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DECEMBER 1971

Westinghouse Astronuclear Laboratory

FINAL PROGRESS REPORT

CR-123601

Contract No. NAS-8-27047

Control No. DCN 1-1-80-00072

IMPLEMENTATION OF RADIATION SHIELDING CALCULATION METHODS

VOLUME 2

SEMINAR/WORKSHOP NOTES

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WESTINGHOUSE
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IMPLEMENTATION OF RADIATION SHIELDING CALCULATION METHODS

VOLUME 2

SEMINAR/WORKSHOP NOTES

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ABSTRACT

This report is Volume 2 of two volumes of the final report on "Implementation of Radiation Shielding Calculation Methods". This volume presents detailed descriptions of the input data for each of the MSFC computer codes applied to the analysis of a realistic nuclear propelled vehicle. The analytical techniques employed include cross section data, preparation, one and two dimensional discrete ordinates transport, point kernel, and single scatter methods.

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1.0 Introduction

This report is Volume 2 of two volumes of the final report on "Implementation of Radiation Shielding Calculation Methods". This work was performed under Contract NAS-8-27047 by the Westinghouse Astronuclear Laboratory. Presented in this volume are detailed descriptions of the input data for the computer codes applied to analyze a realistic nuclear propelled vehicle. This descriptive material was used as the basis for a four day Seminar/Workshop held at Marshall Space Flight Center, in December, 1971.

The majority of the computer codes described in this report were developed for MSFC under Contract NAS-8-24919.* The following computer codes were employed in this analysis:

- GAMLEG-W to provide multigroup, photon transport cross sections.
- APPROPOS to process and spectral-weight multigroup, neutron cross section data.
- NAGS to process multigroup neutron and photon flux distribution data.
- SATURN to process neutron cross section data using a minimum amount of core storage.
- ANISN-W, a multigroup, one-dimensional discrete ordinate transport code.
- DOT-IIW, a multigroup two-dimensional discrete ordinate transport code.
- MAP to calculate the energy and angular dependent radiation transport external to a source.
- DOQ and ADOQ to calculate, respectively, symmetric and asymmetric quadrature coefficients for ANISN-W and DOT-IIW.

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*WANL-PR(LL)-034, "Nuclear Rocket Shielding Methods, Modification, Updating and Input Data Preparation", Volumes 1 through 6, R. K. Disney, et al, Westinghouse Astronuclear Laboratory.

- KAP-VI, a point kernel code.
- SCAP, a single-scatter analysis code.
- CHEAPER to combine DOT-IIW output tape data.
- LHAP, a liquid hydrogen secondary gamma ray analysis code.

A listing of the actual input data for each computer code is included herein. However, due to the large volume of printed, punched, and tape output data, a listing of the actual output is not included. These output data were, however, provided to the Marshall Space Flight Center for future use and were employed during the Seminar/Workshop. Section 2 of this volume describes the basic cross section and other library data which is part of the MSFC code package. Sections 3 through 11 of this volume describe in detail the input to each computer code used in this study.

1.1 Description of the Nuclear Propelled Vehicle

The overall geometry employed in this study is shown in Figure 1-1. The objective of the analysis is to calculate the dose in the crew compartment due to the various radiation sources. The geometry consists of the propulsion module, the propellant module, and the command and control module. The command module selected for analysis is a modified Apollo module to accommodate a six-man crew. The overall weight of the command module is approximately 35,200 kilograms (16,000 pounds). The propellant module consists of a 660,000 kilogram (300,000 pound) capacity tank with a 10^{o} half-angle conical bottom. The propulsion module includes a ~20900 kilogram (~9500 pound) capacity run tank. This propellant tank geometry is the Class I hybrid configuration selected by MacDonnell Douglas Company in Phase III of the Nuclear Shuttle System Definition Study.

The geometry of the Nuclear Subsystem is shown schematically in Figure 1-2. This is a very detailed, realistic, unclassified model of the actual NERVA Nuclear Subsystem. As shown in Figure 1-2, five zone loadings were employed in the reactor core. Surrounding the core in the radial direction are the following: a graphite "filler strip" region, aluminum structure, the beryllium reflector, and a region representing the control vanes. The major regions in the axial direction include the core support plate, the BATH* and lead shield regions, and the dome plenum. The Nuclear Subsystem is enclosed by an aluminum pressure vessel.

More detailed descriptions of these geometries are presented in the various sections of this volume in which the computer code input data are described.

1.2 Description of the Method of Analysis

The following sources of radiation which contribute to the photon dose at the crew compartment were considered in this study: The Nuclear Subsystem; the nozzle, skirt, and skirt extension; the aluminum propellant discharge line; and, the liquid hydrogen in the propellant tanks.

Figures 1-3 and 1-4 illustrate the analytical procedure utