION FOR THE SPECIFIED TEST GROUP OR   -
CD              PATH. (NOTE: THIS IS A LABEL FROM COLS. 7-12 OF THE    -
CD              ACTIVE CHAIN SPECIFIED ON CARD TYPE 09 OR IN A         -
CD              PRESTORED BURNUP CHAIN.)                               -
CD                                                                     -
CD    55-60     LABEL OF ACTIVE ISOTOPE TO BE INCLUDED IN DENOMINATOR  -
CD              OF BURNUP EXPRESSION FOR THE SPECIFIED TEST GROUP OR   -
CD              PATH. (NOTE: THIS IS A LABEL FROM COLS. 7-12 OF THE    -
CD              ACTIVE CHAIN SPECIFIED ON CARD TYPE 09 OR IN A         -
CD              PRESTORED BURNUP CHAIN.)                               -
CD                                                                     -
CD    61-66     LABEL OF ACTIVE ISOTOPE TO BE INCLUDED IN DENOMINATOR  -
CD              OF BURNUP EXPRESSION FOR THE SPECIFIED TEST GROUP OR   -
CD              PATH. (NOTE: THIS IS A LABEL FROM COLS. 7-12 OF THE    -
CD              ACTIVE CHAIN SPECIFIED ON CARD TYPE 09 OR IN A         -
CD              PRESTORED BURNUP CHAIN.)                               -
CD                                                                     -
CD    67-72     LABEL OF ACTIVE ISOTOPE TO BE INCLUDED IN DENOMINATOR  -
CD              OF BURNUP EXPRESSION FOR THE SPECIFIED TEST GROUP OR   -
CD              PATH. (NOTE: THIS IS A LABEL FROM COLS. 7-12 OF THE    -
CD              ACTIVE CHAIN SPECIFIED ON CARD TYPE 09 OR IN A         -
CD              PRESTORED BURNUP CHAIN.)                               -
C                                                                      -
CN              IF THIS CARD IS PRESENT, ONLY ISOTOPES APPEARING IN    -
CN              THIS LIST CONTRIBUTE TOWARD THE CALCULATION OF THE     -
CN              BURNUP DENOMINATOR OF THE TEST GROUP OR PATH SPECIFIED -
CN              IN COLS. 7-12.                                         -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          ISOTOPIC CHAIN DATA (TYPE 09)                              -
C                                                                      -
CL    FORMAT-----(I2,4X,A6,I6,3(A6,E12.5))                             -
C                                                                      -
CD    COLUMNS         CONTENTS...IMPLICATIONS, IF ANY                  -
CD    =======   ========================================================
CD    1-2       09                                                     -
CD                                                                     -
CD    7-12      LABEL OF ISOTOPE UNDERGOING REACTION (REPEATED ON ALL  -
CD              CARDS THAT SPECIFY OTHER REACTIONS FOR THIS ISOTOPE)   -
CD              OR ONE OF THE PRIVILEGED LABELS PUUCH1, PUUCH2, THUCH1,-
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CD                 OR THUCH2 SPECIFYING ONE OF THE PRESTORED BURNUP       -
CD                 CHAINS.                                                -
CD                                                                        -
CD      13-18      REACTION TYPE (REPEATED ON ADDITIONAL CARDS,           -
CD                 IF NECESSARY).                                         -
CD                 0...NO REACTION.                                       -
CD                 1...(N,GAMMA) REACTION.                                -
CD                 2...(N,F) REACTION.                                    -
CD                 3...(N,P) REACTION.                                    -
CD                 4...(N,ALPHA) REACTION.                                -
CD                 5...(N,2N) REACTION.                                   -
CD                 6...BETA-MINUS DECAY.                                  -
CD                 7...BETA-PLUS DECAY.                                   -
CD                 8...ALPHA DECAY.                                       -
CD                                                                        -
CD      19-24      LABEL OF PRODUCT ISOTOPE FROM THE REACTION SPECIFIED   -
CD                 IN COLS. 13-18 OR THE PRIVILEGED LABEL DELETE.         -
CD                                                                        -
CD      25-36      YIELD FRACTION OR, FOR REACTION TYPES 6, 7, AND 8, THE -
CD                 ISOMERIC STATE BRANCHING FRACTION TO THE ISOTOPE       -
CD                 SPECIFIED IN COLS. 19-24.                              -
CD                                                                        -
CD      37-42      LABEL OF PRODUCT ISOTOPE FROM THE REACTION SPECIFIED   -
CD                 IN COLS. 13-18.                                        -
CD                                                                        -
CD      43-54      YIELD FRACTION OR, FOR REACTION TYPE 6, 7, AND 8, THE  -
CD                 ISOMERIC STATE BRANCHING FRACTION TO THE ISOTOPE       -
CD                 SPECIFIED IN COLS. 37-42.                              -
CD                                                                        -
CD      55-60      LABEL OF PRODUCT ISOTOPE FROM THE REACTION SPECIFIED   -
CD                 IN COLS. 13-18.                                        -
CD                                                                        -
CD      61-72      YIELD FRACTION OR, FOR REACTION TYPES 6, 7, AND 8, THE -
CD                 ISOMERIC STATE BRANCHING FRACTION TO THE ISOTOPE       -
CD                 SPECIFIED IN COLS. 55-60.                              -
C                                                                         -
CN                 ALL ISOTOPE LABELS APPEARING IN COLS. 7-12 OF ONE OR   -
CN                 MORE TYPE 09 CARDS ARE DEFINED AS "ACTIVE"; THAT IS,   -
CN                 THEY ARE CONSIDERED IN BURNUP/DECAY CALCULATIONS. ALL  -
CN                 OTHER ISOTOPES ARE "INACTIVE"; THAT IS, THEY ARE       -
CN                 ASSUMED TO UNDERGO NO TRANSMUTATIONS DURING THE        -
CN                 PROBLEM. AT LEAST ONE OF THE ACTIVE ISOTOPES WHICH     -
CN                 IS TO BE INCLUDED IN THE CALCULATION OF CONVERSION AND -
CN                 BREEDING RATIOS MUST BE DEFINED ON A TYPE 24 CARD.     -
CN                                                                        -
CN                 IF COLS. 7-12 ON ONE OF THE TYPE 09 CARDS CONTAIN ANY  -
CN                 OF THE PRIVILEGED LABELS PUUCH1, PUUCH2, THUCH1,       -
CN                 OR THUCH2, THE BURNUP CHAINS WILL BE DETERMINED        -
CN                 FROM PRESTORED DATA.  IN THAT CASE, THE REMAINDER OF   -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CN              THE DATA ON THAT TYPE 09 CARD WILL BE IGNORED.  IF     -
CN              TYPE 09 CARDS ARE SUPPLIED WITH NORMAL ISOTOPE DATA    -
CN              IN ADDITION TO ONE OF THE PRIVILEGED LABELS, THE DATA  -
CN              WILL BE MERGED WITH THE PRESTORED CHAIN DATA.  IF      -
CN              A LABEL IN COLS. 7-12 CORRESPONDS TO ONE OF THE        -
CN              PRESTORED ISOTOPE LABELS, THE DATA ON THAT TYPE 09     -
CN              CARD WILL OVERRIDE THE PRESTORED DATA FOR THE          -
CN              CORRESPONDING REACTION TYPE.  IF IT IS DESIRED TO      -
CN              DELETE ANY OF THE PRESTORED DATA, COLS. 19-24 SHOULD   -
CN              CONTAIN THE PRIVILEGED LABEL DELETE FOR A GIVEN        -
CN              ACTIVE ISOTOPE AND REACTION TYPE SPECIFIED IN COLS.    -
CN              7-12 AND 13-18 RESPECTIVELY.  IF COLS 19-24 CONTAIN    -
CN              THE PRIVILEGED LABEL DELETE, THE REST OF THE DATA ON   -
CN              THAT CARD TYPE 09 WILL BE IGNORED.                     -
CN              THE LABELS USED IN THE PRESTORED CHAINS ARE: TH232,    -
CN              PA233, U-233, U-234, U-235, U-236, U-238, PU238,       -
CN              NP237, PU236, PU239, PU240, PU241, PU242, AM241,       -
CN              AM242, CM242, CM243, CM244, CM245, CM246, LFPP3,       -
CN              LFPP5, LFPP9, LFPPA, DUMP1, AND DUMP2.                 -
C                                                                      -
CN              IF NO TYPE 10 CARDS ARE GIVEN, THE ISOTOPE LABELS ON   -
CN              THE TYPE 09 CARDS IN COLS. 7-12 OR THE NAMES OF THE    -
CN              ISOTOPES IN THE PRESTORED BURNUP CHAINS MUST BE        -
CN              DEFINED IN THE CROSS SECTION LIBRARY ON DATA SET ISOTXS.
CN              IF ANY TYPE 10 CARDS ARE GIVEN, THE LABELS ON THE 09   -
CN              MAY BE LOCAL. THE TYPE 10 CARDS WILL RELATE THE LOCAL  -
CN              LABELS TO SPECIFIC CROSS SECTION LIBRARY LABELS.       -
CN                                                                     -
CN              IF THE FIRST PRODUCT ISOTOPE LABEL (COLS. 19-24) IS    -
CN              BLANK, IT IMPLIES A YIELD OR BRANCHING FRACTION OF     -
CN              1.0. THIS FURTHER IMPLIES THAT THE PRODUCT ISOTOPE IS  -
CN              TO BE IDENTIFIED FROM THE PROTON AND MASS NUMBERS (Z,A)-
CN              OF THE PARENT ISOTOPE (AS GIVEN IN THE CROSS SECTION   -
CN              LIBRARY), MODIFIED BY THE SPECIFIED REACTION. FOR      -
CN              FISSION REACTIONS (N,F), AT LEAST ONE PRODUCT ISOTOPE  -
CN              LABEL MUST BE GIVEN SINCE NO LINKAGE THROUGH A AND Z   -
CN              IS POSSIBLE. IF ONLY ONE PRODUCT ISOTOPE IS NAMED IN   -
CN              COLS. 19-24 FOR ANY REACTION, NO YIELD FRACTION NEED   -
CN              BE ENTERED (1.0 IS ASSUMED). HOWEVER, IF A YIELD       -
CN              FRACTION IS ENTERED, IT MAY HAVE A VALUE OTHER THAN    -
CN              1.0 ONLY FOR FISSION REACTIONS (I.E., REACTION TYPE 2).-
CN              IF MORE THAN ONE PRODUCT ISOTOPE IS LISTED, THE YIELD  -
CN              FRACTIONS MUST BE GIVEN FOR EACH, AND SHOULD SUM TO    -
CN              THE TOTAL YIELD OF NUCLEI/FISSION OF THE PARENT ISOTOPE-
CN              (NORMALLY 2.0). THE ISOMERIC STATE BRANCHING FRACTIONS -
CN              FOR ANY GIVEN PARENT ISOTOPE SHOULD SUM TO 1.0.        -
CN                                                                     -
CN              IF MORE THAN ONE TYPE 09 CARD IS REQUIRED TO SPECIFY   -
CN              THE PRODUCT ISOTOPES, THE LABEL OF THE ISOTOPE UNDER-  -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CN              GOING THE REACTION MUST BE REPEATED IN COLS. 7-12      -
CN              AND THE REACTION TYPE MUST BE REPEATED IN COLS. 13-18  -
CN              ON ALL SUCCEEDING TYPE 09 CARDS NEEDED TO COMPLETELY   -
CN              SPECIFY THE PRODUCT ISOTOPES.                          -
CN                                                                     -
CN              ALL ISOTOPES UNDERGOING THE (N,F) REACTION ARE         -
CN              INCLUDED IN THE CALCULATION OF BURNUP EXCEPT FOR       -
CN              THOSE BURNUP VALUES COMPUTED IN CONNECTION WITH CARD   -
CN              TYPE 06. (SEE DISCUSSION FOLLOWING CARD TYPE 06).      -
CN                                                                     -
CN              A TYPE 25 CARD MUST BE SUPPLIED FOR EACH ACTIVE ISOTOPE-
CN              WHICH HAS A REACTION TYPE OF 6, 7, OR 8.  HOWEVER,     -
CN              TYPE 25 CARDS NEED NOT BE SUPPLIED FOR ISOTOPES IN     -
CN              PRESTORED BURNUP CHAINS UNLESS IT IS DESIRED TO        -
CN              OVERRIDE THE DEFAULT DECAY CONSTANT FOR ANY OF THE     -
CN              ISOTOPES IN THE PRESTORED CHAINS OR TO DELETE SUCH     -
CN              DATA.                                                  -
CN                                                                     -
CN              NOTE THAT THE REBUS-3 CORE STORAGE REQUIREMENT GOES    -
CN              UP AS SQUARE OF NUMBER OF ACTIVE ISOTOPES.             -
CN              IN PARTICULAR, IF A PRESTORED BURNUP CHAIN IS          -
CN              SPECIFIED, THE MAXIMUM STORAGE IS REQUIRED FOR CHAIN   -
CN              THUCH2 AND PROGRESSIVELY LESSER STORAGE IS REQUIRED    -
CN              FOR CHAINS PUUCH2, THUCH1, AND PUUCH1, RESPECTIVELY.   -
C                                                                      -
C-----------------------------------------------------------------------
```

```
C-----------------------------------------------------------------------
CR          ACTIVE ISOTOPE LABEL EQUIVALENCE LIST (TYPE 10)            -
C                                                                      -
CL    FORMAT-----(I2,4X,11A6)                                          -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       10                                                     -
CD                                                                     -
CD    7-12      LOCAL ISOTOPE LABEL FROM COLS. 7-12 OF TYPE 09 CARDS   -
CD              (REPEATED, IF NECESSARY, ON ADDITIONAL CARDS).         -
CD                                                                     -
CD    13-18     LIBRARY ISOTOPE LABEL TO BE EQUIVALENCED TO THE LOCAL  -
CD              LABEL IN COLS. 7-12.                                   -
CD                                                                     -
CD    19-24     LIBRARY ISOTOPE LABEL TO BE EQUIVALENCED TO THE LOCAL  -
CD              LABEL IN COLS. 7-12.                                   -
CD                                                                     -
CD    25-30     LIBRARY ISOTOPE LABEL TO BE EQUIVALENCED TO THE LOCAL  -
CD              LABEL IN COLS. 7-12.                                   -
CD                                                                     -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CD    31-36     LIBRARY ISOTOPE LABEL TO BE EQUIVALENCED TO THE LOCAL   -
CD              LABEL IN COLS. 7-12.                                    -
CD                                                                      -
CD    37-42     LIBRARY ISOTOPE LABEL TO BE EQUIVALENCED TO THE LOCAL   -
CD              LABEL IN COLS. 7-12.                                    -
CD                                                                      -
CD    43-48     LIBRARY ISOTOPE LABEL TO BE EQUIVALENCED TO THE LOCAL   -
CD              LABEL IN COLS. 7-12.                                    -
CD                                                                      -
CD    49-54     LIBRARY ISOTOPE LABEL TO BE EQUIVALENCED TO THE LOCAL   -
CD              LABEL IN COLS. 7-12.                                    -
CD                                                                      -
CD    55-60     LIBRARY ISOTOPE LABEL TO BE EQUIVALENCED TO THE LOCAL   -
CD              LABEL IN COLS. 7-12.                                    -
CD                                                                      -
CD    61-66     LIBRARY ISOTOPE LABEL TO BE EQUIVALENCED TO THE LOCAL   -
CD              LABEL IN COLS. 7-12.                                    -
CD                                                                      -
CD    67-72     LIBRARY ISOTOPE LABEL TO BE EQUIVALENCED TO THE LOCAL   -
CD              LABEL IN COLS. 7-12.                                    -
C                                                                       -
CN              CARD TYPE 10 IS REQUIRED ONLY IF THE ISOTOPE LABELS     -
CN              IN DATA SET ISOTXS DIFFER FROM THE LABELS SPECIFIED     -
CN              ON THE TYPE 09 CARDS OR VIA A PRESTORED BURNUP CHAIN,   -
CN              OR IF DIFFERENT ISOTOPE LABELS (I.E., DIFFERENT         -
CN              MICROSCOPIC CROSS SECTIONS) ARE REQUIRED FOR THE SAME   -
CN              ISOTOPE IN DIFFERENT MATERIALS. IN SUCH CASES, EACH     -
CN              MATERIAL DEFINED ON TYPE 13 OR TYPE 14 CARDS OF DATA    -
CN              SET A.NIP3 MUST CONTAIN ALL THE LIBRARY ISOTOPE LABELS  -
CN              OF THE COMPLETE CHAINS APPLICABLE TO THAT MATERIAL,     -
CN              EVEN IF THE ATOM DENSITY IS 0.0.                        -
C                                                                       -
C------------------------------------------------------------------------


C------------------------------------------------------------------------
CR          REPETITIVE FUEL MANAGEMENT PATH DATA (TYPE 11)              -
C                                                                       -
CL    FORMAT-----(I2,4X,A6,I6,2(I6,2A6))                                -
C                                                                       -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                 -
CD    =======   ========================================================-
CD    1-2       11                                                      -
CD                                                                      -
CD    7-12      PATH LABEL (REPEATED ON ADDITIONAL CARDS,               -
CD              IF NECESSARY).                                          -
CD                                                                      -
CD    13-18     NUMBER OF PREVIOUS BURN CYCLES                          -
CD              (NONEQUILIBRIUM PROBLEMS ONLY).                         -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CD                                                                -
CD      19-24     STAGE NUMBER.                                   -
CD                                                                -
CD      25-30     SECONDARY COMPOSITION LABEL (OR DISCHARGE LABEL).  -
CD                                                                -
CD      31-36     PRIMARY COMPOSITION LABEL OR REGION LABEL.      -
CD                                                                -
CD      37-42     STAGE NUMBER.                                   -
CD                                                                -
CD      43-48     SECONDARY COMPOSITION LABEL (OR DISCHARGE LABEL).  -
CD                                                                -
CD      49-54     PRIMARY COMPOSITION LABEL OR REGION LABEL.      -
C                                                                 -
CN                IF TYPE 35 CARDS ARE PROVIDED, ANY TYPE 11 CARDS WILL -
CN                BE IGNORED.                                     -
CN                                                                -
CN                EACH FUEL MANAGEMENT PATH IS DEFINED BY ITS STAGE  -
CN                NUMBERS IN ASCENDING NUMERICAL ORDER (1,2,3,...,   -
CN                NOT NECESSARILY ORDERED ON THE CARDS). THE FUEL TO BE -
CN                MOVED IS IDENTIFIED BY THE SECONDARY COMPOSITION LABEL,-
CN                WHILE THE LOCATION OF THE FUEL IN THE REACTOR IS GIVEN -
CN                BY THE PRIMARY COMPOSITION LABEL (WHICH IS ASSIGNED   -
CN                TO REGIONS VIA A.NIP3 TYPE 15 CARDS) OR A REGION      -
CN                LABEL.  PRIMARY COMPOSITION NAMES MUST BE UNIQUE      -
CN                RELATIVE TO REGION NAMES. FOR A GIVEN PATH, COLS. 31-36-
CN                AND 49-54 MUST EITHER BE ALL PRIMARY COMPOSITION      -
CN                LABELS OR ALL REGION LABELS.                          -
CN                                                                -
CN                THE SAME SECONDARY COMPOSITION MUST BE USED IN ALL    -
CN                STAGES OF A GIVEN PATH.                               -
CN                                                                -
CN                IF PRIMARY COMPOSITION LABELS ARE BEING USED TO DEFINE -
CN                A PARTICULAR PATH, ALL OF THESE LABELS MUST BE THE SAME-
CN                OR BLANK.                                             -
CN                                                                -
CN                IF THE PATH HAS K STAGES, THE DISCHARGE LABEL (SEE    -
CN                CARD TYPES 14 AND 15) FOR THIS PATH IS ENTERED AS THE -
CN                SECONDARY COMPOSITION LABEL FOR THE K+1 STAGE NUMBER. -
CN                FOR THIS CASE, THE PRIMARY COMPOSITION LABEL OR REGION -
CN                LABEL SHOULD BE BLANK.  THE DISCHARGE LABEL MAY BE    -
CN                OMITTED IF NO FUEL IS RECYCLED (NO REPROCESSING       -
CN                PLANTS SPECIFIED).                                    -
CN                                                                -
CN                FOR EQUILIBRIUM PROBLEMS, IF A SECONDARY COMPOSITION  -
CN                RESIDES IN ONE REGION FOR SEVERAL STAGES OF A MULTI-  -
CN                STAGE PATH AND IN SOME OTHER REGION FOR OTHER STAGES, -
CN                THE USER MUST BE CAREFUL THAT THE VOLUMES OF THE TWO  -
CN                REGIONS ARE COMPATIBLE WITH THE FRACTIONS OF THE      -
CN                COMPOSITIONS WHICH ARE BEING TRANSFERRED.  FOR EXAMPLE,-
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CN              IF A SECONDARY COMPOSITION RBS1 IS LOADED INTO REGION  -
CN              BZ11 IN STAGE 1, REMAINS THERE FOR STAGE 2, AND THEN   -
CN              IS MOVED TO REGION BZ31 FOR STAGE 3 AND REMAINS IN     -
CN              REGION BZ31 FOR STAGES 4 AND 5, THE VOLUMES OF REGIONS -
CN              BZ11 AND BZ31 SHOULD BE IN THE RATIO OF 2.0/3.0.       -
CN              THIS CAN BE SEEN SINCE FOR STAGE 3, HALF OF THE VOLUME -
CN              OF REGION BZ11 IS BEING COMBINED WITH TWO-THIRDS OF THE-
CN              VOLUME OF REGION BZ31 AND MUST BE CONTAINED IN REGION  -
CN              BZ31.  DENOTING THE VOLUMES OF REGIONS BZ11 AND BZ31   -
CN              AS V1 AND V2 RESPECTIVELY, ALGEBRAICALLY ONE MUST      -
CN              SATISFY THE MATERIAL CONSERVATION EQUATION             -
CN                    0.5(V1)+0.33333(V2)+0.33333(V2)=V2.              -
CN                                                                     -
CN              THE USE OF THE TYPE 11 CARDS MAY BE ILLUSTRATED BY THE -
CN              FOLLOWING EXAMPLE.  CONSIDER A FOUR REGION CORE INTO   -
CN              WHICH 4 FUEL TYPES ARE LOADED AND SHUFFLED THROUGH 3   -
CN              BURN STEPS.  THE CONFIGURATION CAN BE PICTURED AS      -
CN                                                                     -
CN              BURN             MATERIAL CONTAINED IN                 -
CN              CYCLE     CORE1     CORE2     CORE3     CORE4          -
CN              -----   --------  --------  --------  --------         -
CN                1     FUEL1(0)  FUEL2(0)  FUEL3(2)  FUEL4(0)         -
CN                2     FUEL3(0)  FUEL1(1)  FUEL2(1)  FUEL4(1)         -
CN                3     FUEL4(2)  FUEL3(1)  FUEL1(2)  FUEL2(2)         -
CN                                                                     -
CN              THE NUMBERS IN PARENTHESES ARE THE NUMBER OF PREVIOUS  -
CN              BURN STEPS THE PARTICULAR FUEL HAS UNDERGONE AT THAT   -
CN              STAGE AND LOCATION IN THE SYSTEM.  THIS SEQUENCE       -
CN              WOULD BE ACCOMPLISHED BY SUPPLYING THE FOLLOWING TYPE  -
CN              11 CARDS WHICH ARE ILLUSTRATED BELOW IN FREE FORMAT    -
CN              STYLE INPUT.                                           -
CN                                                                     -
CN                 11 PATH1 0 1 FUEL1 CORE1 2 FUEL1 CORE2              -
CN                 11 PATH1 0 3 FUEL1 CORE3                            -
CN                 11 PATH2 0 1 FUEL2 CORE2 2 FUEL2 CORE3              -
CN                 11 PATH2 0 3 FUEL2 CORE4                            -
CN                 11 PATH3 2 1 FUEL3 CORE1 2 FUEL3 CORE2              -
CN                 11 PATH3 2 3 FUEL3 CORE3                            -
CN                 11 PATH4 0 1 FUEL4 CORE4 2 FUEL4 CORE4              -
CN                 11 PATH4 0 3 FUEL4 CORE1                            -
CN                                                                     -
CN              NOTE THAT OPERATIONALLY, THE CONFIGURATION ILLUSTRATED -
CN              ABOVE AS BURN CYCLE 1 WOULD BE REACHED ONLY AFTER      -
CN              PERFORMING 3 BURN CYCLES USING THE TYPE 11 CARDS LISTED-
CN              ABOVE.  THUS, COLS. 67-72 ON CARD TYPE 03 SHOULD       -
CN              CONTAIN AT LEAST 5 TO BEGIN APPROXIMATING THE REPEATING-
CN              FUEL MANAGEMENT SCHEME INDICATED ABOVE.  THE REACTOR   -
CN              FOR EACH OF THESE CYCLES WOULD BE AS INDICATED BELOW.  -
CN                                                                     -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CN              BURN             MATERIAL CONTAINED IN                 -
CN              CYCLE     CORE1     CORE2     CORE3     CORE4          -
CN              -----   --------  --------  --------  --------         -
CN                1     FUEL1(0)  FUEL2(0)  FUEL3(0)  FUEL4(0)         -
CN                2     FUEL3(0)  FUEL1(1)  FUEL2(1)  FUEL4(1)         -
CN                3     FUEL4(2)  FUEL3(1)  FUEL1(2)  FUEL2(2)         -
CN                4     FUEL1(0)  FUEL2(0)  FUEL3(2)  FUEL4(0)         -
CN                5     FUEL3(0)  FUEL1(1)  FUEL2(1)  FUEL4(1)         -
CN                6     FUEL4(2)  FUEL3(1)  FUEL1(2)  FUEL2(2)         -
CN                7      ...                                           -
CN                                                                     -
CN              A SECONDARY COMPOSITION MUST BE DEFINED ON DATA SET    -
CN              A.NIP3 TYPE 14 CARDS, AND BE COMPRISED OF MATERIALS    -
CN              DEFINED ON DATA SET A.NIP3 TYPE 13 OR TYPE 14 CARDS. A -
CN              PRIMARY COMPOSITION MUST BE DEFINED ON DATA SET A.NIP3 -
CN              TYPE 14 CARDS IN TERMS OF A SINGLE SECONDARY           -
CN              COMPOSITION, AND BE ASSIGNED TO A REGION VIA DATA SET  -
CN              A.NIP3 TYPE 15 CARDS.                                  -
CN                                                                     -
CN              IN STAGE 1 OF EACH PATH OF AN EQUILIBRIUM PROBLEM, AND -
CN              IN STAGE 1 OF EACH PATH HAVING COLS. 13-18 EQUAL TO 0  -
CN              OF A NON-EQUILIBRIUM PROBLEM, THE SECONDARY COMPOSITION-
CN              TO PRIMARY COMPOSITION/REGION CORRESPONDENCE MUST AGREE-
CN              WITH THAT IMPLIED FROM THE DATA SET A.NIP3 TYPE 14/15  -
CN              CARDS.                                                 -
CN                                                                     -
CN              NOTE THAT FOR AN EQUILIBRIUM PROBLEM, IF A REGION OR   -
CN              COMPOSITION APPEARS IN N STAGES OF A PATH, THEN AT THE -
CN              BOEC, THAT REGION WILL CONTAIN FRESH FUEL, ONCE BURNED -
CN              FUEL, TWICE BURNED FUEL,..., UP TO N-I TH BURNED FUEL  -
CN              IN THE EQUILIBRIUM CONFIGURATION.                      -
CN                                                                     -
CN              IN DEFINING THE MATERIALS USED TO MAKE UP SECONDARY    -
CN              COMPOSITIONS ON TYPE 13 OR TYPE 14 CARDS OF DATA SET   -
CN              A.NIP3, IF CARD TYPE 04 OF DATA SET A.BURN AND THE     -
CN              ASSOCIATED EXTERNAL CYCLE CARDS ARE PRESENT, THE ATOM  -
CN              DENSITY OF ALL POSSIBLE ACTIVE ISOTOPES IN EACH        -
CN              MATERIAL MUST BE SET TO 1.0. THE ATOM DENSITIES OF     -
CN              INACTIVE ISOTOPES ARE THE ACTUAL VALUES (IN UNITS OF   -
CN              ATOMS/CC * 1.0E-24).                                   -
CN                                                                     -
CN              NOTE THAT FOR NON-EQUILIBRIUM PROBLEMS, IF COLS. 67-72 -
CN              ON CARD TYPE 03 IS 0, ONLY STAGE NUMBER 1 ON THE TYPE  -
CN              11 CARDS IS PERTINENT.  OTHER STAGES ON THE TYPE 11    -
CN              CARDS CAN BE REACHED FOR NON-EQUILIBRIUM PROBLEMS ONLY -
CN              IF MORE THAN ONE FUEL MANAGEMENT OPERATION IS CARRIED  -
CN              OUT.                                                   -
C                                                                      -
C-----------------------------------------------------------------------
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
C-----------------------------------------------------------------------
CR          REACTOR CHARGE SPECIFICATIONS (TYPE 12)                    -
C                                                                      -
CL    FORMAT-----(I2,4X,A6,6X,A6,4E12.5)                               -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======    ======================================================-
CD    1-2        12                                                    -
CD                                                                     -
CD    7-12       PATH LABEL (SEE CARD TYPE 11 OR CARD TYPE 35).        -
CD                                                                     -
CD    19-24      FUEL FABRICATION LABEL (SEE CARD TYPE 13).            -
CD                                                                     -
CD    25-36      REFABRICATION TIME (IN DAYS).                         -
CD                                                                     -
CD    37-48      PRELOADING STORAGE TIME (IN DAYS).                    -
CD                                                                     -
CD    49-60      INITIAL ENRICHMENT, E(M)(0) (SEE CARD TYPE 04).       -
CD                                                                     -
CD    61-72      ENRICHMENT MODIFICATION FACTOR, DELTA(M)              -
CD               (SEE CARD TYPE 04). (DEFAULT=1.0).                    -
C                                                                      -
CN               ENRICHMENT IS DEFINED AS THE VOLUME RATIO,            -
CN                                                                     -
CN                     CLASS 1/(CLASS 1 + CLASS 2)                     -
C                                                                      -
C-----------------------------------------------------------------------
```

```
C-----------------------------------------------------------------------
CR          FUEL FABRICATION DATA (TYPE 13)                            -
C                                                                      -
CL    FORMAT-----(I2,4X,A6,6X,3(A6,E12.5))                             -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======    ======================================================-
CD    1-2        13                                                    -
CD                                                                     -
CD    7-12       FUEL FABRICATION LABEL.                               -
CD                                                                     -
CD    19-24      ACTIVE ISOTOPE LABEL.                                 -
CD                                                                     -
CD    25-36      FABRICATION DENSITY OF PURE ISOTOPE                   -
CD               (ATOMS/CC * 1.0E-24).                                 -
CD                                                                     -
CD    37-42      ACTIVE ISOTOPE LABEL.                                 -
CD                                                                     -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CD    43-54     FABRICATION DENSITY OF PURE ISOTOPE                     -
CD              (ATOMS/CC * 1.0E-24).                                   -
CD                                                                      -
CD    55-60     ACTIVE ISOTOPE LABEL.                                   -
CD                                                                      -
CD    61-72     FABRICATION DENSITY OF PURE ISOTOPE                     -
CD              (ATOMS/CC * 1.0E-24).                                   -
C                                                                       -
CN              EACH FUEL FABRICATION LABEL IDENTIFIES A SET OF         -
CN              ISOTOPIC FABRICATION DENSITIES WHICH YIELD THE DESIRED -
CN              DENSITY OF HEAVY METAL (IN GM/CC) IN THE FABRICATED     -
CN              FUEL. THE SPECIFIC VALUE OF THE HEAVY METAL DENSITY     -
CN              WILL DEPEND ON THE PARTICULAR CHEMICAL AND PHYSICAL     -
CN              COMPOSITION OF THE FUEL CHARGES BEING FABRICATED, E.G.,-
CN              OXIDE OR CARBIDE FUEL AT SOME PERCENTAGE OF THEO-       -
CN              RETICAL DENSITY (TD) AND WEIGHT PER CENT HEAVY METAL.   -
CN                                                                      -
CN              FABRICATION DENSITY OF PURE ISOTOPE MEANS THE NUMBER    -
CN              OF ATOMS PER UNIT VOLUME WHICH WOULD BE REQUIRED IN A   -
CN              FABRICATED CHARGE TO GIVE THE DESIRED HEAVY METAL       -
CN              DENSITY ASSUMING ITS COMPOSITION IS 100 PER CENT THIS   -
CN              SINGLE ACTIVE ISOTOPE, I.E., NO ISOTOPIC DISTRIBUTION   -
CN              IN THE ELEMENT.                                         -
CN                                                                      -
CN              AS AN EXAMPLE, SUPPOSE THE FABRICATED FUEL IS TO BE     -
CN              PUO2 AT 95 PER CENT TD. ASSUMING A TD OF 11.4 GM/CC     -
CN              AND 88 WEIGHT PER CENT HEAVY METAL, THIS GIVES A        -
CN              DESIRED HEAVY METAL FABRICATION DENSITY OF 9.5304       -
CN              GM/CC. USING THE VALUE OF 0.6022054E24 FOR AVOGADRO'S   -
CN              NUMBER (SEE CARD TYPE 28) AND THE FOLLOWING ATOMIC      -
CN              WEIGHTS, THE REQUIRED ISOTOPIC FABRICATION DENSITIES    -
CN              ARE,                                                    -
CN                 ISOTOPE      ATOMIC     FABRICATION DENSITY          -
CN                              WEIGHT       OF PURE ISOTOPE            -
CN                  PU238      238.0495         2.40988E-2              -
CN                  PU239      239.0522         2.39977E-2              -
CN                  PU240      240.0540         2.38975E-2              -
CN                  PU241      241.0563         2.37982E-2              -
CN                  PU242      242.0587         2.36996E-2              -
CN                                                                      -
CN              THE CORRESPONDING ATOM DENSITIES OF THE INACTIVE        -
CN              ISOTOPES IN THE FABRICATED FUEL ARE ENTERED DIRECTLY    -
CN              ON THE APPROPRIATE A.NIP3 TYPE 13 OR TYPE 14 CARDS.  IN-
CN              THIS EXAMPLE THE INACTIVE ISOTOPE IS OXYGEN AT AN ATOM -
CN              DENSITY OF 4.89376E-2. ALL ACTIVE ISOTOPE LABELS MUST   -
CN              BE DEFINED ON TYPE 09 CARDS OR VIA THE PRESTORED        -
CN              BURNUP CHAINS.                                          -
C                                                                       -
C-----------------------------------------------------------------------
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
C-----------------------------------------------------------------------
CR           REACTOR DISCHARGE COOLING TIMES (TYPE 14)                 -
C                                                                      -
CL    FORMAT-----(I2,4X,3(A6,E12.5))                                   -
C                                                                      -
CD    COLUMNS             CONTENTS...IMPLICATIONS, IF ANY              -
CD    =======    ==================================================-
CD    1-2        14                                                    -
CD                                                                     -
CD    7-12       REACTOR DISCHARGE LABEL.                              -
CD                                                                     -
CD    13-24      COOLING TIME (IN DAYS).                               -
CD                                                                     -
CD    25-30      REACTOR DISCHARGE LABEL.                              -
CD                                                                     -
CD    31-42      COOLING TIME (IN DAYS).                               -
CD                                                                     -
CD    43-48      REACTOR DISCHARGE LABEL.                              -
CD                                                                     -
CD    49-60      COOLING TIME (IN DAYS).                               -
C                                                                      -
CN               THE TYPE 14 CARDS SHOULD NOT BE SUPPLIED IF THE DATA  -
CN               MANAGEMENT IS SPECIFIED USING THE TYPE 35 CARDS.      -
CN                                                                     -
CN               COOLING TIME MAY INCLUDE THE TIME REQUIRED FOR        -
CN               DELIVERY FROM COOLER TO REPROCESSING PLANT            -
CN               (SEE CARD TYPE 15).                                   -
C                                                                      -
C-----------------------------------------------------------------------
```

```
C-----------------------------------------------------------------------
CR           REACTOR DISCHARGE DESTINATION DATA (TYPE 15)              -
C                                                                      -
CL    FORMAT-----(I2,4X,A6,6X,3(A6,E12.5))                             -
C                                                                      -
CD    COLUMNS             CONTENTS...IMPLICATIONS, IF ANY              -
CD    =======    ==================================================-
CD    1-2        15                                                    -
CD                                                                     -
CD    7-12       REACTOR DISCHARGE LABEL (REPEATED ON ADDITIONAL CARDS, -
CD               IF NECESSARY).                                        -
CD                                                                     -
CD    19-24      REPROCESSING PLANT LABEL.                             -
CD                                                                     -
CD    25-36      FRACTION OF DISCHARGE TO BE DELIVERED TO REPROCESSING -
CD               PLANT.                                                -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CD                                                                     -
CD    37-42     REPROCESSING PLANT LABEL.                              -
CD                                                                     -
CD    43-54     FRACTION OF DISCHARGE TO BE DELIVERED TO REPROCESSING  -
CD              PLANT.                                                 -
CD                                                                     -
CD    55-60     REPROCESSING PLANT LABEL.                              -
CD                                                                     -
CD    61-72     FRACTION OF DISCHARGE TO BE DELIVERED TO REPROCESSING  -
CD              PLANT.                                                 -
C                                                                      -
CN              THE TYPE 15 CARDS SHOULD NOT BE SUPPLIED IF THE DATA   -
CN              MANAGEMENT IS SPECIFIED USING THE TYPE 35 CARDS.       -
CN                                                                     -
CN              ALL REACTOR DISCHARGE NOT DELIVERED TO SOME            -
CN              REPROCESSING PLANT WILL BE CONSIDERED SOLD.            -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          REPROCESSING PLANT SPECIFICATIONS (TYPE 16)                -
C                                                                      -
CL    FORMAT-----(I2,4X,3A6,2E12.5)                                    -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       16                                                     -
CD                                                                     -
CD    7-12      REPROCESSING PLANT LABEL.                              -
CD                                                                     -
CD    13-18     RECOVERY FACTOR SPECIFICATION LABEL.                   -
CD                                                                     -
CD    19-24     CLASS SEPARATION SPECIFICATION LABEL.                  -
CD                                                                     -
CD    25-36     REPROCESSING TIME (IN DAYS).                           -
CD                                                                     -
CD    37-48     VOLUME OF REPROCESSING PLANT INITIAL BATCH             -
CD              OUTPUT (CM**3).                                        -
C                                                                      -
CN              THE TYPE 16 CARDS SHOULD NOT BE SUPPLIED IF THE DATA   -
CN              MANAGEMENT IS SPECIFIED USING THE TYPE 35 CARDS.       -
CN                                                                     -
CN              (COLS. 37-48 ARE PERTINENT ONLY IF CARD TYPE 23 IS     -
CN              PROVIDED.)                                             -
C                                                                      -
C-----------------------------------------------------------------------
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
C-----------------------------------------------------------------------
CR          RECOVERY FACTOR DATA (TYPE 17)                             -
C                                                                      -
CL    FORMAT-----(I2,4X,A6,6X,3(A6,E12.5))                             -
C                                                                      -
CD    COLUMNS            CONTENTS...IMPLICATION, IF ANY                -
CD    =======   ========================================================-
CD    1-2       17                                                     -
CD                                                                     -
CD    7-12      RECOVERY FACTOR SPECIFICATION LABEL (REPEATED ON       -
CD              ADDITIONAL CARDS, IF NECESSARY).                       -
CD                                                                     -
CD    19-24     ACTIVE ISOTOPE LABEL.                                  -
CD                                                                     -
CD    25-36     RECOVERY FRACTION.                                     -
CD                                                                     -
CD    37-42     ACTIVE ISOTOPE LABEL.                                  -
CD                                                                     -
CD    43-54     RECOVERY FRACTION.                                     -
CD                                                                     -
CD    55-60     ACTIVE ISOTOPE LABEL.                                  -
CD                                                                     -
CD    61-72     RECOVERY FRACTION.                                     -
C                                                                      -
CN              THE TYPE 17 CARDS SHOULD NOT BE SUPPLIED IF THE DATA   -
CN              MANAGEMENT IS SPECIFIED USING THE TYPE 35 CARDS.       -
CN                                                                     -
CN              ALL ACTIVE ISOTOPE LABELS MUST BE DEFINED ON TYPE 09   -
CN              CARDS OR VIA THE PRESTORED BURNUP CHAINS.              -
CN                                                                     -
CN              RECOVERY FACTOR APPLIES TO AMOUNTS LEFT AFTER DECAY    -
CN              DURING REPROCESSING TIME.                              -
C                                                                      -
C-----------------------------------------------------------------------
```

```
C-----------------------------------------------------------------------
CR          CLASS SEPARATION DATA (TYPE 18)                            -
C                                                                      -
CL    FORMAT-----(I2,4X,A6,6X,3(A6,E12.5))                             -
C                                                                      -
CD    COLUMNS            CONTENTS...IMPLICATIONS, IF ANY               -
CD    =======   ========================================================-
CD    1-2       18                                                     -
CD                                                                     -
CD    7-12      CLASS SEPARATION SPECIFICATION LABEL (REPEATED ON      -
CD              ADDITIONAL CARDS, IF NECESSARY).                       -
CD                                                                     -
CD    19-24     ACTIVE ISOTOPE LABEL.                                  -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CD                                                                      -
CD      25-36   FRACTION OF ISOTOPE ASSIGNED TO CLASS 1 FUEL.           -
CD                                                                      -
CD      37-42   ACTIVE ISOTOPE LABEL.                                   -
CD                                                                      -
CD      43-54   FRACTION OF ISOTOPE ASSIGNED TO CLASS 1 FUEL.           -
CD                                                                      -
CD      55-60   ACTIVE ISOTOPE LABEL.                                   -
CD                                                                      -
CD      61-72   FRACTION OF ISOTOPE ASSIGNED TO CLASS 1 FUEL.           -
C                                                                       -
CN              ALL ACTIVE ISOTOPE LABELS MUST BE DEFINED ON TYPE 09   -
CN              CARDS.                                                  -
CN                                                                      -
CN              CARD TYPE 18 DEFINES WHICH ISOTOPES ARE TO BE ASSIGNED -
CN              TO CLASS 1 FUEL.                                        -
CN                                                                      -
CN              CLASS 1 FUEL IS NORMALLY CONSIDERED TO BE FUEL THAT    -
CN              ADDS GREATER REACTIVITY TO THE REACTOR THAN DOES CLASS -
CN              2 FUEL. THE COMPLEMENTS OF THE FRACTIONS GIVEN IN COLS.-
CN              25-36, 43-54, AND 61-72 ARE THE FRACTIONS ASSIGNED TO  -
CN              CLASS 2 FUEL.                                           -
CN                                                                      -
CN              ANY ACTIVE ISOTOPE SPECIFIED ON A TYPE 09 CARD OR IN   -
CN              A PRESTORED BURNUP CHAIN THAT IS NOT GIVEN ON CARD     -
CN              TYPE 18 WILL HAVE A FRACTION 0.0 ASSIGNED TO CLASS 1   -
CN              FUEL.                                                   -
C                                                                       -
C------------------------------------------------------------------------
```

```
C------------------------------------------------------------------------
CR          CLASS 1 FABRICATION SPECIFICATIONS (TYPE 19)                -
C                                                                       -
CL      FORMAT-----(I2,4X,A6,6X,2(A6,I6,E12.5))                         -
C                                                                       -
CD      COLUMNS               CONTENTS...IMPLICATIONS, IF ANY           -
CD      =======  =======================================================-
CD      1-2     19                                                      -
CD                                                                      -
CD      7-12    PATH LABEL OF FABRICATION PROCESS OR SALE LABEL         -
CD              (REPEATED ON ADDITIONAL CARDS, IF NECESSARY).           -
CD                                                                      -
CD      19-24   REPROCESSING PLANT LABEL OR EXTERNAL FEED LABEL OF      -
CD              FUEL USED IN FABRICATION.                               -
CD                                                                      -
CD      25-30   PRIORITY LEVEL TO BE ASSIGNED TO ABOVE SOURCE.          -
CD                                                                      -
CD      31-42   DISTRIBUTION FRACTION (DEFAULT=1.0).                    -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CD                                                                     -
CD    43-48     REPROCESSING PLANT LABEL OR EXTERNAL FEED LABEL OF    -
CD              FUEL USED IN FABRICATION.                              -
CD                                                                     -
CD    49-54     PRIORITY LEVEL TO BE ASSIGNED TO ABOVE SOURCE.         -
CD                                                                     -
CD    55-66     DISTRIBUTION FRACTION (DEFAULT=1.0).                   -
C                                                                      -
CN              CARD TYPES 19 AND 20 SPECIFY THE METHOD OF SELECTING   -
CN              FUEL FOR CLASS 1 AND CLASS 2 FABRICATION.              -
CN                                                                     -
CN              THE PRIORITY LEVEL ESTABLISHES THE ORDER OF PREFERENCE -
CN              FOR USE OF REPROCESSING PLANT OUTPUT OR EXTERNAL FEED  -
CN              FUEL IN FABRICATION OF THE VARIOUS BATCHES OF THE      -
CN              REACTOR CHARGE. THE MOST STRAIGHTFORWARD SYSTEM IS ONE -
CN              IN WHICH ONLY ONE BATCH (SPECIFIED BY A PATH OR SALE   -
CN              LABEL) REQUIRES ATOMS FROM A GIVEN PLANT OR EXTERNAL   -
CN              FEED AT EACH PRIORITY LEVEL. IN THIS CASE ALL ATOMS    -
CN              REQUIRED FOR THE BATCH WITH PRIORITY 1 WILL BE TAKEN   -
CN              FIRST, THEN THOSE REQUIRED FOR PRIORITY 2 (IF ANY      -
CN              REMAIN), AND SO ON. PRIORITY LEVELS USED MUST BE       -
CN              CONSECUTIVE STARTING FROM 1 WITH NO OMISSIONS.         -
CN                                                                     -
CN              IF TWO OR MORE PATH OR SALE LABELS SPECIFY THE SAME    -
CN              PLANT OUTPUT OR FEED AT THE SAME PROIRITY LEVEL, THE   -
CN              AVAILABLE ATOMS WILL FIRST BE DISTRIBUTED IN PROPORTION-
CN              TO THE DISTRIBUTION FRACTION OF EACH CHARGE. IF THE    -
CN              REQUIREMENTS OF SOME OF THESE BATCHES ARE SATISFIED    -
CN              WHILE OTHERS ARE NOT, FURTHER PROPORTIONAL             -
CN              DISTRIBUTIONS ARE MADE TO THE REMAINING BATCHES UNTIL  -
CN              EITHER ALL REQUIREMENTS ARE SATISFIED OR ALL AVAILABLE -
CN              ATOMS ARE USED.                                        -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          CLASS 2 FABRICATION SPECIFICATIONS (TYPE 20)               -
C                                                                      -
CL    FORMAT-----(I2,4X,A6,6X,2(A6,I6,E12.5))                          -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   ========================================================-
CD    1-2       20                                                     -
CD                                                                     -
CD    7-12      PATH LABEL OF FABRICATION PROCESS OR SALE LABEL        -
CD              (REPEATED ON ADDITIONAL CARDS, IF NECESSARY).          -
CD                                                                     -
CD    19-24     REPROCESSING PLANT LABEL OR EXTERNAL FEED LABEL OF    -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CD              FUEL USED IN FABRICATION.                              -
CD                                                                     -
CD    25-30     PRIORITY LEVEL TO BE ASSIGNED TO ABOVE SOURCE.         -
CD                                                                     -
CD    31-42     DISTRIBUTION FRACTION (DEFAULT=1.0).                   -
CD                                                                     -
CD    43-48     REPROCESSING PLANT LABEL OR EXTERNAL FEED LABEL OF     -
CD              FUEL USED IN FABRICATION.                              -
CD                                                                     -
CD    49-54     PRIORITY LEVEL TO BE ASSIGNED TO ABOVE SOURCE.         -
CD                                                                     -
CD    55-66     DISTRIBUTION FRACTION (DEFAULT=1.0).                   -
C                                                                      -
CN              THE PRIORITY SYSTEM IS IDENTICAL TO THAT DESCRIBED     -
CN              FOR CLASS 1 MAKEUP ON CARD TYPE 19.                    -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          EXTERNAL FEED SPECIFICATIONS (TYPE 21)                     -
C                                                                      -
CL    FORMAT-----(I2,4X,2A6,E12.5)                                     -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   ========================================================
CD    1-2       21                                                     -
CD                                                                     -
CD    7-12      EXTERNAL FEED LABEL.                                   -
CD                                                                     -
CD    13-18     CLASS SEPARATION SPECIFICATION LABEL.                  -
CD                                                                     -
CD    19-30     VOLUME OF FEED (CM**3). (DEFAULT=1.0E+30).             -
C                                                                      -
CN              THE VOLUME OF ONE OF THE EXTERNAL FEEDS MUST BE LARGE  -
CN              ENOUGH TO ENSURE THAT THERE WILL ALWAYS BE ENOUGH      -
CN              FUEL TO FABRICATE ALL CHARGES. AN INFINITE VOLUME      -
CN              (I.E. 1.0E+30 CM**3) WILL BE ASSIGNED TO THE FEED      -
CN              IF COLS. 19-30 ARE BLANK.                              -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          EXTERNAL FEED COMPOSITION (TYPE 22)                        -
C                                                                      -
CL    FORMAT------(I2,4X,A6,6X,3(A6,E12.5))                            -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CD    =======   ========================================================-
CD    1-2       22                                                      -
CD                                                                      -
CD    7-12      EXTERNAL FEED LABEL (REPEATED ON ADDITIONAL CARD,       -
CD              IF NECESSARY).                                          -
CD                                                                      -
CD    19-24     ACTIVE ISOTOPE LABEL.                                   -
CD                                                                      -
CD    25-36     ATOMIC DENSITY (ATOMS/CC * 1.0E-24).                    -
CD                                                                      -
CD    37-42     ACTIVE ISOTOPE LABEL.                                   -
CD                                                                      -
CD    43-54     ATOMIC DENSITY (ATOMS/CC * 1.0E-24).                    -
CD                                                                      -
CD    55-60     ACTIVE ISOTOPE LABEL.                                   -
CD                                                                      -
CD    61-72     ATOMIC DENSITY (ATOMS/CC * 1.0E-24).                    -
C                                                                       -
CN              ALL ACTIVE ISOTOPE LABELS MUST BE DEFINED VIA THE       -
CN              TYPE 09 CARDS.                                          -
CN                                                                      -
CN                       * * *  OR  * * *                               -
CN                                                                      -
CN              IF THE VOLUME OF THE EXTERNAL FEED (SEE CARD TYPE 21)   -
CN              IS IMMATERIAL TO THE PROBLEM SOLUTION, I.E., NOT A      -
CN              CONSTRAINT, ISOTOPIC SPLITS MAY BE USED IN PLACE OF     -
CN              THE ACTUAL ATOM DENSITIES OF THE FEED.                  -
C                                                                       -
CD    1-2       22                                                      -
CD                                                                      -
CD    7-12      EXTERNAL FEED LABEL (REPEATED ON ADDITIONAL CARD,       -
CD              IF NECESSARY).                                          -
CD                                                                      -
CD    19-24     ACTIVE ISOTOPE LABEL.                                   -
CD                                                                      -
CD    25-36     ISOTOPIC SPLIT.                                         -
CD                                                                      -
CD    37-42     ACTIVE ISOTOPE LABEL.                                   -
CD                                                                      -
CD    43-54     ISOTOPIC SPLIT.                                         -
CD                                                                      -
CD    55-60     ACTIVE ISOTOPE LABEL.                                   -
CD                                                                      -
CD    61-72     ISOTOPIC SPLIT.                                         -
C                                                                       -
CN              ALL ACTIVE ISOTOPE LABELS MUST BE DEFINED ON            -
CN              TYPE 09 CARDS OR VIA A PRESTORED BURNUP CHAIN.          -
CN                                                                      -
CN              THE SUM OF ISOTOPIC SPLITS FOR A GIVEN EXTERNAL FEED    -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CN              LABEL MUST BE 1.0 FOR EACH ELEMENT PRESENT.            -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          REPROCESSING PLANT OUTPUT INITIAL COMPOSITION (TYPE 23)    -
C                                                                      -
CL    FORMAT-----(I2,4X,A6,6X,3(A6,E12.5))                             -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       23                                                     -
CD                                                                     -
CD    7-12      REPROCESSING PLANT LABEL (REPEATED ON ADDITIONAL       -
CD              CARDS, IF NECESSARY).                                  -
CD                                                                     -
CD    19-24     ACTIVE ISOTOPE LABEL.                                  -
CD                                                                     -
CD    25-36     ATOMIC DENSITY (ATOMS/CC * 1.0E-24).                   -
CD                                                                     -
CD    37-42     ACTIVE ISOTOPE LABEL.                                  -
CD                                                                     -
CD    43-54     ATOMIC DENSITY (ATOMS/CC * 1.0E-24).                   -
CD                                                                     -
CD    55-60     ACTIVE ISOTOPE LABEL.                                  -
CD                                                                     -
CD    61-72     ATOMIC DENSITY (ATOMS/CC * 1.0E-24).                   -
C                                                                      -
CN              THE TYPE 23 CARDS SHOULD NOT BE SUPPLIED IF THE DATA   -
CN              MANAGEMENT IS SPECIFIED USING THE TYPE 35 CARDS.       -
CN                                                                     -
CN              ALL ACTIVE ISOTOPE LABELS MUST BE DEFINED ON           -
CN              TYPE 09 CARDS OR VIA A PRESTORED BURNUP CHAIN.         -
CN                                                                     -
CN              CARD TYPE 23 IS PROVIDED ONLY IF IT IS DESIRED TO      -
CN              SPECIFY THE COMPOSITION OF THE REPROCESSING PLANT      -
CN              OUTPUT STORAGE AT THE START OF THE PROBLEM. IF CARD    -
CN              TYPE 23 IS GIVEN, COLS. 37-48 ON CARD TYPE 16 MUST     -
CN              SPECIFY THE VOLUME OF THE REPROCESSING PLANT OUTPUT.   -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          ACTIVE ISOTOPE DESCRIPTIONS (TYPE 24)                      -
C                                                                      -
CL    FORMAT-----(I2,4X,2(A6,I6,6X,E12.5))                             -
C                                                                      -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CD    COLUMNS            CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======    ===================================================-
CD    1-2        24                                                     -
CD                                                                      -
CD    7-12       ACTIVE ISOTOPE LABEL.                                  -
CD                                                                      -
CD    13-18      FISSILE BREEDING RATIO FLAG                            -
CD                                                                      -
CD    25-36      ATOMIC MASS (DEFAULT OBTAINED FROM DATA SET ISOTXS).   -
CD                                                                      -
CD    37-42      ACTIVE ISOTOPE LABEL.                                  -
CD                                                                      -
CD    43-48      FISSILE BREEDING RATIO FLAG                            -
CD                                                                      -
CD    55-66      ATOMIC MASS (DEFAULT OBTAINED FROM DATA SET ISOTXS).   -
C                                                                       -
CN               ACTIVE ISOTOPE LABELS MUST BE DEFINED ON TYPE 09       -
CN               CARDS OR VIA A PRESTORED BURNUP CHAIN AND AT LEAST     -
CN               ONE OF THESE MUST ALSO APPEAR ON A TYPE 24 CARD ON     -
CN               WHICH A 1 APPEARS IN COLS. 13-18 OR 43-48.             -
CN               THE FISSILE BREEDING RATIO FLAG MUST BE EQUAL TO "1"   -
CN               FOR FISSILE ISOTOPES INCLUDED IN THE CALCULATION OF    -
CN               CONVERSION AND BREEDING RATIOS, AND "0" OTHERWISE.     -
CN                                                                      -
CN                                 PRODUCTION OF FISSILE ATOMS          -
CN                    BREEDING RATIO = ---------------------------      -
CN                                 DESTRUCTION OF FISSILE ATOMS         -
CN                                                                      -
CN               IN REBUS-3, AVOGADRO'S NUMBER = 0.6022054E24 UNLESS    -
CN               OVERRIDDEN VIA THE DATA SET A.BURN TYPE 28 CARD DATA.  -
CN               ATOMIC MASSES SHOULD BE CONSISTENT WITH THE VALUE OF   -
CN               AVOGADRO'S NUMBER.                                     -
CN                                                                      -
CN               IF THE ATOMIC MASS AS OBTAINED FROM DATA SET ISOTXS    -
CN               HAS THE VALUE 0.0, THE MASS IS CHANGED TO 1.0.         -
CN               USERS SHOULD BE AWARE THAT ARTIFICIAL ISOTOPES SUCH AS -
CN               LUMPED FISSION PRODUCTS OR DUMMY ISOTOPES MAY HAVE     -
CN               UNREALISTIC MASSES IN DATA SET ISOTXS.  THE TYPE 24    -
CN               CARDS MAY BE USED TO PROVIDE MORE REALISTIC VALUES FOR -
CN               THE MASSES OF SUCH ISOTOPES.                           -
C                                                                       -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          ACTIVE ISOTOPE DECAY CONSTANTS (TYPE 25)                    -
C                                                                       -
CL    FORMAT-----(I2,4X,A6,I6,3(A6,E12.5))                              -
C                                                                       -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CD    COLUMNS          CONTENTS...IMPLICATIONS, IF ANY                 -
CD    =======    ==================================================-
CD    1-2        25                                                    -
CD                                                                     -
CD    7-12       LABEL OF ACTIVE ISOTOPE UNDERGOING REACTION (REPEATED -
CD               ON ALL CARDS THAT SPECIFY OTHER REACTIONS FOR         -
CD               THIS ISOTOPE).                                        -
CD                                                                     -
CD    13-18      REACTION TYPE (REPEATED ON ADDITIONAL CARDS, IF       -
CD               NECESSARY; THE SAME AS ON CARD TYPE 09).              -
CD               6...BETA-MINUS DECAY.                                 -
CD               7...BETA-PLUS DECAY.                                  -
CD               8...ALPHA DECAY.                                      -
CD                                                                     -
CD    19-24      LABEL OF PRODUCT ISOTOPE FROM THE REACTION SPECIFIED  -
CD               IN COLS. 13-18 OR THE PRIVILEGED LABEL DELETE.        -
CD                                                                     -
CD    25-36      DECAY CONSTANT (1/SEC) FOR THE ISOTOPE SPECIFIED IN   -
CD               COLS. 19-24.                                          -
CD                                                                     -
CD    37-42      LABEL OF PRODUCT ISOTOPE FROM THE REACTION SPECIFIED  -
CD               IN COLS. 13-18.                                       -
CD                                                                     -
CD    43-54      DECAY CONSTANT (1/SEC) FOR THE ISOTOPE SPECIFIED IN   -
CD               COLS. 37-42.                                          -
CD                                                                     -
CD    55-60      LABEL OF PRODUCT ISOTOPE FROM THE REACTION SPECIFIED  -
CD               IN COLS. 13-18.                                       -
CD                                                                     -
CD    61-72      DECAY CONSTANT (1/SEC) FOR THE ISOTOPE SPECIFIED IN   -
CD               COLS. 55-60.                                          -
C                                                                      -
CN               A TYPE 25 CARD IS REQUIRED FOR EACH ISOTOPE WHICH HAS -
CN               A REACTION TYPE 6-8 SPECIFIED IN COLS. 13-18 ON A TYPE -
CN               09 CARD.  TYPE 25 CARDS NEED NOT BE SUPPLIED FOR      -
CN               ISOTOPES IN PRESTORED BURNUP CHAINS (SEE CARD TYPE 09) -
CN               UNLESS IT IS DESIRED TO OVERRIDE THE DEFAULT          -
CN               DECAY CONSTANTS FOR ANY OF THE ISOTOPES IN THE        -
CN               PRESTORED CHAINS.  IF A TYPE 09 CARD WAS SUPPLIED WITH -
CN               THE PRIVILEGED LABEL DELETE IN COLS. 19-24 FOR AN     -
CN               ACTIVE ISOTOPE HAVING A REACTION TYPE 6, 7, OR 8, A   -
CN               CORRESPONDING TYPE 25 CARD MUST BE SUPPLIED           -
CN               WHICH SIMILARLY HAS DELETE IN COLS. 19-24 FOR THE     -
CN               SAME ACTIVE ISOTOPE AND REACTION TYPE IN COLS. 7-12   -
CN               AND 13-18 RESPECTIVELY.  IF A TYPE 25 CARD HAS THE    -
CN               PRIVILEGED LABEL DELETE IN COLS 19-24, THE REST OF THE -
CN               DATA ON THAT TYPE 25 CARD WILL BE IGNORED.            -
C                                                                      -
C-----------------------------------------------------------------------
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
C-----------------------------------------------------------------------
CR          ISOTOPES HAVING BURNUP DEPENDENT CROSS SECTIONS (TYPE 26)  -
CN          ******** NOT CURRENTLY IMPLEMENTED ********                -
C                                                                      -
CL    FORMAT-----(I2,4X,11A6)                                          -
C                                                                      -
CD    COLUMNS             CONTENTS...IMPLICATIONS, IF ANY              -
CD    =======    ==========================================================-
CD    1-2        26                                                    -
CD                                                                     -
CD    7-12       LIBRARY ISOTOPE LABEL.                                -
CD                                                                     -
CD    13-18      LIBRARY ISOTOPE LABEL.                                -
CD                                                                     -
CD    19-24      LIBRARY ISOTOPE LABEL.                                -
CD                                                                     -
CD    25-30      LIBRARY ISOTOPE LABEL.                                -
CD                                                                     -
CD    31-36      LIBRARY ISOTOPE LABEL.                                -
CD                                                                     -
CD    37-42      LIBRARY ISOTOPE LABEL.                                -
CD                                                                     -
CD    43-48      LIBRARY ISOTOPE LABEL.                                -
CD                                                                     -
CD    49-54      LIBRARY ISOTOPE LABEL.                                -
CD                                                                     -
CD    55-60      LIBRARY ISOTOPE LABEL.                                -
CD                                                                     -
CD    61-66      LIBRARY ISOTOPE LABEL.                                -
CD                                                                     -
CD    67-72      LIBRARY ISOTOPE LABEL.                                -
C                                                                      -
CN               TYPE 26 CARDS ARE TO BE PROVIDED ONLY IF IT IS DESIRED -
CN               TO USE BURNUP-DEPENDENT CROSS SECTIONS IN A PROBLEM.  -
CN               BURNUP-DEPENDENT MICROSCOPIC CAPTURE AND FISSION CROSS -
CN               SECTIONS WILL BE USED FOR EACH ISOTOPE APPEARING ON A -
CN               TYPE 26 CARD. EACH LIBRARY ISOTOPE LABEL ON A TYPE 26 -
CN               CARD MUST ALSO APPEAR ON A TYPE 10 CARD OR, IN THE    -
CN               ABSENCE OF TYPE 10 CARDS, BE DEFINED BY MEANS OF A TYPE-
CN               09 CARD.                                              -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          END-OF-CYCLE KEFF SEARCH DATA (TYPE 27)                    -
C                                                                      -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CL    FORMAT-----(I2,10X,3E12.5)                                       -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       27                                                     -
CD                                                                     -
CD    13-24     DESIRED END-OF-CYCLE KEFF, KEFF(EOC). (DEFAULT=1.0)    -
CD                                                                     -
CD    25-36     CONVERGENCE CRITERION, EPSD: RELATIVE ERROR ALLOWABLE  -
CD              IN KEFF(EOC).  FOR CONVERGENCE OF END-OF-CYCLE         -
CD              KEFF SEARCH.  (DEFAULT=0.001)                          -
CD                                                                     -
CD    37-48     SECOND BURN CYCLE TIME GUESS FOR END-OF-CYCLE KEFF     -
CD              SEARCH.  (DEFAULT=INITIAL BURN CYCLE TIME GUESS FROM   -
CD              COLS. 37-48 OF CARD TYPE 03 PLUS 10 PER CENT)          -
C                                                                      -
CN              IF A TYPE 27 CARD IS INCLUDED IN THE INPUT DATA, THE   -
CN              REACTOR BURN CYCLE TIME WILL BE ADJUSTED TO ACHIEVE    -
CN              THE SPECIFIED END-OF-CYCLE KEFF.  CARD TYPE 04 (AND    -
CN              ASSOCIATED EXTERNAL CYCLE CARDS) MUST BE PRESENT IN    -
CN              THE INPUT DATA IF AN END-OF-CYCLE KEFF SEARCH IS TO    -
CN              BE DONE.  HOWEVER, AN ENRICHMENT SEARCH AND/OR A       -
CN              BURNUP SEARCH CANNOT BE PERFORMED SIMULTANEOUSLY WITH  -
CN              AN KEFF(EOC) SEARCH.  THEREFORE, IF A TYPE 27 CARD IS  -
CN              PRESENT IN THE INPUT DATA, THE ENRICHMENT AND BURNUP   -
CN              CONVERGENCE CRITERIA (EPSF AND EPSG FROM CARD TYPES 04 -
CN              AND 03 RESPECTIVELY) MUST BE SPECIFIED AS 1.0 OR       -
CN              LARGER.                                                -
CN                                                                     -
CN              USERS SHOULD BE CAREFUL TO SPECIFY THE DESIRED CHARGE  -
CN              SEARCH PARAMETER ON THE TYPE 04 CARD IN COLS. 49-60.   -
CN                                                                     -
CN              NOTE THAT PROBLEMS INVOLVING MEDIUM-TO-HIGH DISCHARGE  -
CN              BURNUP (GREATER THAN ABOUT 20 ATOM PER CENT) WILL      -
CN              REQUIRE AT LEAST 2 CYCLIC MODE ITERATIONS IN ORDER TO  -
CN              INSURE CONVERGED EOC EIGENVALUES. (SEE CARD TYPE 02).  -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          AVOGADRO'S NUMBER (TYPE 28)                                -
C                                                                      -
CL    FORMAT-----(I2,10X,E12.5)                                        -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       28                                                     -
CD                                                                     -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CD    13-24     AVAGADRO'S NUMBER (DEFAULT=0.6022054 E+24)               -
C                                                                        -
C-------------------------------------------------------------------------


C-------------------------------------------------------------------------
CR           SUMMARY EDITS AREA SPECIFICATIONS (TYPE 29)                 -
C                                                                        -
CL    FORMAT-----(I2,4X,9A6)                                             -
C                                                                        -
CD    COLUMNS            CONTENTS...IMPLICATIONS, IF ANY                 -
CD    =======   ==================================================-
CD    1-2       29                                                       -
CD                                                                       -
CD    7-12      AREA LABEL CORRESPONDING TO THE INNER CORE.              -
CD              (DEFAULT=ICORE)                                          -
CD                                                                       -
CD    13-18     AREA LABEL CORRESPONDING TO THE MIDDLE CORE.             -
CD              (DEFAULT=MCORE)                                          -
CD                                                                       -
CD    19-24     AREA LABEL CORRESPONDING TO THE OUTER CORE.              -
CD              (DEFAULT=OCORE)                                          -
CD                                                                       -
CD    25-30     AREA LABEL CORRESPONDING TO THE INNER BLANKET.           -
CD              (DEFAULT=IBLKT)                                          -
CD                                                                       -
CD    31-36     AREA LABEL CORRESPONDING TO THE MIDDLE BLANKET.          -
CD              (DEFAULT=MBLKT)                                          -
CD                                                                       -
CD    37-42     AREA LABEL CORRESPONDING TO THE OUTER BLANKET.           -
CD              (DEFAULT=OBLKT)                                          -
CD                                                                       -
CD    43-48     AREA LABEL CORRESPONDING TO THE RADIAL BLANKET.          -
CD              (DEFAULT=RBLKT)                                          -
CD                                                                       -
CD    49-54     AREA LABEL CORRESPONDING TO THE AXIAL BLANKET.           -
CD              (DEFAULT=ABLKT)                                          -
CD                                                                       -
CD    55-60     AREA LABEL CORRESPONDING TO THE CONTROL RODS.            -
CD              (DEFAULT=CONTRL)                                         -
C                                                                        -
CN              TYPE 29 CARD DATA INDICATE THE CORRESPONDENCE BETWEEN    -
CN              THE AREA LABELS ON THE DATA SET A.NIP3 TYPE 07 CARDS     -
CN              AND THE VARIOUS PORTIONS OF THE REACTOR.  MASS BALANCE   -
CN              WILL BE PROVIDED FOR THE INNER CORE+MIDDLE CORE+OUTER    -
CN              CORE, INNER BLANKET+MIDDLE BLANKET+OUTER BLANKET,        -
CN              RADIAL BLANKET, AND AXIAL BLANKET.                       -
C                                                                        -
C-------------------------------------------------------------------------
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
C----------------------------------------------------------------------
CR          SUMMARY MASS BALANCE ISOTOPE SPECIFICATIONS (TYPE 30)     -
C                                                                     -
CL    FORMAT-----(I2,4X,5(I6,A6))                                     -
C                                                                     -
CD    COLUMNS          CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   ======================================================-
CD    1-2       30                                                    -
CD                                                                    -
CD    7-12      ACTIVE ISOTOPE NUMBER.                                -
CD                                                                    -
CD    13-18     ACTIVE ISOTOPE ABSOLUTE LABEL.                        -
CD                                                                    -
CD    19-24     ACTIVE ISOTOPE NUMBER.                                -
CD                                                                    -
CD    25-30     ACTIVE ISOTOPE ABSOLUTE LABEL.                        -
CD                                                                    -
CD    31-36     ACTIVE ISOTOPE NUMBER.                                -
CD                                                                    -
CD    37-42     ACTIVE ISOTOPE ABSOLUTE LABEL.                        -
CD                                                                    -
CD    43-48     ACTIVE ISOTOPE NUMBER.                                -
CD                                                                    -
CD    49-54     ACTIVE ISOTOPE ABSOLUTE LABEL.                        -
CD                                                                    -
CD    55-60     ACTIVE ISOTOPE NUMBER.                                -
CD                                                                    -
CD    60-66     ACTIVE ISOTOPE ABSOLUTE LABEL.                        -
C                                                                     -
CN              NOTE THAT THE ISOTOPE ABSOLUTE LABELS CORRESPOND TO   -
CN              THE FIVE LEFTMOST CHARACTERS OF THE ENDF/B ABSOLUTE   -
CN              ISOTOPE LABEL.                                        -
CN                                                                    -
CN              TYPE 30 CARD DATA INDICATE THE ABSOLUTE LABELS FOR THE -
CN              22 ACTIVE ISOTOPES WHICH ARE INCLUDED IN THE SUMMARY  -
CN              MASS BALANCE EDITS.  THE DEFAULT LABELS CORRESPONDING -
CN              TO THE 22 ISOTOPES ARE AS LISTED BELOW.               -
CN                      1...TH232                                     -
CN                      2...PA233                                     -
CN                      3...U-233                                     -
CN                      4...U-234                                     -
CN                      5...U-235                                     -
CN                      6...U-236                                     -
CN                      7...U-238                                     -
CN                      8...NP237                                     -
CN                      9...PU236                                     -
CN                     10...PU238                                     -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CN                    11...PU239                                       -
CN                    12...PU240                                       -
CN                    13...PU241                                       -
CN                    14...PU242                                       -
CN                    15...AM241                                       -
CN                    16...AM242                                       -
CN                    17...AM243                                       -
CN                    18...CM242                                       -
CN                    19...CM243                                       -
CN                    20...CM244                                       -
CN                    21...CM245                                       -
CN                    22...CM246                                       -
CN                                                                     -
CN               IF THE ISOTXS DATA SET BEING USED HAD U235 AS THE     -
CN               ABSOLUTE ISOTOPE LABEL FOR URANIUM 235 ISOTOPES IN THE -
CN               SET, THE USER WOULD HAVE TO SUPPLY A TYPE 30 CARD WITH -
CN                    30  5  U235                                      -
CN               (IN FREE FORMAT INPUT) TO ASSURE THAT THE URANIUM 235  -
CN               MASSES WERE INCLUDED IN THE SUMMARY EDITS.            -
CN                                                                     -
CN               NOTE THAT IF SPECIAL ISOTOPES ARE TREATED AS ACTIVE   -
CN               ISOTOPES, THEY CAN BE INCLUDED IN PLACE OF ONE OF THE  -
CN               ABOVE 22 STANDARD ISOTOPES.  FOR EXAMPLE, IF BORON 10  -
CN               WERE AN ACTIVE ISOTOPE AND THE PROBLEM CONTAINED NO   -
CN               THORIUM, ONE MIGHT INPUT A TYPE 30 CARD AS            -
CN                    30  1  B-10                                      -
CN               IN WHICH CASE THE MASS EDIT FOR BORON 10 WILL APPEAR  -
CN               IN THE POSITION WHERE THORIUM NORMALLY APPEARS.       -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          SUMMARY NEUTRON BALANCE ISOTOPE SPECIFICATIONS (TYPE 31)   -
C                                                                      -
CL    FORMAT-----(I2,4X,I6,10A6)                                       -
C                                                                      -
CD    COLUMNS         CONTENTS...IMPLICATIONS, IF ANY                  -
CD    =======    ==================================================-
CD    1-2        31                                                    -
CD                                                                     -
CD    7-12       ISOTOPE CLASSIFICATION.                               -
CD                                                                     -
CD    13-18      ISOTOPE ABSOLUTE OR UNIQUE LABEL                      -
CD                                                                     -
CD    19-24      ISOTOPE ABSOLUTE OR UNIQUE LABEL                      -
CD                                                                     -
CD    25-30      ISOTOPE ABSOLUTE OR UNIQUE LABEL                      -
CD                                                                     -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CD    31-36     ISOTOPE ABSOLUTE OR UNIQUE LABEL.                 -
CD                                                                -
CD    37-42     ISOTOPE ABSOLUTE OR UNIQUE LABEL                  -
CD                                                                -
CD    43-48     ISOTOPE ABSOLUTE OR UNIQUE LABEL.                 -
CD                                                                -
CD    49-54     ISOTOPE ABSOLUTE OR UNIQUE LABEL                  -
CD                                                                -
CD    55-60     ISOTOPE ABSOLUTE OR UNIQUE LABEL.                 -
CD                                                                -
CD    61-66     ISOTOPE ABSOLUTE OR UNIQUE LABEL                  -
CD                                                                -
CD    67-72     ISOTOPE ABSOLUTE OR UNIQUE LABEL                  -
C                                                                 -
CN              IF NO TYPE 31 CARDS ARE SUPPLIED, THE DATA SUPPLIED  -
CN              ON THE TYPE 04 CARDS OF DATA SET A.SUMMAR WILL BE USED -
CN              IF PROVIDED.                                      -
CN                                                                -
CN              THE TYPE 31 CARDS INDICATE THE CLASSIFICATION OF THE  -
CN              ISOTOPES IN THE PROBLEM.  COLS. 7-12 CORRESPOND TO    -
CN              THE FOLLOWING TABLE.                              -
CN                                                                -
CN                     ISOTOPE CLASSIFICATION                     -
CN                          1...FISSILE                           -
CN                          2...FERTILE                           -
CN                          3...OTHER ACTINIDE                    -
CN                          4...FISSION PRODUCT                   -
CN                          5...STRUCTURE                         -
CN                          6...COOLANT                           -
CN                          7...CONTROL                           -
CN                          8...UNDEFINED                         -
CN                          9...SPECIAL                           -
CN                                                                -
CN              NOTE THAT THE ISOTOPE ABSOLUTE LABELS CORRESPOND TO   -
CN              THE FIVE LEFTMOST CHARACTERS OF THE ENDF/B ABSOLUTE   -
CN              ISOTOPE LABEL.                                    -
CN                                                                -
CN              IF AN ISOTOPE LABEL IN COLS. 13-72 CORRESPONDS TO AN  -
CN              ENDF/B ABSOLUTE ISOTOPE LABEL, THEN ALL ISOTOPES IN   -
CN              THE PROBLEM HAVING THAT ABSOLUTE LABEL WILL BE GIVEN  -
CN              THE CLASSIFICATION SPECIFIED IN COLS. 7-12.  IF AN    -
CN              ISOTOPE LABEL CORRESPONDS TO A UNIQUE ISOTOPE LABEL,  -
CN              THEN ONLY THAT UNIQUE ISOTOPE IN THE PROBLEM WILL     -
CN              BE GIVEN THE SPECIFIED CLASSIFICATION AND ALL OTHER   -
CN              ISOTOPES HAVING THE SAME ABSOLUTE LABEL AS THAT OF THE -
CN              SPECIFIED UNIQUE ISOTOPE LABEL WILL BE GIVEN DEFAULT  -
CN              CLASSIFICATIONS.  ISOTOPES WHICH ARE NOT SPECIFIED    -
CN              ON THE TYPE 31 CARDS WILL BE GIVEN DEFAULT            -
CN              CLASSIFICATIONS ACCORDING TO THEIR ABSOLUTE LABELS.   -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          SUMMARY MASS FLOW SPECIFICATIONS 1 (TYPE 32)               -
C                                                                      -
CL    FORMAT-----(I2,4X,4E12.6,2I6)                                    -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       32                                                     -
CD                                                                     -
CD    7-18      EMW, MEGAWATTS ELECTRIC. (DEFAULT=1000.0)              -
CD                                                                     -
CD    19-30     THMW, MEGAWATTS THERMAL. (DEFAULT=2740.0)              -
CD                                                                     -
CD    31-42     CF, CAPACITY FACTOR IN PER CENT. (DEFAULT=0.75)        -
CD                                                                     -
CD    43-54     FPD, CYCLE LENGTH IN FULL POWER DAYS. (DEFAULT=273.75) -
CD                                                                     -
CD    55-60     NPOW, RATIO OF ACTUAL POWER TO POWER USED FOR MASS     -
CD              FLOW CALCULATION. (DEFAULT=2)                          -
CD                                                                     -
CD    61-66     NZONE, NUMBER OF REACTOR ZONES.  NZONE=3 IF THERE ARE  -
CD              NO INTERNAL BLANKETS, OR 4 IF THERE ARE INTERNAL       -
CD              BLANKETS. (DEFAULT=3)                                  -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          SUMMARY MASS FLOW SPECIFICATIONS 2 (TYPE 33)               -
C                                                                      -
CL    FORMAT-----(I2,4X,3E12.6,I6,A6)                                  -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       33                                                     -
CD                                                                     -
CD    7-18      EXT, EXTERNAL CYCLE TIME IN CALENDAR YEARS.            -
CD              (DEFAULT=1.0)                                          -
CD                                                                     -
CD    19-30     FLOSS, FRACTIONAL LOSS IN REPROCESSING. (DEFAULT=0.02) -
CD                                                                     -
CD    31-42     EU235, U-235 FRACTION IN FERTILE URANIUM.              -
CD              (DEFAULT=0.002)                                        -
CD                                                                     -
CD    43-48     NFIS, FISSILE DEFINITION FLAG.  0...U-235 NOT          -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CD               INCLUDED IN FISSILE DEFINITION, 1...U-235 INCLUDED     -
CD               IN FISSILE DEFINITION.  (DEFAULT=1)                    -
CD                                                                      -
CD    49-54      CFEED, LABEL OF EXTERNAL FEED SOURCE FOR THE CORE      -
C                                                                       -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR           SUMMARY MASS FLOW SPECIFICATIONS 3 (TYPE 34)               -
C                                                                       -
CL    FORMAT-----(I2,4X,6I6)                                            -
C                                                                       -
CD    COLUMNS            CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======    ========================================================-
CD    1-2        34                                                     -
CD                                                                      -
CD    7-12       NC, CORE RESIDENCE IN NUMBER OF CYCLES. (DEFAULT=1)    -
CD                                                                      -
CD    13-18      NRB, RADIAL BLANKET RESIDENCE IN NUMBER OF CYCLES.     -
CD                    (DEFAULT=5)                                       -
CD                                                                      -
CD    19-24      NIB, INNER BLANKET RESIDENCE IN NUMBER OF CYCLES.      -
CD                    (DEFAULT=0)                                       -
CD                                                                      -
CD    25-30      NFERAB, FERTILE MATERIAL TYPE IN THE AXIAL BLANKET.    -
CD                      0...URANIUM, 1...THORIUM. (DEFAULT=0)           -
CD                                                                      -
CD    31-36      NFERRB, FERTILE MATERIAL TYPE IN THE RADIAL BLANKET.   -
CD                      0...URANIUM, 1...THORIUM. (DEFAULT=0)           -
CD                                                                      -
CD    37-42      NFERIB, FERTILE MATERIAL TYPE IN THE INNER BLANKET.    -
CD                      0...URANIUM, 1...THORIUM. (DEFAULT=0)           -
C                                                                       -
C-----------------------------------------------------------------------

C-----------------------------------------------------------------------
CR           GENERAL FUEL MANAGEMENT SPECIFICATIONS (TYPE 35)           -
C                                                                       -
CL    FORMAT-----(I2,4X,A6,A6,3(A6,2I6))                                -
C                                                                       -
CD    COLUMNS            CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======    ========================================================-
CD    1-2        35                                                     -
CD                                                                      -
CD    7-12       PATH LABEL (REPEATED ON ADDITIONAL CARDS, IF           -
CD               NECESSARY).                                            -
CD                                                                      -
CD    13-18      PRIMARY COMPOSITION (ZONE) OR SECONDARY COMPOSITION    -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CD              (SUB-ZONE) LABEL                                        -
CD                                                                      -
CD    19-24     REGION OR PRIMARY COMPOSITION (ZONE) LABEL.             -
CD                                                                      -
CD    25-30     BEGINNING STAGE NUMBER FOR WHICH THE COMPOSITION        -
CD              SPECIFIED IN COLS. 13-18 RESIDES IN THE REGION OR ZONE -
CD              SPECIFIED IN COLS. 19-24.                               -
CD                                                                      -
CD    31-36     ENDING STAGE NUMBER FOR WHICH THE COMPOSITION           -
CD              SPECIFIED IN COLS. 13-18 RESIDES IN THE REGION OR ZONE -
CD              SPECIFIED IN COLS. 19-24.                               -
CD                                                                      -
CD    37-42     REGION OR PRIMARY COMPOSITION (ZONE) LABEL.             -
CD                                                                      -
CD    43-48     BEGINNING STAGE NUMBER FOR WHICH THE COMPOSITION        -
CD              SPECIFIED IN COLS. 13-18 RESIDES IN THE REGION OR ZONE -
CD              SPECIFIED IN COLS. 37-42.                               -
CD                                                                      -
CD    49-54     ENDING STAGE NUMBER FOR WHICH THE COMPOSITION           -
CD              SPECIFIED IN COLS. 13-18 RESIDES IN THE REGION OR ZONE -
CD              SPECIFIED IN COLS. 37-42.                               -
CD                                                                      -
CD    55-60     REGION OR PRIMARY COMPOSITION (ZONE) LABEL.             -
CD                                                                      -
CD    61-66     BEGINNING STAGE NUMBER FOR WHICH THE COMPOSITION        -
CD              SPECIFIED IN COLS. 13-18 RESIDES IN THE REGION OR ZONE -
CD              SPECIFIED IN COLS. 55-60.                               -
CD                                                                      -
CD    67-72     ENDING STAGE NUMBER FOR WHICH THE COMPOSITION           -
CD              SPECIFIED IN COLS. 13-18 RESIDES IN THE REGION OR ZONE -
CD              SPECIFIED IN COLS. 55-60.                               -
C                                                                       -
CN              CARD TYPES 35, 36, AND 37 ARE PERTINENT ONLY TO         -
CN              NON-EQUILIBRIUM PROBLEMS.                               -
CN                                                                      -
CN              IF BOTH TYPE 11 AND 35 CARDS ARE PRESENT, THE TYPE 11   -
CN              CARDS WILL BE IGNORED.                                  -
CN                                                                      -
CN              IF COLS. 31-36 AND/OR 49-54 AND/OR 67-72 ARE BLANK OR 0-
CN              THE ENDING STAGE NUMBER WILL BE SET EQUAL TO THE        -
CN              BEGINNING STAGE NUMBER SPECIFIED IN COLS. 25-30 AND/OR -
CN              43-48 AND/OR 61-66.                                     -
CN                                                                      -
CN              FOR A GIVEN PATH, COLS. 19-24, 37-42, AND 55-60 MUST    -
CN              EITHER BE ALL REGION LABELS OR ALL PRIMARY COMPOSITION -
CN              (ZONE) LABELS.  IF ZONE LABELS ARE BEING USED, COLS.    -
CN              13-18 MUST CONTAIN A SUB-ZONE LABEL.                    -
CN                                                                      -
CN              IF ZONE LABELS ARE BEING USED TO DEFINE A PATH, COLS.   -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CN              19-24, 37-42, AND 55-60 MUST ALL CONTAIN THE SAME LABEL-
CN              OR BE BLANK.                                           -
CN                                                                     -
CN              IN STAGE 1 OF EACH PATH, THE ZONE/REGION OR            -
CN              SUB-ZONE/ZONE CORRESPONDENCES MUST AGREE WITH THAT     -
CN              IMPLIED FROM THE DATA SET A.NIP3 TYPE 14/15 CARDS.     -
CN                                                                     -
CN              IF A NON-BLANK LABEL IS SPECIFIED IN COLS. 19-24,      -
CN              37-42, AND.OR 55-60, AND THE CORRESPONDING BEGINNING   -
CN              AND ENDING STAGE NUMBERS ARE BOTH 0, BOTH STAGE        -
CN              NUMBERS WILL BE SET EQUAL TO 1.                        -
CN                                                                     -
CN              STAGE NUMBERS MAY NOT OVERLAP IN A PARTICULAR PATH.    -
CN              THUS THE FOLLOWING DATA (IN FREE FIELD FORMAT) WOULD   -
CN              RESULT IN A FATAL INPUT ERROR...                       -
CN              35 C1 R1 1 4 R2 5 8 R3 3 3                             -
CN                                                                     -
CN              THE MATERIAL IDENTIFIED BY THE ZONE OR SUB-ZONE        -
CN              LABEL IN COLS. 13-18 CAN BE SENT TO TEMPORARY STORAGE  -
CN              BY LEAVING ITS DESTINATION (COLS. 19-24 AND/OR 37-42   -
CN              AND/OR 55-60) BLANK. THUS, IF COLS. 19-24 AND/OR 37-42 -
CN              AND/OR 55-60 ARE BLANK, THE ZONE OR SUB-ZONE           -
CN              SPECIFIED IN COLS. 13-18 WILL BE ASSUMED TO BE         -
CN              TEMPORARILY DISCHARGED FOR THE STAGES SPECIFIED IN     -
CN              COLS. 25-36 AND/OR 43-54 AND/OR 61-72.                 -
CN                                                                     -
CN              THE PATH SPECIFIED IS NON-REPETITIVE SO THAT THE       -
CN              MATERIAL IDENTIFIED BY THE ZONE OR SUB-ZONE LABEL      -
CN              IN COLS. 13-18 WILL BE PERMANENTLY DISCHARGED AFTER    -
CN              THE LAST SPECIFIED STAGE.  HOWEVER, A PATH MAY BE      -
CN              REPEATED BY MEANS OF THE TYPE 37 CARDS.                -
CN                                                                     -
CN              IF THE SMALLEST BEGINNING STAGE NUMBER FOR A PARTICULAR-
CN              PATH IS GREATER THAN 1, COLS. 13-18 MUST CONTAIN A     -
CN              PRIMARY COMPOSITION (ZONE) LABEL, AND COLS. 19-24,     -
CN              37-42, AND 55-60 MUST CONTAIN REGION LABELS.  IN THIS  -
CN              CASE, IT WILL BE ASSUMED THAT THE MATERIAL IDENTIFIED  -
CN              BY THE ZONE LABEL IN COLS. 13-28 IS INTRODUCED AS      -
CN              FRESH FUEL AT THAT STAGE IN THE PATH.                  -
C                                                                      -
C-----------------------------------------------------------------------

C-----------------------------------------------------------------------
CR          GENERAL FUEL MANAGEMENT PARAMETERS (TYPE 36)               -
C                                                                      -
CL    FORMAT-----(I2,4X,3E12.5,2I6)                                    -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CD    1-2       36                                                     -
CD                                                                     -
CD    7-18      BURN CYCLE TIME (IN DAYS)                              -
CD                                                                     -
CD    19-30     SHUTDOWN TIME BETWEEN BURN CYCLES (IN DAYS)            -
CD                                                                     -
CD    31-42     RELATIVE REACTOR POWER (DEFAULT=1.0)                   -
CD                                                                     -
CD    43-48     BEGINNING STAGE NUMBER FOR WHICH THE ABOVE PARAMETERS  -
CD              APPLY                                                  -
CD                                                                     -
CD    49-54     ENDING STAGE NUMBER FOR WHICH THE ABOVE PARAMETERS     -
CD              APPLY                                                  -
C                                                                      -
CN              THE DEFAULT BURN CYCLE TIME AND SHUTDOWN TIME BETWEEN  -
CN              BURN CYCLES ARE SPECIFIED ON THE TYPE 03 CARD ABOVE.   -
CN              THE DEFAULT REACTOR POWER WILL BE WHATEVER WAS         -
CN              SPECIFIED FOR THE NEUTRONICS CALCULATION BEING USED.   -
CN                                                                     -
CN              STAGE 1 WILL ALWAYS USE THESE DATA REGARDLESS OF THE   -
CN              DATA SUPPLIED ON THE TYPE 36 CARDS.  FOR STAGES 2 AND  -
CN              LARGER, ANY STAGE NOT SPECIFIED ON THE TYPE 36 CARDS   -
CN              WILL USE THE DEFAULT VALUES INDICATED ABOVE.           -
CN                                                                     -
CN              IF COLS. 49-54 ARE 0 OR BLANK, THE ENDING STAGE NUMBER -
CN              WILL BE SET EQUAL TO THE BEGINNING STAGE NUMBER        -
CN              SPECIFIED IN COLS 43-48.                               -
C                                                                      -
C-----------------------------------------------------------------------

C-----------------------------------------------------------------------
CR          GENERAL FUEL MANAGEMENT REPETITION FACTORS (TYPE 37)       -
C                                                                      -
CL    FORMAT-----(I2,4X,5(A6,I6))                                      -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       37                                                     -
CD                                                                     -
CD    7-12      PATH LABEL                                             -
CD                                                                     -
CD    13-18     NUMBER OF TIMES THE PATH SPECIFIED IN COLS. 7-12 IS    -
CD              TO BE REPEATED (DEFAULT=0)                             -
CD                                                                     -
CD    19-24     PATH LABEL                                             -
CD                                                                     -
CD    25-30     NUMBER OF TIMES THE PATH SPECIFIED IN COLS. 19-24 IS   -
CD              TO BE REPEATED (DEFAULT=0)                             -
CD                                                                     -
```

Figure 9. BCD Dataset A.BURN (cont'd.)

```
CD    31-36     PATH LABEL                                        -
CD                                                                -
CD    37-42     NUMBER OF TIMES THE PATH SPECIFIED IN COLS. 31-36 IS  -
CD              TO BE REPEATED (DEFAULT=0)                        -
CD                                                                -
CD    43-48     PATH LABEL                                        -
CD                                                                -
CD    49-54     NUMBER OF TIMES THE PATH SPECIFIED IN COLS. 43-48 IS  -
CD              TO BE REPEATED (DEFAULT=0)                        -
CD                                                                -
CD    55-60     PATH LABEL                                        -
CD                                                                -
CD    61-66     NUMBER OF TIMES THE PATH SPECIFIED IN COLS. 55-60 IS  -
CD              TO BE REPEATED (DEFAULT=0)                        -
C                                                                 -
CN              THE TYPE 37 CARDS ARE PERTINENT ONLY IF TYPE 35 CARDS -
CN              ARE PROVIDED.                                     -
CN                                                                -
CN              AFTER COMPLETION OF A PATH AS SPECIFIED ON THE TYPE 35 -
CN              CARDS, IF THAT PATH IS ALSO SPECIFIED ON A TYPE 37  -
CN              CARD, IT WILL BE REPEATED AS MANY TIMES AS SPECIFIED  -
CN              BY THE TYPE 37 CARD DATA.                         -
C                                                                 -
C-----------------------------------------------------------------------

CEOF
```

Figure 9. BCD Dataset A.BURN (cont'd.)

Appendix B

BCD DATASET A.DIF3D

The BCD dataset listed in Figure 10 specifies the user input for the finite difference[6] and nodal[10] options of the neutronics portion of REBUS-3. Note that the entire dataset may be omitted if the default values are acceptable. Also, A.DIF3D is not pertinent if the neutronics is being supplied by the spatial flux synthesis module SYN3D.[7]

Either the formats specified in Figure 10 or the free format option indicated in Appendix I may be used for dataset A.DIF3D.

The user should see References 6 and 10 for further details concerning the use of dataset A.DIF3D and the finite difference and nodal options of DIF3D.

```
C***********************************************************************
C                                                                      -
C                       REVISED 12/15/82                               -
C                                                                      -
CF          A.DIF3D                                                    -
CE          ONE-, TWO-, AND THREE-DIMENSIONAL DIFFUSION THEORY         -
CE          MODULE-DEPENDENT BCD INPUT                                 -
C                                                                      -
CN                      THIS BCD DATASET MAY BE WRITTEN EITHER         -
CN                      IN FREE FORMAT (UNFORM=A.DIF3D) OR             -
CN                      ACCORDING TO THE FORMATS SPECIFIED FOR EACH    -
CN                      CARD TYPE (DATASET=A.DIF3D).                   -
CN                                                                     -
CN                      COLUMNS 1-2 MUST CONTAIN THE CARD TYPE NUMBER. -
CN                                                                     -
CN                      A BLANK OR ZERO FIELD GIVES THE DEFAULT OPTION -
CN                      INDICATED.                                     -
CN                                                                     -
CN                      NON-DEFAULTED DATA ITEMS ON THE A.DIF3D        -
CN                      DATA SET ALWAYS OVERRIDE THE CORRESPONDING     -
CN                      DATA ON THE RESTART DATA SET DIF3D.            -
C                                                                      -
C***********************************************************************


C-----------------------------------------------------------------------
CR          PROBLEM TITLE (TYPE 01)                                    -
C                                                                      -
CL    FORMAT-----(I2,4X,11A6)                                          -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       01                                                     -
CD                                                                     -
CD    7-72      ANY ALPHANUMERIC CHARACTERS (1 CARD ONLY).             -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          STORAGE AND DUMP SPECIFICATIONS (TYPE 02)                  -
C                                                                      -
CL    FORMAT-----(I2,4X,3I6)                                           -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       02                                                     -
CD                                                                     -
CD    7-12      POINTR CONTAINER ARRAY SIZE IN FAST CORE MEMORY (FCM)  -
```

Figure 10. BCD Dataset A.DIF3D

```
CD              IN REAL*8 WORDS (DEFAULT=10000).                        -
CD                                                                      -
CD    13-18     POINTR CONTAINER ARRAY SIZE IN EXTENDED CORE            -
CD              MEMORY (ECM) IN REAL*8 WORDS (DEFAULT=30000).           -
CD                                                                      -
CD    19-24     POINTR DEBUGGING EDIT.                                  -
CD              0...NO DEBUGGING PRINTOUT (DEFAULT).                    -
CD              1...DEBUGGING DUMP PRINTOUT.                            -
CD              2...DEBUGGING TRACE PRINTOUT.                           -
CD              3...BOTH DUMP AND TRACE PRINTOUT.                       -
C                                                                       -
C------------------------------------------------------------------------


C------------------------------------------------------------------------
CR          PROBLEM CONTROL PARAMETERS (TYPE 03)                        -
C                                                                       -
CL    FORMAT-----(I2,4X,11I6)                                           -
C                                                                       -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                 -
CD    =======   ========================================================-
CD    1-2       03                                                      -
CD                                                                      -
CD    7-12      PROBLEM TYPE.                                           -
CD              0...K-EFFECTIVE PROBLEM (DEFAULT).                      -
CD              1...FIXED SOURCE PROBLEM.                               -
CD                                                                      -
CD    13-18     SOLUTION TYPE.                                          -
CD              0...REAL SOLUTION (DEFAULT).                            -
CD              1...ADJOINT SOLUTION.                                   -
CD              2...BOTH REAL AND ADJOINT SOLUTION.                     -
CD                                                                      -
CD    19-24     CHEBYSHEV ACCELERATION OF OUTER ITERATIONS.             -
CD              0...YES, ACCELERATE THE OUTER ITERATIONS (DEFAULT).     -
CD              1...NO ACCELERATION.                                    -
CD                                                                      -
CD    25-30     MINIMUM PLANE-BLOCK (RECORD) SIZE IN REAL*8 WORDS FOR   -
CD              I/O TRANSFER IN THE CONCURRENT INNER ITERATION          -
CD              STRATEGY. THE DEFAULT (=4500) IS HIGHLY RECOMMENDED.    -
CD                                                                      -
CD    31-36     OUTER ITERATION CONTROL.                                -
CD             -3...BYPASS DIF3D MODULE.                                -
CD             -2...CALCULATE DATA MANAGEMENT PARAMETERS AND PERFORM    -
CD                  NEUTRONICS EDITS ONLY.                              -
CD             -1...CALCULATE DATA MANAGEMENT PARAMETERS, CALCULATE     -
CD                  OVERRELAXATION FACTORS AND PERFORM NEUTRONICS       -
CD                  EDITS ONLY.                                         -
CD          .GE.0...MAXIMUM NUMBER OF OUTER ITERATIONS (DEFAULT=30).    -
CD                                                                      -
```

Figure 10. BCD Dataset A.DIF3D (cont'd.)

```
CD    37-42     RESTART FLAG.                                           -
CD              0...THIS IS NOT A RESTART (DEFAULT).                    -
CD              1...THIS IS A RESTART PROBLEM.                          -
CD                                                                      -
CD    43-48     JOB TIME LIMIT, MAXIMUM (CP AND PP(OR WAIT)) PROCESSOR -
CD              SECONDS (DEFAULT=1000000000).                           -
CD                                                                      -
CD    49-54     NUMBER OF UPSCATTER ITERATIONS PER OUTER ITERATION      -
CD              (DEFAULT=5).  PERTINENT TO UPSCATTER PROBLEMS ONLY.     -
CD                                                                      -
CD    55-60     CONCURRENT ITERATION EFFICIENCY OPTION.                 -
CD              0...PERFORM THE ESTIMATED NO. OF INNER ITERATIONS FOR   -
CD                  EACH GROUP.                                         -
CD              1...AVOID THE LAST PASS OF INNER ITERATIONS IN THOSE    -
CD                  GROUPS FOR WHICH THE NO. OF ITERATIONS IN THE LAST -
CD                  PASS ARE LESS THAN A CODE DEPENDENT THRESHOLD.      -
CD                                                                      -
CD    61-66     ACCELERATION OF OPTIMUM OVERRELAXATION FACTOR           -
CD              CALCULATION.                                            -
CD              0...NO ACCELERATION (DEFAULT).                          -
CD              1...ASYMPTOTIC SOURCE EXTRAPOLATION OF POWER ITERATIONS-
CD                  USED TO ESTIMATE THE SPECTRAL RADIUS OF EACH INNER  -
CD                  (WITHIN GROUP) ITERATION MATRIX.                    -
CD    67-72     OPTIMUM OVERRELAXATION FACTOR ESTIMATION ITERATION      -
CD              CONTROL. THE DEFAULT (=50) IS STRONGLY RECOMMENDED.     -
C                                                                       -
CN              THE MAXIMUM NUMBER OF OUTER ITERATIONS SENTINEL         -
CN              SPECIFIES THE NUMBER OF OUTERS THAT CAN BE PERFORMED    -
CN              (COLS. 31-36) EACH TIME THE DIF3D MODULE IS INVOKED.    -
CN                                                                      -
CN              THE DIF3D TERMINATION PROCEDURE WILL ALWAYS:            -
CN                   1...(RE)WRITE THE APPROPRIATE FLUX FILES           -
CN                       (RTFLUX OR ATFLUX).                            -
CN                   2...(RE)WRITE THE RESTART FILE DIF3D.              -
CN              TO FACILITATE AUTOMATIC RESTART, THE RESTART FLAG       -
CN              ON THE DIF3D RESTART CONTROL FILE WILL BE TURNED ON     -
CN              AUTOMATICALLY UPON DETECTION OF:                        -
CN                   1...MAXIMUM NUMBER OF OUTER ITERATIONS.            -
CN                   2...TIME LIMIT.                                    -
CN                                                                      -
CN                                                                      -
CN              TO RESTART THE FLUX CALCULATION:                        -
CN              EITHER                                                  -
CN                                                                      -
CN                  PROVIDE THE RESTART DATA SET DIF3D AND              -
CN                  THE APPROPRIATE FLUX DATA SET (RTFLUX OR ATFLUX)    -
CN                  AND SPECIFY THEM UNDER "BLOCK=OLD" IN THE BCD       -
CN                  INPUT DATA                                          -
CN              OR                                                      -
```

Figure 10. BCD Dataset A.DIF3D (cont'd.)

```
CN                   1...SET THE RESTART FLAG (COLS. 37-42) TO 1 ON    -
CN                       THE TYPE 03 CARD. THIS PERMITS IMMEDIATE      -
CN                       RESUMPTION OF OUTER ITERATION ACCELERATION.   -
CN                   2...INCLUDE THE LATEST K-EFFECTIVE ESTIMATE       -
CN                       (COLS. 13-24) AND THE DOMINANCE RATIO         -
CN                       ESTIMATE ON THE TYPE 06 CARD (COLS. 61-72).   -
CN                   3...INCLUDE THE OPTIMUM OVERRELAXATION FACTORS    -
CN                       FOR EACH GROUP (TYPE 07 CARD).                -
CN                   4...PROVIDE THE APPROPRIATE FLUX DATA SET (RTFLUX -
CN                       OR ATFLUX) AND SPECIFY IT UNDER "BLOCK=OLD"   -
CN                       IN THE BCD INPUT DATA.                        -
CN                                                                     -
CN              A NON-ZERO TIME LIMIT (COLS. 43-48) OVERRIDES          -
CN              THE ACTUAL TIME LIMIT DETERMINED INTERNALLY            -
CN              BY SYSTEM ROUTINES IN THE ANL AND LBL PRODUCTION       -
CN              IMPLEMENTATIONS                                        -
CN                                                                     -
CN              THE TIME LIMIT PARAMETER (COLS. 43-48) IS PERTINENT    -
CN              TO EACH ENTRY TO THE DIF3D MODULE.                     -
CN                                                                     -
CN              IT IS RECOMMENDED THAT AN ODD NUMBER OF UPSCATTER      -
CN              ITERATIONS BE SPECIFIED (COLS. 49-54) TO AVOID         -
CN              ADDITIONAL I/O OVERHEAD.                               -
CN                                                                     -
CN              THE USER IS CAUTIONED TO MONITOR THE POINT-WISE        -
CN              FISSION SOURCE CONVERGENCE TO ENSURE THAT MONOTONIC    -
CN              CONVERGENCE IS OBTAINED WHEN THE EFFICIENCY OPTION     -
CN              (COLS. 55-60) IS ACTIVATED.                            -
CN                                                                     -
CN              THE OPTIMUM OVERRELAXATION FACTOR ACCELERATION OPTION  -
CN              IS PRIMARILY INTENDED FOR PROBLEMS KNOWN TO HAVE HIGH  -
CN              (>1.8) OPTIMUM OVERRELAXATION FACTORS.                 -
CN                                                                     -
CN              ITERATION CONTROL (COLS. 67-72) OF THE OPTIMUM         -
CN              OVERRELAXATION FACTOR ESTIMATION IS PRIMARILY INTENDED -
CN              FOR USE IN CONJUNCTION WITH THE ASYMPTOTIC ACCELERATION-
CN              OPTION (COLS. 61-66).                                  -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          EDIT OPTIONS (TYPE 04)                                     -
C                                                                      -
CL    FORMAT-----(I2,4X,10I6)                                          -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       04                                                     -
```

Figure 10. BCD Dataset A.DIF3D (cont'd.)

```
CD                                                                    -
CD    7-12      PROBLEM DESCRIPTION EDIT (IN ADDITION TO USER INPUT    -
CD              SPECIFICATIONS WHICH ARE ALWAYS EDITED.                -
CD              0...NO EDITS (DEFAULT).                                -
CD              1...PRINT EDITS.                                       -
CD              2...WRITE EDITS TO AUXILIARY OUTPUT FILE.              -
CD              3...WRITE EDITS TO BOTH PRINT AND AUXILIARY OUTPUT FILE-
CD                                                                     -
CD    13-18     GEOMETRY (REGION TO MESH INTERVAL) MAP EDIT.           -
CD              0...NO EDITS (DEFAULT).                                -
CD              1...PRINT EDITS.                                       -
CD              2...WRITE EDITS TO AUXILIARY OUTPUT FILE.              -
CD              3...WRITE EDITS TO BOTH PRINT AND AUXILIARY OUTPUT FILE-
CD                                                                     -
CD    19-24     GEOMETRY (ZONE TO MESH INTERVAL) MAP EDIT.             -
CD              0...NO EDITS (DEFAULT).                                -
CD              1...PRINT EDITS.                                       -
CD              2...WRITE EDITS TO AUXILIARY OUTPUT FILE.              -
CD              3...WRITE EDITS TO BOTH PRINT AND AUXILIARY OUTPUT FILE-
CD                                                                     -
CD    25-30     MACROSCOPIC CROSS SECTION EDIT.                        -
CD              ENTER TWO DIGIT NUMBER SP WHERE                        -
CD                                                                     -
CD              S CONTROLS THE SCATTERING AND PRINCIPAL CROSS SECTIONS -
CD              P CONTROLS THE PRINCIPAL CROSS SECTIONS EDIT ONLY.     -
CD                                                                     -
CD              THE INTEGERS S AND P SHOULD BE ASSIGNED ONE OF THE     -
CD              FOLLOWING VALUES (LEADING ZEROES ARE IRRELEVANT).      -
CD              0...NO EDITS (DEFAULT).                                -
CD              1...PRINT EDITS.                                       -
CD              2...WRITE EDITS TO AUXILIARY OUTPUT FILE.              -
CD              3...WRITE EDITS TO BOTH PRINT AND AUXILIARY OUTPUT FILE-
CD                                                                     -
CD    31-36     BALANCE EDITS                                          -
CD              ENTER 3 DIGIT NUMBER GBR WHERE                         -
CD                                                                     -
CD              G CONTROLS GROUP BALANCE EDITS INTEGRATED OVER THE     -
CD              REACTOR                                                -
CD              B CONTROLS REGION BALANCE EDIT BY GROUP                -
CD              R CONTROLS REGION BALANCE EDIT TOTALS                  -
CD                (INCLUDING NET PRODUCTION AND ENERGY MEDIANS)        -
CD                                                                     -
CD              THE INTEGERS G, B, AND R SHOULD BE ASSIGNED ONE OF THE -
CD              FOLLOWING VALUES (LEADING ZEROES ARE IRRELEVANT)       -
CD              0...NO EDITS (DEFAULT).                                -
CD              1...PRINT EDITS.                                       -
CD              2...WRITE EDITS TO AUXILIARY OUTPUT FILE.              -
CD              3...WRITE EDITS TO BOTH PRINT AND AUXILIARY OUTPUT FILE-
CD                                                                     -
```

Figure 10. BCD Dataset A.DIF3D (cont'd.)

```
CD   37-42     POWER EDITS                                          -
CD             ENTER 2 DIGIT NUMBER RM WHERE                        -
CD                                                                  -
CD             R CONTROLS REGION POWER AND AVERAGE POWER DENSITY EDITS-
CD             M CONTROLS POWER DENSITY BY MESH INTERVAL EDIT (PWDINT)-
CD                                                                  -
CD             THE INTEGERS R AND M SHOULD BE ASSIGNED              -
CD             ONE OF THE FOLLOWING VALUES (LEADING ZEROES ARE      -
CD             IRRELEVANT)                                          -
CD             0...NO EDITS (DEFAULT).                              -
CD             1...PRINT EDITS.                                     -
CD             2...WRITE EDITS TO AUXILIARY OUTPUT FILE.            -
CD             3...WRITE EDITS TO BOTH PRINT AND AUXILIARY OUTPUT FILE-
CD                                                                  -
CD   43-48     FLUX EDITS                                           -
CD             ENTER 3 DIGIT INTEGER RMB WHERE                      -
CD                                                                  -
CD             R CONTROLS FLUX EDIT BY REGION AND GROUP             -
CD               INCLUDING GROUP AND REGION TOTALS                  -
CD             M CONTROLS TOTAL (GROUP INTEGRATED) FLUX EDIT        -
CD               BY MESH INTERVAL                                   -
CD             B CONTROLS TOTAL FLUX EDIT BY MESH INTERVAL AND GROUP -
CD               (RTFLUX OR ATFLUX)                                 -
CD                                                                  -
CD             THE INTEGERS R, M, AND B SHOULD BE ASSIGNED          -
CD             ONE OF THE FOLLOWING VALUES (LEADING ZEROES ARE      -
CD             IRRELEVANT)                                          -
CD             0...NO EDITS (DEFAULT).                              -
CD             1...PRINT EDITS.                                     -
CD             2...WRITE EDITS TO AUXILIARY OUTPUT FILE.            -
CD             3...WRITE EDITS TO BOTH PRINT AND AUXILIARY OUTPUT FILE-
CD                                                                  -
CD   49-54     ZONE AVERAGED (REAL) FLUX EDIT.                      -
CD             0...NO EDITS (DEFAULT).                              -
CD             1...PRINT EDITS.                                     -
CD             2...WRITE EDITS TO AUXILIARY OUTPUT FILE.            -
CD             3...WRITE EDITS TO BOTH PRINT AND AUXILIARY OUTPUT FILE-
CD                                                                  -
CD   55-60     REGION AVERAGED FLUX EDIT.                           -
CD             0...NO EDITS (DEFAULT).                              -
CD             1...PRINT EDITS.                                     -
CD             2...WRITE EDITS TO AUXILIARY OUTPUT FILE.            -
CD             3...WRITE EDITS TO BOTH PRINT AND AUXILIARY OUTPUT FILE-
CD                                                                  -
CD   61-66     STANDARD INTERFACE FILES TO BE WRITTEN IN ADDITION   -
CD             TO RTFLUX AND/OR ATFLUX.                             -
CD             0...NONE (DEFAULT).                                  -
CD             1...WRITE PWDINT.                                    -
CD             2...WRITE RZFLUX.                                    -
```

Figure 10. BCD Dataset A.DIF3D (cont'd.)

```
CD                3...WRITE BOTH PWDINT AND RZFLUX.                        -
CD                                                                         -
CD     67-72      MASTER DIF3D EDIT SENTINEL DURING CRITICALITY SEARCHES -
CD               -1...SUPPRESS ALL DIF3D EDITS EXCEPT THE ITERATION        -
CD                    HISTORY AND ERROR DIAGNOSTICS                        -
CD                0...EDIT INPUT DATA ON 1ST SEARCH PASS, OUTPUT           -
CD                    INTEGRALS UPON CONVERGENCE OR UPON ACHIEVING THE     -
CD                    MAXIMUM SEARCH PASS LIMIT.                           -
CD                N...ALSO INVOKE SPECIFIED DIF3D EDITS EVERY N-TH         -
CD                    SEARCH PASS.                                         -
C                                                                          -
CN                MULTI-DIGIT EDIT SPECIFICATION EXAMPLES.                 -
CN                                                                         -
CN                ENTERING THE INTEGER 201 IN COLUMNS 31-36 YIELDS         -
CN                THE GROUP BALANCE EDIT ON THE AUXILIARY FILE AND         -
CN                THE REGION BALANCE EDIT ON THE PRIMARY PRINT FILE.       -
CN                                                                         -
CN                ENTERING THE INTEGER 30 IN COLUMNS 31-36 YIELDS          -
CN                THE REGION BALANCE EDIT BY GROUP ON BOTH THE PRINT AND -
CN                THE AUXILIARY OUTPUT FILES.                              -
C                                                                          -
C---------------------------------------------------------------------------


C---------------------------------------------------------------------------
CR            CONVERGENCE CRITERIA (TYPE 05)                               -
C                                                                          -
CL     FORMAT-----(I2,10X,3E12.5)                                          -
C                                                                          -
CD     COLUMNS             CONTENTS...IMPLICATIONS, IF ANY                 -
CD     =======    ==========================================================-
CD     1-2        05                                                       -
CD                                                                         -
CD     13-24      EIGENVALUE CONVERGENCE CRITERION FOR STEADY STATE        -
CD                CALCULATION (DEFAULT VALUE = 1.0E-7 IS RECOMMENDED).     -
CD                                                                         -
CD     25-36      POINTWISE FISSION SOURCE CONVERGENCE CRITERION           -
CD                FOR STEADY STATE SHAPE CALCULATION                       -
CD                (DEFAULT VALUE = 1.0E-5 IS RECOMMENDED).                 -
CD                                                                         -
CD     37-48      AVERAGE FISSION SOURCE CONVERGENCE CRITERION             -
CD                FOR STEADY STATE SHAPE CALCULATION                       -
CD                (DEFAULT VALUE = 1.0E-5 IS RECOMMENDED).                 -
C                                                                          -
CN                IN UPSCATTERING PROBLEMS IT IS RECOMMENDED THAT          -
CN                THE EIGENVALUE CONVERGENCE CRITERION (COLS. 13-24)       -
CN                BE .1 TIMES THE POINTWISE FISSION SOURCE CONVERGENCE     -
CN                CRITERION (COLS. 25-36).                                 -
C                                                                          -
```

Figure 10. BCD Dataset A.DIF3D (cont'd.)

```
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          OTHER FLOATING POINT DATA (TYPE 06)                         -
C                                                                       -
CL    FORMAT-----(I2,10X,5E12.5)                                        -
C                                                                       -
CD    COLUMNS             CONTENTS...IMPLICATIONS, IF ANY               -
CD    =======    ========================================================-
CD    1-2        06                                                     -
CD                                                                      -
CD    13-24      K-EFFECTIVE OF REACTOR (DEFAULT IS OBTAINED FROM       -
CD               THE APPROPRIATE RTFLUX OR ATFLUX FILE, IF PRESENT.     -
CD               OTHERWISE DEFAULT = 1.0).                              -
CD                                                                      -
CD    25-36      ANY POINTWISE FISSION SOURCE WILL BE NEGLECTED IN THE  -
CD               POINTWISE FISSION SOURCE CONVERGENCE TEST IF IT IS     -
CD               LESS THAN THIS FACTOR TIMES THE R.M.S. FISSION         -
CD               SOURCE (DEFAULT VALUE = .001 IS RECOMMENDED).          -
CD                                                                      -
CD    37-48      ERROR REDUCTION FACTOR TO BE ACHIEVED BY EACH SERIES   -
CD               OF INNER ITERATIONS FOR EACH GROUP DURING A SHAPE      -
CD               CALCULATION - STRONGLY RECOMMENDED THAT THE DEFAULT    -
CD               VALUE OF (.04) BE USED.                                -
CD                                                                      -
CD    49-60      STEADY STATE REACTOR POWER (WATTS). (DEFAULT = 1.0).   -
CD                                                                      -
CD    61-72      DOMINANCE RATIO (FOR RESTART JOBS ONLY).               -
C                                                                       -
CN               K-EFFECTIVE SPECIFICATIONS (COLS. 13-24):              -
CN                    1...FOR K-EFFECTIVE PROBLEMS, SUPPLY ESTIMATED    -
CN                        K-EFFECTIVE OF REACTOR.                       -
CN                    2...FOR RESTARTED K-EFFECTIVE PROBLEMS, SUPPLY    -
CN                        LATEST K-EFFECTIVE ESTIMATE SUPPLIED ON THE   -
CN                        ITERATION HISTORY EDIT.                       -
CN                    3...FOR SOURCE PROBLEMS, SUPPLY K-EFFECTIVE OF    -
CN                        THE REACTOR.                                  -
CN               DEFAULT IS OBTAINED FROM THE APPROPRIATE RTFLUX OR     -
CN               ATFLUX FILE, IF PRESENT.  OTHERWISE DEFAULT=1.0 .      -
C                                                                       -
CN               NON-MONOTONIC POINTWISE FISSION SOURCE CONVERGENCE     -
CN               IS USUALLY INDICATIVE OF THE NEED TO TIGHTEN THE ERROR -
CN               REDUCTION FACTOR(COLS. 37-48).  THIS IS FREQUENTLY TRUE-
CN               IN TRIANGULAR GEOMETRY PROBLEMS WHERE A VALUE OF .01 IS-
CN               USUALLY SUFFICIENT TO OBTAIN MONOTONIC CONVERGENCE.    -
C-----------------------------------------------------------------------
```

Figure 10. BCD Dataset A.DIF3D (cont'd.)

```
C-----------------------------------------------------------------------
CR          OPTIMUM OVERRELAXATION FACTORS (TYPE 07)                   -
C                                                                      -
CL    FORMAT-----(I2,10X,5E12.5)                                       -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   ========================================================
CD    1-2         07                                                   -
CD                                                                     -
CD    13-24     OPTIMUM OVERRELAXATION FACTOR FOR GROUP 1.             -
CD                                                                     -
CD    25-36     OPTIMUM OVERRELAXATION FACTOR FOR GROUP 2.             -
CD                                                                     -
CD    37-48     OPTIMUM OVERRELAXATION FACTOR FOR GROUP 3.             -
CD                                                                     -
CD    49-60     OPTIMUM OVERRELAXATION FACTOR FOR GROUP 4.             -
CD                                                                     -
CD    61-72     OPTIMUM OVERRELAXATION FACTOR FOR GROUP 5.             -
C                                                                      -
CN              REPEAT 5 VALUES PER CARD FOR AS MANY TYPE 07 CARDS     -
CN              AS ARE NEEDED.                                         -
CN                                                                     -
CN              THE OPTIMUM OVERRELAXATION FACTORS ARE NORMALLY        -
CN              OBTAINED FROM THE RESTART INSTRUCTIONS PRINTED         -
CN              IMMEDIATELY AFTER THE DIF3D ITERATION HISTORY EDIT.    -
CN              IN THE RESTART INSTRUCTIONS, THE FACTORS ARE ALWAYS    -
CN              EDITTED IN THE --REAL PROBLEM-- ORDERING AND SHOULD BE -
CN              ENTERED ON THE TYPE 07 CARD --EXACTLY-- AS EDITTED     -
CN              IN THE RESTART INSTRUCTIONS.                           -
CN                                                                     -
CN              THE PERMISSIBLE FACTOR RANGE IS BOUNDED BY 1.0 AND 2.0 -
CN              INCLUSIVE. A ZERO OR BLANK FACTOR ENTRY DEFAULTS       -
CN              TO 1.0. FACTORS ARE COMPUTED FOR THOSE GROUPS HAVING   -
CN              A FACTOR OF 1.0; FACTORS GREATER THAN 1.0 ARE NOT      -
CN              RECOMPUTED.                                            -
CN                                                                     -
CN              TYPE 07 CARDS ARE PRIMARILY INTENDED FOR RESTART JOBS  -
CN              ONLY (STRONGLY RECOMMENDED).                           -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          NEAR CRITICAL SOURCE PROBLEM ASYMPTOTIC EXTRAPOLATION      -
CR          PARAMETERS (TYPE 08)                                       -
C                                                                      -
CC          ***** WARNING...SELECT THIS OPTION ONLY IF THE  *****      -
CC          ***** ASYMPTOTIC EXTRAPOLATION IS REQUIRED FOR  *****      -
CC          ***** THIS PROBLEM.                             *****      -
```

Figure 10. BCD Dataset A.DIF3D (cont'd.)

```
C                                                                       -
CL    FORMAT-----(I2,4X,I6,E12.5)                                       -
C                                                                       -
CD    COLUMNS            CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   ========================================================-
CD    1-2       08                                                      -
CD                                                                      -
CD    7-12      NUMBER OF OUTER (POWER) ITERATIONS PERFORMED PRIOR TO   -
CD              ASYMPTOTIC EXTRAPOLATION OF NEAR CRITICAL SOURCE        -
CD              PROBLEM (DEFAULT=5).                                    -
CD                                                                      -
CD    13-24     EIGENVALUE OF THE HOMOGENEOUS PROBLEM CORRESPONDING     -
CD              TO THE NEAR CRITICAL SOURCE PROBLEM. THIS EIGENVALUE    -
CD              MUST BE LESS THAN ONE.                                  -
CD                                                                      -
CD    25-30     INITIAL FLUX GUESS SENTINEL.                            -
CD              0...FLAT FLUX GUESS=1.0 (DEFAULT)                       -
CD              1...FLAT FLUX GUESS=0.0                                 -
C                                                                       -
CN              THE TYPE 08 CARD IS REQUIRED TO ACTIVATE AN ALTERNATE   -
CN              SPECIAL ACCELERATION SCHEME FOR NEAR CRITICAL           -
CN              SOURCE PROBLEMS.                                        -
CN                                                                      -
CN              IF COLS. 13-24 ARE ZERO OR BLANK, THE HOMOGENEOUS       -
CN              PROBLEM EIGENVALUE WILL BE ESTIMATED. IN THIS CASE, IT  -
CN              IS RECOMMENDED TO INCREASE THE NUMBER OF ITERATIONS IN  -
CN              COLS. 7-12 TO AT LEAST 10.                              -
C                                                                       -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          SN TRANSPORT OPTIONS (TYPE 09)                              -
C                                                                       -
CL    FORMAT-----(I2,4X,2I6,6X,E12.4)                                   -
C                                                                       -
CD    COLUMNS            CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   ========================================================-
CD    1-2       09                                                      -
CD                                                                      -
CD    7-12      SN ORDER.                                               -
CD                                                                      -
CD    13-18     MAXIMUM ALLOWED NUMBER OF LINE SWEEPS PER LINE PER      -
CD              INNER ITERATION (DEFAULT=10).                           -
CD                                                                      -
CD    25-36     LINE SWEEP CONVERGENCE CRITERION (DEFAULT=1.0E-4).      -
C                                                                       -
CN              TO INVOKE THE DIF3D TRANSPORT OPTION, THE TYPE 09 CARD  -
CN              MUST BE PRESENT WITH A NONZERO SN ORDER. FOR THE TIME   -
```

Figure 10. BCD Dataset A.DIF3D (cont'd.)

```
CN              BEING, USERS MUST ALSO CONTINUE TO 'PRELIB' TO          -
CN              DATASET 'C116.B99983.MODLIB' TO INVOKE THIS OPTION.     -
C------------------------------------------------------------------------


C------------------------------------------------------------------------
CR          PARAMETERS FOR NODAL HEXAGONAL GEOMETRY OPTION (TYPE 10)    -
C                                                                       -
CL    FORMAT-----(I2,4X,5I6)                                            -
C                                                                       -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                 -
CD    =======   ========================================================-
CD    1-2       10                                                      -
CD                                                                      -
CD    7-12      ORDER OF NODAL APPROXIMATION IN HEX-PLANE.              -
CD              2...NH2 APPROXIMATION.                                  -
CD              3...NH3 APPROXIMATION.                                  -
CD              4...NH4 APPROXIMATION (DEFAULT).                        -
CD                                                                      -
CD    13-18     ORDER OF NODAL APPROXIMATION IN Z-DIRECTION.            -
CD              2...QUADRATIC APPROXIMATION.                            -
CD              3...CUBIC APPROXIMATION (DEFAULT).                      -
CD                                                                      -
CD    19-24     COARSE-MESH REBALANCE ACCELERATION CONTROL.             -
CD             -1...NO COARSE-MESH REBALANCE ACCELERATION.              -
CD          .GE.0...NUMBER OF COARSE-MESH REBALANCE ITERATIONS PER      -
CD                  OUTER ITERATION (DEFAULT=2).                        -
CD                                                                      -
CD    25-30     ASYMPTOTIC SOURCE EXTRAPOLATION OF OUTER ITERATIONS.    -
CD              0...APPLY ASYMPTOTIC SOURCE EXTRAPOLATION TO OUTER      -
CD                  ITERATIONS (DEFAULT).                               -
CD              1...NO ASYMPTOTIC SOURCE EXTRAPOLATION.                 -
CD                                                                      -
CD    31-36     NUMBER OF AXIAL PARTIAL CURRENT SWEEPS PER GROUP        -
CD              PER OUTER ITERATION (DEFAULT=2).                        -
C                                                                       -
CN              THE TYPE 10 CARD IS PERTINENT ONLY WHEN THE NODAL       -
CN              HEXAGONAL GEOMETRY OPTION (A.NIP3 TYPE 03 CARD          -
CN              GEOMETRY-TYPE SENTINEL VALUES BETWEEN 110 AND 128)      -
CN              IS SPECIFIED.                                           -
CN                                                                      -
CN              IT IS RECOMMENDED THAT THE DEFAULT VALUES FOR THE       -
CN              ORDER OF THE NODAL APPROXIMATION IN THE HEX-PLANE       -
CN              (COLS. 7-12) AND FOR THE ORDER OF THE NODAL APPROXI-    -
CN              MATION IN THE Z-DIRECTION (COLS. 13-18) BE SPECIFIED.   -
C                                                                       -
C------------------------------------------------------------------------
```

Figure 10. BCD Dataset A.DIF3D (cont'd.)

```
C-----------------------------------------------------------------------
CR          AXIAL COARSE-MESH REBALANCE BOUNDARIES FOR NODAL           -
CR          HEXAGONAL GEOMETRY OPTION (TYPE 11)                        -
C                                                                      -
CL    FORMAT-----(I2,10X,3(I6,E12.5))                                  -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   ===================================================-
CD    1-2       11                                                     -
CD                                                                     -
CD    13-18     NUMBER OF AXIAL COARSE-MESH REBALANCE INTERVALS.       -
CD                                                                     -
CD    19-30     UPPER Z-COORDINATE.                                    -
CD                                                                     -
CD    31-36     NUMBER OF AXIAL COARSE-MESH REBALANCE INTERVALS.       -
CD                                                                     -
CD    37-48     UPPER Z-COORDINATE.                                    -
CD                                                                     -
CD    49-54     NUMBER OF AXIAL COARSE-MESH REBALANCE INTERVALS.       -
CD                                                                     -
CD    55-66     UPPER Z-COORDINATE.                                    -
C                                                                      -
CN              THE TYPE 11 CARD IS PERTINENT ONLY WHEN THE THREE-     -
CN              DIMENSIONAL NODAL HEXAGONAL GEOMETRY OPTION (A.NIP3    -
CN              TYPE 03 CARD GEOMETRY-TYPE SENTINEL VALUES BETWEEN     -
CN              120 AND 128) IS SPECIFIED.                             -
CN                                                                     -
CN              IF NO TYPE 11 CARDS ARE PRESENT, THE AXIAL COARSE-MESH -
CN              REBALANCE INTERVALS ARE DEFINED BY THE Z-COORDINATE    -
CN              VALUES SPECIFIED ON A.NIP3 CARD 09.                    -
CN                                                                     -
CN              BOUNDARIES ARE SPECIFIED VIA NUMBER PAIRS.             -
CN              EACH NUMBER PAIR IS OF THE FORM (N(I), Z(I)). THERE    -
CN              ARE N(I) AXIAL COARSE-MESH REBALANCE INTERVALS BETWEEN -
CN              Z(I-1) AND Z(I), WHERE Z(0) IS THE LOWER REACTOR       -
CN              BOUNDARY IN THE Z-DIRECTION. NUMBER PAIRS MUST BE      -
CN              GIVEN IN ORDER OF INCREASING MESH COORDINATES. ALL     -
CN              AXIAL COARSE-MESH REBALANCE BOUNDARIES MUST COINCIDE   -
CN              WITH THE MESH LINES WHICH BOUND MESH INTERVALS.        -
C                                                                      -
C-----------------------------------------------------------------------
CEOF
```

Figure 10. BCD Dataset A.DIF3D (cont'd.)

Appendix C

BCD DATASET A.HMG4C

The BCD dataset listed in Figure 11 specifies the user input for the cross section homogenization portion of the REBUS-3 code. Note that the entire dataset may be omitted if all of the default values are acceptable to the user.

Some of the specifications in A.HMG4C can alternatively be provided in the A.NIP3 dataset. In particular, the data supplied in cols. 7-12, 19-24, and 31-36 on card type 02 of dataset A.HMG4C can be provided instead in cols. 37-42, 55-60, and 49-54, respectively, on card type 02 of dataset A.NIP3.

Either the formats specified in Figure 11 or the free format option indicated in Appendix I may be used for dataset A.HMG4C.

```
C***********************************************************************
C                                                                      -
C                       PREPARED 9/26/79 AT ANL                        -
C                                                                      -
CF          A.HMG4C                                                    -
CE          INPUT FOR CCCC TO ARC SYSTEM CROSS SECTION HOMOGENIZATION  -
C                                                                      -
CN                      THIS IS A USER-SUPPLIED BCD DATA SET.          -
CN                      THE LIST FOR EACH RECORD IS GIVEN IN TERMS     -
CN                      OF THE BCD FORMAT OF THAT DATA CARD.           -
CN                      COLUMNS 1-2 NORMALLY CONTAIN THE CARD TYPE     -
CN                      NUMBER.                                        -
CN                      A BLANK FIELD GIVES THE DEFAULT OPTION         -
CN                      INDICATED.                                     -
CN                      ALL INPUT CARDS ARE OPTIONAL.                  -
C                                                                      -
C***********************************************************************


C-----------------------------------------------------------------------
CR          PROBLEM TITLE (TYPE 01)                                    -
C                                                                      -
CL    FORMAT-----(I2,4X,11A6)                                          -
C                                                                      -
CD    COLUMNS         CONTENTS...IMPLICATIONS, IF ANY                  -
CD    =======   =======================================================-
CD    1-2       01                                                     -
CD                                                                     -
CD    7-72      ANY ALPHANUMERIC CHARACTERS.                           -
C                                                                      -
CN              UP TO SIX TYPE 01 CARDS MAY BE USED.                   -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          PROBLEM OPTIONS (TYPE 02)                                  -
C                                                                      -
CL    FORMAT-----(I2,4X,8I6)                                           -
C                                                                      -
CD    COLUMNS         CONTENTS...IMPLICATIONS, IF ANY                  -
CD    =======   =======================================================-
CD    1-2       02                                                     -
CD                                                                     -
CD    7-12      SIZE OF MAIN CORE CONTAINER ARRAY IN REAL*8 WORDS      -
CD              (SINGLE WORDS ON CDC SYSTEMS). (DEFAULT=20000).        -
CD                                                                     -
CD    13-18     PRINT FILE MASTER CONTROL FLAG.                        -
CD              0...PRINT GENERAL RUN INFORMATION AND REQUESTED EDITS  -
```

Figure 11. BCD Dataset A.HMG4C

```
CD                   (DEFAULT).                                        -
CD               1...SUPPRESS ALL PRINTING EXCEPT DIAGNOSTICS.         -
CD                                                                     -
CD     19-24     COMPXS EDIT FLAG.                                     -
CD               0...NO EDIT (DEFAULT).                                -
CD               1...PRINT COMPLETE EDIT OF THE CREATED COMPXS FILE.   -
CD               2...WRITE COMPLETE EDIT OF THE CREATED COMPXS FILE    -
CD                   ON THE AUXILIARY OUTPUT FILE.                     -
CD               3...COMPXS EDIT WRITTEN ON BOTH PRINT AND AUXILIARY   -
CD                   OUTPUT FILES.                                     -
CD                                                                     -
CD     25-30     ISOTXS EDIT FLAG.                                     -
CD               0...NO EDIT (DEFAULT).                                -
CD               1...PRINT RUNNING EDIT OF ISOTXS (I.E. NOT EVERY      -
CD                   ISOTOPE ON THE FILE IS PRINTED, ONLY THOSE        -
CD                   ACTUALLY REFERENCED).                             -
CD               2...WRITE RUNNING EDIT OF ISOTXS ON THE AUXILIARY     -
CD                   OUTPUT FILE.                                      -
CD               3...RUNNING EDIT OF ISOTXS WRITTEN ON BOTH PRINT      -
CD                   AND AUXILIARY OUTPUT FILES.                       -
CD                                                                     -
CD     31-36     POINTR DEBUGGING EDIT FLAG.                           -
CD               0...NO DEBUGGING PRINTOUT (DEFAULT).                  -
CD               1...DUMP PRINTOUTS ONLY.                              -
CD               2...TRACE PRINTOUTS ONLY.                             -
CD               3...BOTH TRACE AND DUMP PRINTOUT.                     -
CD                                                                     -
CD               NOTE THAT HMG4C CONTAINS NO DUMPS, I.E. 1 IS NOT      -
CD               A RELEVANT VALUE FOR THIS FLAG.                       -
CD                                                                     -
CD     37-42     PROMPT FISSION SPECTRUM OPTION FLAG.                  -
CD               0...IGNORE ISOTOPE FISSION VECTORS, IF PRESENT IN     -
CD                   ISOTXS, AND USE THE SET FISSION VECTOR FOR ALL    -
CD                   COMPOSITIONS (DEFAULT). IF A SET FISSION SPECTRUM -
CD                   IS NOT PRESENT IN ISOTXS, THE COMPOSITION FISSION -
CD                   SPECTRA WILL BE COMPUTED BY THE TOTAL FISSION     -
CD                   SOURCE WEIGHTING METHOD USING ISOTOPE FISSION     -
CD                   VECTORS.                                          -
CD               1...USE ISOTOPE FISSION VECTORS, IF PRESENT IN ISOTXS, -
CD                   TO COMPUTE COMPOSITION FISSION VECTORS WITH TOTAL -
CD                   FISSION SOURCE WEIGHTING, I.E., UNDER ASSUMPTION  -
CD                   THAT FLUX IS GROUP INDEPENDENT. THIS IS THE       -
CD                   PREFERRED WEIGHTING METHOD. IF AN ISOTOPE FISSION -
CD                   VECTOR IS NOT PRESENT, THE SET FISSION VECTOR WILL -
CD                   BE USED IN ITS PLACE.                             -
CD               2...USE ISOTOPE FISSION VECTORS, IF PRESENT IN ISOTXS, -
CD                   TO COMPUTE COMPOSITION FISSION VECTORS WITH       -
CD                   NU*SIGMA(FISSION) WEIGHTING. THIS METHOD OF       -
CD                   COMPUTING A FISSION SPECTRUM IS NOT RECOMMENDED.  -
```

Figure 11. BCD Dataset A.HMG4C (cont'd.)

```
CD                  IF AN ISOTOPE FISSION VECTOR IS NOT PRESENT, THE   -
CD                  SET FISSION VECTOR WILL BE USED IN ITS PLACE.      -
CD                                                                     -
CD    43-48     AUXILIARY OUTPUT FILE MASTER CONTROL FLAG.             -
CD              0...SUPPRESS ALL OUTPUT TO AUXILIARY FILE (DEFAULT).   -
CD              1...WRITE GENERAL RUN INFORMATION AND REQUESTED        -
CD                  EDITS ON AUXILIARY OUTPUT FILE.                    -
CD                                                                     -
CD              NOTE THAT ERROR DIAGNOSTICS ARE NOT WRITTEN ON THE     -
CD              AUXILIARY OUTPUT FILE.                                 -
CD                                                                     -
CD    49-54     EDIT FLAG FOR A SUPPLIED COMPXS FILE.                  -
CD              0...NO EDIT (DEFAULT).                                 -
CD              1...PRINT COMPLETE EDIT OF SUPPLIED COMPXS FILE.       -
CD              2...WRITE COMPLETE EDIT OF SUPPLIED COMPXS FILE ON     -
CD                  THE AUXILIARY OUTPUT FILE.                         -
CD              3...EDIT OF SUPPLIED COMPXS WRITTEN ON BOTH PRINT AND  -
CD                  AUXILIARY OUTPUT FILES.                            -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
C                                                                      -
CR            SCATTERING CROSS SECTION TRUNCATION OPTION  (TYPE 03)    -
C                                                                      -
CL     FORMAT-----(I2,4X,E12.5)                                        -
C                                                                      -
CD     COLUMNS           CONTENTS...IMPLICATIONS, IF ANY               -
CD     =======    ======================================================-
CD     1-2        03                                                   -
CD                                                                     -
CD     7-18       SCATTERING MATRIX TRUNCATION FRACTION (DEFAULT=1.0)  -
C                                                                      -
CN                THE SCATTERING CROSS SECTION BANDWIDTH OF A          -
CN                COMPOSITION IN FILE COMPXS IS TRUNCATED AT           -
CN                THE POINT WHERE THE INPUT FRACTION (COL 7-18)        -
CN                OF THE TOTAL SCATTERING CROSS SECTION HAS            -
CN                BEEN ACCUMULATED.  A VALUE OF .999 IS                -
CN                GENERALLY SUFFICIENT TO RETAIN THE RIGOR             -
CN                OF A CALCULATION WHILE SIGNIFICANTLY REDUCING        -
CN                THE SCATTERING BANDWIDTH AND HENCE, THE I/O          -
CN                TIMES ASSOCIATED WITH THE SCATTERING SOURCE          -
CN                DETERMINATION IN A NEUTRONICS CALCULATION.           -
C                                                                      -
C-----------------------------------------------------------------------

CEOF
```

Figure 11. BCD Dataset A.HMG4C (cont'd.)

Appendix D

BCD DATASET A.MASFLO

The BCD dataset listed in Figure 12 specifies the user input for execution of a standalone mass flow edit calculation. This calculation would normally follow a REBUS-3 calculation in which the mass flow summary data has been punched out for future use. The dataset A.STP027 controls the punching of this summary data.

Either the formats specified in Figure 12 or the free format option indicated in Appendix I may be used for dataset A.MASFLO.

```
C***********************************************************************
C                                                                      -
C                       PREPARED 08/11/81 AT ANL                       -
C                                                                      -
CF          A.MASFLO                                                   -
CE          INPUT FOR REBUS-3 SUMMARY MASS FLOW EDITS                  -
C                                                                      -
CN                      THIS IS A USER-SUPPLIED BCD DATA SET.          -
CN                      THE LIST FOR EACH RECORD IS GIVEN IN TERMS     -
CN                      OF THE BCD FORMAT OF THAT DATA CARD.           -
CN                      COLUMNS 1-2 NORMALLY CONTAIN THE CARD TYPE     -
CN                      NUMBER.                                        -
CN                      A BLANK FIELD GIVES THE DEFAULT OPTION         -
CN                      INDICATED.                                     -
C                                                                      -
C***********************************************************************


C-----------------------------------------------------------------------
CR          PROBLEM TITLE (TYPE 01)                                    -
C                                                                      -
CL     FORMAT-----(I2,4X,11A6)                                         -
C                                                                      -
CD     COLUMNS          CONTENTS...IMPLICATIONS, IF ANY                -
CD     =======  ===============================================-
CD     1-2      01                                                     -
CD                                                                     -
CD     7-72     ANY ALPHANUMERIC CHARACTERS.                           -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          ISOTOPE SPECIFICATIONS (TYPE 02)                           -
C                                                                      -
CL     FORMAT-----(I2,4X,5(I6,A6))                                     -
C                                                                      -
CD     COLUMNS          CONTENTS...IMPLICATIONS, IF ANY                -
CD     =======  ===============================================-
CD     1-2      02                                                     -
CD                                                                     -
CD     7-12     ACTIVE ISOTOPE NUMBER.                                 -
CD                                                                     -
CD     13-18    ACTIVE ISOTOPE ABSOLUTE LABEL.                         -
CD                                                                     -
CD     19-24    ACTIVE ISOTOPE NUMBER.                                 -
CD                                                                     -
CD     25-30    ACTIVE ISOTOPE ABSOLUTE LABEL.                         -
CD                                                                     -
```

Figure 12. BCD Dataset A.MASFLO

```
CD     31-36      ACTIVE ISOTOPE NUMBER.                                 -
CD                                                                       -
CD     37-42      ACTIVE ISOTOPE ABSOLUTE LABEL.                         -
CD                                                                       -
CD     43-48      ACTIVE ISOTOPE NUMBER.                                 -
CD                                                                       -
CD     49-54      ACTIVE ISOTOPE ABSOLUTE LABEL.                         -
CD                                                                       -
CD     55-60      ACTIVE ISOTOPE NUMBER.                                 -
CD                                                                       -
CD     60-66      ACTIVE ISOTOPE ABSOLUTE LABEL.                         -
C                                                                        -
CN                THE DEFAULT LABELS CORRESPONDING TO THE 22 STANDARD    -
CN                ISOTOPES ARE AS LISTED BELOW.                          -
CN                          1...TH232                                    -
CN                          2...PA233                                    -
CN                          3...U-233                                    -
CN                          4...U-234                                    -
CN                          5...U-235                                    -
CN                          6...U-236                                    -
CN                          7...U-238                                    -
CN                          8...NP237                                    -
CN                          9...PU236                                    -
CN                         10...PU238                                    -
CN                         11...PU239                                    -
CN                         12...PU240                                    -
CN                         13...PU241                                    -
CN                         14...PU242                                    -
CN                         15...AM241                                    -
CN                         16...AM242                                    -
CN                         17...AM243                                    -
CN                         18...CM242                                    -
CN                         19...CM243                                    -
CN                         20...CM244                                    -
CN                         21...CM245                                    -
CN                         22...CM246                                    -
CN                                                                       -
CN                AT THIS TIME, THE MASS FLOW SUMMARY WILL EDIT DATA FOR -
CN                ONLY ISOTOPES 1-7, AND 10-14.  LABELS GIVEN ON THIS    -
CN                CARD MUST CORRESPOND TO LABELS SUPPLIED ON THE CARD    -
CN                TYPES 09-11 BELOW.                                     -
C                                                                        -
C-------------------------------------------------------------------------


C-------------------------------------------------------------------------
CR            PLANT SPECIFICATIONS (TYPE 03)                             -
C                                                                        -
CL     FORMAT-----(I2,4X,4E12.6,2I6)                                     -
```

Figure 12. BCD Dataset A.MASFLO (cont'd.)

```
C                                                                        -
CD      COLUMNS             CONTENTS...IMPLICATIONS, IF ANY              -
CD      =======     ======================================================
CD      1-2         03                                                   -
CD                                                                       -
CD      7-18        EMW, MW ELECTRICAL (DEFAULT=1000.0)                  -
CD                                                                       -
CD      19-30       THMW, MW THERMAL (DEFAULT=2740.0)                    -
CD                                                                       -
CD      31-42       CF, PLANT CAPACITY FACTOR IN PER CENT (DEFAULT=75.0) -
CD                                                                       -
CD      43-54       FPD, CYCLE LENGTH, FULL POWER DAYS (DEFAULT=273.75)  -
CD                                                                       -
CD      55-60       NPOW, RATIO OF ACTUAL POWER TO POWER USED FOR MASS   -
CD                  FLOW CALCULATION (DEFAULT=2)                         -
CD                                                                       -
CD      61-66       NZONE, NUMBER OF REACTOR ZONES USED FOR MASS FLOW    -
CD                  EDITS,  THE STANDARD ZONES ARE CORE, AXIAL BLANKET,  -
CD                  RADIAL BLANKET, AND INTERNAL BLANKET.  NZONE SHOULD  -
CD                  BE SET TO 3 UNLESS THERE ARE INTERNAL BLANKETS, IN   -
CD                  WHICH CASE NZONE SHOULD BE SET TO 4. (DEFAULT=3)     -
C                                                                        -
C-------------------------------------------------------------------------


C-------------------------------------------------------------------------
C                                                                        -
CR           FUEL RESIDENCE DETAILS (TYPE 04)                            -
C                                                                        -
CL      FORMAT-----(I2,4X,6I6)                                           -
C                                                                        -
CD      COLUMNS             CONTENTS...IMPLICATIONS, IF ANY              -
CD      =======     ======================================================
CD      1-2         04                                                   -
CD                                                                       -
CD      7-12        NC, CORE RESIDENCE, NUMBER OF CYCLES (DEFAULT=2)     -
CD                                                                       -
CD      13-18       NRB, RADIAL BLANKET RESIDENCE, NUMBER OF CYCLES      -
CD                       (DEFAULT=5)                                     -
CD                                                                       -
CD      19-24       NIB, INNER BLANKET RESIDENCE, NUMBER OF CYCLES       -
CD                       (DEFAULT=0)                                     -
CD                                                                       -
CD      25-30       NFERAB, AXIAL BLANKET FERTILE TYPE, 0...URANIUM,     -
CD                  1...THORIUM (DEFAULT=0)                              -
CD                                                                       -
CD      31-36       NFERRB, RADIAL BLANKET FERTILE TYPE, 0...URANIUM,    -
CD                  1...THORIUM (DEFAULT=0)                              -
CD                                                                       -
```

Figure 12. BCD Dataset A.MASFLO (cont'd.)

```
CD     37-42      NFERIB, INNER BLANKET FERTILE TYPE, 0...URANIUM,        -
CD                1...THORIUM (DEFAULT=0)                                 -
C                                                                         -
C-------------------------------------------------------------------------


C-------------------------------------------------------------------------
C                                                                         -
CR           EXTERNAL SPECIFICATIONS (TYPE 05)                            -
C                                                                         -
CL      FORMAT-----(I2,4X,3E12.6,I6)                                      -
C                                                                         -
CD     COLUMNS             CONTENTS...IMPLICATIONS, IF ANY                -
CD     =======    =========================================================-
CD     1-2        05                                                      -
CD                                                                        -
CD     7-18       EXT, EXTERNAL CYCLE TIME IN CALENDAR YEARS              -
CD                (DEFAULT=1.0)                                           -
CD                                                                        -
CD     19-30      FLOSS, FRACTIONAL LOSS IN REPROCESSING (DEFAULT=0.02)   -
CD                                                                        -
CD     31-42      EU235, U-235 FRACTION IN FERTILE URANIUM                -
CD                (DEFAULT=0.002)                                         -
CD                                                                        -
CD     43-48      NFIS, 0...U-235 NOT INCLUDED IN FISSILE DEFINITION,     -
CD                      1...U-235 INCLUDED IN FISSILE DEFINITION          -
CD                (DEFAULT=1)                                             -
C                                                                         -
C-------------------------------------------------------------------------


C-------------------------------------------------------------------------
C                                                                         -
CR           BREEDING RATIO SPECIFICATIONS (TYPE 06)                      -
C                                                                         -
CL     FORMAT------(I2,4X,4E12.6)                                         -
C                                                                         -
CD     COLUMNS             CONTENTS...IMPLICATIONS, IF ANY                -
CD     =======    =========================================================-
CD     1-2        06                                                      -
CD                                                                        -
CD     7-18       CORE BREEDING RATIO                                     -
CD                                                                        -
CD     19-30      AXIAL BLANKET BREEDING RATIO                            -
CD                                                                        -
CD     31-42      RADIAL BLANKET BREEDING RATIO                           -
CD                                                                        -
CD     43-54      INTERNAL BLANKET BREEDING RATIO                         -
C                                                                         -
```

Figure 12. BCD Dataset A.MASFLO (cont'd.)

```
CN               IF CARD TYPES 09 AND/OR TYPE 10 CONTAIN DATA FOR PA233,-
CN               THE INPUT BREEDING RATIOS WILL BE MODIFIED BY          -
CN               ASSUMING THAT ALL OF THE PA233 MASS CORRESPONDS TO     -
CN               U-233                                                  -
C                                                                       -
C------------------------------------------------------------------------


C------------------------------------------------------------------------
C                                                                       -
CR           POWER SPLIT SPECIFICATIONS (TYPE 07)                       -
C                                                                       -
CL     FORMAT-----(I2,4X,4E12.6)                                        -
C                                                                       -
CD     COLUMNS             CONTENTS...IMPLICATIONS, IF ANY              -
CD     =======   ===================================================== -
CD     1-2       07                                                     -
CD                                                                      -
CD     7-18      PER CENT OF POWER IN THE CORE                          -
CD                                                                      -
CD     19-30     PER CENT OF POWER IN THE AXIAL BLANKET                 -
CD                                                                      -
CD     31-42     PER CENT OF POWER IN THE RADIAL BLANKET                -
CD                                                                      -
CD     43-54     PER CENT OF POWER IN THE INTERNAL BLANKET              -
C                                                                       -
C------------------------------------------------------------------------


C------------------------------------------------------------------------
C                                                                       -
CR           HEAVY METAL SPECIFICATIONS (TYPE 08)                       -
C                                                                       -
CL     FORMAT-----(I2,4X,4E12.6)                                        -
C                                                                       -
CD     COLUMNS             CONTENTS...IMPLICATIONS, IF ANY              -
CD     =======   ===================================================== -
CD     1-2       08                                                     -
CD                                                                      -
CD     7-18      KG OF HEAVY METAL IN THE CORE                          -
CD                                                                      -
CD     19-30     KG OF HEAVY METAL IN THE AXIAL BLANKET                 -
CD                                                                      -
CD     31-42     KG OF HEAVY METAL IN THE RADIAL BLANKET                -
CD                                                                      -
CD     43-54     KG OF HEAVY METAL IN THE INTERNAL BLANKET              -
C                                                                       -
C------------------------------------------------------------------------
```

Figure 12. BCD Dataset A.MASFLO (cont'd.)

```
C-----------------------------------------------------------------------
C                                                                      -
CR           BEGINNING OF EQUILIBRIUM CYCLE MASSES (TYPE 09)           -
C                                                                      -
CL     FORMAT-----(I2,4X,A6,4E12.6)                                    -
C                                                                      -
CD     COLUMNS            CONTENTS...IMPLICATIONS, IF ANY              -
CD     =======    ======================================================-
CD     1-2        09                                                   -
CD                                                                     -
CD     7-12       ABSOLUTE ISOTOPE LABEL                               -
CD                                                                     -
CD     13-24      NUMBER OF KG IN THE CORE AT THE BEGINNING OF         -
CD                EQUILIBRIUM CYCLE FOR THE ISOTOPE IN COLS. 7-12      -
CD                                                                     -
CD     25-36      NUMBER OF KG IN THE AXIAL BLANKET AT THE BEGINNING OF -
CD                EQUILIBRIUM CYCLE FOR THE ISOTOPE IN COLS. 7-12      -
CD                                                                     -
CD     37-48      NUMBER OF KG IN THE RADIAL BLANKET AT THE BEGINNING OF -
CD                EQUILIBRIUM CYCLE FOR THE ISOTOPE IN COLS. 7-12      -
CD                                                                     -
CD     49-60      NUMBER OF KG IN THE INTERNAL BLANKET AT THE BEGINNING -
CD                EQUILIBRIUM CYCLE FOR THE ISOTOPE IN COLS. 7-12      -
C                                                                      -
CN                LABELS GIVEN IN COLS. 7-12 ON THE TYPE 09 CARDS MUST -
CN                CORRESPOND TO LABELS SUPPLIED ON THE TYPE 02 CARDS OR -
CN                TO ONE OF THE STANDARD LABELS (SEE CARD TYPE 02).  NOTE-
CN                THAT AT THIS TIME, THE MASS FLOW SUMMARY WILL EDIT DATA-
CN                ONLY FOR ISOTOPES 1-7, AND 10-14.                    -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
C                                                                      -
CR           END OF EQUILIBRIUM CYCLE MASSES (TYPE 10)                 -
C                                                                      -
CL     FORMAT-----(I2,4X,A6,4E12.6)                                    -
C                                                                      -
CD     COLUMNS            CONTENTS...IMPLICATIONS, IF ANY              -
CD     =======    ======================================================-
CD     1-2        10                                                   -
CD                                                                     -
CD     7-12       ABSOLUTE ISOTOPE LABEL                               -
CD                                                                     -
CD     13-24      NUMBER OF KG IN THE CORE AT THE END OF               -
CD                EQUILIBRIUM CYCLE FOR THE ISOTOPE IN COLS. 7-12      -
CD                                                                     -
```

Figure 12. BCD Dataset A.MASFLO (cont'd.)

```
CD    25-36    NUMBER OF KG IN THE AXIAL BLANKET AT THE END OF       -
CD             EQUILIBRIUM CYCLE FOR THE ISOTOPE IN COLS. 7-12       -
CD                                                                   -
CD    37-48    NUMBER OF KG IN THE RADIAL BLANKET AT THE END OF      -
CD             EQUILIBRIUM CYCLE FOR THE ISOTOPE IN COLS. 7-12       -
CD                                                                   -
CD    49-60    NUMBER OF KG IN THE INTERNAL BLANKET AT THE END OF    -
CD             EQUILIBRIUM CYCLE FOR THE ISOTOPE IN COLS. 7-12       -
C                                                                    -
CN             LABELS GIVEN IN COLS. 7-12 ON THE TYPE 10 CARDS MUST  -
CN             CORRESPOND TO LABELS SUPPLIED ON THE TYPE 02 CARDS OR -
CN             TO ONE OF THE STANDARD LABELS (SEE CARD TYPE 02).  NOTE-
CN             THAT AT THIS TIME, THE MASS FLOW SUMMARY WILL EDIT DATA-
CN             ONLY FOR ISOTOPES 1-7, AND 10-14.                     -
C                                                                    -
C---------------------------------------------------------------------


C---------------------------------------------------------------------
C                                                                    -
CR          CORE FEED SPECIFICATIONS (TYPE 11)                       -
C                                                                    -
CL    FORMAT-----(I2,4X,3(A6,E12.6))                                 -
C                                                                    -
CD    COLUMNS          CONTENTS...IMPLICATIONS, IF ANY               -
CD    =======  ======================================================-
CD    1-2      11                                                    -
CD                                                                   -
CD    7-12     ABSOLUTE ISOTOPE LABEL                                -
CD                                                                   -
CD    13-24    NUMBER OF KG OF CORE FEED AT THE BEGINNING OF         -
CD             EQUILIBRIUM CYCLE FOR THE ISOTOPE IN COLS. 7-12       -
CD                                                                   -
CD    25-20    ABSOLUTE ISOTOPE LABEL                                -
CD                                                                   -
CD    31-42    NUMBER OF KG OF CORE FEED AT THE BEGINNING OF         -
CD             EQUILIBRIUM CYCLE FOR THE ISOTOPE IN COLS. 25-30      -
CD                                                                   -
CD    43-48    ABSOLUTE ISOTOPE LABEL                                -
CD                                                                   -
CD    49-60    NUMBER OF KG OF CORE FEED AT THE BEGINNING OF         -
CD             EQUILIBRIUM CYCLE FOR THE ISOTOPE IN COLS. 43-48      -
C                                                                    -
CN             LABELS GIVEN IN COLS. 7-12, 25-30, AND 43-48 ON THE   -
CN             TYPE 11 CARDS MUST CORRESPOND TO LABELS SUPPLIED ON THE-
CN             TYPE 02 CARDS OR TO ONE OF THE STANDARD LABELS (SEE   -
CN             CARD TYPE 02).  NOTE THAT AT THIS TIME, THE MASS FLOW -
CN             SUMMARY WILL EDIT DATA ONLY FOR ISOTOPES 1-7, AND     -
CN             10-14.                                                -
```

Figure 12. BCD Dataset A.MASFLO (cont'd.)

```
C                                                                       -
C-----------------------------------------------------------------------

CEOF
```

Figure 12. BCD Dataset A.MASFLO (cont'd.)

Appendix E

BCD DATASET A.NIP3

The BCD dataset A.NIP3 listed in Figure 13 specifies the user input for the general neutronics modeling used by the various neutronics options available to the REBUS-3 code. Dataset A.NIP3 is used by the finite difference[6] and nodal[10] options of the neutronics portion of the REBUS-3 code and by the spatial flux synthesis option[7] as well.

Note that the data supplied in cols. 37-42, 49-54, and 55-60 on card type 02 can instead be provided in cols. 7-12, 31-36, and 19-24, respectively on card type 02 of dataset A.HMG4C.

Either the formats specified in Figure 13 or the free format option indicated in Appendix I may be used for dataset A.NIP3.

The user should see Ref. 6 for further details concerning the use of dataset A.NIP3.

```
C**********************************************************************-
C                                                                      -
C                       PREPARED 8/28/75 AT ANL                        -
C                       LAST REVISED 03/25/82                          -
C                                                                      -
CF          A.NIP3                                                     -
CE          NEUTRONICS MODEL INPUT FOR CODES WHICH REQUIRE CCCC        -
CE          INTERFACE FILES                                            -
C                                                                      -
CN                      THIS BCD DATA SET MAY BE WRITTEN EITHER        -
CN                      IN FREE FORMAT (UNFORM=A.NIP3) OR ACCORDING TO -
CN                      THE FORMATS SPECIFIED FOR EACH CARD TYPE       -
CN                      (DATASET=A.NIP3).                              -
CN                                                                     -
CN                      COLUMNS 1-2 MUST CONTAIN THE CARD TYPE         -
CN                      NUMBER.                                        -
CN                                                                     -
CN                      UNLESS OTHERWISE STATED, BLANKS ARE NOT        -
CN                      MEANINGFUL IN A6 LABEL FIELDS.                 -
C                                                                      -
C                                                                      -
CN                ***  CARD TYPE DIRECTORY  ***                        -
CN                                                                     -
CN    TYPE                    CONTENTS                                 -
CN    ====    =====================================================    -
CN     01     PROBLEM TITLE                                            -
CN     02     INPUT PROCESSING SPECIFICATIONS                          -
CN     03     PROBLEM GEOMETRY                                         -
CN     04     EXTERNAL BOUNDARY CONDITIONS                             -
CN     05     EXTERNAL BOUNDARY CONDITION CONSTANTS                    -
CN     06     REGION BOUNDARIES FOR ORTHOGONAL GEOMETRIES              -
CN     07     AREA SPECIFICATIONS                                      -
CN     09     VARIABLE-MESH STRUCTURE                                  -
CN     10     INTERNAL BLACK ABSORBER CONDITIONS                       -
CN     11     INTERNAL BLACK ABSORBER CONDITION CONSTANTS              -
CN     12     FINITE-GEOMETRY TRANSVERSE DISTANCES                     -
CN     13     MATERIAL SPECIFICATIONS                                  -
CN     14     COMPOSITION (ZONE) SPECIFICATIONS                        -
CN     15     REGION/COMPOSITION CORRESPONDENCE                        -
CN     19     REGION OR MESH DISTRIBUTED INHOMOGENEOUS SOURCE          -
CN     21     SEARCH EDIT OPTIONS AND CONVERGENCE CRITERIA             -
CN     22     SEARCH PARAMETER DATA                                    -
CN     23     CONCENTRATION MODIFIERS FOR CRITICALITY SEARCH           -
CN     24     MESH MODIFIERS FOR CRITICALITY SEARCH                    -
CN     25     BUCKLING MODIFIERS FOR CRITICALITY SEARCH                -
CN     26     ALPHA MODIFIERS FOR CRITICALITY SEARCH                   -
CN     29     HEXAGON DIMENSION                                        -
CN     30     REGION DEFINITIONS FOR ARRAYS OF HEXAGONS                -
CN     31     BACKGROUND REGION FOR ARRAYS OF HEXAGONS                 -
```

Figure 13. BCD Dataset A.NIP3

```
CN      34      COMPOSITION- AND GROUP-DEPENDENT BUCKLINGS                      -
CN      35      DIRECTIONAL DIFFUSION COEF. SCHEME                              -
CN      36      DIRECTIONAL DIFFUSION COEF./COMPOSITION CORRESPONDENCE          -
CN      37      FISSION ENERGY CONVERSION FACTORS                               -
CN      38      CAPTURE ENERGY CONVERSION FACTORS                               -
CN      39      NUCLIDE SET ASSIGNMENTS                                         -
CN      40      SOURCE EDIT, SYNTHESIS TRIAL FUNCTION SOURCE                    -
CN      41      NATURAL DECAY INHOMOGENEOUS SOURCE                              -
CN      42      SOURCE SPECTRA                                                  -
CN      43      GRAPHICS OUTPUT CONTROL                                         -
C                                                                               -
C*******************************************************************************-


C--------------------------------------------------------------------------------
CR         PROBLEM TITLE (TYPE 01)                                              -
C                                                                               -
CL    FORMAT-----(I2,4X,11A6)                                                   -
C                                                                               -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                         -
CD    =======   =======================================================-
CD    1-2       01                                                              -
CD                                                                              -
CD    7-72      ANY ALPHANUMERIC CHARACTERS.                                    -
C                                                                               -
CN              ANY NUMBER OF TYPE 01 CARDS MAY BE USED.                        -
C                                                                               -
C--------------------------------------------------------------------------------


C--------------------------------------------------------------------------------
CR         INPUT PROCESSING SPECIFICATION (TYPE 02)                             -
C                                                                               -
CL    FORMAT-----(I2,10X,8I6)                                                   -
C                                                                               -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                         -
CD    =======   =======================================================-
CD    1-2       02                                                              -
CD                                                                              -
CD    13-18     POINTR DEBUGGING EDIT FOR GEOMETRY PROCESSING MODULE.           -
CD              0...NO DEBUGGING PRINTOUT (DEFAULT).                            -
CD              1...DEBUGGING DUMP PRINTOUT.                                    -
CD              2...DEBUGGING TRACE PRINTOUT.                                   -
CD              3...FULL DEBUGGING PRINTOUT (DUMP+TRACE).                       -
CD                                                                              -
CD    19-24     GEOMETRY PROCESSING MODULE EDIT.                                -
CD              0...NO EDITS (DEFAULT).                                         -
CD              1...PRINT GEOMETRY EDITS.                                       -
CD              2...WRITE GEOMETRY EDITS TO AUXILIARY OUTPUT FILE.              -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CD                 3...GEOMETRY EDITS GO TO BOTH PRINT AND AUXILIARY   -
CD                     OUTPUT FILES.                                   -
CD                                                                     -
CD                 OPTIONS 2 AND 3 ARE OPERATIVE ONLY FOR THOSE CODES  -
CD                 WHICH RECOGNIZE AUXILIARY OUTPUT FILES.             -
CD                                                                     -
CD      25-30      SIZE OF MAIN CORE STORAGE ARRAY FOR GEOMETRY        -
CD                 PROCESSING MODULE (GNIP4C) IN REAL*8 WORDS          -
CD                 (DEFAULT=10000).                                    -
CD                                                                     -
CD      31-36      SIZE OF BULK CORE STORAGE ARRAY FOR GEOMETRY        -
CD                 PROCESSING MODULE (GNIP4C) IN REAL*8 WORDS          -
CD                 (DEFAULT=0).                                        -
CD                                                                     -
CD      37-42      SIZE OF MAIN CORE STORAGE ARRAY FOR CROSS SECTION   -
CD                 PROCESSING MODULES IN REAL*8 WORDS (DEFAULT = 20000). -
CD                                                                     -
CD      43-48      SIZE OF BULK CORE STORAGE ARRAY FOR CROSS SECTION   -
CD                 PROCESSING MODULES IN REAL*8 WORDS (DEFAULT=0).     -
CD                                                                     -
CD      49-54      POINTR DEBUGGING EDIT FOR CROSS SECTION PROCESSING  -
CD                 MODULES.                                            -
CD                 0...NO DEBUGGING PRINTOUT (DEFAULT).                -
CD                 1...DEBUGGING DUMP PRINTOUT.                        -
CD                 2...DEBUGGING TRACE PRINTOUT.                       -
CD                 3...FULL DEBUGGING PRINTOUT (DUMP+TRACE).           -
CD                                                                     -
CD      55-60      CROSS SECTION PROCESSING EDIT.                      -
CD                 0...NO EDITS (DEFAULT).                             -
CD                 1...PRINT CROSS SECTION EDITS.                      -
CD                 2...WRITE CROSS SECTION EDITS TO AUXILIARY OUTPUT FILE.-
CD                 3...CROSS SECTION EDITS GO TO BOTH PRINT AND AUXILIARY -
CD                     OUTPUT FILES.                                   -
CD                                                                     -
CD      61-66      REGION/MESH INTERVAL PRINTER-PLOTTER MAP EDIT DURING -
CD                 GEOMETRY PROCESSING.                                -
CD                 0...NO MAP (DEFAULT).                               -
CD                 1...PRINT REGION MAP.                               -
CD                 2...WRITE REGION MAP TO AUXILIARY OUTPUT FILE.      -
CD                 3...WRITE REGION MAP TO BOTH PRINT AND AUXILIARY OUTPUT-
CD                     FILES.                                          -
CD                                                                     -
CD      67-72      ZONE(COMPOSITION)/MESH INTERVAL PRINTER-PLOTTER MAP -
CD                 EDIT DURING GEOMETRY PROCESSING.                    -
CD                 0...NO MAP (DEFAULT).                               -
CD                 1...PRINT ZONE MAP.                                 -
CD                 2...WRITE ZONE MAP TO AUXILIARY OUTPUT FILE.        -
CD                 3...WRITE ZONE MAP TO BOTH PRINT AND AUXILIARY OUTPUT -
CD                     FILES.                                          -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CD                                                                      -
CN              EDIT OPTIONS 2 AND 3 ARE OPERATIVE ONLY FOR THOSE       -
CN              CODES WHICH RECOGNIZE AUXILIARY OUTPUT FILES.           -
CN                                                                      -
CN              THE PRINTER-PLOTTER MAP OPTIONS (COLS. 61-72) ARE       -
CN              ENTIRELY SEPARATE FROM THE GRAPHICS MAP OPTIONS         -
CN              IN COLS. 7-48 OF THE TYPE 43 CARD.                      -
C                                                                       -
C------------------------------------------------------------------------


C------------------------------------------------------------------------
CR          PROBLEM GEOMETRY SPECIFICATION (TYPE 03)                    -
C                                                                       -
CL    FORMAT-----(I2,10X,I6)                                            -
C                                                                       -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY.                -
CD    =======   ========================================================-
CD    1-2       03                                                      -
CD                                                                      -
CD    13-18     GEOMETRY TYPE.                                          -
CD              10...SLAB                                               -
CD              20...CYLINDER                                           -
CD              30...SPHERE                                             -
CD              40...X-Y                                                -
CD              44...X-Y-Z                                              -
CD              50...R-Z                                                -
CD              60...R-THETA                                            -
CD              62...R-THETA-Z                                          -
CD              64...THETA-R                                            -
CD              66...THETA-R-Z                                          -
CD              70...TRIANGULAR, RHOMBIC BOUNDARY, CORE CENTER AT       -
CD                   60 DEGREE ANGLE (SIXTH CORE SYMMETRY).             -
CD              72...TRIANGULAR, RECTANGULAR BOUNDARY, HALF CORE        -
CD                   SYMMETRY.                                          -
CD              74...TRIANGULAR, RHOMBIC BOUNDARY, CORE CENTER AT       -
CD                   120 DEGREE ANGLE (THIRD CORE SYMMETRY).            -
CD              76...TRIANGULAR, 60 DEGREE TRIANGULAR BOUNDARY,         -
CD                   SIXTH CORE SYMMETRY.                               -
CD              78...TRIANGULAR, RECTANGULAR BOUNDARY, QUARTER          -
CD                   CORE SYMMETRY.                                     -
CD              80...TRIANGULAR, RECTANGULAR BOUNDARY, FULL CORE.       -
CD              90...TRIANGULAR-Z, RHOMBIC BOUNDARY IN PLANE, CORE      -
CD                   CENTER LINE AT 60 DEGREE ANGLE.                    -
CD              92...TRIANGULAR-Z, RECTANGULAR BOUNDARY IN PLANE,       -
CD                   HALF CORE SYMMETRY IN PLANE.                       -
CD              94...TRIANGULAR-Z, RHOMBIC BOUNDARY IN PLANE, CORE      -
CD                   CENTER LINE AT 120 DEGREE ANGLE.                   -
CD              96...TRIANGULAR-Z, 60 DEGREE TRIANGULAR BOUNDARY        -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CD                    IN PLANE.                                        -
CD                 98...TRIANGULAR-Z, RECTANGULAR BOUNDARY IN PLANE,   -
CD                      QUARTER CORE SYMMETRY IN PLANE.                -
CD                100...TRIANGULAR-Z, RECTANGULAR BOUNDARY IN PLANE,   -
CD                      FULL CORE IN PLANE.                            -
CD                110...HEXAGONAL, FULL CORE.                          -
CD                114...HEXAGONAL, SIXTH CORE SYMMETRY.                -
CD                116...HEXAGONAL, THIRD CORE SYMMETRY.                -
CD                120...HEXAGONAL-Z, FULL CORE IN PLANE.               -
CD                124...HEXAGONAL-Z, SIXTH CORE SYMMETRY IN PLANE.     -
CD                126...HEXAGONAL-Z, THIRD CORE SYMMETRY IN PLANE.     -
CD                                                                     -
C                                                                      -
CN                 THE HEXAGONAL AND HEXAGONAL-Z GEOMETRY OPTIONS MAY  -
CN                 NOT BE AVAILABLE IN ALL VERSIONS OF DIF3D.          -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR             EXTERNAL BOUNDARY CONDITIONS (TYPE 04)                  -
C                                                                      -
CL    FORMAT-----(I2,10X,6I6)                                          -
C                                                                      -
CD    COLUMNS             CONTENTS...IMPLICATIONS, IF ANY              -
CD    =======     ======================================================-
CD    1-2         04                                                   -
CD                                                                     -
CD    13-18       BOUNDARY CONDITION AT LOWER "X" BOUNDARY OF REACTOR. -
CD                                                                     -
CD    19-24       BOUNDARY CONDITION AT UPPER "X" BOUNDARY OF REACTOR. -
CD                                                                     -
CD    25-30       BOUNDARY CONDITION AT LOWER "Y" BOUNDARY OF REACTOR. -
CD                                                                     -
CD    31-36       BOUNDARY CONDITION AT UPPER "Y" BOUNDARY OF REACTOR. -
CD                                                                     -
CD    37-42       BOUNDARY CONDITION AT LOWER Z BOUNDARY OF REACTOR.   -
CD                                                                     -
CD    43-48       BOUNDARY CONDITION AT UPPER Z BOUNDARY OF REACTOR.   -
CD                                                                     -
CD                                                                     -
CD                2...PHI=0.                                           -
CD                3...PHI PRIME=0.                                     -
CD                4...D * PHI PRIME + A * PHI = 0.                     -
CD                6...REPEATING (PERIODIC) WITH OPPOSITE FACE.         -
CD                7...REPEATING (PERIODIC) WITH NEXT ADJACENT BOUNDARY -
CD                    (SEE DISCUSSION BELOW).                          -
CD                8...INVERTED REPEATING ALONG THIS FACE               -
CD                    (180 DEGREE ROTATION).                           -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CD                 9...INCOMING ANGULAR FLUX ZERO (TRANSPORT ONLY).     -
CD                 10..REFLECTIVE (TRANSPORT ONLY).                     -
CD                 11..PERIODIC (TRANSPORT ONLY).                       -
CD                 12..WHITE (TRANSPORT ONLY).                          -
CD                                                                      -
C                                                                       -
CN                 PHI PRIME IS THE DERIVATIVE OF THE FLUX IN THE       -
CN                 DIRECTION OF THE REACTOR OUTWARD NORMAL. D IS THE    -
CN                 DIFFUSION COEFFICIENT IN THE MESH INTERVAL           -
CN                 IMMEDIATELY INSIDE THE REACTOR BOUNDARY. IF COLS.    -
CN                 43-48 ARE 4 AND NO TYPE 05 CARD IS SUPPLIED TO SPECIFY -
CN                 THE CONSTANT A, THE VALUE 0.46920 WILL BE USED BY    -
CN                 DEFAULT.                                             -
CN                                                                      -
CN                 CONDITIONS 2-8 APPLY TO DIFFUSION THEORY PROBLEMS,   -
CN                 AND 9-12 APPLY TO TRANSPORT THEORY PROBLEMS.         -
CN                                                                      -
CN                 "X" REPRESENTS THE FIRST DIMENSION COORDINATE (X IN  -
CN                 X-Y GEOMETRY, R IN R-Z, ETC.). "Y" REPRESENTS THE    -
CN                 SECOND DIMENSION COORDINATE (Y IN X-Y GEOMETRY, Z IN -
CN                 R-Z, ETC.). WHEN THE MODEL IS THREE-DIMENSIONAL, THE -
CN                 THIRD DIMENSION IS ALWAYS Z.                         -
CN                                                                      -
CN                 REPEATING CONDITIONS (6,7,8) ARE ONLY APPLICABLE TO  -
CN                 THE FIRST TWO DIMENSIONS.                            -
CN                                                                      -
CN                 NOTE FOR REPEATING CONDITION 7.  LET XL DENOTE THE   -
CN                 LOWER "X" BOUNDARY, XU DENOTE THE UPPER "X" BOUNDARY, -
CN                 YL DENOTE THE LOWER "Y" BOUNDARY AND YU DENOTE THE   -
CN                 UPPER Y BOUNDARY.  FOR REPEATING BOUNDARY CONDITIONS -
CN                 (CONDITION 7), THE SEQUENCE OF BOUNDARIES IMPLIED BY -
CN                 THE TERM "NEXT ADJACENT BOUNDARY" IS XL, YL, XU, YU. -
CN                 OF THE TWO BOUNDARIES INVOLVED, THE ONE APPEARING    -
CN                 FIRST IN THE SEQUENCE IS ASSIGNED THE BOUNDARY       -
CN                 CONDITION (7), THE SECOND IS IGNORED.  FOR EXAMPLE,  -
CN                 IF XL AND YL ARE THE PERIODIC BOUNDARIES, COLS. 13-18 -
CN                 MUST CONTAIN A 7, COLS. 25-30 WILL BE IGNORED.       -
C                                                                       -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR             EXTERNAL BOUNDARY CONDITION CONSTANTS (TYPE 05)          -
C                                                                       -
CL      FORMAT-----(I2,8X,A2,E12.5,12X,2I6)                             -
C                                                                       -
CD      COLUMNS     CONTENTS...IMPLICATIONS, IF ANY                     -
CD      =======    =================================================-
CD      1-2        05                                                   -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CD                                                                 -
CD    11-12      BOUNDARY DESIGNATOR.                              -
CD               XL..."X" LOWER.                                   -
CD               XU..."X" UPPER.                                   -
CD               YL..."Y" LOWER.                                   -
CD               YU..."Y" UPPER.                                   -
CD               ZL...Z LOWER.                                     -
CD               ZU...Z UPPER.                                     -
CD                                                                 -
CD    13-24      VALUE OF CONSTANT A REFERRED TO ON CARD TYPE 04.  -
CD                                                                 -
CD    37-42      HIGHER-ENERGY GROUP NUMBER FOR WHICH CONSTANTS APPLY. -
CD                                                                 -
CD    43-48      LOWER-ENERGY GROUP NUMBER FOR WHICH CONSTANTS APPLY.  -
C                                                                  -
CN               AS MANY TYPE 05 CARDS AS NECESSARY MAY BE USED TO -
CN               SPECIFY THE EXTERNAL BOUNDARY CONDITIONS.         -
CN                                                                 -
CN               IF NO "HIGHER-ENERGY GROUP NUMBER" IS SUPPLIED (COLS. -
CN               37-42 ARE BLANK), THE CONSTANTS GIVEN APPLY TO ALL -
CN               ENERGY GROUPS. IF NO "LOWER-ENERGY GROUP NUMBER" IS -
CN               SUPPLIED (COLS. 43-48 ARE BLANK), THE CONSTANTS GIVEN -
CN               APPLY TO THE "HIGHER-ENERGY GROUP" ONLY. IF NO GROUP -
CN               NUMBERS ARE SUPPLIED (COLS. 37-48 ARE BLANK), THE -
CN               CONSTANTS GIVEN APPLY TO ALL ENERGY GROUPS.       -
CN                                                                 -
CN               DATA ON THIS CARD MAY BE OVERLAYED. THAT IS, BOUNDARY -
CN               CONSTANTS DEFINED ON LATER TYPE 5 CARDS SUPERCEDE DATA -
CN               FOR ENERGY RANGES PREVIOUSLY SPECIFIED.           -
CN                                                                 -
CN               "X" REPRESENTS THE FIRST DIMENSION COORDINATE (X IN -
CN               SECOND DIMENSION COORDINATE (Y IN X-Y GEOMETRY, Z IN -
CN               X-Y GEOMETRY, R IN R-Z, ETC.). "Y" REPRESENTS THE -
CN               R-Z, ETC.). WHEN THE MODEL IS THREE-DIMENSIONAL, THE -
CN               THIRD DIMENSION IS ALWAYS Z.                      -
C                                                                  -
C-------------------------------------------------------------------


C-------------------------------------------------------------------
CR          REGION BOUNDARY COORDINATES AND CONSTANT MESH STRUCTURE -
CR          (TYPE 06)                                              -
C                                                                  -
CL    FORMAT-----(I2,4X,A6,2E12.5,2I6,2E12.5)                      -
C                                                                  -
CD    COLUMNS            CONTENTS...IMPLICATIONS, IF ANY           -
CD    =======    ===================================================-
CD    1-2        06                                                -
CD                                                                 -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CD    7-12      REGION LABEL (REPEATED ON ADDITIONAL TYPE 06 CARDS).   -
CD                                                                     -
CD    13-24     "X"-DIRECTION LOWER-BOUNDARY COORDINATE.               -
CD                                                                     -
CD    25-36     "X"-DIRECTION UPPER-BOUNDARY COORDINATE.               -
CD                                                                     -
CD    37-42     FOR ONE-DIMENSIONAL AND TWO-DIMENSIONAL GEOMETRIES,    -
CD              NUMBER OF INTERVALS IN "X"-DIRECTION.                  -
CD                                                                     -
CD                                     ** OR **                        -
CD                                                                     -
CD              FOR THREE-DIMENSIONAL GEOMETRIES, LOWER Z MESH         -
CD              LINE NUMBER OF THE REGION.                             -
CD                                                                     -
CD    43-48     FOR TWO-DIMENSIONAL GEOMETRIES, NUMBER OF INTERVALS    -
CD              IN "Y"-DIRECTION.                                      -
CD                                                                     -
CD                                     ** OR **                        -
CD                                                                     -
CD              FOR THREE-DIMENSIONAL GEOMETRIES, UPPER Z MESH         -
CD              LINE NUMBER OF THE REGION.                             -
CD                                                                     -
CD    49-60     "Y"-DIRECTION LOWER-BOUNDARY COORDINATE.               -
CD                                                                     -
CD    61-72     "Y"-DIRECTION UPPER-BOUNDARY COORDINATE.               -
C                                                                      -
CN              CARD TYPE 06 IS NOT PERTINENT FOR TRIANGULAR,          -
CN              TRIANGULAR-Z, HEXAGONAL, OR HEXAGONAL-Z GEOMETRIES.    -
CN              SEE CARD TYPE 30.                                      -
CN                                                                     -
CN              "X" REPRESENTS THE FIRST DIMENSION COORDINATE (X IN    -
CN              X-Y GEOMETRY, R IN R-Z, ETC.). "Y" REPRESENTS THE      -
CN              SECOND DIMENSION COORDINATE (Y IN X-Y GEOMETRY, Z IN   -
CN              R-Z, ETC.). WHEN THE MODEL IS THREE-DIMENSIONAL, THE   -
CN              THIRD DIMENSION IS ALWAYS Z.                           -
C                                                                      -
CN              IN GEOMETRIES INVOLVING AN ANGULAR DIMENSION (THETA)   -
CN              THE ANGULAR VARIABLE MUST BE GIVEN IN RADIANS.         -
CN                                                                     -
CN              REGIONS MAY BE DEFINED USING THE OVERLAY PRECEDURE,    -
CN              WITH THE LATEST REGION ASSIGNMENT OVERLAYING THE       -
CN              PREVIOUS CONFIGURATION, OR USING THE USUAL PROCEDURE,  -
CN              WITH EACH REGION'S BOUNDARIES GIVEN EXPLICITLY.        -
CN              REGION LABELS MUST BE NON-BLANK.                       -
CN                                                                     -
CN              THE MESH FOR A DIRECTION MUST BE COMPLETELY SPECIFIED  -
CN              EITHER ON THE TYPE 06 OR 09 CARDS. IF MESH DATA ARE    -
CN              SUPPLIED ON BOTH TYPE 06 AND 09 CARDS, THE TYPE 09     -
CN              DATA WILL BE USED.                                     -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CN                                                                     -
CN              FOR ONE-DIMENSIONAL PROBLEMS, ONLY THE "X"-DIRECTION   -
CN              UPPER BOUNDARIES NEED BE GIVEN FOR REGIONS AFTER THE   -
CN              FIRST.  IF THIS OPTION IS USED THE TYPE 6 CARDS MUST   -
CN              BE ARRANGED SO AS TO DEFINE REGIONS SEQUENTIALLY,      -
CN              MOVING FROM LEFT TO RIGHT.  IN OTHER WORDS THE         -
CN              X-DIRECTION UPPER BOUNDARIES MUST BE IN ASCENDING      -
CN              ORDER.                                                 -
CN                                                                     -
CN              FOR THREE-DIMENSIONAL GEOMETRIES, THE DEFINITION OF    -
CN              THE MESH STRUCTURE MUST BE SUPPLIED ON TYPE 09 CARDS.  -
CN                                                                     -
CN              THE LOWEST Z MESH LINE NUMBER (CORRESPONDING TO THE    -
CN              FIRST Z BOUNDARY) OF THE MODEL IS 0 (ZERO). THE        -
CN              LARGEST Z MESH LINE NUMBER (CORRESPONDING TO THE       -
CN              SECOND Z BOUNDARY) IS EQUAL TO THE NUMBER OF Z MESH    -
CN              INTERVALS.                                             -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          AREA SPECIFICATIONS (TYPE 07)                              -
C                                                                      -
CL    FORMAT-----(I2,4X,11A6)                                          -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       07                                                     -
CD                                                                     -
CD    7-12      AREA LABEL (REPEATED ON ADDITIONAL TYPE 07 CARDS).     -
CD                                                                     -
CD    13-18     LABEL OF REGION COMPRISING AREA.                       -
CD                                                                     -
CD    19-24     LABEL OF REGION COMPRISING AREA.                       -
CD                                                                     -
CD    25-30     LABEL OF REGION COMPRISING AREA.                       -
CD                                                                     -
CD    31-36     LABEL OF REGION COMPRISING AREA.                       -
CD                                                                     -
CD    37-42     LABEL OF REGION COMPRISING AREA.                       -
CD                                                                     -
CD    43-48     LABEL OF REGION COMPRISING AREA.                       -
CD                                                                     -
CD    49-54     LABEL OF REGION COMPRISING AREA.                       -
CD                                                                     -
CD    55-60     LABEL OF REGION COMPRISING AREA.                       -
CD                                                                     -
CD    61-66     LABEL OF REGION COMPRISING AREA.                       -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CD                                                                       -
CD    67-72     LABEL OF REGION COMPRISING AREA.                         -
C                                                                        -
CN              AREA LABELS MUST BE NON-BLANK. THE FIRST BLANK REGION    -
CN              LABEL ENCOUNTERED TERMINATES READING OF THE DATA ON      -
CN              THAT PARTICULAR TYPE 07 CARD. A REGION CAN BE PLACED     -
CN              IN AS MANY AREAS AS THE USER DESIRES.                    -
CN                                                                       -
CN              THE CONCEPT OF AREAS DOES NOT EXIST IN THE CCCC          -
CN              ENVIRONMENT. ONLY CERTAIN CODES WRITTEN AT ANL MAKE      -
CN              USE OF AREAS, AND IN THOSE CODES AREAS ARE USED FOR      -
CN              EDIT PURPOSES ONLY.                                      -
C                                                                        -
C-------------------------------------------------------------------------


C-------------------------------------------------------------------------
CR          VARIABLE-MESH STRUCTURE (TYPE 09)                            -
C                                                                        -
CL    FORMAT-----(I2,9X,A1,3(I6,E12.5))                                  -
C                                                                        -
CD    COLUMNS         CONTENTS...IMPLICATIONS, IF ANY                    -
CD    -------   --------------------------------------------------------------
CD    1-2       09                                                       -
CD                                                                       -
CD    12        COORDINATE DIRECTION.                                    -
CD              X..."X" COORDINATE DIRECTION.                            -
CD              Y..."Y" COORDINATE DIRECTION.                            -
CD              Z...Z-COORDINATE DIRECTION.                              -
CD                                                                       -
CD    13-18     NUMBER OF INTERVALS.                                     -
CD                                                                       -
CD    19-30     UPPER COORDINATE.                                        -
CD                                                                       -
CD    31-36     NUMBER OF INTERVALS.                                     -
CD                                                                       -
CD    37-48     UPPER COORDINATE.                                        -
CD                                                                       -
CD    49-54     NUMBER OF INTERVALS.                                     -
CD                                                                       -
CD    55-66     UPPER COORDINATE.                                        -
C                                                                        -
CN              NOTE THAT A Z IN COL. 12 IS PERTINENT ONLY IF THE        -
CN              GEOMETRY IS THREE-DIMENSIONAL.                           -
CN                                                                       -
CN              "X" REPRESENTS THE FIRST DIMENSION COORDINATE (X IN      -
CN              X-Y GEOMETRY, R IN R-Z, ETC.). "Y" REPRESENTS THE        -
CN              SECOND DIMENSION COORDINATE (Y IN X-Y GEOMETRY, Z IN     -
CN              R-Z, ETC.). WHEN THE MODEL IS THREE-DIMENSIONAL, THE     -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CN              THIRD DIMENSION IS ALWAYS Z.                           -
C                                                                      -
CN              IN GEOMETRIES INVOLVING AN ANGULAR DIMENSION (THETA)   -
CN              THE ANGULAR VARIABLE MUST BE GIVEN IN RADIANS.         -
CN                                                                     -
CN              EACH NUMBER PAIR IS OF THE FORM (N(I), X(I)). THERE    -
CN              ARE N(I) INTERVALS BETWEEN X(I-1) AND X(I), WHERE X(0) -
CN              IS THE LOWER REACTOR BOUNDARY IN THIS DIRECTION.       -
CN              NUMBER PAIRS MUST BE GIVEN IN ORDER OF INCREASING      -
CN              MESH COORDINATES. ALL REGION BOUNDARIES MUST COINCIDE  -
CN              WITH THE MESH LINES THAT BOUND MESH INTERVALS.         -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          INTERNAL BLACK ABSORBER CONDITIONS (TYPE 10)               -
C                                                                      -
CL    FORMAT-----(I2,10X,10A6)                                         -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       10                                                     -
CD                                                                     -
CD    13-18     LABEL OF COMPOSITION (CCCC ZONE) WHICH IS TO BE        -
CD              TREATED WITH INTERNAL BLACK BOUNDARY CONDITION.        -
CD                                                                     -
CD    19-24     LABEL OF COMPOSITION (CCCC ZONE) WHICH IS TO BE        -
CD              TREATED WITH INTERNAL BLACK BOUNDARY CONDITION.        -
CD                                                                     -
CD    25-30     LABEL OF COMPOSITION (CCCC ZONE) WHICH IS TO BE        -
CD              TREATED WITH INTERNAL BLACK BOUNDARY CONDITION.        -
CD                                                                     -
CD    31-36     LABEL OF COMPOSITION (CCCC ZONE) WHICH IS TO BE        -
CD              TREATED WITH INTERNAL BLACK BOUNDARY CONDITION.        -
CD                                                                     -
CD    37-42     LABEL OF COMPOSITION (CCCC ZONE) WHICH IS TO BE        -
CD              TREATED WITH INTERNAL BLACK BOUNDARY CONDITION.        -
CD                                                                     -
CD    43-48     LABEL OF COMPOSITION (CCCC ZONE) WHICH IS TO BE        -
CD              TREATED WITH INTERNAL BLACK BOUNDARY CONDITION.        -
CD                                                                     -
CD    49-54     LABEL OF COMPOSITION (CCCC ZONE) WHICH IS TO BE        -
CD              TREATED WITH INTERNAL BLACK BOUNDARY CONDITION.        -
CD                                                                     -
CD    55-60     LABEL OF COMPOSITION (CCCC ZONE) WHICH IS TO BE        -
CD              TREATED WITH INTERNAL BLACK BOUNDARY CONDITION.        -
CD                                                                     -
CD    61-66     LABEL OF COMPOSITION (CCCC ZONE) WHICH IS TO BE        -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CD              TREATED WITH INTERNAL BLACK BOUNDARY CONDITION.        -
CD                                                                     -
CD    67-72     LABEL OF COMPOSITION (CCCC ZONE) WHICH IS TO BE        -
CD              TREATED WITH INTERNAL BLACK BOUNDARY CONDITION.        -
C                                                                      -
CN              AS MANY TYPE 10 CARDS CAN BE USED AS ARE NECESSARY TO  -
CN              SPECIFY ALL OF THE DESIRED COMPOSITION (CCCC ZONE)     -
CN              LABELS.                                                -
CN                                                                     -
CN              EACH REGION WHICH IS COMPOSED OF ANY COMPOSITION       -
CN              LISTED ON TYPE 10 CARDS WILL BE TREATED AS A BLACK     -
CN              ABSORBER ACCORDING TO THE INTERNAL BOUNDARY CONDITIONS -
CN              GIVEN ON TYPE 11 CARDS TO FOLLOW.                      -
CN                                                                     -
CN              THE REGIONS WHICH ARE COMPRISED OF THESE COMPOSITIONS  -
CN              ARE SPECIFIED ON TYPE 15 CARDS.                        -
CN                                                                     -
CN              THE FIRST BLANK COMPOSITION LABEL TERMINATES READING   -
CN              OF THE DATA ON THAT PARTICULAR TYPE 10 CARD.           -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          INTERNAL BLACK ABSORBER CONDITION CONSTANTS                -
CR          (TYPE 11)                                                  -
C                                                                      -
CL    FORMAT-----(I2,10X,2E12.5,24X,2I6)                               -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    -------   ------------------------------------------------------ -
CD    1-2       11                                                     -
CD                                                                     -
CD    13-24     THE CONSTANT A, DEFINED BELOW.                         -
CD                                                                     -
CD    25-36     THE CONSTANT B, DEFINED BELOW.                         -
CD                                                                     -
CD    61-66     HIGHER-ENERGY GROUP NUMBER FOR WHICH CONSTANTS APPLY.  -
CD                                                                     -
CD    67-72     LOWER-ENERGY GROUP NUMBER FOR WHICH CONSTANTS APPLY.   -
C                                                                      -
CN              THE INTERNAL BLACK BOUNDARY CONDITION IS SPECIFIED AS  -
CN                                                                     -
CN                           A*PHI PRIME + B/D*PHI = 0.                -
CN                                                                     -
CN              IF NO "HIGHER-ENERGY GROUP NUMBER" IS SUPPLIED (COLS.  -
CN              61-66 ARE BLANK), THE CONSTANTS GIVEN APPLY TO ALL     -
CN              ENERGY GROUPS. IF NO "LOWER-ENERGY GROUP NUMBER" IS    -
CN              SUPPLIED (COLS. 67-72 ARE BLANK), THE CONSTANTS GIVEN  -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CN              APPLY TO THE "HIGHER-ENERGY GROUP" ONLY. IF NO GROUP   -
CN              NUMBERS ARE SUPPLIED (COLS. 61-72 ARE BLANK), THE      -
CN              CONSTANTS GIVEN APPLY TO ALL ENERGY GROUPS.            -
CN                                                                     -
CN              DATA ON THIS CARD MAY BE OVERLAYED. THAT IS, CONSTANTS -
CN              DEFINED ON LATER TYPE 11 CARDS SUPERCEDE DATA FOR      -
CN              ENERGY RANGES PREVIOUSLY SPECIFIED.                    -
CN                                                                     -
CN              ANY GROUP FOR WHICH NO INTERNAL BLACK ABSORBER         -
CN              CONDITION CONSTANTS ARE SPECIFIED ON TYPE 11 CARDS     -
CN              WILL BE TREATED AS BEING NON-BLACK.                    -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          FINITE-GEOMETRY TRANVERSE DISTANCES (TYPE 12)              -
C                                                                      -
CL    FORMAT-----(I2,4X,A6,4E12.5)                                     -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   ========================================================-
CD    1-2       12                                                     -
CD                                                                     -
CD    7-12      REGION OR AREA LABEL.                                  -
CD                                                                     -
CD    13-24     ACTUAL TRANSVERSE HALF-HEIGHT OR RADIUS.               -
CD                                                                     -
CD    25-36     TRANSVERSE EXTRAPOLATION DISTANCE.                     -
CD                                                                     -
CD    37-48     ACTUAL TRANSVERSE HALF-HEIGHT IN THE SECOND DIRECTION  -
CD              FOR A FINITE ONE-DIMENSIONAL RECTANGULAR SLAB.         -
CD                                                                     -
CD    49-60     TRANSVERSE EXTRAPOLATION DISTANCE IN THE SECOND        -
CD              DIRECTION FOR A FINITE ONE-DIMENSIONAL RECTANGULAR     -
CD              SLAB.                                                  -
C                                                                      -
CN              THE DATA ON THE TYPE 12 CARDS ARE USED TO CALCULATE    -
CN              REGION VOLUMES AND, IN THE ABSENCE OF TYPE 34 CARDS,   -
CN              BUCKLINGS.  REGION VOLUMES ARE CALCULATED USING        -
CN              ACTUAL HALF-HEIGHTS (EXCLUDING THE EXTRAPOLATION       -
CN              DISTANCE).                                             -
CN                                                                     -
CN              AN AREA LABEL IN COLS. 7-12 IMPLIES ALL THE REGIONS    -
CN              ASSIGNED TO THAT AREA.                                 -
CN                                                                     -
CN              THE REGION-DEPENDENT DATA THAT IS PROVIDED ON THIS     -
CN              CARD IS CONVERTED BY THE GNIP4C INPUT PROCESSOR TO     -
CN              COMPOSITION-DEPENDENT DATA.  THIS IS A POTENTIAL       -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CN              PROBLEM FOR USERS IF THEY HAVE ASSIGNED ONE            -
CN              COMPOSITION TO TWO OR MORE REGIONS WITH DIFFERENT      -
CN              HALF HEIGHTS.                                          -
CN                                                                     -
CN              IF THERE IS NO REGION LABEL (COLS.7-12 ARE BLANK), THE -
CN              DATA ON THE CARD APPLY TO ALL REGIONS OF THE REACTOR.  -
CN              IF THERE IS NO REGION LABEL AND IF THERE ARE NO TYPE 34-
CN              CARD (COMPOSITION AND GROUP DEPENDENT BUCKLING         -
CN              SPECIFICATIONS), THE DATA ON THIS CARD WILL BE USED TO -
CN              CALCULATE A SPACE- AND ENERGY-INDEPENDENT BUCKLING AND -
CN              TO CALCULATE REGION VOLUMES. IN THIS MODE OF INPUT     -
CN              ONLY ONE TYPE 12 CARD SHOULD BE SUPPLIED.              -
CN                                                                     -
CN              IF MORE THAN ONE TYPE 12 CARD IS PRESENT (EACH CARD    -
CN              WITH A VALID REGION OR AREA LABEL IN COLS. 7-12), THE  -
CN              DATA ON THE CARDS WILL BE USED TO CALCULATE REGION     -
CN              VOLUMES.                                               -
CN                                                                     -
CN              DATA ON THIS CARD MAY BE OVERLAYED. THAT IS,           -
CN              TRANSVERSE DISTANCES DEFINED ON LATER TYPE 12          -
CN              CARDS SUPERCEDE DATA FOR REGIONS PREVIOUSLY            -
CN              SPECIFIED.                                             -
CN                                                                     -
CN              IF TYPE 34 CARDS ARE PRESENT, BUCKLINGS WILL BE TAKEN  -
CN              FROM TYPE 34 CARDS AND WILL NOT BE CALCULATED FROM     -
CN              TYPE 12 CARD DATA.  EVEN IF BUCKLINGS ARE TAKEN FROM   -
CN              TYPE 34 CARDS, REGION VOLUMES ARE CALCULATED USING     -
CN              TYPE 12 CARD DATA WHEN TYPE 12 CARDS ARE PRESENT.      -
CN                                                                     -
CN              IN THE ABSENCE OF TYPE 12 AND TYPE 34 CARDS NO         -
CN              BUCKLINGS WILL BE USED AND REGION VOLUMES WILL BE      -
CN              CALCULATED USING UNIT TRANSVERSE HEIGHTS.              -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          MATERIAL SPECIFICATIONS (TYPE 13)                          -
C                                                                      -
CL    FORMAT-----(I2,10X,A6,3(A6,E12.5))                               -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   ========================================================-
CD    1-2       13                                                     -
CD                                                                     -
CD    13-18     MATERIAL LABEL (REPEATED ON ADDITIONAL TYPE 13 CARDS). -
CD                                                                     -
CD    19-24     UNIQUE ISOTOPE LABEL.                                  -
CD                                                                     -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CD    25-36     ISOTOPE ATOM DENSITY (ATOMS/CC * 1.E-24).              -
CD                                                                     -
CD    37-42     UNIQUE ISOTOPE LABEL.                                  -
CD                                                                     -
CD    43-54     ISOTOPE ATOM DENSITY (ATOMS/CC * 1.E-24).              -
CD                                                                     -
CD    55-60     UNIQUE ISOTOPE LABEL.                                  -
CD                                                                     -
CD    61-72     ISOTOPE ATOM DENSITY (ATOMS/CC * 1.E-24).              -
C                                                                      -
CN              MATERIAL LABELS MUST BE NON-BLANK.                     -
CN                                                                     -
CN              MATERIALS CAN BE DEFINED ON A TYPE 13 CARD IN TERMS    -
CN              OF ISOTOPES AND/OR IN TERMS OF OTHER MATERIALS. IN THE -
CN              LATTER CASE THE "ISOTOPE LABEL" IS A MATERIAL LABEL    -
CN              AND THE "ISOTOPE ATOM DENSITY" IS A VOLUME FRACTION.   -
CN                                                                     -
CN              THE CONCEPT OF MATERIALS DOES NOT EXIST IN THE CCCC    -
CN              ENVIRONMENT, AND THE IDENTITY OF INDIVIDUAL MATERIALS  -
CN              IS LOST WHEN THE CCCC FILES ARE CREATED. TYPE 13       -
CN              CARDS ARE PROVIDED AS AN INPUT CONVENIENCE ONLY.       -
C                                                                      -
C-----------------------------------------------------------------------


C------   --------------------------------------------------------------
CR          COMPOSITION SPECIFICATIONS (TYPE 14)                       -
C                                                                      -
CL    FORMAT-----(I2,10X,A6,3(A6,E12.5))                               -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       14                                                     -
CD                                                                     -
CD    13-18     COMPOSITION LABEL (REPEATED ON ADDITIONAL TYPE 14      -
CD              CARDS).                                                -
CD                                                                     -
CD    19-24     MATERIAL LABEL.                                        -
CD                                                                     -
CD    25-36     MATERIAL VOLUME FRACTION.                              -
CD                                                                     -
CD    37-42     MATERIAL LABEL.                                        -
CD                                                                     -
CD    43-54     MATERIAL VOLUME FRACTION.                              -
CD                                                                     -
CD    55-60     MATERIAL LABEL.                                        -
CD                                                                     -
CD    61-72     MATERIAL VOLUME FRACTION.                              -
C                                                                      -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CN              COMPOSITION LABELS MUST BE NON-BLANK.                  -
CN                                                                     -
CN              WHEN A "MATERIAL LABEL" HAS NOT BEEN SPECIFIED         -
CN              (COLS.13-18 OF A TYPE 13 OR TYPE 14 CARD), THE         -
CN              "MATERIAL" WILL BE INTERPRETED AS AN ISOTOPE AND       -
CN              THE "VOLUME FRACTION" WILL BE INTERPRETED AS AN ATOM   -
CN              DENSITY.                                               -
CN                                                                     -
CN              WHEN AN ISOTOPE (OR MATERIAL) IS REFERENCED MORE THAN -
CN              ONCE FOR A SINGLE COMPOSITION, THE ATOM DENSITIES      -
CN              (OR VOLUME FRACTIONS) ARE SUMMED.                      -
CN                                                                     -
CN              TWO TYPES OF COMPOSITIONS (PRIMARY AND SECONDARY) CAN  -
CN              BE DEFINED ON TYPE 14 CARDS. SECONDARY COMPOSITIONS    -
CN              ARE MIXTURES OF MATERIALS AND/OR ISOTOPES. PRIMARY     -
CN              COMPOSITIONS ARE MIXTURES OF SECONDARY COMPOSITIONS,   -
CN              MATERIALS AND/OR ISOTOPES. ONLY PRIMARY COMPOSITIONS   -
CN              MAY BE ASSIGNED TO REGIONS ON THE TYPE 15 CARDS.       -
CN                                                                     -
CN              SECONDARY COMPOSITIONS ARE TREATED AS CCCC SUBZONES.   -
CN              THOSE CONSTITUENTS OF A PRIMARY COMPOSITION WHICH ARE  -
CN              NOT THEMSELVES SUBZONES (I.E. ISOTOPES AND MATERIALS   -
CN              DIRECTLY ASSIGNED TO PRIMARY COMPOSITIONS) ARE         -
CN              COMBINED INTO CCCC PRIMARY ZONE ASSIGNMENTS.           -
CN                                                                     -
CN              AN EXAMPLE OF A SET OF TYPE 13 AND 14 CARDS            -
CN                                                                     -
CN                13  FUEL1 U238   .020    PU239  .003    016    .042  -
CN                13  FUEL2 U238   .015    PU239  .004    016    .042  -
CN                13  SS    FE     .055    CR     .015    NI     .012  -
CN                13  COOL  NA23   .022    SS     0.1                  -
CN                14  MIX1  FUEL1  1.0                                 -
CN                14  MIX2  FUEL1  0.5     FUEL2  0.5                  -
CN                14  COMP1 MIX1   0.4     SS     0.2     COOL   0.4   -
CN                14  COMP2 MIX2   0.4     SS     0.2     COOL   0.4   -
CN                14  COMP3 MIX1   0.2     MIX2   0.2     SS     0.2   -
CN                14  COMP3 COOL   0.2                                 -
CN                14  COMP4 NA23   .022                                -
CN                                                                     -
CN                    THE MATERIAL COOL IS DEFINED IN TERMS OF AN      -
CN                    ISOTOPE (NA23) AND A MATERIAL (SS).              -
CN                                                                     -
CN                    MIX1 AND MIX2 ARE SECONDARY COMPOSITIONS.        -
CN                    COMP1, COMP2, COMP3 AND COMP4 ARE PRIMARY        -
CN                    COMPOSITIONS.                                    -
CN                                                                     -
CN                    IN THE CCCC FILES MIX1 WILL BE ASSIGNED AS       -
CN                    SUBZONES TO BOTH COMP1 AND COMP3. THE PRIMARY    -
CN                    ZONE ASSIGNMENTS OF COMP1, COMP2 AND COMP3       -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CN                     WILL CONSIST OF SS AND COOL. COMP4 WILL HAVE     -
CN                     NO SUBZONES.                                     -
C                                                                       -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          ASSIGNMENT OF REGION TO COMPOSITION (CCCC ZONE)             -
CR          (TYPE 15)                                                   -
C                                                                       -
CL    FORMAT-----(I2,4X,11A6)                                           -
C                                                                       -
CD    COLUMNS             CONTENTS...IMPLICATIONS, IF ANY               -
CD    =======   =====================================================-
CD    1-2       15                                                      -
CD                                                                      -
CD    7-12      COMPOSITION (CCCC ZONE) LABEL (REPEATED ON ADDITIONAL   -
CD              TYPE 15 CARDS).                                         -
CD                                                                      -
CD    13-18     REGION LABEL OR AREA LABEL DEFINING REGION(S)           -
CD              CONTAINING SPECIFIED COMPOSITION.                       -
CD                                                                      -
CD    19-24     REGION LABEL OR AREA LABEL DEFINING REGION(S)           -
CD              CONTAINING SPECIFIED COMPOSITION.                       -
CD                                                                      -
CD    25-30     REGION LABEL OR AREA LABEL DEFINING REGION(S)           -
CD              CONTAINING SPECIFIED COMPOSITION.                       -
CD                                                                      -
CD    31-36     REGION LABEL OR AREA LABEL DEFINING REGION(S)           -
CD              CONTAINING SPECIFIED COMPOSITION.                       -
CD                                                                      -
CD    37-42     REGION LABEL OR AREA LABEL DEFINING REGION(S)           -
CD              CONTAINING SPECIFIED COMPOSITION.                       -
CD                                                                      -
CD    43-48     REGION LABEL OR AREA LABEL DEFINING REGION(S)           -
CD              CONTAINING SPECIFIED COMPOSITION.                       -
CD                                                                      -
CD    49-54     REGION LABEL OR AREA LABEL DEFINING REGION(S)           -
CD              CONTAINING SPECIFIED COMPOSITION.                       -
CD                                                                      -
CD    55-60     REGION LABEL OR AREA LABEL DEFINING REGION(S)           -
CD              CONTAINING SPECIFIED COMPOSITION.                       -
CD                                                                      -
CD    61-66     REGION LABEL OR AREA LABEL DEFINING REGION(S)           -
CD              CONTAINING SPECIFIED COMPOSITION.                       -
CD                                                                      -
CD    67-72     REGION LABEL OR AREA LABEL DEFINING REGION(S)           -
CD              CONTAINING SPECIFIED COMPOSITION.                       -
C                                                                       -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CN              AN AREA LABEL IN COLS. 13-72 IMPLIES ALL THE REGIONS   -
CN              ASSIGNED TO THAT AREA.  AREAS ARE DEFINED ON THE       -
CN              TYPE 07 CARD.                                          -
CN                                                                     -
CN              WHEN A PARTICULAR REGION OR AREA IS REFERENCED ON      -
CN              MORE THAN ONE TYPE 15 CARD, THE LAST REFERENCE         -
CN              TO THAT REGION (EITHER DIRECTLY, OR THROUGH AN AREA)   -
CN              ESTABLISHES THE COMPOSITION ASSIGNMENT.                -
CN              I.E. A REGION/COMPOSITION CORRESPONDENSE ESTABLISHED   -
CN              ON ONE TYPE 15 CARD CAN BE OVERWRITTEN BY A            -
CN              REFERENCE ON A LATER TYPE 15 CARD.                     -
CN                                                                     -
CN              COMPOSITION LABELS MUST BE NON-BLANK.  THE FIRST       -
CN              BLANK REGION LABEL ENCOUNTERED TERMINATES READING      -
CN              OF THE DATA ON THAT PARTICULAR TYPE 15 CARD.           -
CN                                                                     -
CN              ONLY PRIMARY COMPOSITION LABELS (SEE CARD TYPE 14)     -
CN              CAN APPEAR IN COLS. 7-12. PRIMARY COMPOSITIONS ARE     -
CN              EQUIVALENT TO CCCC ZONES. A REGION CAN CONTAIN ONLY    -
CN              ONE PRIMARY COMPOSITION.                               -
CN                                                                     -
CN              WHEN THERE ARE NO TYPE 14 CARDS (THE MACROSCOPIC       -
CN              CROSS SECTIONS ALREADY EXIST) THE COMPOSITION          -
CN              LABEL FIELDS SHOULD CONTAIN COMPOSITION NUMBERS        -
CN              INSTEAD (I2,4X,I6,10A6).                               -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          DISTRIBUTED ISOTROPIC INHOMOGENEOUS SOURCE DATA DEFINED    -
CR          EITHER BY REGION OR MESH INTERVAL (TYPE 19)                -
C                                                                      -
CL    FORMAT-----(I2,4X,A6,2I6,4E12.5)                                 -
C                                                                      -
C                                                                      -
CD    COLUMNS            CONTENTS...IMPLICATIONS, IF ANY               -
CD    -------   ------------------------------------------------------ -
CD    1-2       19                                                     -
CD                                                                     -
CD    7-12      LABEL OF REGION OR AREA (BLANK IF DATA ARE GIVEN BY    -
CD              MESH INTERVALS).  IF THE GEOMETRY HAS BEEN SPECIFIED   -
CD              BY AN INPUT GEODST FILE (AND NOT BY A.NIP TYPE 06      -
CD              OR 30 CARDS) USE THE REGION NUMBER (I6) INSTEAD OF     -
CD              THE REGION LABEL.                                      -
CD                                                                     -
CD    13-18     HIGHER-ENERGY GROUP NUMBER.                            -
CD                                                                     -
CD    19-24     LOWER-ENERGY GROUP NUMBER.                             -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CD                                                                     -
CD    25-36     ISOTROPIC SOURCE VALUE IN THE SPECIFIED MESH INTERVAL, -
CD              REGION OR AREA FOR THIS ENERGY RANGE.  (NEUTRONS PER   -
CD              SECOND PER UNIT VOLUME).                               -
CD                                                                     -
CD    37-48     LOWER "X" DIRECTION COORDINATE OF MESH INTERVAL        -
CD              CONTAINING THIS SOURCE.                                -
CD                                                                     -
CD    49-60     LOWER "Y" DIRECTION COORDINATE OF MESH INTERVAL        -
CD              CONTAINING THIS SOURCE.                                -
C                                                                      -
CD    61-72     LOWER Z DIRECTION COORDINATE OF MESH INTERVAL          -
CD              CONTAINING THIS SOURCE.                                -
CD                                                                     -
CN              AN AREA LABEL IN COLS. 7-12 IMPLIES ALL THE REGIONS    -
CN              ASSIGNED TO THAT AREA.                                 -
CN                                                                     -
CN              IF THERE IS NO REGION LABEL (COLS. 7-12 ARE BLANK),    -
CN              THE SOURCE SPECIFIED IN COLS. 25-36 IS PLACED IN THE   -
CN              MESH BOX DEFINED BY COLS. 37-48, 49-60 AND 61-72.      -
CN                                                                     -
CN              IF THERE IS A REGION LABEL (COLS. 7-12 ARE NON-BLANK), -
CN              THE MESH COORDINATE FIELDS (COLS. 37-48, 49-60 AND     -
CN              61-72) ARE IGNORED AND THE SOURCE SPECIFIED IN COLS.   -
CN              25-36 IS PLACED IN EVERY MESH BOX IN THE REGION.       -
CN                                                                     -
CN              "X" REPRESENTS THE FIRST DIMENSION COORDINATE (X IN    -
CN              X-Y GEOMETRY, R IN R-Z, ETC.). "Y" REPRESENTS THE      -
CN              SECOND DIMENSION COORDINATE (Y IN X-Y GEOMETRY, Z IN   -
CN              R-Z, ETC.). WHEN THE MODEL IS THREE-DIMENSIONAL, THE   -
CN              THIRD DIMENSION IS ALWAYS Z.                           -
C                                                                      -
CN              IN GEOMETRIES INVOLVING AN ANGULAR DIMENSION (THETA)   -
CN              THE ANGULAR VARIABLE MUST BE GIVEN IN RADIANS.         -
CN                                                                     -
CN              IF NO "HIGHER-ENERGY GROUP NUMBER" IS SUPPLIED (COLS.  -
CN              13-18 ARE BLANK), THE SOURCE VALUE GIVEN APPLIES TO    -
CN              ALL ENERGY GROUPS. IF NO "LOWER-ENERGY GROUP NUMBER"   -
CN              IS SUPPLIED (COLS. 19-24 ARE BLANK), THE SOURCE VALUE  -
CN              GIVEN APPLIES TO THE "HIGHER-ENERGY GROUP" ONLY. IF    -
CN              NO GROUP NUMBERS ARE SUPPLIED (COLS. 13-24 ARE BLANK), -
CN              THE SOURCE VALUE GIVEN APPLIES TO ALL ENERGY GROUPS.   -
CN                                                                     -
CN              DATA ON THIS CARD MAY BE OVERLAYED. THAT IS, SOURCE    -
CN              VALUES DEFINED ON LATER TYPE 19 CARDS SUPERCEDE DATA   -
CN              FOR REGIONS AND GROUPS PREVIOUSLY SPECIFIED.           -
CN                                                                     -
CN              AN EDIT OF THE OUTPUT FIXSRC FILE MAY BE OBTAINED BY   -
CN              SUPPLYING THE EDIT SENTINEL ON THE TYPE 40 CARD.       -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          SEARCH EDIT OPTIONS AND CONVERGENCE CRITERIA (TYPE 21)     -
C                                                                      -
CL    FORMAT-----(I2,10X,2I6,2E12.5,2I6)                               -
C                                                                      -
CD    COLUMNS          CONTENTS...IMPLICATIONS, IF ANY                 -
CD    =======   =======================================================-
CD    1-2       21                                                     -
CD                                                                     -
CD    13-18     SEARCH FILE PROCESSING EDIT SENTINEL                   -
CD                  0, NO EDITS (DEFAULT).                             -
CD                  1, PRINT EDITS.                                    -
CD                  2, WRITE EDITS TO AUXILIARY OUTPUT FILE.           -
CD                  3, WRITE EDITS TO BOTH PRINT AND AUXILIARY OUTPUT  -
CD                     FILE.                                           -
CD                                                                     -
CD    19-24     MAXIMUM NUMBER OF SEARCH PASSES (DEFAULT=4).           -
CD                                                                     -
CD    25-36     DESIRED KEFF, KEFF(0) (DEFAULT=1.0).                   -
CD                                                                     -
CD    37-48     CONVERGENCE CRITERION, EPSILON: RELATIVE ERROR BOUND   -
CD              FOR KEFF (DEFAULT=.01).                                -
CD                                                                     -
CD              ABSOLUTE VALUE OF ((KEFF-KEFF(0)) / KEFF(0)).LE.       -
CD              EPSILON.                                               -
CD                                                                     -
CD    49-54     SEARCH (MODULE) PARAMETER EDIT OPTIONS                 -
CD              ENTER TWO-DIGIT NUMBER (IF) WHERE                      -
CD                                                                     -
CD              I CONTROLS INTERMEDIATE PASS PARAMETER EDITS           -
CD              F CONTROLS FINAL SEARCH PASS PARAMETER EDITS           -
CD                                                                     -
CD              THE INTEGERS I AND F ARE ASSIGNED ONE OF THE           -
CD              FOLLOWING VALUES (LEADING ZEROES ARE IRRELEVANT)       -
CD              0...NO EDITS                                           -
CD              1...PRINT EDITS (DEFAULT FOR F)                        -
CD              2...WRITE EDITS TO AUXILIARY OUTPUT FILE               -
CD              3...WRITE EDITS TO BOTH PRINT AND AUXILIARY OUTPUT FILE-
CD                                                                     -
CD    55-60     SEARCH (MODULE) QUANTITY EDIT OPTIONS                 --
CD              ENTER TWO-DIGIT NUMBER (IF) WHERE                      -
CD                                                                     -
CD              I CONTROLS INTERMEDIATE PASS QUANTITY EDITS            -
CD              F CONTROLS FINAL SEARCH PASS QUANTITY EDITS            -
CD                                                                     -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CD              THE INTEGERS I AND F ARE ASSIGNED ONE OF THE           -
CD              FOLLOWING VALUES (LEADING ZEROES ARE IRRELEVANT)       -
CD              0...NO EDITS (DEFAULT)                                 -
CD              1...PRINT EDITS                                        -
CD              2...WRITE EDITS TO AUXILIARY OUTPUT FILE               -
CD              3...WRITE EDITS TO BOTH PRINT AND AUXILIARY OUTPUT FILE-
C                                                                      -
CN              EACH SEARCH PASS REQUIRES THE SUCCESSFUL COMPLETION    -
CN              OF AN EIGENVALUE PROBLEM BY A NEUTRONICS MODULE.       -
CN              SUCCESSFUL NEUTRONICS MODULE COMPLETION IS INDICATED BY-
CN                1.  OUTER ITERATIONS CONVERGED OR                    -
CN                2.  MAXIMUM NUMBER OF OUTER ITERATIONS ATTAINED.     -
C                                                                      -
CN              NONZERO DATA ON THIS CARD OVERRIDES DATA IN AN EXISTING-
CN              SEARCH FILE DURING A SEARCH PROBLEM RESTART.           -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          SEARCH PARAMETER DATA (TYPE 22)                            -
C                                                                      -
CL    FORMAT-----(I2,10X,5E12.5)                                       -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       22                                                     -
CD                                                                     -
CD    13-24     INITIAL ESTIMATE OF X (DEFAULT=0.0).                   -
CD                                                                     -
CD    25-36     SECOND ESTIMATE OF X (IGNORED IF COLS. 61-72 ARE       -
CD              NON-ZERO) (DEFAULT=0.1 (X=0.0), =1.1*X (X NE 0.0))     -
CD                                                                     -
CD    37-48     LOWER BOUND FOR X (DEFAULT=0.0).                       -
CD                                                                     -
CD    49-60     UPPER BOUND FOR X (DEFAULT=1.0).                       -
CD                                                                     -
CD    61-72     DERIVATIVE OF KEFF WITH RESPECT TO X (OPTIONAL).       -
CN              (PROVIDES AN ALTERNATE METHOD FOR OBTAINING SECOND     -
CN              ESTIMATE OF X IN COLS. 25-36).                         -
C                                                                      -
CN              COLS. 25-36 ARE IGNORED IF COLS. 61-72 CONTAIN OTHER   -
CN              THAN BLANK OR 0.0.                                     -
CN                                                                     -
CN              GENERAL SEARCH EXPRESSION:  P(X) = P(0) + X * M,       -
CN              WHERE P IS THE QUANTITY BEING VARIED, X IS THE SEARCH  -
CN              PARAMETER, AND M IS THE QUANTITY MODIFIER OBTAINED     -
CN              FROM INFORMATION CONTAINED ON ONE OF THE MUTUALLY      -
CN              EXCLUSIVE CARD TYPES 23, 24, 25, OR 26.  X IS TO BE    -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CN             VARIED UNTIL THE DESIRED KEFF IS REACHED.  THE SEARCH  -
CN             WILL BE TERMINATED IF X EXCEEDS ITS BOUNDS OR IF THE   -
CN             MAXIMUM NUMBER OF SEARCH PASSES ARE REACHED.           -
CN             (SOME CODES MAY ALSO TRIGGER JOB TERMINATION BETWEEN   -
CN             SEARCH PASSES IF IT IS ESTIMATED THAT JOB TIME LIMIT   -
CN             WOULD BE EXCEEDED DURING THE NEXT SEARCH PASS).        -
CN                                                                    -
CN             FOR EFFICIENT SEARCHING, SCALE THE SEARCH QUANTITY     -
CN             SUCH THAT THE MAGNITUDES OF THE SEARCH PARAMETER       -
CN             ESTIMATES LIE IN THE INTERVAL (.1,10.)                 -
CN                                                                    -
CN             NONZERO DATA ON THIS CARD OVERRIDES DATA IN AN EXISTING-
CN             SEARCH FILE DURING A SEARCH PROBLEM RESTART.           -
C                                                                     -
C----------------------------------------------------------------------


C----------------------------------------------------------------------
CR          CONCENTRATION MODIFIERS FOR CRITICALITY SEARCH (TYPE 23)  -
C                                                                     -
CL     FORMAT-----(I2,4X,11A6)                                        -
C                                                                     -
CD     COLUMNS           CONTENTS...IMPLICATIONS, IF ANY              -
CD     =======     ===================================================-
CD     1-2         23                                                 -
CD                                                                    -
CD     7-12        COMPOSITION LABEL OF COMPOSITION (FROM CARD TYPE 14)  -
CD                 TO BE USED AS THE MODIFIER M IN THE SEARCH FORMULA.   -
CD                                                                    -
CD     13-18       COMPOSITION LABEL OF COMPOSITION (FROM CARD TYPE 14)  -
CD                 TO WHICH MODIFIER M IS ADDED AS A SUBZONE.         -
CD                                                                    -
CD     19-24       COMPOSITION LABEL OF COMPOSITION (FROM CARD TYPE 14)  -
CD                 TO WHICH MODIFIER M IS ADDED AS A SUBZONE.         -
CD                                                                    -
CD     25-30       COMPOSITION LABEL OF COMPOSITION (FROM CARD TYPE 14)  -
CD                 TO WHICH MODIFIER M IS ADDED AS A SUBZONE.         -
CD                                                                    -
CD     31-36       COMPOSITION LABEL OF COMPOSITION (FROM CARD TYPE 14)  -
CD                 TO WHICH MODIFIER M IS ADDED AS A SUBZONE.         -
CD                                                                    -
CD     37-42       COMPOSITION LABEL OF COMPOSITION (FROM CARD TYPE 14)  -
CD                 TO WHICH MODIFIER M IS ADDED AS A SUBZONE.         -
CD                                                                    -
CD     43-48       COMPOSITION LABEL OF COMPOSITION (FROM CARD TYPE 14)  -
CD                 TO WHICH MODIFIER M IS ADDED AS A SUBZONE.         -
CD                                                                    -
CD     49-54       COMPOSITION LABEL OF COMPOSITION (FROM CARD TYPE 14)  -
CD                 TO WHICH MODIFIER M IS ADDED AS A SUBZONE.         -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CD                                                                      -
CD    55-60     COMPOSITION LABEL OF COMPOSITION (FROM CARD TYPE 14)    -
CD              TO WHICH MODIFIER M IS ADDED AS A SUBZONE.              -
CD                                                                      -
CD    61-66     COMPOSITION LABEL OF COMPOSITION (FROM CARD TYPE 14)    -
CD              TO WHICH MODIFIER M IS ADDED AS A SUBZONE.              -
CD                                                                      -
CD    67-72     COMPOSITION LABEL OF COMPOSITION (FROM CARD TYPE 14)    -
CD              TO WHICH MODIFIER M IS ADDED AS A SUBZONE.              -
C                                                                       -
CN              IN THE SEARCH FORMULA  P(X) = P(0) + X * M,             -
CN              P(0) DENOTES THOSE PRIMARY COMPOSITIONS (ZONES,         -
CN              COLS. 13-72) TO WHICH THE MODIFIER COMPOSITIONS (M,     -
CN              COLS. 7-12) ARE ADDED AS SUBZONES,                      -
CN              X IS THE VOLUME FRACTION APPLIED TO THE MODIFIER        -
CN              COMPOSITIONS (CCCC ZONES OR SUBZONES) COMPRISING M,     -
CN              AND P(X) DENOTES THE RESULTANT COMPOSITIONS.            -
CN              CARD TYPE 23 DEFINES P(0) AND M IN TERMS OF COMPOSITION-
CN              LABELS DEFINED ON CARD TYPE 14.                         -
CN                                                                      -
CN              THE MODIFIER COMPOSITION (CCCC ZONE OR SUBZONE) NAME    -
CN              IN COLS. 7-12 MUST BE A SUBZONE OR AN UNASSIGNED (NOT   -
CN              ASSIGNED TO A REGION ON A TYPE 15 CARD) PRIMARY ZONE    -
CN              CONTAINING NO SUBZONES.                                 -
CN                                                                      -
CN              THE MODIFIER COMPOSITIONS (M) BECOME SUBZONES OF        -
CN              EACH ZONE SPECIFIED IN COLS. 13-72.  WHEN A SUBZONE IS  -
CN              SPECIFIED IN COLS 13-72, THE MODIFIER COMPOSITIONS (M)  -
CN              BECOME SUBZONES IN EACH ZONE CONTAINING THE SUBZONE     -
CN              IN COLS. 13-72.  IN BOTH CASES THE VOLUME FRACTION      -
CN              OF THE ADDED SUBZONES IS X.                             -
CN                                                                      -
CN              A MODIFIER COMPOSITION (M) CANNOT MODIFY ANOTHER        -
CN              MODIFIER COMPOSITION OR A COMPOSITION WHICH ALREADY     -
CN              CONTAINS THE MODIFIER COMPOSITION AS A ZONE OR SUBZONE.-
CN                                                                      -
CN              AN EXAMPLE OF A SET OF TYPE 23 CARDS USING THE SAMPLE   -
CN              TYPE 14 CARDS PRESENTED IN THE TYPE 14 CARD DESCRIPTION-
CN              FOLLOWS:                                                -
CN                                                                      -
CN                23  COMP4 COMP1 MIX2                                  -
CN                23  MIX1  COMP2                                       -
CN                                                                      -
CN                    IN THE CCCC FILES COMP4 WILL BECOME A SUBZONE     -
CN                    OF COMP1, COMP2 AND COMP3.  MIX1 WILL BECOME      -
CN                    A SUBZONE OF COMP2.                               -
CN                                                                      -
CN              REPEAT TYPE 23 CARDS AS NEEDED.                         -
C                                                                       -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          MESH MODIFIERS FOR CRITICALITY SEARCH (TYPE 24)            -
C                                                                      -
CL    FORMAT-----(I2,9X,A1,3E12.5)                                     -
C                                                                      -
CD    COLUMNS         CONTENTS...IMPLICATIONS, IF ANY                  -
CD    =======   =======================================================-
CD    1-2       24                                                     -
CD                                                                     -
CD    12        COORDINATE DIRECTION.                                  -
CD              X..."X" COORDINATE DIRECTION.                          -
CD              Y..."Y" COORDINATE DIRECTION.                          -
CD              Z..."Z" COORDINATE DIRECTION.                          -
CD                                                                     -
CD    13-24     LOWER (COARSE MESH) COORDINATE.                        -
CD                                                                     -
CD    25-36     UPPER (COARSE MESH) COORDINATE.                        -
CD                                                                     -
CD    37-48     MESH MODIFIER, M, FOR EACH MESH INTERVAL BETWEEN       -
CD              THE ABOVE COORDINATES.                                 -
C                                                                      -
CN              IN THE SEARCH FORMULA P(X) = P(0) + X * M,             -
CN              P(X) IS THE RESULTING MESH INTERVAL,                   -
CN              P(0) IS THE INITIAL MESH INTERVAL, AND                 -
CN              M IS THE MESH INTERVAL MODIFIER.                       -
CN                                                                     -
CN              DATA ON THIS CARD MAY BE OVERLAYED.  THAT IS MESH      -
CN              MODIFIERS DEFINED ON LATER TYPE 24 CARDS SUPERCEDE    -
CN              DATA FOR REGIONS SPECIFIED PREVIOUSLY.                 -
CN                                                                     -
CN              REPEAT TYPE 24 CARDS AS NEEDED.                        -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR         COMPOSITION DEPENDENT BUCKLING MODIFIERS FOR CRITICALITY    -
CR         SEARCH (TYPE 25)                                            -
C                                                                      -
CL    FORMAT-----(I2,4X,A6,E12.5)                                      -
C                                                                      -
CD    COLUMNS         CONTENTS...IMPLICATIONS, IF ANY                  -
CD    =======   =======================================================-
CD    1-2       25                                                     -
CD                                                                     -
CD    7-12      COMPOSITION (ZONE) LABEL.                              -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CD                                                                   -
CD    13-24     BUCKLING MODIFIER, M, IN FIRST TRANSVERSE DIRECTION.  -
C                                                                    -
CD    25-36     BUCKLING MODIFIER, M, IN SECOND TRANSVERSE DIRECTION -
CD              FOR A FINITE ONE-DIMENSIONAL RECTANGULAR SLAB.       -
C                                                                    -
CN              IN THE SEARCH FORMULA  P(X) = P(0) + X * M,          -
CN              P(X) IS THE RESULTING BUCKLING, P(0) IS THE INITIAL  -
CN              BUCKLING, AND M IS THE BUCKLING MODIFIER.            -
CN              P(0) WILL BE EVALUATED FROM THE TRANSVERSE HEIGHTS   -
CN              GIVEN ON CARD TYPE 12 OR TAKEN DIRECTLY FROM BUCKLINGS -
CN              GIVEN ON CARD TYPE 34.                               -
CN                                                                   -
CN              IF COLS. 7-12 ARE BLANK, THE DATA IN COLS. 13-24 APPLY -
CN              TO ALL COMPOSITIONS (ZONES) OF THE REACTOR.          -
CN                                                                   -
CN              REPEAT TYPE 25 CARDS AS NEEDED.                      -
C                                                                    -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          ALPHA MODIFIER FOR CRITICALITY SEARCH (TYPE 26)          -
C                                                                    -
CL    FORMAT------(I2,10X,E12.5)                                     -
C                                                                    -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY              -
CD    =======   =====================================================-
CD    1-2       26                                                   -
CD                                                                   -
CD    13-24     ALPHA MODIFIER, M.                                   -
CD                                                                   -
C                                                                    -
CN              IN THE SEARCH FORMULA  P(X) = P(0) + X * M,          -
CN              P(X) IS THE RESULTING ALPHA, P(0) IS THE INITIAL ALPHA,-
CN              AND M IS THE ALPHA MODIFIER.                         -
C                                                                    -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          HEXAGON DIMENSION (TYPE 29)                              -
C                                                                    -
CL    FORMAT------(I2,10X,E12.5,2I6)                                 -
C                                                                    -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY              -
CD    =======   =====================================================-
CD    1-2       29                                                   -
CD                                                                   -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CD     13-24       DIMENSION OF HEXAGON ACROSS FLATS.                    -
CD                                                                       -
CD     25-30       TOTAL NUMBER OF HEXAGONAL RINGS IN THE REGION OF      -
CD                 SOLUTION.                                             -
CD                                                                       -
CD     31-36       FOR TRIANGULAR AND TRIANGULAR-Z GEOMETRIES, THE       -
CD                 NUMBER OF EQUAL PARTS INTO WHICH EACH SIDE OF THE     -
CD                 BASIC EQUILATERAL TRIANGLES MAKING UP THE HEXAGONS ARE -
CD                 SUBDIVIDED.  THUS E.G., IF COLS 31-36 CONTAIN 3, THE  -
CD                 HEXAGON CONTAINS 54 MESH POINTS INSTEAD OF THE NORMAL -
CD                 6.                                                    -
C                                                                        -
CN                 IF THE NUMBER OF RINGS IS NOT PROVIDED IN COLS. 25-30, -
CN                 IT IS DERIVED FROM THE TYPE 30 CARDS.                 -
CN                                                                       -
CN                 IF COLS. 31-36 ARE BLANK, THE TRIANGLES ARE NOT       -
CN                 SUBDIVIDED.                                           -
CN                                                                       -
CN                 THE TYPE 29 CARD IS PERTINENT ONLY IF COLS. 13-18 ON  -
CN                 CARD TYPE 03 ARE GREATER THAN OR EQUAL TO 70.         -
CN                                                                       -
CN                 FOR TRIANGULAR-Z AND HEXAGONAL-Z GEOMETRIES THE       -
CN                 AXIAL (Z) MESH MUST BE SPECIFIED ON TYPE 9 CARDS.     -
C                                                                        -
C-------------------------------------------------------------------------


C-------------------------------------------------------------------------
CR             LOCATIONS OF REGIONS FOR TRIANGULAR, TRIANGULAR-Z,        -
CR             HEXAGONAL, AND HEXAGONAL-Z GEOMETRIES (TYPE 30)           -
C                                                                        -
CL     FORMAT-----(I2,4X,A6,3I6,2E12.5)                                  -
C                                                                        -
CD     COLUMNS             CONTENTS...IMPLICATIONS, IF ANY               -
CD     -------     ======================================================-
CD     1-2         30                                                    -
CD                                                                       -
CD     7-12        REGION LABEL (REPEATED ON ADDITIONAL TYPE 30 CARDS).  -
CD                                                                       -
CD     13-18       HEXAGONAL RING NUMBER WHERE REGION IS LOCATED.        -
CD                                                                       -
CD     19-24       STARTING HEXAGON POSITION FOR THIS REGION.            -
CD                                                                       -
CD     25-30       FINAL HEXAGON POSITION FOR THIS REGION.               -
CD                                                                       -
CD     31-42       LOWER Z BOUNDARY OF REGION.                           -
CD                                                                       -
CD     43-54       UPPER Z BOUNDARY OF REGION.                           -
CD                                                                       -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
C                                                                       -
CN              REGION LABELS MUST BE NON-BLANK.                        -
CN                                                                      -
CN              IF THE STARTING POSITION (COLS. 19-24) IS BLANK OR      -
CN              ZERO, THE REGION LABEL IS ASSIGNED TO THE WHOLE RING.   -
CN                                                                      -
CN              IF THE FINAL POSITION (COLS. 25-30) IS BLANK OR ZERO,   -
CN              THE REGION LABEL IS ASSIGNED TO THE POSITION IN 19-24   -
CN              OF THE RING IN 13-18.                                   -
CN                                                                      -
CN              DATA ON THIS CARD MAY BE OVERLAYED. THAT IS, REGION     -
CN              ASSIGNMENTS DEFINED ON LATER TYPE 30 CARDS SUPERCEDE    -
CN              DATA FOR RINGS AND POSITIONS PREVIOUSLY SPECIFIED.      -
CN                                                                      -
CN              THE REGION LOWER AND UPPER Z BOUNDARIES MUST COINCIDE   -
CN              WITH MESH LINES, WHICH BOUND MESH INTERVALS.            -
CN                                                                      -
CN              THE FIGURE BELOW ILLUSTRATES THE ORDER OF NAMING        -
CN              RINGS AND HEXAGONS IN THE RINGS.  THE FIRST NUMBER OF   -
CN              EACH NUMBERED PAIR IS THE RING NUMBER, AND THE SECOND   -
CN              NUMBER IS THE HEXAGON NUMBER IN THAT RING.              -
CN              THE REGION OF SOLUTION DEPENDS ON THE VALUE IN COLS.    -
CN              13-18 ON CARD TYPE 03 AS FOLLOWS.                       -
CN                                                                      -
CN       COLS. 13-18 ON CARD TYPE 03       REGION OF SOLUTION           -
CN       ============= ==============  ==============================   -
CN                80                   ENTIRE FIGURE AS SHOWN BELOW     -
CN                72                   IN THE 180 DEGREE SECTOR A-B     -
CN                78                   IN THE 90 DEGREE SECTOR A-C      -
CN                70                   IN THE 60 DEGREE SECTOR A-D      -
CN                74                   IN THE 120 DEGREE SECTOR A-E     -
CN               110                   ENTIRE FIGURE AS SHOWN BELOW     -
CN               114                   IN THE 60 DEGREE SECTOR F-C      -
CN               116                   IN THE 120 DEGREE SECTOR F-G     -
CN                                                                      -
CN                       G               E              C               -
CN                                                                      -
CN                         *             *            *                 -
CN                                                                      -
CN       B                   *           *          *                   -
CN           *                                                       D  -
CN              *              *         *        *               *     -
CN                 *          ====== ====== ======             *        -
CN                    *       =3,5 = =3,4 = =3,3 =          *           -
CN                       *    ====== ====== ======       *              -
CN                         ====== ====== ====== ======                  -
CN                         =3,6 = =2,3 = =2,2 = =3,2 =                  -
CN                         ====== ====== ====== ======                  -
CN                     ====== ====== ====== ====== ======               -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CN                     =3,7 = =2,4 = =1,1 = =2,1 = =3,1 =  *  *  *  F  -
CN                     ====== ====== ====== ====== ======              -
CN                         ====== ====== ====== ======                 -
CN                         =3,8 = =2,5 = =2,6 = =3,12=                 -
CN                         ====== ====== ====== ======                 -
CN                            ====== ====== ======      *              -
CN                            =3,9 = =3,10= =3,11=         *           -
CN                            ====== ====== ======            *        -
CN                                                               *     -
CN                                                                  A  -
CN                                                                     -
CN                                                                     -
CN              ALTHOUGH THE REGIONS OF SOLUTION DIFFER FOR THE        -
CN              TRIANGULAR AND HEXAGONAL GEOMETRY MODELS, TYPE 30      -
CN              CARDS COMPOSED FOR TRIANGULAR GEOMETRY MODELS CAN ALSO -
CN              BE USED FOR HEXAGONAL GEOMETRY MODELS.                 -
CN                                                                     -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          BACKGROUND REGION NAME FOR TRIANGULAR, TRIANGULAR-Z,       -
CR          HEXAGONAL, AND HEXAGONAL-Z GEOMETRIES (TYPE 31)            -
C                                                                      -
CL    FORMAT-----(I2,4X,A6)                                            -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       31                                                     -
CD                                                                     -
CD    7-12      BACKGROUND REGION NAME.                                -
C                                                                      -
CN              ANY PORTION OF THE REACTOR NOT SPECIFIED ON THE        -
CN              TYPE 30 CARDS WILL BE IN THE BACKGROUND REGION.        -
CN                                                                     -
CN              IF THE BACKGROUND REGION NAME (COLS. 7-12) IS BLANK,   -
CN              OR IF THERE IS NO TYPE 31 CARD, THE BACKGROUND REGION  -
CN              WILL BE ASSIGNED A REGION NUMBER 0 (ZERO).  NOTE THAT  -
CN              SOME CCCC CODES EXCLUDE SUCH A REGION FROM THE REGION  -
CN              OF SOLUTION, WHILE OTHER CCCC CODES MAY NOT ALLOW      -
CN              ZERO REGION NUMBERS.                                   -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          COMPOSITION AND GROUP DEPENDENT BUCKLING SPECIFICATIONS    -
CR          (TYPE 34)                                                  -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
C                                                                      -
CL    FORMAT-----(I2,4X,A6,2(E12.5,2I6))                               -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       34                                                     -
CD                                                                     -
CD    7-12      COMPOSITION LABEL.                                     -
CD                                                                     -
CD    13-24     BUCKLING (B**2).                                       -
CD                                                                     -
CD    25-30     HIGHER ENERGY BROAD GROUP NUMBER TO WHICH BUCKLING     -
CD              IN COLS. 13-24 APPLIES.                                -
CD                                                                     -
CD    31-36     LOWER ENERGY BROAD GROUP NUMBER TO WHICH BUCKLING      -
CD              IN COLS. 13-24 APPLIES.                                -
CD                                                                     -
CD    37-48     BUCKLING (B**2).                                       -
CD                                                                     -
CD    49-54     HIGHER ENERGY BROAD GROUP NUMBER TO WHICH BUCKLING     -
CD              IN COLS. 37-48 APPLIES.                                -
CD                                                                     -
CD    55-60     LOWER ENERGY BROAD GROUP NUMBER TO WHICH BUCKLING      -
CD              IN COLS. 37-48 APPLIES.                                -
C                                                                      -
CN              IF THERE IS NO COMPOSITION LABEL (COLS. 7-12 ARE       -
CN              BLANK), THE BUCKLINGS ON THIS CARD WILL APPLY TO       -
CN              ALL COMPOSITIONS.                                      -
CN                                                                     -
CN              IF NO "HIGHER-ENERGY GROUP NUMBER" IS SUPPLIED IN      -
CN              COLS. 25-30, THE BUCKLING GIVEN IN COLS. 13-24 APPLIES -
CD              TO ALL ENERGY GROUPS.  IF THERE IS A "HIGHER-ENERGY    -
CD              GROUP NUMBER" IN COLS. 25-30, BUT NO "LOWER-ENERGY     -
CD              GROUP NUMBER" IS SUPPLIED IN COLS. 31-36, THE BUCKLING -
CD              GIVEN IN COLS. 13-24 APPLIES TO THE "HIGHER-ENERGY     -
CD              GROUP" ONLY.                                           -
CN                                                                     -
CN              IF NO "HIGHER-ENERGY GROUP NUMBER" IS SUPPLIED IN      -
CN              COLS. 49-54, THE DATA IN COLS. 37-60 ARE IGNORED. IF   -
CN              THERE IS A "HIGHER-ENERGY GROUP NUMBER" IN COLS. 49-54,-
CN              BUT NO "LOWER-ENERGY GROUP NUMBER" IN COLS. 55-60,     -
CN              THE BUCKLING GIVEN IN COLS. 37-48 APPLIES TO THE       -
CN              "HIGHER-ENERGY GROUP" ONLY.                            -
CN                                                                     -
CN              BUCKLINGS CAN BE OVERLAYED. THAT IS, BUCKLINGS DEFINED -
CN              ON LATER TYPE 34 CARDS SUPERCEDE DATA FOR COMPOSITIONS -
CN              AND/OR ENERGY RANGES PREVIOUSLY DEFINED. THE EXCEPTION -
CN              TO THIS RULE IS THE SITUATION DESCRIBED IN THE PRE-    -
CN              CEDING PARAGRAPHS WHERE DATA IS SPECIFICALLY IGNORED.  -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CN                                                                -
CN          EXAMPLE        34    **  .001  1  3  .002  4  7      -
CN                         34    COMP1  .003  1  5               -
CN                         34    COMP1  .004  3                  -
CN                         34    COMP2  .005                     -
CN                                                                -
CN          THIS EXAMPLE IS IN FREE-FORMAT - ** IMPLIES A BLANK   -
CN          LABEL.  COMPOSITION COMP1 IS BUCKLED .003 IN GROUPS   -
CN          1-2, .004 IN GROUP 3, .003 IN GROUPS 4-5, .002 IN     -
CN          GROUPS 6-7, AND ZERO IN ALL OTHER GROUPS.             -
CN          COMPOSITION COMP2 IS BUCKLED .005 IN ALL GROUPS.  ALL -
CN          OTHER COMPOSITIONS ARE BUCKLED .001 IN GROUPS 1-3,    -
CN          .002 IN GROUPS 4-7 AND ZERO IN ALL OTHER GROUPS.      -
CN                                                                -
CN          WHEN ANY TYPE 34 CARDS EXIST, BUCKLINGS WILL NOT BE   -
CN          CALCULATED FROM FINITE GEOMETRY DATA ON TYPE 12 CARDS. -
C                                                                 -
C------------------------------------------------------------------


C------------------------------------------------------------------
CR          DIRECTIONAL DIFFUSION COEFFICIENT FACTOR SCHEME (TYPE 35) -
C                                                                 -
CL    FORMAT-----(I2,4X,A6,6F6.2,2I6)                             -
C                                                                 -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY           -
CD    =======    ==================================================-
CD    1-2        35                                               -
CD                                                                -
CD    7-12       DIRECTIONAL DIFFUSION COEFFICIENT FACTOR SCHEME LABEL. -
CD                                                                -
CD    13-18      FIRST DIMENSION DIFFUSION COEFFICIENT MULTIPLIER, A1. -
CD                                                                -
CD    19-24      FIRST DIMENSION DIFFUSION COEFFICIENT ADDITIVE   -
CD               TERM, B1.                                        -
CD                                                                -
CD    25-30      SECOND DIMENSION DIFFUSION COEFFICIENT MULTIPLIER, A2. -
CD                                                                -
CD    31-36      SECOND DIMENSION DIFFUSION COEFFICIENT ADDITIVE  -
CD               TERM, B2.                                        -
CD                                                                -
CD    37-42      THIRD DIMENSION DIFFUSION COEFFICIENT MULTIPLIER, A3. -
CD                                                                -
CD    43--48     THIRD DIMENSION DIFFUSION COEFFICIENT ADDITIVE   -
CD               TERM, B3.                                        -
CD                                                                -
CD    49-54      HIGHER ENERGY BROAD GROUP NUMBER TO WHICH DATA IN -
CD               COLS. 13-48 APPLY.                               -
CD                                                                -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CD      55-60   LOWER ENERGY BROAD GROUP NUMBER TO WHICH DATA IN       -
CD              COLS. 13-48 APPLY.                                     -
C                                                                      -
CN              IF MORE THAN ONE TYPE 35 CARD IS NEEDED FOR A GIVEN    -
CN              DIFFUSION COEFFICIENT FACTOR SCHEME, THE LABEL IN      -
CN              COLS. 7-12 MUST BE REPEATED ON EACH ADDITIONAL CARD.   -
CN                                                                     -
CN              FIRST, SECOND AND THIRD DIMENSIONS REFER TO THE        -
CN              DIMENSIONS IN THE ORDER THEY ARE NAMED ON CARD TYPE 3. -
CN              E.G. FOR R-Z GEOMETRY R IS THE FIRST DIMENSION, AND    -
CN              Z IS THE SECOND.                                       -
CN                                                                     -
CN              THE FIRST DIMENSION DIFFUSION COEFFICIENT, D1, IS      -
CN              CALCULATED FROM THE HOMOGENEOUS DIFFUSION COEFFICIENT, -
CN              D, AS FOLLOWS:                                         -
CN                                                                     -
CN                                   D1 = A1*D+B1                      -
CN                                                                     -
CN              THE OTHER TWO DIMENSIONS ARE HANDLED IN A SIMILAR WAY. -
CN                                                                     -
CN              IF THE "HIGHER ENERGY BROAD GROUP NUMBER" IS NOT       -
CN              PROVIDED (COLS. 49-54 ARE BLANK OR ZERO), THE          -
CN              CONSTANTS SPECIFIED IN COLS. 13-48 WILL APPLY TO ALL   -
CN              BROAD GROUPS FOR THE PARTICULAR SCHEME.                -
CN                                                                     -
CN              IF THE "LOWER ENERGY BROAD GROUP NUMBER" IS NOT        -
CN              PROVIDED (COLS. 55-60 ARE BLANK OR ZERO), THE          -
CN              CONSTANTS SPECIFIED IN COLS. 13-48 WILL APPLY TO THE   -
CN              HIGHER ENERGY BROAD GROUP NUMBER (COLS. 49-54) ONLY.   -
CN                                                                     -
CN              THE CONSTANTS DEFINING A PARTICULAR SCHEME CAN BE      -
CN              OVERLAYED. THAT IS, FACTORS DEFINED ON LATER TYPE 35   -
CN              CARDS SUPERCEDE DATA FOR ENERGY RANGES PREVIOUSLY      -
CN              DEFINED.                                               -
CN                                                                     -
CN              DIRECTIONAL DIFFUSION COEFFICIENT FACTOR SCHEMES ARE   -
CN              ASSIGNED TO COMPOSITIONS ON TYPE 36 CARDS.             -
CN                                                                     -
CN              IF NO TYPE 36 CARDS ARE SUPPLIED, AND ONLY ONE SCHEME  -
CN              IS DEFINED (THE SAME LABEL APPEARS IN COLS. 7-12 OF    -
CN              ALL TYPE 35 CARDS), THE FACTORS WILL BE USED IN ALL    -
CN              COMPOSITIONS.                                          -
CN                                                                     -
CN              IF NO TYPE 36 CARDS ARE SUPPLIED AND MORE THAN ONE     -
CN              SCHEME IS DEFINED, THE FACTORS FOR THE FIRST DEFINED   -
CN              SCHEME (I.E. THAT SCHEME LABEL WHICH APPEARS ON THE    -
CN              FIRST TYPE 35 CARD) WILL BE USED IN ALL COMPOSITIONS.  -
CN                                                                     -
CN              THE CALCULATION OF TRANSVERSE LEAKAGE BY THE DIF3D     -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CN              CODE WILL USE THE THIRD DIMENSION DIFFUSION            -
CN              COEFFICIENT FOR THE PSEUDO ABSORPTION,                 -
CN                     D-B-SQUARED = (A3*D+B3)*B**2                    -
CN              REGARDLESS OF THE PROBLEM DIMENSIONS.  OTHER           -
CN              CODES USING THE COMPXS FILE MAY BEHAVE DIFFERENTLY -   -
CN              IT IS UP TO THE USER TO CHOOSE THE PROPER              -
CN              COEFFICIENT TO MODIFY.                                 -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          DIRECTIONAL DIFFUSION COEFFICIENT FACTORS-COMPOSITION      -
CR          CORRESPONDENCE (TYPE 36)                                   -
C                                                                      -
CL    FORMAT-----(I2,4X,11A6)                                          -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======    ===================================================== -
CD    1-2        36                                                    -
CD                                                                     -
CD    7-12       DIRECTIONAL DIFFUSION COEFFICIENT FACTOR SCHEME LABEL -
CD               (SEE CARD TYPE 35).                                   -
CD                                                                     -
CD    13-18      COMPOSITION TO WHICH DIFFUSION COEFFICIENT FACTORS ARE -
CD               ASSIGNED.                                             -
CD                                                                     -
CD    19-24      COMPOSITION TO WHICH DIFFUSION COEFFICIENT FACTORS ARE -
CD               ASSIGNED.                                             -
CD                                                                     -
CD    25-30      COMPOSITION TO WHICH DIFFUSION COEFFICIENT FACTORS ARE -
CD               ASSIGNED.                                             -
CD                                                                     -
CD    31-36      COMPOSITION TO WHICH DIFFUSION COEFFICIENT FACTORS ARE -
CD               ASSIGNED.                                             -
CD                                                                     -
CD    37-42      COMPOSITION TO WHICH DIFFUSION COEFFICIENT FACTORS ARE -
CD               ASSIGNED.                                             -
CD                                                                     -
CD    43-48      COMPOSITION TO WHICH DIFFUSION COEFFICIENT FACTORS ARE -
CD               ASSIGNED.                                             -
CD                                                                     -
CD    49-54      COMPOSITION TO WHICH DIFFUSION COEFFICIENT FACTORS ARE -
CD               ASSIGNED.                                             -
CD                                                                     -
CD    55-60      COMPOSITION TO WHICH DIFFUSION COEFFICIENT FACTORS ARE -
CD               ASSIGNED.                                             -
CD                                                                     -
CD    61-66      COMPOSITION TO WHICH DIFFUSION COEFFICIENT FACTORS ARE -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CD              ASSIGNED.                                              -
CD                                                                     -
CD    67-72     COMPOSITION TO WHICH DIFFUSION COEFFICIENT FACTORS ARE -
CD              ASSIGNED.                                              -
C                                                                      -
CN              IF MORE THAN ONE TYPE 36 CARD IS REQUIRED TO ASSIGN    -
CN              GIVEN DIFFUSION COEFFICIENT FACTORS TO COMPOSITIONS,   -
CN              THE LABEL IN COLS. 7-12 MUST BE REPEATED ON THE        -
CN              ADDITIONAL CARDS.                                      -
CN                                                                     -
CN              IF NO TYPE 36 CARDS ARE SUPPLIED, AND ONLY ONE         -
CN              DIRECTIONAL DIFFUSION COEFFICIENT FACTOR SCHEME IS     -
CN              DEFINED (THE SAME LABEL APPEARS IN COLS. 7-12 OF ALL   -
CN              TYPE 35 CARDS), THE FACTORS WILL BE USED IN ALL        -
CN              COMPOSITIONS.                                          -
CN                                                                     -
CN              IF NO TYPE 36 CARDS ARE SUPPLIED AND MORE THAN ONE     -
CN              SCHEME IS DEFINED, THE FACTORS FOR THE FIRST DEFINED   -
CN              SCHEME WILL BE USED IN ALL COMPOSITIONS.               -
CN                                                                     -
CN              IF NO COMPOSITIONS ARE DEFINED IN COLS. 13-72, THE     -
CN              SCHEME IDENTIFIED BY THE LABEL IN COLS. 7-12 WILL BE   -
CN              USED FOR ALL COMPOSITIONS.                             -
CN                                                                     -
CN              THE SCHEME-COMPOSITION CORRESPONDENCE DATA CAN BE      -
CN              OVERLAYED. THAT IS, DATA GIVEN ON LATER TYPE 36 CARDS  -
CN              SUPERCEDES DATA PREVIOUSLY DEFINED.                    -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          FISSION ENERGY CONVERSION FACTOR DATA (TYPE 37)            -
C                                                                      -
CL    FORMAT-----(I2,10X,3(A6,E12.5))                                  -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       37                                                     -
CD                                                                     -
CD    13-18     COMPOSITION LABEL.                                     -
CD                                                                     -
CD    19-30     ENERCY CONVERSION FACTOR FOR THIS COMPOSITION          -
CD              (FISSIONS/WATT-SEC.).                                  -
CD                                                                     -
CD    31-36     COMPOSITION LABEL.                                     -
CD                                                                     -
CD    37-48     ENERGY CONVERSION FACTOR FOR THIS COMPOSITION          -
CD              (FISSIONS/WATT-SEC.).                                  -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CD                                                                   -
CD    49-54      COMPOSITION LABEL.                                  -
CD                                                                   -
CD    55-66      ENERGY CONVERSION FACTOR FOR THIS COMPOSITION       -
CD               (FISSIONS/WATT-SEC.).                               -
C                                                                    -
CN               IF TYPE 37 OR TYPE 38 CARDS ARE PROVIDED FOR A      -
CN               A PARTICULAR COMPOSITION, THE ENERGY CONVERSION     -
CN               FACTORS IN DATA SET ISOTXS WILL BE IGNORED FOR THAT -
CN               COMPOSITION, AND THE DATA ON THE TYPE 37 AND TYPE 38 -
CN               CARDS WILL BE USED INSTEAD.                         -
CN                                                                   -
CN               IF THE FIRST LABEL (COLS. 13-18) ON A TYPE 37 CARD IS -
CN               BLANK, THE ASSOCIATED CONVERSION FACTOR WILL BE     -
CN               ENTERED FOR ALL COMPOSITIONS.                       -
CN                                                                   -
CN               IF COLS. 31-36 ARE BLANK THE DATA IN COLS. 37-66 ARE -
CN               NEGLECTED.  IF COLS. 49-54 ARE BLANK THE DATA IN    -
CN               COLS. 55-66 ARE NEGLECTED.                          -
CN                                                                   -
CN               DATA ON THIS CARD MAY BE OVERLAYED. THAT IS, FACTORS -
CN               DEFINED ON LATER TYPE 37 CARDS SUPERCEDE DATA FOR   -
CN               COMPOSITIONS PREVIOUSLY SPECIFIED.                  -
CN                                                                   -
CN               THE ENERGY CONVERSION FACTOR FOR ANY COMPOSITION NOT -
CN               REFERENCED ON A TYPE 37 OR TYPE 38 CARD WILL BE     -
CN               DETERMINED FROM DATA IN ISOTXS.                     -
C                                                                    -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          CAPTURE ENERGY CONVERSION FACTOR DATA (TYPE 38)          -
C                                                                    -
CL    FORMAT-----(I2,10X,3(A6,E12.5))                                -
C                                                                    -
CD    COLUMNS            CONTENTS...IMPLICATIONS, IF ANY             -
CD    =======    ====================================================-
CD    1-2        38                                                  -
CD                                                                   -
CD    13-18      COMPOSITION LABEL.                                  -
CD                                                                   -
CD    19-30      ENERGY CONVERSION FACTOR FOR THIS COMPOSITION       -
CD               (CAPTURES/WATT-SEC.).                               -
CD                                                                   -
CD    31-36      COMPOSITION LABEL.                                  -
CD                                                                   -
CD    37-48      ENERGY CONVERSION FACTOR FOR THIS COMPOSITION       -
CD               (CAPTURES/WATT-SEC.).                               -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CD                                                                     -
CD    49-54     COMPOSITION LABEL.                                     -
CD                                                                     -
CD    55-66     ENERGY CONVERSION FACTOR FOR THIS COMPOSITION          -
CD              (CAPTURES/WATT-SEC.).                                  -
C                                                                      -
CN              IF TYPE 37 OR TYPE 38 CARDS ARE PROVIDED FOR A         -
CN              A PARTICULAR COMPOSITION, THE ENERGY CONVERSION        -
CN              FACTORS IN DATA SET ISOTXS WILL BE IGNORED FOR THAT    -
CN              COMPOSITION, AND THE DATA ON THE TYPE 37 AND TYPE 38   -
CN              CARDS WILL BE USED INSTEAD.                            -
CN                                                                     -
CN              IF THE FIRST LABEL (COLS. 13-18) ON A TYPE 38 CARD IS  -
CN              BLANK, THE ASSOCIATED CONVERSION FACTOR WILL BE        -
CN              ENTERED FOR ALL COMPOSITIONS.                          -
CN                                                                     -
CN              IF COLS. 31-36 ARE BLANK THE DATA IN COLS. 37-66 ARE   -
CN              NEGLECTED.  IF COLS. 49-54 ARE BLANK THE DATA IN       -
CN              COLS. 55-66 ARE NEGLECTED.                             -
CN                                                                     -
CN              DATA ON THIS CARD MAY BE OVERLAYED. THAT IS, FACTORS   -
CN              DEFINED ON LATER TYPE 38 CARDS SUPERCEDE DATA FOR      -
CN              COMPOSITIONS PREVIOUSLY SPECIFIED.                     -
CN                                                                     -
CN              THE ENERGY CONVERSION FACTOR FOR ANY COMPOSITION NOT   -
CN              REFERENCED ON A TYPE 37 OR TYPE 38 CARD WILL BE        -
CN              DETERMINED FROM DATA IN ISOTXS.                        -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          NUCLIDE SET ASSIGNMENTS (TYPE 39)                          -
C                                                                      -
CL    FORMAT-----(I2,4X,11A6)                                          -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   ========================================================-
CD    1-2       39                                                     -
CD                                                                     -
CD    7-12      NUCLIDE SET LABEL.                                     -
CD                                                                     -
CD    13-18     ISOTOPE TO BE ASSIGNED TO THIS NUCLIDE SET.            -
CD                                                                     -
CD    19-24     ISOTOPE TO BE ASSIGNED TO THIS NUCLIDE SET.            -
CD                                                                     -
CD    25-30     ISOTOPE TO BE ASSIGNED TO THIS NUCLIDE SET.            -
CD                                                                     -
CD    31-36     ISOTOPE TO BE ASSIGNED TO THIS NUCLIDE SET.            -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CD                                                                      -
CD    37-42     ISOTOPE TO BE ASSIGNED TO THIS NUCLIDE SET.             -
CD                                                                      -
CD    43-48     ISOTOPE TO BE ASSIGNED TO THIS NUCLIDE SET.             -
CD                                                                      -
CD    49-54     ISOTOPE TO BE ASSIGNED TO THIS NUCLIDE SET.             -
CD                                                                      -
CD    55-60     ISOTOPE TO BE ASSIGNED TO THIS NUCLIDE SET.             -
CD                                                                      -
CD    61-66     ISOTOPE TO BE ASSIGNED TO THIS NUCLIDE SET.             -
CD                                                                      -
CD    67-72     ISOTOPE TO BE ASSIGNED TO THIS NUCLIDE SET.             -
C                                                                       -
CN              NUCLIDE SET ASSIGNMENTS ARE OPTIONAL. THEIR USE MAY     -
CN              REDUCE THE SIZE OF THE CCCC ATOM DENSITY FILE (ZNATDN)  -
CN              AND, THEREFORE, THE RUNNING TIME FOR CROSS SECTION      -
CN              HOMOGENIZATION.                                         -
CN                                                                      -
CN              ALL ISOTOPES USED IN A PARTICULAR ZONE OR A             -
CN              PARTICULAR SUBZONE MUST BE ASSIGNED TO THE SAME         -
CN              NUCLIDE SET.                                            -
CN                                                                      -
CN              WHEN NO TYPE 39 CARDS ARE PROVIDED, ALL ISOTOPES ARE    -
CN              ASSIGNED TO A SINGLE NUCLIDE SET.                       -
C                                                                       -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          SOURCE EDIT AND SYNTHESIS TRIAL FUNCTION SOURCE             -
CR          SPECIFICATION (TYPE 40)                                     -
C                                                                       -
CL    FORMAT-----(I2,4X,4I6)                                            -
C                                                                       -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                 -
CD    =======   =========================================================
CD    1-2       40                                                      -
CD                                                                      -
CD    7-12      EDIT FLAG FOR POINTWISE INHOMOGENEOUS SOURCE            -
CD                  0, NO EDITS (DEFAULT).                              -
CD                  1, PRINT EDITS.                                     -
CD                  2, WRITE EDITS TO AUXILIARY OUTPUT FILE.            -
CD                  3, WRITE EDITS TO BOTH PRINT AND AUXILIARY OUTPUT   -
CD                     FILE.                                            -
CD                                                                      -
CD    13-18     RTFLUX FILE VERSION NUMBER FOR A SYNTHESIS TRIAL        -
CD              FUNCTION SOURCE.                                        -
CD                    S(X,Y,Z,G)=D(X,Y,Z,G)*FLUX(X,Y,Z,G)               -
CD              WHERE D IS A DIFFUSION COEFFICIENT AND FLUX IS A FLUX   -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CD              (OR ADJOINT FLUX) FROM AN INPUT RTFLUX (OR ATFLUX)      -
CD              FILE.  USE A NEGATIVE VALUE FOR ATFLUX.  SET TO ZERO    -
CD              WHEN ANOTHER TYPE OF SOURCE IS REQUIRED.                -
CD                                                                      -
CD    19-24     VERSION NUMBER OF GEODST FILE SPECIFYING COMPOSITION    -
CD              DISTRIBUTION REQUIRED FOR A SYNTHESIS TRIAL FUNCTION    -
CD              SOURCE.  0 OR 1 IMPLIES THE GEOMETRY DEFINED BY THE     -
CD              CURRENT A.NIP3 DATASET.  THIS PARAMETER IS USED ONLY    -
CD              WHEN THE FLUX FILE VERSION IN COLS. 13-18 IS .GE. 1.    -
CD                                                                      -
CD    25-30     WORD LENGTH PARAMETER FOR THE FIXSRC FILE SOURCE        -
CD              DISTRIBUTION.  ON SINGLE-WORD-LENGTH MACHINES           -
CD              (E.G. CDC) THIS INPUT FIELD IS IGNORED.  ON DOUBLE-     -
CD              WORD-LENGTH MACHINES A VALUE OF 1 WILL PRODUCE A        -
CD              SHORT-WORD (I.E. REAL*4) FILE, A VALUE OF 2 WILL        -
CD              PRODUCE A DOUBLE-WORD (I.E. REAL*8) FILE.  THE DIF3D    -
CD              CODE REQUIRES A DOUBLE-WORD FILE  ON DOUBLE-WORD-       -
CD              LENGTH MACHINES.  (DEFAULT = 2 ON DOUBLE-WORD-LENGTH    -
CD              MACHINES)                                               -
C                                                                       -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          NATURAL DECAY INHOMOGENEOUS SOURCE SPECIFICATIONS           -
CR          (TYPE 41)                                                   -
C                                                                       -
CL    FORMAT-----(I2,4X,2(A6,E12.5,A6))                                 -
C                                                                       -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                 -
CD    =======   =========================================================-
CD    1-2       41                                                      -
C                                                                       -
CD    7-12      ISOTOPE LABEL                                           -
CD                                                                      -
CD    13-24     DECAY CONSTANT                                          -
CD                                                                      -
CD    25-30     SPECTRUM LABEL OF SPECTRUM TO BE USED WITH THIS         -
CD              ISOTOPE (SEE CARD TYPE 42)                              -
CD                                                                      -
CD    31-36     ISOTOPE LABEL                                           -
CD                                                                      -
CD    37-48     DECAY CONSTANT                                          -
CD                                                                      -
CD    49-54     SPECTRUM LABEL OF SPECTRUM TO BE USED WITH THIS         -
CD              ISOTOPE (SEE CARD TYPE 42)                              -
C                                                                       -
CN              WHEN THERE ARE TYPE 41 CARDS A FIXSRC FILE WILL BE      -
CN              CREATED CONTAINING THE DISTRIBUTED SOURCE               -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CN                      S(X,Y,Z,G) = SUM OVER ISOTOPES (I) OF             -
CN                        SCHI(G,I)*DC(I)*ATND(X,Y,Z,I)                   -
CN               WHERE SCHI IS AN ISOTOPE SOURCE SPECTRUM (SEE THE TYPE -
CN               42 CARDS), DC IS THE DECAY CONSTANT AND ATND IS THE    -
CN               ISOTOPE NUMBER DENSITY.                                -
CN                                                                      -
CN               AS MANY TYPE 41 CARDS SHOULD BE PROVIDED AS ARE        -
CN               NECESSARY TO SPECIFY ALL ISOTOPES REQUIRED.            -
CN                                                                      -
CN               WHEN THE SPECTRUM LABEL IS BLANK THE SOURCE WILL BE    -
CN               COMPUTED WITH THE SPECTRUM EQUAL TO 1.0 IN ALL GROUPS. -
C                                                                       -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR           SOURCE SPECTRUM DATA (TYPE 42)                             -
C                                                                       -
CL     FORMAT-----(I2,4X,A6,5E12.5)                                     -
C                                                                       -
CD     COLUMNS             CONTENTS...IMPLICATIONS, IF ANY              -
CD     =======    ==================================================-
CD     1-2        42                                                    -
CD                                                                      -
CD     7-12       SPECTRUM LABEL                                        -
CD                                                                      -
CD     13-24      GROUP MULTIPLIER (SPECTRUM), FIRST GROUP.             -
CD                                                                      -
CD     25-36      GROUP MULTIPLIER (SPECTRUM), NEXT GROUP.              -
CD                                                                      -
CD     37-48      GROUP MULTIPLIER (SPECTRUM), NEXT GROUP.              -
CD                                                                      -
CD     49-60      GROUP MULTIPLIER (SPECTRUM), NEXT GROUP.              -
CD                                                                      -
CD     61-72      GROUP MULTIPLIER (SPECTRUM), NEXT GROUP.              -
C                                                                       -
CN                AS MANY TYPE 42 CARDS, FIVE ENERGY GROUPS PER CARD,   -
CN                SHOULD BE PROVIDED AS ARE NECESSARY TO SPECIFY ALL THE -
CN                SPECTRA NEEDED FOR THE NATURAL DECAY SOURCE           -
CN                CALCULATION.  THE FIRST TYPE 42 CARD MUST HAVE A      -
CN                NON-BLANK SPECTRUM LABEL.  A REPEATED SPECTRUM LABEL  -
CN                IMPLIES A CONTINUATION OF THE LAST CARD WITH THE SAME -
CN                LABEL.  A BLANK SPECTRUM LABEL IMPLIES A CONTINUATION -
CN                OF THE SPECTRUM ON THE PREVIOUS TYPE 42 CARD.         -
CN                                                                      -
CN                WHEN THE NUMBER OF DATA FOR A PARTICULAR SPECTRUM IS  -
CN                LESS THAN THE TOTAL NUMBER OF ENERGY GROUPS, THE      -
CN                REMAINING ELEMENTS OF THE SPECTRUM ARE SET TO ZERO.   -
CN                WHEN THE NUMBER OF DATA IS GREATER THAN THE NUMBER    -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CN              OF GROUPS THE SURPLUS ELEMENTS ARE IGNORED.             -
C                                                                       -
C------------------------------------------------------------------------


C------------------------------------------------------------------------
CR          GRAPHICS OUTPUT CONTROL (TYPE 43)                           -
C                                                                       -
CL    FORMAT-----(I2,4X,I6,3E12.4,3I6)                                  -
C                                                                       -
CD    COLUMNS            CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======    ========================================================-
CD    1-2        43                                                     -
CD                                                                      -
CD    7-12       GRAPHICS OUTPUT SENTINEL FOR MAP                       -
CD               0...NO GRAPHICS (DEFAULT)                              -
CD               1...GENERATE MAP                                       -
CD                                                                      -
CD    13-24      HEIGHT OF GRAPHICS OUTPUT FIELD (DEFAULT=11.0 INCHES)  -
CD                                                                      -
CD    25-36      WIDTH OF GRAPHICS OUTPUT FIELD (DEFAULT=11.0 INCHES)   -
CD                                                                      -
CD    37-48      FOR TRIANGULAR AND HEXAGONAL GEOMETRIES - THIS FIELD   -
CD               CONTAINS THE FLAT-TO-FLAT DISTANCE ACROSS EACH         -
CD               HEXAGON, IN INCHES (DEFAULT = 0.5 INCHES)              -
CD                                                                      -
CD               FOR ORTHOGONAL GEOMETRIES - THIS FIELD CONTAINS THE    -
CD               MINIMUM REDUCTION ALLOWED FOR LABELS (DEFAULT = 0.5).  -
CD               SEE THE NOTE BELOW.                                    -
C                                                                       -
CD    49-54      PRINTER PLOTTER SENTINEL - HEXAGONAL MAP ONLY          -
CD               1...FLAT-TO-FLAT HEXAGON DIMENSION = 8 ROWS            -
CD               2...FLAT-TO-FLAT HEXAGON DIMENSION = 6 ROWS (DEFAULT)  -
CD                                                                      -
CD    55-60      MAXIMUM NO. OF ROWS IN PRINTER-PLOTTER FIELD -         -
CD               HEXAGONAL MAP ONLY (DEFAULT = 48)                      -
CD                                                                      -
CD    61-66      MAXIMUM NO. OF PRINT COLUMNS IN PRINTER-PLOTTER FIELD  -
CD               - HEXAGONAL MAP ONLY (DEFAULT = 130)                   -
C                                                                       -
CN               THE GRAPHICS OPTION MAY NOT BE AVAILABLE IN ALL        -
CN               VERSIONS OF THE INPUT PROCESSOR GNIP4C.                -
CN                                                                      -
CN               THIS CARD CONTROLS THE FORMAT OF THE PRINTER-PLOTTER   -
CN               OUTPUT FOR HEXAGONAL MAPS BUT DOES NOT ACTUALLY        -
CN               TRIGGER THE PRINTER MAP.  THAT IS DONE BY A SENTINEL   -
CN               ON THE TYPE 02 CARD.  THIS CARD HAS NO EFFECT ON THE   -
CN               PRINTER-PLOTTER MAP OF ORTHOGONAL GEOMETRY MODELS.     -
CN                                                                      -
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

```
CN              FOR TRIANGULAR AND HEXAGONAL GEOMETRIES THE SCALE      -
CN              OF THE PLOT IS DETERMINED BY THE FLAT-TO-FLAT DISTANCE -
CN              IN COLS. 37-48.  THE SIZE OF THE GRAPHICS PAGE IS SET  -
CN              BY THE DATA IN COLS. 13-36.  THE CODE GENERATES AS     -
CN              MANY PAGES OF GRAPHICS OUTPUT AS IT TAKES TO COVER THE -
CN              ENTIRE MAP.  LABELS ARE CENTERED IN EACH HEXAGON, AND  -
CN              THE CHARACTER SIZE IS A FIXED FRACTION (1/8) OF THE    -
CN              FLAT-TO-FLAT DISTANCE.                                 -
CN                                                                     -
CN              FOR ORTHOGONAL GEOMETRIES THE SCALE OF THE PLOT IS     -
CN              SET BY THE CODE SO THAT THE ENTIRE MAP IS FORCED       -
CN              TO FIT IN A SINGLE GRAPHICS PAGE.  THE MAXIMUM         -
CN              SIZE OF THE GRAPHICS PAGE IS SET BY THE DATA IN        -
CN              COLS. 13-36.  LABELS WITH 0.1 INCH CHARACTER HEIGHT    -
CN              ARE PLACE IN REGIONS AS LONG AS THERE IS ROOM.  IF THE -
CN              REGION IS TOO SMALL, THE LABEL IS REDUCED IN SIZE.  IF -
CN              TO FIT IN THE REGION THE LABEL SIZE MUST BE REDUCED    -
CN              BY A FACTOR SMALLER THAN THE NUMBER IN COLS. 37-48     -
CN              NO LABEL IS DRAWN.  WHEN THE NUMBER IN COLS. 37-48     -
CN              IS GREATER THAN 1.0 NO LABELS ARE DRAWN.               -
C                                                                      -
C-----------------------------------------------------------------------

CEOF
```

Figure 13. BCD Dataset A.NIP3 (cont'd.)

Appendix F

BCD DATASET A.STP027

The BCD dataset listed in Figure 14 specifies the user input for control of the standard path STP027 which guides the flow of the REBUS-3 calculation. Note that the entire dataset may be omitted if the various default values are acceptable to the user. Dataset A.STP027 corresponds to the dataset A.STP004 used in REBUS-2.[1]

For the standalone export version of REBUS-3, cols. 7-12 and 37-42 on card type 01, and cols. 13-18 and 31-36 on card type 02 are not pertinent.

Either the formats specified in Figure 14 or the free format option indicated in Appendix I may be used for dataset A.STP027.

```
C***********************************************************************
C                                                                      -
C                       PREPARED 03/21/83 AT ANL                       -
C                                                                      -
CF          A.STP027                                                   -
CE          FUEL CYCLE STANDARD PATH BCD INPUT                         -
C                                                                      -
CN                      THIS IS A USER SUPPLIED BCD DATA SET.  THE     -
CN                      LIST FOR EACH RECORD IS GIVEN IN TERMS OF THE  -
CN                      BCD FORMAT OF THE DATA CARD.  COLUMNS 1-2      -
CN                      NORMALLY CONTAIN THE CARD TYPE NUMBER.         -
CN                                                                     -
CN                      A.STP027 NEED NOT BE SUPPLIED AT ALL - OR      -
CN                      EITHER CARD TYPE MAY BE OMITTED.               -
C                                                                      -
C***********************************************************************


C-----------------------------------------------------------------------
CR          GENERAL PROBLEM SPECIFICATIONS (TYPE 01)                   -
C                                                                      -
CL    FORMAT-----(I2,4X,11I6)                                          -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       01                                                     -
CD                                                                     -
CD    7-12      0...DO NOT ACTIVATE ERRSET (DEFAULT).                  -
CD              1...ACTIVATE ERRSET TO FORCE AN ABEND UPON ENCOUNTERING-
CD                  ANY ERROR DETECTED BY THE FORTRAN EXTENDED ERROR   -
CD                  HANDLING FACILITY.                                 -
CD                                                                     -
CD    13-18     0...NORMAL PROBLEM (DEFAULT).                          -
CD              1...EXECUTION ONLY THROUGH THE FUEL CYCLE INPUT        -
CD                  PROCESSOR (FCI002) FOR DEBUGGING OF A NEW CASE.    -
CD                  NOT PERTINENT FOR A RESTART PROBLEM.               -
CD                                                                     -
CD    19-24     0...DISABLE CRITICALITY SEARCH SPECIFIED BY            -
CD                  A.NIP3 (DEFAULT).                                  -
CD              1...ENABLE CRITICALITY SEARCH.                         -
CD                                                                     -
CD    25-30     0...EQUILIBRIUM PROBLEM (DEFAULT).                     -
CD              1...NONEQUILIBRIUM PROBLEM.                            -
CD                                                                     -
CD    31-36     0...ENABLE NEUTRONICS (DEFAULT).                       -
CD              1...DISABLE NEUTRONICS - I.E. ASSUME THE ORIGINAL FLUX -
CD                  DISTRIBUTION, AS COMPUTED BY THE FIRST NEUTRONICS  -
CD                  CALCULATION, OR AS GIVEN BY THE RZFLUX DATA SET    -
CD                  THAT IS PROVIDED IN THE BLOCK=OLD DATA SETS, IS    -
```

Figure 14. BCD Dataset A.STP027

```
CD                  APPLICABLE THROUGHOUT THE PROBLEM.  THE             -
CD                  FLUX LEVEL IS RENORMALIZED AT EACH SUBINTERVAL SO   -
CD                  AS TO MAINTAIN A CONSTANT POWER LEVEL. PERTINENT    -
CD                  ONLY FOR NONEQUILIBRIUM PROBLEMS (I.E. A 1 IN COLS.-
CD                  25-30)                                              -
CD                                                                      -
CD              NOTES ON THE USE OF THIS OPTION:                        -
CD              1. COLS. 31-36 MUST BE 0 IF COLS. 25-30 ARE 0.          -
CD              2. IF COLS. 31-36 ARE 1, THEN COLS. 61-66 ON CARD       -
CD                 TYPE 02 OF DATA SET A.BURN SHOULD BE 0.              -
CD              3. A NEUTRONICS SOLUTION IS ALWAYS OBTAINED AT THE      -
CD                 END OF THE BURN STEP EVEN IF COLS. 31-36 ARE 1.      -
CD              4. IF RZFLUX APPEARS AMONG THE BLOCK=OLD DATA SETS,     -
CD                 COLS. 31-36 ARE IGNORED AND THE SUPPLIED RZFLUX IS   -
CD                 USED THROUGHOUT THE PROBLEM WITH RENORMALIZATION TO -
CD                 MAINTAIN CONSTANT POWER.                             -
CD              5. WARNING! IN THE CASE OF A RESTART PROBLEM,           -
CD                 THE RZFLUX DATA SET IS AUTOMATICALLY                 -
CD                 RECREATED FROM THE RESTART DATA SET RFILES. HENCE    -
CD                 ANY SUPPLIED RZFLUX DATA SET WILL BE OVERWRITTEN.    -
CD                                                                      -
CD      37-42   0...CREATE A CONDENSED VERSION OF DATA SET ISOTXS AND   -
CD                  A CORRESPONDING VERSION OF DATA SET NDXSRF          -
CD              1...USE THE ORIGINAL ISOTXS AND NDXSRF DATA SETS        -
CD                                                                      -
CD      43-48   0...NO PERIODIC SAVES (DEFAULT).                        -
CD              N...MAKE A PERIODIC SAVE EVERY X/N MINUTES WHERE X IS   -
CD                  THE PROBLEM JOB TIME AS PUNCHED ON THE JOB CARD.    -
CD                                                                      -
CD      49-54   0...NORMAL PROBLEM (DEFAULT).                           -
CD              N...TERMINATE PROBLEM WITH A WRAPUP AFTER N NEUTRONICS -
CD                  SOLUTIONS HAVE BEEN COMPLETED.                      -
CD                                                                      -
CD      55-60   0...DO NOT EXECUTE A STANDALONE MASS FLOW SUMMARY EDIT -
CD              1...EXECUTE A STANDALONE MASS FLOW SUMMARY EDIT         -
CD                                                                      -
CD      61-66   AVAILABLE TIME FOR THE PROBLEM IN SECONDS               -
CD              (DEFAULT=100000)                                        -
CD                                                                      -
CD      66-72   0...NORMAL PROBLEM (DEFAULT).                           -
CD              1...HIGH BURNUP PROBLEM.                                -
C                                                                       -
CN              THE AVAILABLE TIME IN COLS. 61-66 SHOULD NORMALLY NOT   -
CN              BE SPECIFIED SINCE THE REMAINING LIMITING TIME FOR THE -
CN              PROBLEM IS OBTAINED FROM THE SYSTEM.  HOWEVER, IF       -
CN              COLS. 61-66 ARE NOT 0, THE VALUE SUPPLIED WILL BE USED -
CN              TO COMPUTE A VALUE FOR THE REMAINING LIMITING TIME      -
CN              WHICH WILL BE COMPARED WITH THE VALUE OBTAINED FROM     -
CN              THE SYSTEM.  THE DETERMINATION OF WHEN A PROBLEM        -
```

Figure 14. BCD Dataset A.STP027 (cont'd.)

```
CN              WRAPUP IS REQUIRED WILL MAKE USE OF THE SMALLER OF     -
CN              THE TWO VALUES OF THE REMAINING LIMITING TIME.         -
CN              NOTE THAT WHEN A LEGITIMATE VALUE FOR THE REMAINING    -
CN              LIMITING TIME CAN NOT BE OBTAINED FROM THE SYSTEM      -
CN              (AS FOR EXAMPLE IN THE CASE OF THE EXPORT VERSION      -
CN              OF REBUS-3) USE OF COLS. 61-66 IS ESSENTIAL TO AVOID   -
CN              EXCEEDING THE AVAILABLE TIME FOR A PROBLEM WITHOUT     -
CN              OBTAINING A RESTART DATA SET.                          -
CN                                                                     -
CN              THE USE OF THE PERIODIC SAVE OPTION DOES NOT DISABLE   -
CN              THE SAVE WHICH IS MADE IF A JOB RUNS OUT OF TIME.      -
CN                                                                     -
CN              A RESTART PROBLEM IS INDICATED BY PUTTING THE          -
CN              DATA SET RFILES IN THE 'BLOCK=OLD' DSIB.               -
CN                                                                     -
CN              USING A 0 IN COLS. 37-42 WILL PRODUCE A SUBSET OF DATA -
CN              SET ISOTXS ON LOGICAL UNIT NUMBER 46 WHICH CONTAINS    -
CN              ONLY THE ISOTOPES USED IN THE PROBLEM, AND WHICH       -
CN              CONTAINS ONLY A TOTAL SCATTERING MATRIX. ALSO,         -
CN              A CONSISTENT NDXSRF DATA SET WILL BE PRODUCED ON       -
CN              LOGICAL UNIT NUMBER 54.                                -
CN              THIS CONDENSATION WILL REDUCE THE I/O TIME,            -
CN              ESPECIALLY FOR EQUILIBRIUM PROBLEMS.                   -
CN              NOTE THAT IF COLS. 37-42 ARE 0, THE CONSISTENT DATA    -
CN              SETS ISOTXS AND NDXSRF ARE ON LOGICAL UNIT NUMBERS     -
CN              46 AND 54, RESPECTIVELY.  IF COLS. 37-42 ARE 1, THE    -
CN              CONSISTENT LOGICAL UNIT NUMBERS ARE 35 AND 37.         -
CN                                                                     -
CN              IF COLS. 55-60 ARE 1, ONLY THE STANDALONE MASS FLOW    -
CN              SUMMARY EDIT WILL BE EXECUTED AND DATA SET A.MASFLO    -
CN              SHOULD BE PROVIDED.  A NORMAL EQUILILIBRIUM REBUS-3    -
CN              PROBLEM WILL PROVIDE A MASS FLOW SUMMARY EDIT AS PART  -
CN              OF ITS NORMAL OUTPUT DEPENDING UPON THE DATA IN DATA   -
CN              SET A.BURN CARD TYPES 31-34.  IF COLS. 31-36 ON DATA   -
CN              SET A.STP027 CARD TYPE 02 ARE 1, THE INPUT FOR THE MASS-
CN              FLOW SUMMARY EDITS WILL BE PUNCHED FOR SUBSEQUENT USE  -
CN              WITH A STANDALONE EXECUTION OF THE MASS FLOW SUMMARY.  -
CN                                                                     -
CN              IF COLS. 66-72 ARE 1, CYCLIC MODE ITERATIONS WILL BE   -
CN              INITIATED AT THE INTERMEDIATE SEARCH LEVEL FOR AN      -
CN              EQUILIBRIUM PROBLEM.  THE MAXIMUM NUMBER OF CYCLIC MODE-
CN              ITERATIONS PERMITTED IS SET BY THE VALUE SUPPLIED IN   -
CN              COLS. 67-72 ON CARD TYPE 02 OF DATA SET A.BURN.  ALSO, -
CN              IF COLS. 66-72 ARE 1, FOR AN ENRICHMENT SEARCH, THE    -
CN              USER SUPPLIED CONVERGENCE CRITERION EPSF ON THE DATA   -
CN              SET A.BURN TYPE 04 CARD IS TEMPORARILY INCREASED BY A  -
CN              FACTOR OF 50 DURING THE PRELIMINARY SERACH PROCEDURE.  -
CN              COLS. 66-72 SHOULD BE SET TO 1 FOR PROBLEMS HAVING     -
CN              ATOM PERCENT BURNUPS GREATER THAN THE ORDER OF 30 A/O. -
```

Figure 14. BCD Dataset A.STP027 (cont'd.)

```
C                                                                     -
C----------------------------------------------------------------------


C----------------------------------------------------------------------
CR          EDIT SPECIFICATIONS (TYPE 02)                             -
C                                                                     -
CL    FORMAT-----(I2,4X,10I6)                                         -
C                                                                     -
CD    COLUMNS             CONTENTS...IMPLICATIONS, IF ANY             -
CD    =======    ==================================================-
CD    1-2        02                                                   -
CD                                                                    -
CD    7-12       0...SUPPRESS NEUTRONICS EDITS UNTIL LAST             -
CD                   PASS (DEFAULT).                                  -
CD               1...ENABLE NEUTRONICS EDITS.                         -
CD                                                                    -
CD    13-18      0...ENABLE REACTION SUMMARY EXECUTION (DEFAULT).     -
CD               1...DISABLE REACTION SUMMARY EXECUTION.              -
CD                                                                    -
CD    19-24      0...SUPPRESS EDITS OF OPEN DATA SETS AFTER COMPLETION -
CD                   OF EACH MODULE (DEFAULT).                        -
CD               1...ENABLE EDITS OF OPEN DATA SETS AFTER COMPLETION  -
CD                   OF EACH MODULE.                                  -
CD                                                                    -
CD    25-30      0...SUPPRESS EDITS OF ATOM DENSITIES USED IN EACH    -
CD                   NEUTRONICS SOLUTION (DEFAULT).                   -
CD               1...ENABLE EDITS OF ATOM DENSITIES IN THE FINAL PASS -
CD                   WITH FULL EDITS.                                 -
CD              -1...ENABLE EDITS OF ATOM DENSITIES AT ALL TIMES.     -
CD                                                                    -
CD    31-36      0...DO NOT PUNCH THE MASS FLOW SUMMARY DATA          -
CD                   (DEFAULT)                                        -
CD               1...PUNCH THE MASS FLOW SUMMARY DATA                 -
CD                                                                    -
CD    37-42      0...SUPPRESS EDITS OF ZNATDN DATA SET (DEFAULT).     -
CD               1...ENABLE ZNATDN EDITS.                             -
CD                                                                    -
CD    43-48      0...SUPPRESS MASS FLOW EDITS (DEFAULT).              -
CD               1...ENABLE MASS FLOW EDITS.                          -
CD                                                                    -
CD    49-54      0...DO NOT INVOKE UDOIT1 MODULE (DEFAULT).           -
CD               1...INVOKE UDOIT1 MODULE.                            -
CD                                                                    -
CD    55-60      0...DO NOT INVOKE UDOIT3 MODULE (DEFAULT).           -
CD               1...INVOKE UDOIT3 MODULE.                            -
CD                                                                    -
CD    61-66      0...PROVIDE FULL EDITS FROM ALL MODULES (DEFAULT).   -
CD               1...SUPPRESS EDITS COMPLETELY FROM MODULES MODDIF AND -
```

Figure 14. BCD Dataset A.STP027 (cont'd.)

```
CD                    RESNDX.  ALSO, FOR EQUILIBRIUM PROBLEMS, EDITS FROM-
CD                    MODULE FCC004 WILL BE SUPPRESSED EXCEPT FOR THE    -
CD                    FINAL PASS WITH FULL EDITS.                        -
C                                                                        -
CN                IF COLS. 43-48 ARE 1, CARD TYPES 32-34 OF DATA SET     -
CN                A.BURN SHOULD BE SUPPLIED.                             -
CN                                                                       -
CN                COLS. 61-66 WILL ONLY AFFECT THE EDITS ROUTED TO       -
CN                PAPER OUTPUT.  THE FICHE OUTPUT, IF ANY, WILL CONTAIN  -
CN                ALL OF THE EDITS.                                      -
C                                                                        -
C-------------------------------------------------------------------------

CEOF
```

Figure 14. BCD Dataset A.STP027 (cont'd.)

Appendix G

BCD DATASET A.SUMMAR

The BCD dataset listed in Figure 15 specifies the user input for the module SUMMARY which edits the summary reaction rates and isotopic masses. Note that the entire dataset may be omitted if all of the default values are acceptable to the user.

Either the formats specified in Figure 15 or the free format option indicated in Appendix I may be used for dataset A.SUMMAR.

Since SUMMARY is not implemented in the export standalone version of REBUS-3, dataset A.SUMMAR is not pertinent in this case.

```
C***********************************************************************
C                                                                      -
C                       PREPARED 02/10/83 AT ANL                       -
C                                                                      -
CF          A.SUMMAR                                                   -
CE          SUMMARY BCD INPUT                                          -
C                                                                      -
CN                      THIS IS A USER SUPPLIED BCD DATA SET.  THE     -
CN                      LIST FOR EACH RECORD IS GIVEN IN TERMS OF THE  -
CN                      BCD FORMAT OF THE DATA CARD.  COLUMNS 1-2      -
CN                      NORMALLY CONTAIN THE CARD TYPE NUMBER.         -
C                                                                      -
C***********************************************************************


C-----------------------------------------------------------------------
CR          STORAGE AND OUTPUT EDITS (TYPE 01)                         -
C                                                                      -
CL    FORMAT-----(I2,22X,5I6)                                          -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   ===================================================-
CD    1-2       01                                                     -
CD                                                                     -
CD   25-30      POINTR DEBUGGING EDIT                                  -
CD              0...NO DEGUGGING EDIT (DEFAULT)                        -
CD              1...DEBUGGING DUMP PRINTOUT                            -
CD              2...DEBUGGING TRACE PRINTOUT                           -
CD              3...FULL DEBUGGING PRINTOUT (TRACE AND DUMP)           -
CD                                                                     -
CD   31-36      POINTR CONTAINER ARRAY SIZE IN REAL*8 WORDS            -
CD              (DEFAULT IS THE AVAILABLE CORE)                        -
CD                                                                     -
CD   37-42      OUTPUT FLAG                                            -
CD             -1...MINIMUM OUTPUT EDITS                               -
CD              0...STANDARD OUTPUT EDITS (DEFAULT)                    -
CD              1...DEBUGGING OUTPUT EDITS (MAXIMUM OUTPUT)            -
CD                                                                     -
CD   43-48      PLOTTER FLAG                                           -
CD              0...PLOT FLUX AND POWER DENSITY (DEFAULT)              -
CD              1...DO NOT PRODUCE PLOT OUTPUT                         -
CD                                                                     -
CD   49-54      ABNORMAL ERROR FLAG                                    -
CD              0...DO NOT INVOKE ABEND FOR AN ABNORMAL ERROR (DEFAULT)-
CD              1...INVOKE ABEND FOR AN ABNORMAL ERROR                 -
C                                                                      -
CN              CARD TYPE 01 MUST BE PRESENT IN ORDER TO PLOT FLUX AND -
CN              POWER DENSITY.                                         -
C                                                                      -
```

Figure 15. BCD Dataset A.SUMMAR

```
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          PLOT SPECIFICATIONS (TYPE 03)                              -
C                                                                      -
CL    FORMAT-----(I2,9X,A1,2I6)                                        -
C                                                                      -
CD    COLUMNS             CONTENTS...IMPLICATIONS, IF ANY              -
CD    =======    ==========================================================-
CD    1-2        03                                                    -
CD                                                                     -
CD   12          FLAG DIRECTION OF PLOT                                -
CD               X...PLOT IS IN THE DIRECTION OF THE X-AXIX (DEFAULT)  -
CD               Y...PLOT IS IN THE DIRECTION OF THE Y-AXIS            -
CD                                                                     -
CD   13-18       THE NUMBER OF THE LINE IN THE ABOVE DIRECTION FOR     -
CD               WHICH DATA IS TO BE PLOTTED (DEFAULT=1)               -
CD                                                                     -
CD   19-24       THE NUMBER OF THE LEVEL IN THE Z-DIRECTION FOR WHICH  -
CD               DATA IS TO BE PLOTTED (DEFAULT=1)                     -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          ISOTOPE CLASSIFICATION (TYPE 04)                           -
C                                                                      -
CL    FORMAT-----(I2,4X,I6,10A6)                                       -
C                                                                      -
CD    COLUMNS             CONTENTS...IMPLICATIONS, IF ANY              -
CD    =======    ==========================================================-
CD    1-2        04                                                    -
CD                                                                     -
CD    7-12       ISOTOPE CLASSIFICATION                                -
CD               1...FISSILE                                           -
CD               2...FERTILE                                           -
CD               3...OTHER ACTINIDE                                    -
CD               4...FISSION PRODUCT                                   -
CD               5...STRUCTURE                                         -
CD               6...COOLANT                                           -
CD               7...CONTROL                                           -
CD               8...UNDEFINED                                         -
CD               9...SPECIAL                                           -
CD                                                                     -
CD   13-18       ISOTXS ISOTOPE NAME IN THIS CLASSIFICATION            -
CD                                                                     -
CD   19-24       ISOTXS ISOTOPE NAME IN THIS CLASSIFICATION            -
CD                                                                     -
```

Figure 15. BCD Dataset A.SUMMAR (cont'd.)

```
CD    25-30       ISOTXS ISOTOPE NAME IN THIS CLASSIFICATION            -
CD                                                                      -
CD    31-36       ISOTXS ISOTOPE NAME IN THIS CLASSIFICATION            -
CD                                                                      -
CD    37-42       ISOTXS ISOTOPE NAME IN THIS CLASSIFICATION            -
CD                                                                      -
CD    43-48       ISOTXS ISOTOPE NAME IN THIS CLASSIFICATION            -
CD                                                                      -
CD    49-54       ISOTXS ISOTOPE NAME IN THIS CLASSIFICATION            -
CD                                                                      -
CD    55-60       ISOTXS ISOTOPE NAME IN THIS CLASSIFICATION            -
CD                                                                      -
CD    61-66       ISOTXS ISOTOPE NAME IN THIS CLASSIFICATION            -
CD                                                                      -
CD    67-72       ISOTXS ISOTOPE NAME IN THIS CLASSIFICATION            -
C                                                                       -
CN                ANY VALUE IN COLS. 7-12 OTHER THAN 1-7 OR 9 WILL      -
CN                CORRESPOND TO A CLASSIFICATION OF UNDEFINED AND WILL
CN                BE INDICATED AS CLASSIFICATION 8 IN THE SUMMARY OUTPUT -
CN                                                                      -
CN                IF NO TYPE 04 CARDS ARE SUPPLIED, THE CODE WILL       -
CN                DETERMINE THE ISOTOPE CLASSIFICATION OF EACH OF THE   -
CN                ISOTOPES IN THE PROBLEM BY COMPARING THE ENDF/B       -
CN                ABSOLUTE ISOTOPE NAMES WITH THE ISOTXS ISOTOPE NAMES. -
CN                                                                      -
CN                THE TYPE 04 CARDS ARE USED TO CHANGE DEFAULT VALUES   -
CN                SET IN THE CODE.                                      -
C                                                                       -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR            MODIFIY ISOTOPE SPECIFICATIONS (TYPE 05)                  -
C                                                                       -
CL     FORMAT-----(I2,4X,A6,A4,2X,F12.5,7A6)                            -
C                                                                       -
CD     COLUMNS             CONTENTS...IMPLICATIONS, IF ANY              -
CD     =======    ======================================================-
CD     1-2        05                                                    -
CD                                                                      -
CD     7-12       ENDF/B ABSOLUTE ISOTOPE NAME                          -
CD                                                                      -
CD    13-16       ALPHANUMERIC NUCLIDE TYPE I.D.                        -
CD                FISS...THE ISOTOPE NAMED IS TREATED AS FISSILE IN     -
CD                       CALCULATING BREEDING RATIOS                    -
CD                FERT...THE ISOTOPE NAMED IS TREATED AS FERTILE IN     -
CD                       CALCULATING BREEDING RATIOS                    -
CD                SPEC...THE ISOTOPE NAMED WILL NOT BE INCLUDED IN THE  -
```

Figure 15. BCD Dataset A.SUMMAR (cont'd.)

```
CD                        CALCULATION OF BREEDING RATIOS, BUT FISSION AND -
CD                        AND SOURCE REACTION RATES WILL BE CALCULATED    -
CD                                                                        -
CD   19-30       ATOMIC WEIGHT FOR THE ISOTOPE NAMED IN COLS. 7-12
CD                                                                        -
CD   31-36       ISOTXS ISOTOPE NAME FOR WHICH THESE DATA ARE TO BE       -
CD               USED                                                     -
CD   37-42       ISOTXS ISOTOPE NAME FOR WHICH THESE DATA ARE TO BE       -
CD               USED                                                     -
CD   43-48       ISOTXS ISOTOPE NAME FOR WHICH THESE DATA ARE TO BE       -
CD               USED                                                     -
CD   49-54       ISOTXS ISOTOPE NAME FOR WHICH THESE DATA ARE TO BE       -
CD               USED                                                     -
CD   55-60       ISOTXS ISOTOPE NAME FOR WHICH THESE DATA ARE TO BE       -
CD               USED                                                     -
CD   61-66       ISOTXS ISOTOPE NAME FOR WHICH THESE DATA ARE TO BE       -
CD               USED                                                     -
CD   67-72       ISOTXS ISOTOPE NAME FOR WHICH THESE DATA ARE TO BE       -
CD               USED                                                     -
C                                                                         -
CN               SEE COMMENTS FOLLOWING THE TYPE 06 CARD DESCRIPTION      -
C                                                                         -
C-------------------------------------------------------------------------


C-------------------------------------------------------------------------
CR          DEFINE ISOTOPE SPECIFICATIONS (TYPE 06)                       -
C                                                                         -
CL   FORMAT-----(I2,4X,A6,A4,2X,F12.5,7A6)                                -
C                                                                         -
CD   COLUMNS              CONTENTS...IMPLICATIONS, IF ANY                 -
CD   =======     ==========================================================-
CD   1-2         06                                                       -
CD                                                                        -
CD   7-12        ENDF/B ABSOLUTE ISOTOPE NAME                             -
CD                                                                        -
CD   13-16       ALPHANUMERIC NUCLIDE TYPE I.D.                           -
CD               FISS...THE ISOTOPE NAMED IS TREATED AS FISSILE IN        -
CD                      CALCULATING BREEDING RATIOS                       -
CD               FERT...THE ISOTOPE NAMED IS TREATED AS FERTILE IN        -
CD                      CALCULATING BREEDING RATIOS                       -
CD               SPEC...THE ISOTOPE NAMED WILL NOT BE INCLUDED IN THE     -
CD                      CALCULATION OF BREEDING RATIOS, BUT FISSION AND   -
CD                      AND SOURCE REACTION RATES WILL BE CALCULATED      -
CD                                                                        -
CD   19-30       ATOMIC WEIGHT FOR THE ISOTOPE NAMED IN COLS. 7-12        -
CD                                                                        -
CD   31-36       ISOTXS ISOTOPE NAME FOR WHICH THESE DATA ARE TO BE       -
CD               USED                                                     -
CD   37-42       ISOTXS ISOTOPE NAME FOR WHICH THESE DATA ARE TO BE       -
```

Figure 15. BCD Dataset A.SUMMAR (cont'd.)

```
CD              USED                                                   -
CD   43-48      ISOTXS ISOTOPE NAME FOR WHICH THESE DATA ARE TO BE    -
CD              USED                                                   -
CD   49-54      ISOTXS ISOTOPE NAME FOR WHICH THESE DATA ARE TO BE    -
CD              USED                                                   -
CD   55-60      ISOTXS ISOTOPE NAME FOR WHICH THESE DATA ARE TO BE    -
CD              USED                                                   -
CD   61-66      ISOTXS ISOTOPE NAME FOR WHICH THESE DATA ARE TO BE    -
CD              USED                                                   -
CD   67-72      ISOTXS ISOTOPE NAME FOR WHICH THESE DATA ARE TO BE    -
CD              USED                                                   -
C                                                                      -
CN              IF NO TYPE 05 OR TYPE 06 CARDS ARE SUPPLIED, THE CODE -
CN              WILL DETERMINE THE ATOMIC WEIGHT AND TYPE OF EACH OF THE
CN              ISOTOPES IN THE PROBLEM BY COMPARING THE ENDF/B NAMES -
CN              WITH THE ISOTXS ISOTOPE NAMES.                         -
CN                                                                     -
CN              THE TYPE 05 CARDS ARE USED TO CHANGE DEFAULT VALUES    -
CN              SET IN THE CODE.                                       -
CN                                                                     -
CN              IF TYPE 06 CARDS ARE SUPPLIED, ANY TYPE 05 CARD DATA   -
CN              WILL BE IGNORED AND ONLY ISOTOPES NAMED ON THE TYPE 06 -
CN              CARDS WILL BE INCLUDED IN THE REACTION SUMMARY.        -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          CORE REGION SPECIFICATION (TYPE 07)                        -
C                                                                      -
CL    FORMAT-----(I2,4X,11A6)                                          -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       07                                                     -
CD                                                                     -
CD    7-12      LABEL OF REGION CONSIDERED TO BE IN THE CORE BY THE    -
CD              REACTION SUMMARY                                       -
CD                                                                     -
CD   13-18      LABEL OF REGION CONSIDERED TO BE IN THE CORE BY THE    -
CD              REACTION SUMMARY                                       -
CD                                                                     -
CD   19-24      LABEL OF REGION CONSIDERED TO BE IN THE CORE BY THE    -
CD              REACTION SUMMARY                                       -
CD                                                                     -
CD   25-30      LABEL OF REGION CONSIDERED TO BE IN THE CORE BY THE    -
CD              REACTION SUMMARY                                       -
CD                                                                     -
CD   31-36      LABEL OF REGION CONSIDERED TO BE IN THE CORE BY THE    -
```

Figure 15. BCD Dataset A.SUMMAR (cont'd.)

```
CD             REACTION SUMMARY                                 -
CD                                                              -
CD   37-42     LABEL OF REGION CONSIDERED TO BE IN THE CORE BY THE   -
CD             REACTION SUMMARY                                 -
CD                                                              -
CD   43-48     LABEL OF REGION CONSIDERED TO BE IN THE CORE BY THE   -
CD             REACTION SUMMARY                                 -
CD                                                              -
CD   49-54     LABEL OF REGION CONSIDERED TO BE IN THE CORE BY THE   -
CD             REACTION SUMMARY                                 -
CD                                                              -
CD   55-60     LABEL OF REGION CONSIDERED TO BE IN THE CORE BY THE   -
CD             REACTION SUMMARY                                 -
CD                                                              -
CD   61-66     LABEL OF REGION CONSIDERED TO BE IN THE CORE BY THE   -
CD             REACTION SUMMARY                                 -
CD                                                              -
CD   67-72     LABEL OF REGION CONSIDERED TO BE IN THE CORE BY THE   -
CD             REACTION SUMMARY                                 -
C                                                               -
CN             IF NO TYPE 07 CARDS ARE SUPPLIED, THE CODE ASSUMES THAT-
CN             ALL REGIONS HAVING A TOTAL ATOM DENSITY OF ISOTOPES   -
CN             LABELED 'FISS' GREATER THAN 7.0E+20 ATOMS/CC ARE TO BE -
CN             INCLUDED IN THE CORE.                            -
C                                                               -
C-----------------------------------------------------------------------

CEOF
```

Figure 15. BCD Dataset A.SUMMAR (cont'd.)

Appendix H

BCD DATASET A.SYN3D

The dataset listed in Figure 16 specifies the user input dataset for the spatial flux synthesis option of the neutronics portion of REBUS-3. The presence of A.SYN3D in the input deck is used to indicate that SYN3D[7] is to be used rather than the finite difference[6] or nodal[10] options of DIF3D.

Since module SYN3D predates the development of the FFORM free format input processing capability[11], the A.SYN3D BCD data must be supplied using the formats specified in Figure 16. Free format input is not an option for dataset A.SYN3D.

The user should see Ref. 7 for further details concerning the use of dataset A.SYN3D and the SYN3D code.

```
C***********************************************************************
C                                                                      -
C                       PREPARED 09/19/74 AT ANL                       -
C                                                                      -
CF          A.SYN3D                                                    -
CE          BCD INPUT FOR SYNTHESIS CALCULATIONS                       -
C                                                                      -
CN                      THIS IS A USER SUPPLIED BCD DATA SET.          -
CN                      THE LIST FOR EACH RECORD IS GIVEN IN TERMS     -
CN                      OF THE BCD FORMAT OF THAT DATA CARD.           -
CN                      COLUMNS 1-2 CONTAIN THE CARD TYPE NUMBER.      -
CN                      BLANK FIELDS PRODUCE THE DEFAULT VALUES.       -
CN                                                                     -
CN                      CARD TYPES 01 THROUGH 06 CONTAIN THE MODEL     -
CN                      GEOMETRY SPECIFICATIONS. CARD TYPES 07         -
CN                      THROUGH 21 DESCRIBE THE SYNTHESIS SCHEME.      -
C                                                                      -
C***********************************************************************


C-----------------------------------------------------------------------
CR          PROBLEM TITLE (TYPE 01)                                    -
C                                                                      -
CL    FORMAT-----(I2,4X,11A6)                                          -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       01                                                     -
CD                                                                     -
CD    7-72      ANY ALPHANUMERIC CHARACTERS.                           -
C                                                                      -
CN              AS MANY TYPE 01 CARDS MAY BE USED AS ARE NECESSARY.    -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          GENERAL MODEL GEOMETRY SPECIFICATIONS (TYPE 02)            -
C                                                                      -
CL    FORMAT-----(I2,4X,11I6)                                          -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       02                                                     -
CD                                                                     -
CD    7-12      MAXSIZ, SIZE OF MAIN CORE STORAGE ARRAY IN REAL*8      -
CD              WORDS (SINGLE WORDS ON CDC SYSTEMS), SPECIFIED IN      -
CD              THOUSANDS OF WORDS (DEFAULT=10, I.E., 10000 WORDS).    -
```

Figure 16. BCD Dataset A.SYN3D

```
CD                                                                   -
CD    13-18      NCALC, CALCULATION OPTIONS.                         -
CD               0...DO NOT SOLVE SYNTHESIS EQUATIONS, ONLY UPDATE   -
CD                   INTEGRALS TO INCLUDE WHAT IS NEEDED FOR FLUX AND -
CD                   POWER EDITS AND GO TO EDITS.  IF THERE ARE ANY  -
CD                   CARDS OF TYPES 16 THRU 21 A COMBINING COEFFICIENT -
CD                   FILE (DCCOEF OR ACCOEF) MUST BE AVAILABLE       -
CD                   (DEFAULT).                                      -
CD               1...UPDATE INTEGRALS AND SOLVE A DIRECT EIGENVALUE  -
CD                   PROBLEM.                                        -
CD               2...UPDATE INTEGRALS AND SOLVE BOTH A DIRECT AND    -
CD                   ADJOINT EIGENVALUE PROBLEM.                     -
CD               3...UPDATE INTEGRALS AND SOLVE AN ADJOINT EIGENVALUE -
CD                   PROBLEM.                                        -
CD                                                                   -
CD    19-24      MAXITR, MAXIMUM NUMBER OF EIGENVALUE ITERATIONS     -
CD               ALLOWED (DEFAULT=10).                               -
CD                                                                   -
CD    25-30      IBCXL, BOUNDARY CONDITION FOR THE LOWER "X" BOUNDARY -
CD               (X=0.) OF THE THREE-DIMENSIONAL MODEL.              -
CD                                                                   -
CD    31-36      IBCXU, BOUNDARY CONDITION FOR THE UPPER "X" BOUNDARY -
CD               OF THE THREE-DIMENSIONAL MODEL.                     -
CD                                                                   -
CD    37-42      IBCYL, BOUNDARY CONDITION FOR THE LOWER "Y" BOUNDARY -
CD               OF THE THREE-DIMENSIONAL MODEL.                     -
CD                                                                   -
CD    43-48      IBCYU, BOUNDARY CONDITION FOR THE UPPER "Y" BOUNDARY -
CD               OF THE THREE-DIMENSIONAL MODEL.                     -
CD                                                                   -
CD    49-54      IBCZL, BOUNDARY CONDITION FOR THE LOWER "Z" BOUNDARY -
CD               OF THE THREE-DIMENSIONAL MODEL.                     -
CD                                                                   -
CD    55-60      IBCZU, BOUNDARY CONDITION FOR THE UPPER "Z" BOUNDARY -
CD               OF THE THREE-DIMENSIONAL MODEL.                     -
CD                                                                   -
CD               THE POSSIBLE BOUNDARY CONDITIONS ARE:               -
CD               1...ZERO FLUX.                                      -
CD               2...REFLECTIVE.                                     -
CD               3...EXTRAPOLATED (C*D*DEL PHI + PHI = 0).           -
CD                   THE CONSTANTS C FOR THE EXTRAPOLATED BOUNDARY   -
CD                   CONDITION ARE SPECIFIED ON CARD TYPE 06.        -
CD               4...PERIODIC WITH OPPOSITE BOUNDARY.                -
CD               5...PERIODIC WITH NEXT BOUNDARY GOING IN THE ORDER  -
CD                   LOWER X, UPPER Y, UPPERX, LOWER Y.              -
CD               6...PERIODIC WITH NEXT BOUNDARY GOING IN THE ORDER  -
CD                   LOWER X, UPPER Y, UPPERX, LOWER Y.              -
CD                   CLOCKWISE.                                      -
CD               7...PERIODIC, INVERTED ALONG THE SAME BPUNDARY.     -
```

Figure 16. BCD Dataset A.SYN3D (cont'd.)

```
CD                                                                     -
CD              PERIODIC CONDITIONS (CONDITIONS 4 THROUGH 7) CAN ONLY  -
CD              APPLY TO "X" AND "Y" BOUNDARIES.                       -
CD                                                                     -
CD    61-66     LGROUP, THE NUMBER OF ENERGY GROUPS AFTER GROUP        -
CD              COLLAPSING. THIS NUMBER MUST BE PROVIDED WHEN A GENERAL-
CD              GROUP COLLAPSING SCHEME IS EMPLOYED (CARD TYPES 11 AND -
CD              12 PRESENT IN INPUT), OTHERWISE, MAY BE IGNORED.       -
CD                                                                     -
CD    67-72     IEDIT, EDIT OPTIONS FOR HMG4C OVERLAY. IGNORED IN THE  -
CD              ARC SYSTEM SYN3D.                                      -
CD                                                                     -
CD              0...NO EDIT DESIRED.                                   -
CD              1...NORMAL EDIT SHOWING CORE USED AND ELAPSED TIME.    -
CD              2...EDIT 1 PLUS COMPLETE EDIT OF MACROSCOPIC CROSS     -
CD                  SECTION FILE WRITTEN BY HMG4C (COMPXS).            -
CD              3...EDIT 2 PLUS RUNNING EDIT OF ISOTXS (I.E. ONLY THAT -
CD                  DATA FROM ISOTXS WHICH IS ACTUALLY USED IS EDITED).-
CD              4...EDIT 3 PLUS BPOINTER TRACE PRINTS.                 -
C                                                                      -
CN              WHEN THERE IS NO INPUT INTTOC FILE THE "X" AND "Y"     -
CN              BOUNDARY CONDITIONS ARE PICKED UP FROM THE FIRST       -
CN              GEODST FILE ON THE TYPE 05 CARD. WHEN THERE IS AN      -
CN              INPUT INTTOC FILE THE OLD BOUNDARY CONDITIONS ARE      -
CN              ASSUMED. THE DEFAULT "Z" BOUNDARY CONDITIONS ARE       -
CN              ZERO CURRENT.                                          -
C                                                                      -
CN              IF THE "X" AND "Y" BOUNDARY CONDITIONS ARE EXTRAPOLATED-
CN              THE CODE DOES NOT PICK UP THE CONSTANTS FROM THE       -
CN              GOEDST FILE - CARD TYPE 06 IS REQUIRED.                -
C                                                                      -
CN              FOR TWO-DIMENSIONAL (XY OR RZ) PROBLEMS THE SECOND     -
CN              DIMENSION IS TREATED AS THE "Z" DIMENSION.  THE        -
CN              SECOND DIMENSION BOUNDARY CONDITIONS GO IN COLS.       -
CN              49-54 AND 55-60.                                       -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          GENERAL PROBLEM CONSTANTS (TYPE 03)                        -
C                                                                      -
CL    FORMAT-----(I2,10X,5E12.5)                                       -
C                                                                      -
CD    COLUMNS         CONTENTS...IMPLICATIONS, IF ANY                  -
CD    =======   =======================================================-
CD    1-2       03                                                     -
CD                                                                     -
CD    13-24     GUESS, K (EIGENVALUE) ESTIMATE FOR WIELANDT ITERATION  -
```

Figure 16. BCD Dataset A.SYN3D (cont'd.)

```
CD                (DEFAULT=NO WIELANDT ITERATION).  THE BEST CHOICE    -
CD                IS A NUMBER SLIGHTLY HIGHER THAN THE EXPECTED K.     -
CD                                                                     -
CD    25-36       CONVRG, EIGENVALUE CONVERGENCE CRITERION             -
CD                (DEFAULT=1.E-5).                                     -
CD                                                                     -
CD    37-48       TOTAL POWER IN WATTS (DEFAULT = 1 WATT).             -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR            AXIAL MESH DESCRIPTION (TYPE 04)                         -
C                                                                      -
CL    FORMAT-----(I2,10X,3(I6,E12.5))                                  -
C                                                                      -
CD    COLUMNS            CONTENTS...IMPLICATIONS, IF ANY               -
CD    =======     ======================================================-
CD    1-2         04                                                   -
CD                                                                     -
CD    13-18       N, NUMBER OF INTERVALS INTO WHICH A PORTION OF THE "Z" -
CD                AXIS IS TO BE DIVIDED (DEFAULT=2).                   -
CD                                                                     -
CD    19-30       Z, UPPER COORDINATE OF THAT PORTION                  -
CD                (DEFAULT=.5CM EACH).                                 -
CD                                                                     -
CD    31-36       N, NUMBER OF INTERVALS INTO WHICH A PORTION OF THE "Z" -
CD                AXIS IS TO BE DIVIDED.                               -
CD                                                                     -
CD    37-48       Z, UPPER COORDINATE OF THAT PORTION.                 -
CD                                                                     -
CD    49-54       N, NUMBER OF INTERVALS INTO WHICH A PORTION OF THE "Z" -
CD                AXIS IS TO BE DIVIDED.                               -
CD                                                                     -
CD    55-66       Z, UPPER COORDINATE OF THAT PORTION.                 -
C                                                                      -
CN                THE AXIAL MESH DESCRIPTION STARTS AT Z=0.            -
CN                                                                     -
CN                AS MANY TYPE 04 CARDS ARE USED AS ARE NECESSARY TO   -
CN                SPECIFY THE AXIAL MESH DESCRIPTION.                  -
CN                                                                     -
CN                WHEN THERE ARE NO TYPE 04 OR 05 CARDS THE CODE WILL  -
CN                EXPECT TO FIND A GEOMETRY FILE (GEODST,1) FROM WHICH -
CN                TO EXTRACT THE DATA.                                 -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
```

Figure 16. BCD Dataset A.SYN3D (cont'd.)

```
CR          AXIAL GEOMETRY DESCRIPTION (TYPE 05)                       -
C                                                                      -
CL    FORMAT-----(I2,10X,I6,6X,4E12.5)                                 -
C                                                                      -
CD    COLUMNS         CONTENTS...IMPLICATIONS, IF ANY                  -
CD    =======   =======================================================-
CD    1-2       05                                                     -
CD                                                                     -
CD    13-18     IVER, THE VERSION NUMBER FOR A GEODST FILE DESCRIBING  -
CD              A TWO-DIMENSIONAL GEOMETRY.                            -
CD                                                                     -
CD    25-36     ZBOT, THE LOWER AXIAL LIMIT OF AN AXIAL ZONE           -
CD              CHARACTERIZED BY THE TWO-DIMENSIONAL GEOMETRY IN       -
CD              GEODST, IVER.                                          -
CD                                                                     -
CD    37-48     ZTOP, THE UPPER AXIAL LIMIT OF THE SAME ZONE.          -
CD                                                                     -
CD    49-60     ZBOT, THE LOWER AXIAL LIMIT OF AN AXIAL ZONE           -
CD              CHARACTERIZED BY THE TWO-DIMENSIONAL GEOMETRY IN       -
CD              GEODST, IVER.                                          -
CD                                                                     -
CD    61-72     ZTOP, THE UPPER AXIAL LIMIT OF THE SAME ZONE.          -
C                                                                      -
CN              AS MANY TYPE 05 CARDS ARE USED AS ARE NECESSARY TO     -
CN              SPECIFY THE AXIAL GEOMETRY DESCRIPTION.                -
CN                                                                     -
CN              WHEN THERE ARE NO TYPE 04 OR 05 CARDS THE CODE WILL    -
CN              EXPECT TO FIND A GEOMETRY FILE (GEODST,1) FROM WHICH   -
CN              TO EXTRACT THE DATA.                                   -
CN                                                                     -
CN              THE USER MAY OVERLAY GEOMETRIES IN BUILDING A MODEL.   -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          CONSTANTS FOR EXTRAPOLATED BOUNDARY CONDITIONS (TYPE 06)   -
C                                                                      -
CL    FORMAT-----(I2,8X,A2,2(2I6,E12.5))                               -
C                                                                      -
CD    COLUMNS         CONTENTS...IMPLICATIONS, IF ANY                  -
CD    =======   =======================================================-
CD    1-2       06                                                     -
CD                                                                     -
CD    11-12     B, THE BOUNDARY DESIGNATOR IDENTIFYING THE BOUNDARY    -
CD              OF ONE OF THE THREE DIMENSIONS.                        -
CD              XL..."X" LOWER.                                        -
CD              XU..."X" UPPER.                                        -
CD              YL..."Y" LOWER.                                        -
```

Figure 16. BCD Dataset A.SYN3D (cont'd.)

```
CD              YU..."Y" UPPER.                                       -
CD              ZL..."Z" LOWER.                                       -
CD              ZU..."Z" UPPER.                                       -
CD                                                                    -
CD    13-18     IGHI, THE HIGHEST ENERGY GROUP WHICH USES THE         -
CD              CONSTANT C.                                           -
CD                                                                    -
CD    19-24     IGLO, THE LOWEST ENERGY GROUP WHICH USES THE          -
CD              CONSTANT C.                                           -
CD                                                                    -
CD    25-36     C, THE CONSTANT FOR IBC=3 ON THE TYPE 02 CARD         -
CD                                                                    -
CD    37-42     IGHI, THE HIGHEST ENERGY GROUP WHICH USES THE         -
CD              CONSTANT C.                                           -
CD                                                                    -
CD    43-48     IGLO, THE LOWEST ENERGY GROUP WHICH USES THE          -
CD              CONSTANT C.                                           -
CD                                                                    -
CD    49-60     C, THE CONSTANT FOR IBC=3 ON THE TYPE 02 CARD         -
C                                                                     -
CN              AS MANY TYPE 06 CARDS ARE USED AS ARE NECESSARY TO    -
CN              SPECIFY THE REQUIRED VALUES FOR THE CONSTANT C.       -
C                                                                     -
CN              WHEN AN EXTRAPOLATED BOUNDARY CONDITION IS SPECIFIED  -
CN              ON THE TYPE 2 CARD, AND THE CORRESPONDING CONSTANTS   -
CN              ARE NOT SPECIFIED ON A TYPE 6 CARD, A DEFAULT VALUE   -
CN              OF C=2.13 IS USED (FOR THE PARTICULAR BOUNDARY AND    -
CN              GROUP RANGE NOT SPECIFIED).                           -
C                                                                     -
C----------------------------------------------------------------------


C----------------------------------------------------------------------
CR          EXPANSION FUNCTION SPECIFICATION (TYPE 07)                -
C                                                                     -
CL    FORMAT-----(I2,4X,A6,I6,6X,4E12.5)                              -
C                                                                     -
CD    COLUMNS          CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================
CD    1-2       07                                                    -
CD                                                                    -
CD    7-12      TITFUN, FLUX FILE NAME. TITFUN MAY BE "UNIT" WHICH    -
CD              IMPLIES A UNIT FLUX IN ALL GROUPS EVEN THOUGH SUCH A  -
CD              FILE DOES NOT ACTUALLY EXIST. "UNIT" MUST BE ENTERED  -
CD              IN COLS. 7-10.                                        -
CD                                                                    -
CD    13-18     IVER, FLUX FILE VERSION NUMBER.  IN THE CASE OF A UNIT -
CD              FLUX IVER IS UNNECESSARY.                             -
CD                                                                    -
```

Figure 16. BCD Dataset A.SYN3D (cont'd.)

```
CD    25-36     ZBOT, THE LOWER LIMIT OF AN AXIAL ZONE WHERE THE       -
CD              FUNCTION IS USED.                                      -
CD                                                                     -
CD    37-48     ZTOP, THE UPPER LIMIT OF THAT ZONE.                    -
CD                                                                     -
CD    49-60     ZBOT, THE LOWER LIMIT OF AN AXIAL ZONE WHERE THE       -
CD              FUNCTION IS USED.                                      -
CD                                                                     -
CD    61-72     ZTOP, THE UPPER LIMIT OF THAT ZONE.                    -
CD                                                                     -
CD              (DEFAULT= A UNIT FLUX WILL BE USED EVERYWHERE AS THE   -
CD              ONLY EXPANSION FUNCTION).                              -
C                                                                      -
CN              AS MANY TYPE 07 CARDS ARE USED AS ARE NECESSARY TO     -
CN              SPECIFY THE EXPANSION FUNCTION DATA.                   -
C                                                                      -
C-----------------------------------------------------------------------
```

```
C-----------------------------------------------------------------------
CR          WEIGHTING FUNCTION SPECIFICATION (TYPE 08)                 -
C                                                                      -
CL    FORMAT-----(I2,4X,A6,I6,6X,4E12.5)                               -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       08                                                     -
CD                                                                     -
CD    7-12      TITFUN, FLUX FILE NAME. TITFUN MAY BE "UNIT" WHICH     -
CD              IMPLIES A UNIT FLUX IN ALL GROUPS EVEN THOUGH SUCH A   -
CD              FILE DOES NOT ACTUALLY EXIST. "UNIT" MUST BE ENTERED   -
CD              IN COLS. 7-10.                                         -
CD                                                                     -
CD    13-18     IVER, FLUX FILE VERSION NUMBER.  IN THE CASE OF A      -
CD              FLUX IVER IS UNNECESSARY.                              -
CD                                                                     -
CD    25-36     ZBOT, THE LOWER LIMIT OF AN AXIAL ZONE WHERE THE       -
CD              FUNCTION IS USED.                                      -
CD                                                                     -
CD    37-48     ZTOP, THE UPPER LIMIT OF THAT ZONE.                    -
CD                                                                     -
CD    49-60     ZBOT, THE LOWER LIMIT OF AN AXIAL ZONE WHERE THE       -
CD              FUNCTION IS USED.                                      -
CD                                                                     -
CD    61-72     ZTOP, THE UPPER LIMIT OF THAT ZONE.                    -
CD                                                                     -
CD              (DEFAULT = IF NO TYPE 08 CARDS ARE PROVIDED THE        -
CD              EXPANSION FUNCTIONS WILL BE USED AS WEIGHTING          -
CD              FUNCTIONS).                                            -
```

Figure 16. BCD Dataset A.SYN3D (cont'd.)

```
C                                                                      -
CN              AS MANY TYPE 08 CARDS ARE USED AS ARE NECESSARY TO    -
CN              SPECIFY THE WEIGHTING FUNCTION DATA.                   -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          SPECIAL GROUP COLLAPSING SCHEME FOR EXPANSION FUNCTION     -
CR          (TYPE 09)                                                  -
C                                                                      -
CL    FORMAT-----(I2,4X,11I6)                                          -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   ========================================================-
CD    1-2       09                                                     -
CD                                                                     -
CD    7-12      LGP, LOWEST ENERGY GROUP IN COLLAPSED GROUP I.         -
CD                                                                     -
CD    13-18     LGP, LOWEST ENERGY GROUP NUMBER IN COLLAPSED GROUP     -
CD              I+1.                                                   -
CD                                                                     -
CD    19-24     LGP, LOWEST ENERGY GROUP NUMBER IN COLLAPSED GROUP     -
CD              I+2.                                                   -
CD                                                                     -
CD    25-30     LGP, LOWEST ENERGY GROUP NUMBER IN COLLAPSED GROUP     -
CD              I+3.                                                   -
CD                                                                     -
CD    31-36     LGP, LOWEST ENERGY GROUP NUMBER IN COLLAPSED GROUP     -
CD              I+4.                                                   -
CD                                                                     -
CD    37-42     LGP, LOWEST ENERGY GROUP NUMBER IN COLLAPSED GROUP     -
CD              I+5.                                                   -
CD                                                                     -
CD    43-48     LGP, LOWEST ENERGY GROUP NUMBER IN COLLAPSED GROUP     -
CD              I+6.                                                   -
CD                                                                     -
CD    49-54     LGP, LOWEST ENERGY GROUP NUMBER IN COLLAPSED GROUP     -
CD              I+7.                                                   -
CD                                                                     -
CD    55-60     LGP, LOWEST ENERGY GROUP NUMBER IN COLLAPSED GROUP     -
CD              I+8.                                                   -
CD                                                                     -
CD    61-66     LGP, LOWEST ENERGY GROUP NUMBER IN COLLAPSED GROUP     -
CD              I+9.                                                   -
CD                                                                     -
CD    67-72     LGP, LOWEST ENERGY GROUP NUMBER IN COLLAPSED GROUP     -
CD              I+10.                                                  -
CD                                                                     -
```

Figure 16. BCD Dataset A.SYN3D (cont'd.)

```
CD              (DEFAULT = NO GROUP COLLAPSING).                       -
C                                                                      -
CN              AS MANY TYPE 09 CARDS MAY BE USED AS ARE NECESSARY TO  -
CN              SWEEP THE NUMBER OF COLLAPSED GROUPS. THE TYPE 09 CARDS-
CN              MUST BE IN ORDER, STARTING WITH THE HIGHEST ENERGY     -
CN              GROUP. THE LAST GROUP NUMBER ON THE LAST CARD MUST BE  -
CN              EQUAL TO THE NUMBER OF GROUPS BEFORE GROUP COLLAPSING. -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          SPECIAL GROUP COLLAPSING SCHEME FOR WEIGHTING FUNCTION     -
CR          (TYPE 10)                                                  -
C                                                                      -
CL    FORMAT-----(I2,4X,11I6)                                          -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       10                                                     -
CD                                                                     -
CD    7-12      LGP, LOWEST ENERGY GROUP NUMBER IN COLLAPSED GROUP I.  -
CD                                                                     -
CD    13-18     LGP, LOWEST ENERGY GROUP NUMBER IN COLLAPSED GROUP     -
CD              I+1.                                                   -
CD                                                                     -
CD    19-24     LGP, LOWEST ENERGY GROUP NUMBER IN COLLAPSED GROUP     -
CD              I+2.                                                   -
CD                                                                     -
CD    25-30     LGP, LOWEST ENERGY GROUP NUMBER IN COLLAPSED GROUP     -
CD              I+3.                                                   -
CD                                                                     -
CD    31-36     LGP, LOWEST ENERGY GROUP NUMBER IN COLLAPSED GROUP     -
CD              I+4.                                                   -
CD                                                                     -
CD    37-42     LGP, LOWEST ENERGY GROUP NUMBER IN COLLAPSED GROUP     -
CD              I+5.                                                   -
CD                                                                     -
CD    43-48     LGP, LOWEST ENERGY GROUP NUMBER IN COLLAPSED GROUP     -
CD              I+6.                                                   -
CD                                                                     -
CD    49-54     LGP, LOWEST ENERGY GROUP NUMBER IN COLLAPSED GROUP     -
CD              I+7.                                                   -
CD                                                                     -
CD    55-60     LGP, LOWEST ENERGY GROUP NUMBER IN COLLAPSED GROUP     -
CD              I+8.                                                   -
CD                                                                     -
CD    61-66     LGP, LOWEST ENERGY GROUP NUMBER IN COLLAPSED GROUP     -
CD              I+9.                                                   -
```

Figure 16. BCD Dataset A.SYN3D (cont'd.)

```
CD                                                                     -
CD    67-72     LGP, LOWEST ENERGY GROUP NUMBER IN COLLAPSED GROUP     -
CD              I+10.                                                  -
CD                                                                     -
CD              (DEFAULT = NO GROUP COLLAPSING IF NO TYPE 09 CARD.     -
CD              IF TYPE 09 CARD IS PRESENT, BUT NO TYPE 10 CARD, THE   -
CD              EXPANSION FUNCTION COLLAPSING SCHEME IS REPEATED FOR   -
CD              THE WEIGHTING FUNCTION).                               -
C                                                                      -
CN              AS MANY TYPE 10 CARDS MAY BE USED AS ARE NECESSARY TO  -
CN              SWEEP THE NUMBER OF COLLAPSED GROUPS. THE TYPE 10 CARDS-
CN              MUST BE IN ORDER, STARTING WITH THE HIGHEST ENERGY     -
CN              GROUP. THE LAST GROUP NUMBER ON THE LAST CARD MUST BE  -
CN              EQUAL TO THE NUMBER OF GROUPS BEFORE GROUP COLLAPSING. -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          GENERAL GROUP COLLAPSING SCHEME FOR EXPANSION FUNCTION     -
CR          (TYPE 11)                                                  -
C                                                                      -
CL    FORMAT-----(I2,10X,5E12.4)                                       -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       11                                                     -
CD                                                                     -
CD    13-24     U(I,J), GROUP COLLAPSING MATRIX FOR EXPANSION FUNCTION.-
CD                                                                     -
CD    25-36     U(I,J), GROUP COLLAPSING MATRIX FOR EXPANSION FUNCTION.-
CD                                                                     -
CD    37-48     U(I,J), GROUP COLLAPSING MATRIX FOR EXPANSION FUNCTION.-
CD                                                                     -
CD    49-60     U(I,J), GROUP COLLAPSING MATRIX FOR EXPANSION FUNCTION.-
CD                                                                     -
CD    61-72     U(I,J), GROUP COLLAPSING MATRIX FOR EXPANSION FUNCTION.-
CD                                                                     -
CD              (DEFAULT = NO GROUP COLLAPSING).                       -
C                                                                      -
CN              EXPANSION FUNCTION DATA IS SPECIFIED IN THE ORDER      -
CN              ((U(I,J),I=1,LGROUP,J=1,NGROUP), U BEING EQUAL TO THE  -
CN              GROUP COLLAPSING MATRIX, LGROUP BEING EQUAL TO THE     -
CN              NUMBER OF ENERGY GROUPS AFTER GROUP COLLAPSING AND     -
CN              NGROUP BEING EQUAL TO THE NUMBER OF ENERGY GROUPS      -
CN              BEFORE GROUP COLLAPSING.                               -
CN                                                                     -
CN              AS MANY TYPE 11 CARDS ARE USED AS ARE NECESSARY TO     -
CN              SPECIFY THE EXPANSION FUNCTION DATA.                   -
```

Figure 16. BCD Dataset A.SYN3D (cont'd.)

```
C                                                                      -
C-----------------------------------------------------------------------
```

```
C-----------------------------------------------------------------------
CR          GENERAL GROUP COLLAPSING SCHEME FOR WEIGHTING FUNCTION     -
CR              (TYPE 12)                                              -
C                                                                      -
CL    FORMAT-----(I2,10X,5E12.4)                                       -
C                                                                      -
CD    COLUMNS             CONTENTS...IMPLICATIONS, IF ANY              -
CD    =======    ==============================================-
CD    1-2        12                                                    -
CD                                                                     -
CD    13-24      U(I,J), GROUP COLLAPSING MATRIX FOR WEIGHTING FUNCTION.-
CD                                                                     -
CD    25-36      U(I,J), GROUP COLLAPSING MATRIX FOR WEIGHTING FUNCTION.-
CD                                                                     -
CD    37-48      U(I,J), GROUP COLLAPSING MATRIX FOR WEIGHTING FUNCTION.-
CD                                                                     -
CD    49-60      U(I,J), GROUP COLLAPSING MATRIX FOR WEIGHTING FUNCTION.-
CD                                                                     -
CD    61-72      U(I,J), GROUP COLLAPSING MATRIX FOR WEIGHTING FUNCTION.-
CD                                                                     -
CD               (DEFAULT = NO GROUP COLLAPSING IF NO TYPE 11 CARD.    -
CD               IF TYPE 11 CARD IS PRESENT, BUT NO TYPE 12 CARD, THE  -
CD               EXPANSION FUNCTION COLLAPSING SCHEME IS REPEATED FOR  -
CD               THE WEIGHTING FUNCTION).                              -
C                                                                      -
CN               WEIGHTING FUNCTION DATA IS SPECIFIED IN THE ORDER     -
CN               ((U(I,J),I=1,LGROUP,J=1,NGROUP), U BEING EQUAL TO THE -
CN               GROUP COLLAPSING MATRIX, LGROUP BEING EQUAL TO THE    -
CN               NUMBER OF ENERGY GROUPS AFTER GROUP COLLAPSING AND    -
CN               NGROUP BEING EQUAL TO THE NUMBER OF ENERGY GROUPS     -
CN               BEFORE GROUP COLLAPSING.                              -
CN                                                                     -
CN               AS MANY TYPE 12 CARDS ARE USED AS ARE NECESSARY TO    -
CN               SPECIFY THE WEIGHTING FUNCTION DATA.                  -
C                                                                      -
C-----------------------------------------------------------------------
```

```
C-----------------------------------------------------------------------
CR          GROUP FLUX ELIMINATION FOR INPUT FUNCTIONS (TYPE 13)       -
C                                                                      -
CL    (I2,4X,A6,9I6)                                                   -
C                                                                      -
CD    COLUMNS             CONTENTS...IMPLICATIONS, IF ANY              -
CD    =======    ==============================================-
```

Figure 16. BCD Dataset A.SYN3D (cont'd.)

```
CD    1-2       13                                                     -
CD                                                                     -
CD    7-12      TITFUN, FLUX FILE NAME. TITFUN MAY BE "UNIT" WHICH     -
CD              MUST BE ENTERED IN COLS. 7-10.                         -
CD                                                                     -
CD    13-18     IVER, FLUX FILE VERSION NUMBER.                        -
CD                                                                     -
CD    19-24     IGHI, HIGHEST ENERGY GROUP OF A SEQUENCE OF GROUP      -
CD              FLUXES (AFTER COLLAPSING, IF ANY) TO BE EXCLUDED FROM  -
CD              THE SYNTHESIS CALCULATION.                             -
CD                                                                     -
CD    25-30     IGLO, LOWEST ENERGY GROUP OF THE SEQUENCE.             -
CD                                                                     -
CD    31-36     IGHI, HIGHEST ENERGY GROUP OF A SEQUENCE OF GROUP      -
CD              FLUXES (AFTER COLLAPSING, IF ANY) TO BE EXCLUDED FROM  -
CD              THE SYNTHESIS CALCULATION.                             -
CD                                                                     -
CD    37-42     IGLO, LOWEST ENERGY GROUP OF THE SEQUENCE.             -
CD                                                                     -
CD    43-48     IGHI, HIGHEST ENERGY GROUP OF A SEQUENCE OF GROUP      -
CD              FLUXES (AFTER COLLAPSING, IF ANY) TO BE EXCLUDED FROM  -
CD              THE SYNTHESIS CALCULATION.                             -
CD                                                                     -
CD    49-54     IGLO, LOWEST ENERGY GROUP OF THE SEQUENCE.             -
CD                                                                     -
CD    55-60     IGHI, HIGHEST ENERGY GROUP OF A SEQUENCE OF GROUP      -
CD              FLUXES (AFTER COLLAPSING, IF ANY) TO BE EXCLUDED FROM  -
CD              THE SYNTHESIS CALCULATION.                             -
CD                                                                     -
CD    61-66     IGLO, LOWEST ENERGY GROUP OF THE SEQUENCE.             -
CD                                                                     -
CD              (DEFAULT = ALL GROUP FLUXES ARE USED).                 -
C                                                                      -
CN              AS MANY TYPE 13 CARDS ARE USED AS ARE NECESSARY TO     -
CN              SPECIFY THE ENERGY GROUPS TO BE EXCLUDED FROM THE      -
CN              SYNTHESIS CALCULATION.                                 -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CK          EXPANSION FUNCTION SCALING FACTORS (TYPE 14)               -
C                                                                      -
CL    FORMAT-----(I2,4X,A6,I6,2(2I6,E12.4))                            -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       14                                                     -
CD                                                                     -
```

Figure 16. BCD Dataset A.SYN3D (cont'd.)

```
CD    7-12        TITFUN, FLUX FILE NAME. TITFUN MAY BE "UNIT" WHICH    -
CD                MUST BE ENTERED IN COLS. 7-10.                        -
CD                                                                      -
CD    13-18       IVER, FLUX FILE VERSION NUMBER.                       -
CD                                                                      -
CD    19-24       IGLO, THE FIRST ENERGY GROUP OF A SEQUENCE OF GROUP   -
CD                FLUXES TO BE SCALED BY ESCALE WHEN USED AS EXPANSION  -
CD                FUNCTIONS.                                            -
CD                                                                      -
CD    25-30       IGHI, THE LAST ENERGY GROUP OF THAT SEQUENCE.         -
CD                                                                      -
CD    31-42       ESCALE, THE EXPANSION FUNCTION SCALING FACTOR         -
CD                (DEFAULT = 1.0).                                      -
CD                                                                      -
CD    43-48       IGLO, THE FIRST ENERGY GROUP OF A SEQUENCE OF GROUP   -
CD                FLUXES TO BE SCALED BY ESCALE WHEN USED AS EXPANSION  -
CD                FUNCTIONS.                                            -
CD                                                                      -
CD    49-54       IGHI, THE LAST ENERGY GROUP OF THAT SEQUENCE.         -
CD                                                                      -
CD    55-66       ESCALE, THE EXPANSION FUNCTION SCALING FACTOR         -
CD                (DEFAULT = 1.0).                                      -
C                                                                       -
CN                IF THE FLUX FILE VERSION NUMBER IS BLANK, THE LAST    -
CN                NAMED FLUX FILE IS AUTOMATICALLY ASSUMED.             -
CN                                                                      -
CN                AS MANY TYPE 14 CARDS ARE USED AS ARE NECESSARY TO    -
CN                SPECIFY THE REQUIRED SCALING FACTOR DATA.             -
C                                                                       -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
C                                                                       -
CR            WEIGHTING FUNCTION SCALING FACTORS (TYPE 15)              -
C                                                                       -
CL    FORMAT-----(I2,4X,A6,I6,2(2I6,E12.4))                             -
C                                                                       -
CD    COLUMNS              CONTENTS...IMPLICATIONS, IF ANY              -
CD    =======     ===================================================== -
CD    1-2         15                                                    -
CD                                                                      -
CD    7-12        TITFUN, FLUX FILE NAME. TITFUN MAY BE "UNIT" WHICH    -
CD                MUST BE ENTERED IN COLS. 7-10.                        -
CD                                                                      -
CD    13-18       IVER, FLUX FILE VERSION NUMBER.                       -
CD                                                                      -
CD    19-24       IGLO, THE FIRST ENERGY GROUP OF A SEQUENCE OF GROUP   -
CD                FLUXES TO BE SCALED BY ESCALE WHEN USED AS WEIGHTING  -
```

Figure 16. BCD Dataset A.SYN3D (cont'd.)

```
CD              FUNCTIONS.                                             -
CD                                                                     -
CD    25-30     IGHI, THE LAST ENERGY GROUP OF THAT SEQUENCE.          -
CD                                                                     -
CD    31-42     ESCALE, THE WEIGHTING FUNCTION SCALING FACTOR.         -
CD              (DEFAULT = 1.0).                                       -
CD                                                                     -
CD    43-48     IGLO, THE FIRST ENERGY GROUP OF A SEQUENCE OF GROUP    -
CD              FLUXES TO BE SCALED BY ESCALE WHEN USED AS WEIGHTING   -
CD              FUNCTIONS.                                             -
CD                                                                     -
CD    49-54     IGHI, THE LAST ENERGY GROUP OF THAT SEQUENCE.          -
CD                                                                     -
CD    55-66     ESCALE, THE WEIGHTING FUNCTION SCALING FACTOR          -
CD              (DEFAULT = 1.0).                                       -
C                                                                      -
CN              IF THE FLUX FILE VERSION NUMBER IS BLANK, THE LAST     -
CN              NAMED FLUX FILE IS AUTOMATICALLY ASSUMED.              -
CN                                                                     -
CN              AS MANY TYPE 15 CARDS ARE USED AS ARE NECESSARY TO     -
CN              SPECIFY THE REQUIRED SCALING FACTOR DATA.              -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
C                                                                      -
CR          SYNTHESIS OUTPUT OPTIONS (TYPE 16)                         -
C                                                                      -
CL    FORMAT-----(I2,4X,11I6)
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       16                                                     -
CD                                                                     -
CD    7-12      NDENOM, PERTURBATION DENOMINATOR OPTION.               -
CD              0...DO NOT CALCULATE PERTURBATION DENOMINATOR          -
CD                  (DEFAULT).                                         -
CD              1...CALCULATE PERTURBATION DENOMINATOR.                -
CD                                                                     -
CD    13-18     N3DFLX, OUTPUT RTFLUX OPTION.                          -
CD              0...DO NOT CONSTRUCT AN OUTPUT RTFLUX FILE (DEFAULT).  -
CD              .GT.0...THE VERSION NUMBER FOR THE OUTPUT RTFLUX FILE. -
CD              BE CAREFUL NOT TO ACCIDENTALLY DESTROY AN INPUT        -
CD              RTFLUX FILE.                                           -
CD                                                                     -
CD    19-24     N3DADJ, OUTPUT ATFLUX OPTION.                          -
CD              0...DO NOT CONSTRUCT AN OUTPUT ATFLUX FILE (DEFAULT).  -
CD              .GT.0...THE VERSION NUMBER FOR THE OUTPUT ATFLUX FILE. -
```

Figure 16. BCD Dataset A.SYN3D (cont'd.)

```
CD              BE CAREFUL NOT TO ACCIDENTALLY DESTROY AN INPUT       -
CD              ATFLUX FILE.                                          -
CD                                                                    -
CD    25-30     NPWDNT, OUTPUT PWDINT OPTION.                         -
CD              0...DO NOT CONSTRUCT AN OUTPUT PWDINT FILE (DEFAULT). -
CD              .GT.0...THE VERSION NUMBER FOR THE OUTPUT PWDINT FILE. -
CD                                                                    -
CD    31-36     NRZFLX, OUTPUT RZFLUX OPTION.                         -
CD              0...DO NOT CONSTRUCT AN OUTPUT RZFLUX (DEFAULT).      -
CD              .GT.0...THE VERSION NUMBER FOR THE OUTPUT RZFLUX FILE. -
CD                                                                    -
CD    37-42     NGEODT, OUTPUT GEODST OPTION.                         -
CD              0...DO NOT CONSTRUCT AN OUTPUT GEODST FILE (DEFAULT). -
CD              .GT.0...THE VERSION NUMBER FOR THE OUTPUT GEODST FILE. -
CD              BE CAREFUL NOT TO ACCIDENTALLY DESTROY AN INPUT       -
CD              GEODST FILE.                                          -
CD                                                                    -
CD    43-48     NPRRZF, FLUX INTEGRAL EDIT OPTION.                    -
CD              0...DO NOT EDIT THE AVERAGE FLUXES BY ZONE (DEFAULT). -
CD              .GT.0...EDIT THE AVERAGE FLUXES.                      -
C                                                                     -
C----------------------------------------------------------------------
```

```
C----------------------------------------------------------------------
CR          DIRECT COMBINING COEFFICIENT PLOTS (TYPE 17)              -
C                                                                     -
CL    FORMAT-----(I2,4X,11I6)                                         -
C                                                                     -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY               -
CD    =======   ======================================================-
CD    1-2       17                                                    -
CD                                                                    -
CD    7-12      IPLDCC(1), AN ENERGY GROUP (AFTER GROUP COLLAPSING, IF -
CD              ANY) FOR WHICH THE MODAL COMPONENTS OF THE TOTAL AXIAL -
CD              DIRECT FLUX ARE TO BE PRINTER-PLOTTED.                -
CD                                                                    -
CD    13-18     IPLDCC(2), AN ENERGY GROUP (AFTER GROUP COLLAPSING, IF -
CD              ANY) FOR WHICH THE MODAL COMPONENTS OF THE TOTAL AXIAL -
CD              DIRECT FLUX ARE TO BE PRINTER-PLOTTED.                -
CD                                                                    -
CD    19-24     IPLDCC(3), AN ENERGY GROUP (AFTER GROUP COLLAPSING, IF -
CD              ANY) FOR WHICH THE MODAL COMPONENTS OF THE TOTAL AXIAL -
CD              DIRECT FLUX ARE TO BE PRINTER-PLOTTED.                -
CD                                                                    -
CD    25-30     IPLDCC(4), AN ENERGY GROUP (AFTER GROUP COLLAPSING, IF -
CD              ANY) FOR WHICH THE MODAL COMPONENTS OF THE TOTAL AXIAL -
```

Figure 16. BCD Dataset A.SYN3D (cont'd.)

```
CD              DIRECT FLUX ARE TO BE PRINTER-PLOTTED.                 -
CD                                                                     -
CD    31-36     IPLDCC(5), AN ENERGY GROUP (AFTER GROUP COLLAPSING, IF -
CD              ANY) FOR WHICH THE MODAL COMPONENTS OF THE TOTAL AXIAL -
CD              DIRECT FLUX ARE TO BE PRINTER-PLOTTED.                 -
CD                                                                     -
CD    37-42     IPLDCC(6), AN ENERGY GROUP (AFTER GROUP COLLAPSING, IF -
CD              ANY) FOR WHICH THE MODAL COMPONENTS OF THE TOTAL AXIAL -
CD              DIRECT FLUX ARE TO BE PRINTER-PLOTTED.                 -
CD                                                                     -
CD    43-48     IPLDCC(7), AN ENERGY GROUP (AFTER GROUP COLLAPSING, IF -
CD              ANY) FOR WHICH THE MODAL COMPONENTS OF THE TOTAL AXIAL -
CD              DIRECT FLUX ARE TO BE PRINTER-PLOTTED.                 -
CD                                                                     -
CD    49-54     IPLDCC(8), AN ENERGY GROUP (AFTER GROUP COLLAPSING, IF -
CD              ANY) FOR WHICH THE MODAL COMPONENTS OF THE TOTAL AXIAL -
CD              DIRECT FLUX ARE TO BE PRINTER-PLOTTED.                 -
CD                                                                     -
CD    55-60     IPLDCC(9), AN ENERGY GROUP (AFTER GROUP COLLAPSING, IF -
CD              ANY) FOR WHICH THE MODAL COMPONENTS OF THE TOTAL AXIAL -
CD              DIRECT FLUX ARE TO BE PRINTER-PLOTTED.                 -
CD                                                                     -
CD    61-66     IPLDCC(10), AN ENERGY GROUP (AFTER GROUP COLLAPSING, IF-
CD              ANY) FOR WHICH THE MODAL COMPONENTS OF THE TOTAL AXIAL -
CD              DIRECT FLUX ARE TO BE PRINTER-PLOTTED.                 -
CD                                                                     -
CD    67-72     IPLDCC(11), AN ENERGY GROUP (AFTER GROUP COLLAPSING, IF-
CD              ANY) FOR WHICH THE MODAL COMPONENTS OF THE TOTAL AXIAL -
CD              DIRECT FLUX ARE TO BE PRINTER-PLOTTED.                 -
CD                                                                     -
CD              IF NO TYPE 17 CARDS ARE PRESENT, THERE WILL BE NO      -
CD              PLOTS (DEFAULT).                                       -
C                                                                      -
CN              DIRECT COMBINING COEFFICIENT PLOTS DATA IS SPECIFIED   -
CN              SUCH THAT (IPLDCC(I),I=1,NPLDCC), NPLDCC BEING THE     -
CN              NUMBER OF GROUPS FOR WHICH PLOTS ARE TO BE OUTPUT      -
CN              (NPLDCC.LE.LGROUP).                                    -
CN                                                                     -
CN              AS MANY TYPE 17 CARDS ARE USED AS ARE NECESSARY TO     -
CN              SPECIFY THE DATA FOR THE REQUIRED PLOTS.               -
C                                                                      -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CR          ADJOINT COMBINING COEFFICIENTS PLOTS (TYPE 18)             -
C                                                                      -
CL    FORMAT-----(I2,4X,11I6)                                          -
C                                                                      -
```

Figure 16. BCD Dataset A.SYN3D (cont'd.)

```
CD   COLUMNS          CONTENTS...IMPLICATIONS, IF ANY                  -
CD   =======    ==================================================-
CD   1-2        18                                                     -
CD                                                                     -
CD   7-12       IPLACC(1), AN ENERGY GROUP (AFTER GROUP COLLAPSING, IF -
CD              ANY) FOR WHICH THE MODAL COMPONENTS OF THE TOTAL AXIAL -
CD              ADJOINT FLUX ARE TO BE PRINTER-PLOTTED.                -
CD                                                                     -
CD   13-18      IPLACC(2), AN ENERGY GROUP (AFTER GROUP COLLAPSING, IF -
CD              ANY) FOR WHICH THE MODAL COMPONENTS OF THE TOTAL AXIAL -
CD              ADJOINT FLUX ARE TO BE PRINTER-PLOTTED.                -
CD                                                                     -
CD   19-24      IPLACC(3), AN ENERGY GROUP (AFTER GROUP COLLAPSING, IF -
CD              ANY) FOR WHICH THE MODAL COMPONENTS OF THE TOTAL AXIAL -
CD              ADJOINT FLUX ARE TO BE PRINTER-PLOTTED.                -
CD                                                                     -
CD   25-30      IPLACC(4), AN ENERGY GROUP (AFTER GROUP COLLAPSING, IF -
CD              ANY) FOR WHICH THE MODAL COMPONENTS OF THE TOTAL AXIAL -
CD              ADJOINT FLUX ARE TO BE PRINTER-PLOTTED.                -
CD                                                                     -
CD   31-36      IPLACC(5), AN ENERGY GROUP (AFTER GROUP COLLAPSING, IF -
CD              ANY) FOR WHICH THE MODAL COMPONENTS OF THE TOTAL AXIAL -
CD              ADJOINT FLUX ARE TO BE PRINTER-PLOTTED.                -
CD                                                                     -
CD   37-42      IPLACC(6), AN ENERGY GROUP (AFTER GROUP COLLAPSING, IF -
CD              ANY) FOR WHICH THE MODAL COMPONENTS OF THE TOTAL AXIAL -
CD              ADJOINT FLUX ARE TO BE PRINTER-PLOTTED.                -
CD                                                                     -
CD   43-48      IPLACC(7), AN ENERGY GROUP (AFTER GROUP COLLAPSING, IF -
CD              ANY) FOR WHICH THE MODAL COMPONENTS OF THE TOTAL AXIAL -
CD              ADJOINT FLUX ARE TO BE PRINTER-PLOTTED.                -
CD                                                                     -
CD   49-54      IPLACC(8), AN ENERGY GROUP (AFTER GROUP COLLAPSING, IF -
CD              ANY) FOR WHICH THE MODAL COMPONENTS OF THE TOTAL AXIAL -
CD              ADJOINT FLUX ARE TO BE PRINTER-PLOTTED.                -
CD                                                                     -
CD   55-60      IPLACC(9), AN ENERGY GROUP (AFTER GROUP COLLAPSING, IF -
CD              ANY) FOR WHICH THE MODAL COMPONENTS OF THE TOTAL AXIAL -
CD              ADJOINT FLUX ARE TO BE PRINTER-PLOTTED.                -
CD                                                                     -
CD   61-66      IPLACC(10), AN ENERGY GROUP (AFTER GROUP COLLAPSING, IF-
CD              ANY) FOR WHICH THE MODAL COMPONENTS OF THE TOTAL AXIAL -
CD              ADJOINT FLUX ARE TO BE PRINTER-PLOTTED.                -
CD                                                                     -
CD   67-72      IPLACC(11), AN ENERGY GROUP (AFTER GROUP COLLAPSING, IF-
CD              ANY) FOR WHICH THE MODAL COMPONENTS OF THE TOTAL AXIAL -
CD              ADJOINT FLUX ARE TO BE PRINTER-PLOTTED.                -
CD                                                                     -
CD              IF NO TYPE 18 CARDS ARE PRESENT, THERE WILL BE NO      -
```

Figure 16. BCD Dataset A.SYN3D (cont'd.)

```
CD              PLOTS (DEFAULT).                                       -
C                                                                      -
CN              ADJOINT COMBINING COEFFICIENT PLOTS DATA IS SPECIFIED  -
CN              SUCH THAT (IPLACC(I),I=1,NPLACC), NPLACC BEING THE     -
CN              NUMBER OF GROUPS FOR WHICH PLOTS ARE TO BE OUTPUT      -
CN              (NPLACC.LE.LGROUP).                                    -
CN                                                                     -
CN              AS MANY TYPE 18 CARDS ARE USED AS ARE NECESSARY TO     -
CN              SPECIFY THE DATA FOR THE REQUIRED PLOTS.               -
C                                                                      -
C-----------------------------------------------------------------------
```

```
C-----------------------------------------------------------------------
CR          TWO-DIMENSIONAL DIRECT FLUX EDITS (TYPE 19)                -
C                                                                      -
CL    FORMAT-----(I2,4X,10I6)                                          -
C                                                                      -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======   =======================================================-
CD    1-2       19                                                     -
CD                                                                     -
CD    7-12      IPRRTF(1,1), A GROUP NUMBER USED IN IDENTIFYING A PLANE-
CD              OF DIRECT FLUXES TO BE EDITED.                         -
CD                                                                     -
CD    13-18     IPRRTF(2,1), AN AXIAL MESH INTERVAL USED IN IDENTIFYING-
CD              THE PLANE OF DIRECT FLUXES TO BE EDITED.               -
CD                                                                     -
CD    19-24     IPRRTF(1,2), A GROUP NUMBER USED IN IDENTIFYING A PLANE-
CD              OF DIRECT FLUXES TO BE EDITED.                         -
CD                                                                     -
CD    25-30     IPRRTF(2,2), AN AXIAL MESH INTERVAL USED IN IDENTIFYING-
CD              THE PLANE OF DIRECT FLUXES TO BE EDITED.               -
CD                                                                     -
CD    31-36     IPRRTF(1,3), A GROUP NUMBER USED IN IDENTIFYING A PLANE-
CD              OF DIRECT FLUXES TO BE EDITED.                         -
CD                                                                     -
CD    37-42     IPRRTF(2,3), AN AXIAL MESH INTERVAL USED IN IDENTIFYING-
CD              THE PLANE OF DIRECT FLUXES TO BE EDITED.               -
CD                                                                     -
CD    43-48     IPRRTF(1,4), A GROUP NUMBER USED IN IDENTIFYING A PLANE-
CD              OF DIRECT FLUXES TO BE EDITED.                         -
CD                                                                     -
CD    49-54     IPRRTF(2,4), AN AXIAL MESH INTERVAL USED IN IDENTIFYING-
CD              THE PLANE OF DIRECT FLUXES TO BE EDITED.               -
CD                                                                     -
CD    55-60     IPRRTF(1,5), A GROUP NUMBER USED IN IDENTIFYING A PLANE-
CD              OF DIRECT FLUXES TO BE EDITED.                         -
CD                                                                     -
```

Figure 16. BCD Dataset A.SYN3D (cont'd.)

```
CD    61-66      IPRRTF(2,5), AN AXIAL MESH INTERVAL USED IN IDENTIFYING-
CD               THE PLANE OF DIRECT FLUXES TO BE EDITED.               -
CD                                                                      -
CD               (DEFAULT = NO EDITS).                                  -
C                                                                       -
CN               THE TWO-DIMENSIONAL DIRECT FLUX EDIT DATA IS SPECIFIED -
CN               SUCH THAT ((IPRRTF(I,N),I=1,2),N=1,NPRRTF), NPRRTF     -
CN               BEING THE NUMBER OF PLANAR EDITS TO BE DONE.           -
CN               WHEN THE PROBLEM IS TWO-DIMENSIONAL ALL AXIAL MESH     -
CN               INTERVALS ARE EDITED WHEN IPRRTF(2,N).GT.0.            -
CN                                                                      -
CN               AS MANY TYPE 19 CARDS ARE USED AS ARE NECESSARY TO     -
CN               SPECIFY THE DATA REQUIRED FOR THE DIRECT FLUX EDITS.   -
C                                                                       -
C-----------------------------------------------------------------------


C-----------------------------------------------------------------------
CD           TWO-DIMENSIONAL ADJOINT FLUX EDITS (TYPE 20)               -
C                                                                       -
CL    FORMAT-----(I2,4X,10I6)                                           -
C                                                                       -
CD    COLUMNS            CONTENTS...IMPLICATIONS, IF ANY                -
CD    =======    ========================================================-
CD    1-2        20                                                     -
CD                                                                      -
CD    7-12       IPRATF(1,1), A GROUP NUMBER USED IN IDENTIFYING A PLANE
CD               OF ADJOINT FLUXES TO BE EDITED.                        -
CD                                                                      -
CD    13-18      IPRATF(2,1), AN AXIAL MESH INTERVAL USED IN IDENTIFYING-
CD               THE PLANE OF ADJOINT FLUXES TO BE EDITED.              -
CD               A PLANE OF ADJOINT FLUXES TO BE EDITED.                -
CD                                                                      -
CD    19-24      IPRATF(1,2), A GROUP NUMBER USED IN IDENTIFYING A PLANE
CD               OF ADJOINT FLUXES TO BE EDITED.                        -
CD                                                                      -
CD    25-30      IPRATF(2,2), AN AXIAL MESH INTERVAL USED IN IDENTIFYING-
CD               THE PLANE OF ADJOINT FLUXES TO BE EDITED.              -
CD                                                                      -
CD    31-36      IPRATF(1,3), A GROUP NUMBER USED IN IDENTIFYING A PLANE
CD               OF ADJOINT FLUXES TO BE EDITED.                        -
CD                                                                      -
CD    37-42      IPRATF(2,3), AN AXIAL MESH INTERVAL USED IN IDENTIFYING-
CD               THE PLANE OF ADJOINT FLUXES TO BE EDITED.              -
CD                                                                      -
CD    43-48      IPRATF(1,4), A GROUP NUMBER USED IN IDENTIFYING A PLANE
CD               OF ADJOINT FLUXES TO BE EDITED.                        -
CD                                                                      -
CD    49-54      IPRATF(2,4), AN AXIAL MESH INTERVAL USED IN IDENTIFYING-
```

Figure 16. BCD Dataset A.SYN3D (cont'd.)

```
CD              THE PLANE OF ADJOINT FLUXES TO BE EDITED.           -
CD                                                                  -
CD    55--60    IPRATF(1,5), A GROUP NUMBER USED IN IDENTIFYING A PLANE
CD              OF ADJOINT FLUXES TO BE EDITED.                     -
CD                                                                  -
CD    61-66     IPRATF(2,5), AN AXIAL MESH INTERVAL USED IN IDENTIFYING-
CD              THE PLANE OF ADJOINT FLUXES TO BE EDITED.           -
CD                                                                  -
CD              (DEFAULT = NO EDITS).                               -
CN                                                                  -
CN              THE TWO-DIMENSIONAL ADJOINT FLUX EDIT DATA IS SPECIFIED-
CN              SUCH THAT ((IPRATF(I,N),I=1,2),N=1,NPRATF), NPRATF  -
CN              BEING THE NUMBER OF PLANAR EDITS TO BE DONE.        -
CN              WHEN THE PROBLEM IS TWO-DIMENSIONAL ALL AXIAL MESH  -
CN              INTERVALS ARE EDITED WHEN IPRATF(2,N).GT.0.         -
CN                                                                  -
CN              AS MANY TYPE 20 CARDS ARE USED AS ARE NECESSARY TO  -
CN              SPECIFY THE DAT REQUIRED FOR THE ADJOINT FLUX EDITS. -
C                                                                   -
C--------------------------------------------------------------------


C--------------------------------------------------------------------
CR          TWO-DIMENSIONAL PLANAR POWER EDITS (TYPE 21)            -
C                                                                   -
CL    FORMAT-----(I2,4X,10I6)                                       -
C                                                                   -
CD    COLUMNS           CONTENTS...IMPLICATIONS, IF ANY             -
CD    =======   =====================================================-
CD    1-2       21                                                  -
CD                                                                  -
CD    7-12      IPRPWD(1), AN AXIAL MESH INTERVAL IDENTIFYING A PLANE -
CD              OF POWER EDITS                                      -
CD                                                                  -
CD    13-18     IPRPWD(2), AN AXIAL MESH INTERVAL IDENTIFYING A PLANE -
CD              OF POWER EDITS                                      -
CD                                                                  -
CD    19-24     IPRPWD(3), AN AXIAL MESH INTERVAL IDENTIFYING A PLANE -
CD              OF POWER EDITS                                      -
CD                                                                  -
CD    25-30     IPRPWD(4), AN AXIAL MESH INTERVAL IDENTIFYING A PLANE -
CD              OF POWER EDITS                                      -
CD                                                                  -
CD    31-36     IPRPWD(5), AN AXIAL MESH INTERVAL IDENTIFYING A PLANE -
CD              OF POWER EDITS                                      -
CD                                                                  -
CD    37-42     IPRPWD(6), AN AXIAL MESH INTERVAL IDENTIFYING A PLANE -
CD              OF POWER EDITS                                      -
CD                                                                  -
```

Figure 16. BCD Dataset A.SYN3D (cont'd.)

```
CD    43-48     IPRPWD(7), AN AXIAL MESH INTERVAL IDENTIFYING A PLANE  -
CD              OF POWER EDITS                                         -
CD                                                                     -
CD    49-54     IPRPWD(8), AN AXIAL MESH INTERVAL IDENTIFYING A PLANE  -
CD              OF POWER EDITS                                         -
CD                                                                     -
CD    55-60     IPRPWD(9), AN AXIAL MESH INTERVAL IDENTIFYING A PLANE  -
CD              OF POWER EDITS                                         -
CD                                                                     -
CD    61-66     IPRPWD(10), AN AXIAL MESH INTERVAL IDENTIFYING A PLANE -
CD              OF POWER EDITS                                         -
CD                                                                     -
CD              (DEFAULT = NO EDITS).                                  -
CN                                                                     -
CN              THE TWO-DIMENSIONAL PLANAR POWER EDIT DATA IS          -
CN              SPECIFIED SUCH THAT (IPRPWD(I),I=1,NPRPWD), NPRPWD     -
CN              BEING THE NUMBER OF PLANAR EDITS DESIRED.              -
CN              WHEN THE PROBLEM IS TWO-DIMENSIONAL ALL AXIAL MESH     -
CN              INTERVALS ARE EDITED IF IPRPWD(1).GT.0.                -
CN                                                                     -
CN              AS MANY TYPE 21 CARDS ARE USED AS ARE NECESSARY TO     -
CN              SPECIFY THE DATA REQUIRED FPR THE PLANAR POWER EDITS.  -
C                                                                      -
C-----------------------------------------------------------------------

COEF
```

Figure 16. BCD Dataset A.SYN3D (cont'd.)

Appendix I

FFORM, A FREE-FORMAT INPUT ROUTINE

Subroutine FFORM enables programmers to implement free-format input in a relatively simple manner. The design of the routine and its usage were dictated by the following goals and constraints:

1. The syntax had to be consistent with ARC System dataset descriptions. ARC System input datasets consist of sets of type-numbered cards with an arbitrary number of cards allowed of each type. Individual cards contain a limited number of data, and the data may be a mix of fixed point numbers, floating point numbers and literals.

2. The applications should not be restricted to ARC System input.

3. Implementation should not force an abrupt conversion from formatted input to free-format, if only in order not to obsolete existing, formatted input decks. This argues for a scheme that works in parallel to conventional, formatted FORTRAN READ's. Free-format input can then be coded into programs without disturbing the FORTRAN READ's already there.

4. All coding must by exportable. This requirement precludes the use of IBM list-directed READ's. It encourages the development of a FORTRAN callable subroutine.

5. Whatever syntax is available must be consistent with CCCC (Committee on Computer Code Coordination) standards.

The convenience of free-format input is not without some cost. On a formatted card a blank field is interpreted as a zero. Users cannot leave a blank on a free-format card, however, and expect the input processor to interpret it as a blank or a zero (zeroes and blanks must be specified explicitly). Users who are new to free-format input processors will find they make this mistake a few times as they adapt to the system.

I.1 FFORM CALLING SEQUENCE

CALL FFORM(DATA,NDATA,MAXDTA,NFL,IFLAG,NOUT)

DATA	an array (REAL*8 on IBM machines) into which FFORM is to place the data found on a card.
NDATA	the number of words of data encountered by FFORM on the card.
MAXDTA	the length of the array DATA (REAL*8 words on IBM machines). If NDATA is greater than MAXDTA the extra words are not returned. (input)
NFL	the logical unit number of the BCD file to be read. (input)
IFLAG	error flag returned by FFORM. 0, an end of file was encountered. 1, a card was read and data transferred successfully. -1, an input error (an unrecognized format) was encountered.
NOUT	the logical unit number for the output error messages. If NOUT=0 no messages are printed. (input)

Each call to FFORM causes a single card image record (the next record) to be read from logical unit NFL. FFORM scans the first 72 columns of the card image, interprets the data and translates the BCD representation into the appropriate variable type. The user must provide an array, DATA in the calling sequence shown above, into which the data on the card are to be placed. If a card contains more data than there is space for (i.e. if, on return, NDATA is greater than MAXDTA) only MAXDTA words are transfered to the DATA array. Hollerith data are stored six characters to the word.

On IBM machines the word length difference between INTEGER*4 and REAL*8 variables causes a small problem. If the Nth datum on an input card is an integer, FFORM places it in the first half (the first 4 bytes) of DATA(N). In the routine that calls FFORM, the array DATA must be equivalenced with an INTEGER*4 array dimensioned 2*MAXDTA when a mix of integer and floating point data is to be read. On CDC machines integer, floating point and literal data are all stored in single words.

I.2 FFORM USAGE

Figure 17 is an example of how FFORM can be used in parallel with formatted FORTRAN READ's. This style of coding has been used in most of our current input processors. The example shows one way to cope with INTEGER*4 data on IBM machines. A REAL*8 one-dimensional array DATA is equivalenced with an INTEGER*4, two-dimensional array IDATA. On IBM systems IDATA is dimensioned (2,MAXDTA); on CDC systems IDATA is dimensioned (1,MAXDTA). In the previous section it was noted that on IBM machines FFORM places INTEGER*4 words in the first half of the appropriate 8-byte element of the DATA array. With DATA and IDATA dimensioned as shown in Figure 17 an integer which is the Nth datum on an input card returns from FFORM in IDATA(1,N) on both IBM and CDC machines.

```
CSW
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION DATA(12),IDATA(2,12)
CSW
CLW
C     DIMENSION DATA(12),IDATA(1,12)
CLW
      DIMENSION FLPT(4), INT(4), HOL(4)
      EQUIVALENCE (DATA(1),IDATA(1,1))
      DATA BLANK/6H      /
      MAXDTA=12
C
C  FORMATTED READ.
C
      IF( NOFORM.EQ.1 ) GO TO 20
   12 FORMAT(2X,4(F6.1,I6,A6))
CIBM
      READ (NIN,12,END=100) (FLPT(I),INT(I),HOL(I),I=1,4)
      GO TO 30
CIBM
CDC*
C     READ (NIN,12) (FLPT(I),INT(I),HOL(I),I=1,4)
C     IF( EOF(NIN) ) 100,30
CDC*
CRAY
C     READ (NIN,12) (FLPT(I),INT(I),HOL(I),I=1,4)
C     IF( IEOF(NIN) ) 100,30
CRAY
C  UNFORMATTED READ.
C
   20 CONTINUE
      DO 22 I=1,10,3
      DATA(I)=0.0
      IDATA(1,I+1)=0
      DATA(I+2)=BLANK
   22 CONTINUE
      CALL FFORM(DATA,NDATA,MAXDTA,NIN,IFLAG,NOUT)
      DO 24 I=1,4
      J=3*(I-1)+1
      FLPT(I)=DATA(J)
      INT(I)=IDATA(1,J+1)
      HOL(I)=DATA(J+2)
   24 CONTINUE
      IF( IFLAG.EQ.0 ) GO TO 100
   30 CONTINUE
  100 CONTINUE
```

Figure 17. An Example of FFORM Usage

In order that ARC System codes can identify the input style chosen by the user a new dataset designation, UNFORM=dataset, has been added to the STUFF input preprocessor, and an additional parameter has been added to the first record of BCD datasets produced by STUFF. The lead records of BCD datasets produced by STUFF must now be read:

```
    READ(M,99)ANAME,J,K,NOFORM,(N(I),I=1,J)
 99 FORMAT(A8,3I5/(16I5))
```

(see Reference 2, pg. 53 for the old format). NOFORM=0 if the dataset is in the formatted style (DATASET=dataset or SUBLOCK=dataset), NOFORM=1 for free-format datasets (UNFORM=dataset). When MODIFY=dataset is used the modifications must be in the same style as the original dataset. NOSORT=dataset situations are usually special cases and, as such, are exempt from ARC System conventions. Stuff always sets NOFORM=0 for NOSORT datasets; the programmer may choose to ignore the NOFORM parameter if his application permits. Note that some datasets may be supplied in formatted style and others in free-format style within the same job.

I.3 FFORM SYNTAX

The rules for writing free-format card images are given below. The first five must be observed in any application of FFORM; the sixth applies to ARC System input only.

I.3.1 Delimiters

Data (integers, floating point numbers and Hollerith words) must be separated either by blanks or by combinations of one or more of the four special delimiters:

,	comma
(	left parenthesis
)	right parenthesis
/	slash

I.3.2 Data Forms

Integer and real numbers must be written according to the usual FORTRAN rules and may not have imbedded blanks. Hollerith data can be supplied in any of the following three ways:

1. A string of letters and numbers, beginning with a letter, with no imbedded blanks.

   e.g. U238 PU239

2. A string of symbols surrounded by asterisks or apostrophes. In the current version of FFORM for CDC machines only the asterisk can be used to set off Hollerith data; the apostrophe has not been implemented.

   e.g. *NA 23* 'REG1'

3. A string preceded by the Hollerith prefix nH, where n is an integer constant.

   e.g. 3HO16

On IBM machines an asterisk may be part of a Hollerith string only when that string is surrounded by apostrohpes (e.g. 'X*Y') or defined by the nH convention (e.g. 3HX*Y). Similarly an apostrophe may be a part of a Hollerith string only when that string is surrounded by asterisks (e.g. *ED'S*) or defined by the nH convention (e.g. 4HED'S). On CDC machines (where FFORM currently does not recognize apostrophes) an asterisk may be part of a Hollerith string only when that string is defined by the nH convention.

When a single asterisk (or apostrophe) is encountered the remaining data on the card are treated as Hollerith data. This does not apply, of course, to an asterisk that is clearly a part of a Hollerith string.

When FFORM passes the data it has read to the calling program, it has stored Hollerith data six characters to the word. If the input description calls for one or more separate Hollerith words each word, therefore, must be six characters or less.

I.3.3 Implied Blanks and Zeroes

Pairs of commas, slashes, or left and right parentheses in consecutive columns of the card image will be interpreted as integer zeroes. Pairs of asterisks (or apostrophes) in consecutive columns of the card image imply Hollerith blanks.

e.g. ,, = () = // = 0
** = '' = 1H

I.3.4 nR, the Repeat Option

nR causes the previous datum to be repeated n-1 times. n is an integer constant. When several pieces of data are enclosed by slashes or parentheses and are followed by a repeat instruction, the entire string of data will be repeated. Repeats can be nested by the use of slashes and parentheses, but each pair of symbols (// or ()) can be used only once per nest. This limits the depth of the nest to two levels.

e.g. 1.0,3R/2.0,1/2R = 1.0 1.0 1.0 2.0 1 2.0 1
/(WORD 2R) 3R/ 4R = WORD 24R

I.3.5 $, End of Card

All data including and following a $ will be ignored. This will permit the user to include comments on a card. The symbol $ between asterisks (or apostrophes) or somewhere in an nH field is not affected.

I.3.6 UNFORM and Card Type Numbers

t are input in free-format form must be specified by "UNFORM=dataset" instead of the usual "DATASET=dataset". Card type numbers must continue to appear in columns 1-2, but all subsequent data can be punched without regard to field definitions.

e.g.
```
UNFORM=A.NIP3
01    title
02    0 1 0 7R
     etc.
```

Title cards in ARC System BCD datasets (the type 01 cards for several datasets) will continue to be read by ARC System input processors in the formatted mode.

Appendix J

REBUS-3 LOGIC FLOW

Figure 18 indicates the main logical flow for REBUS-3, including the CCCC[5] interface datasets read and written by each of the major code areas. The flow chart is a simplification of the actual standard path STP027 logical flow, but it indicates the major areas involved. Several local ANL options are also included such as conversion of the ARC System[2] dataset XS.ISO to the CCCC dataset ISOTXS, and condensation of dataset ISOTXS. The dataset COMPXS which is not a CCCC dataset is also indicated since it is directly involved in the communication between the computational modules.

The main computational loop is indicated by the heavy lines. The interface datasets read and written by each code area are indicated to the side of the code involved, although the many scratch files are not shown in the interest of simplification. The names of the modules are indicated in parentheses in each of the code area boxes. Again, in the interest of simplifying the diagram, various code modules are not shown. These include COPYDS which saves various datasets on the STACK file, BCDINP which reads dataset A.DIF3D and writes the code dependent file DIF3D, MODDIF which controls the edits from the DIF3D code, NUC018 which provides a flux renormalization capability in place of the actual neutronics calculation, and INITFL which generates a starting RTFLUX.

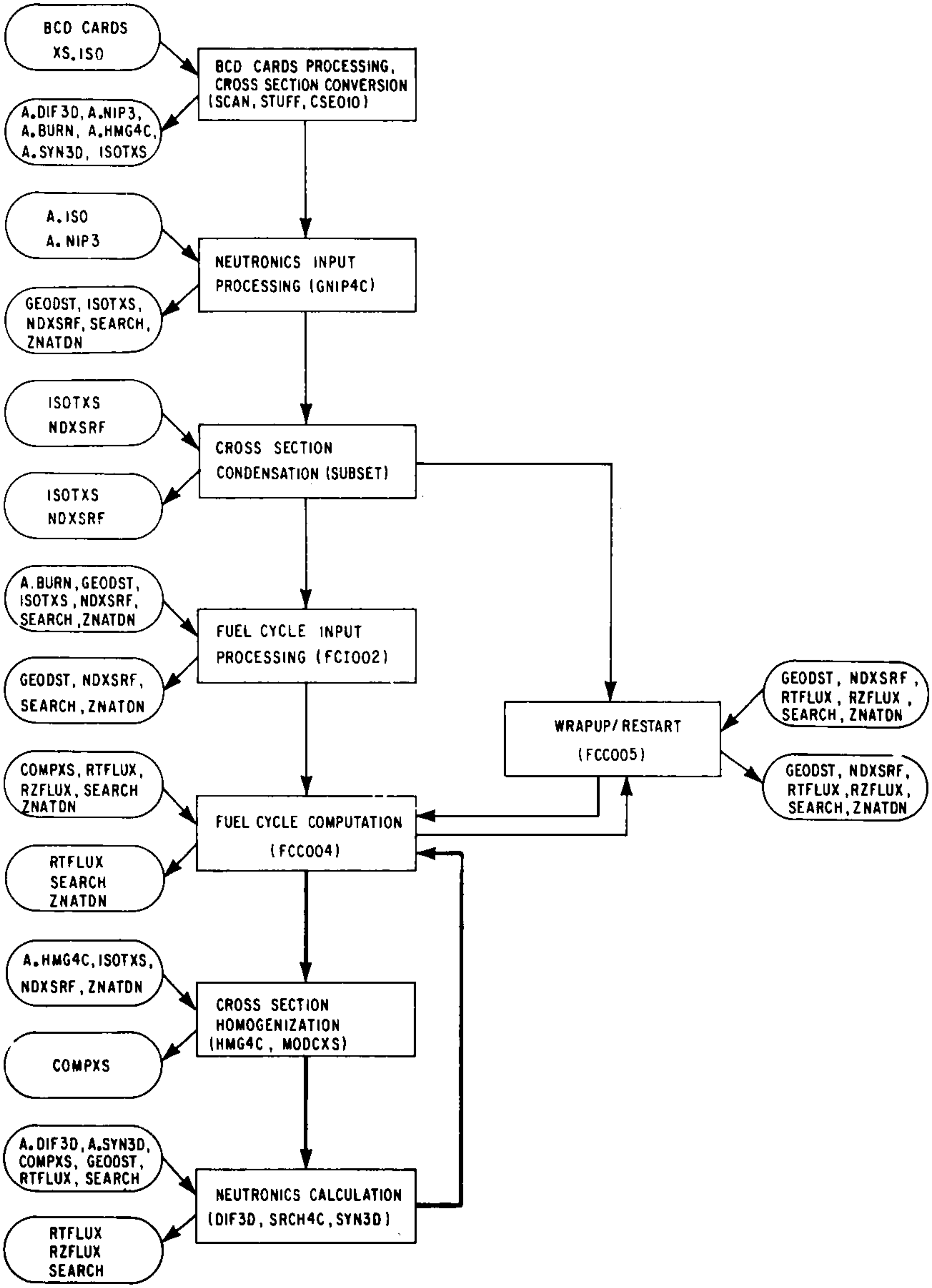

Figure 18 Simplified REBUS-3 Logical Flow

Distribution for ANL-83-2

Internal:

P. B. Abramson
C. H. Adams
P. I. Amundson
C. L. Beck
E. S. Beckjord
J. C. Beitel
S. K. Bhattacharyya
R. N. Blomquist
M. M. Bretscher
H. Bigelow
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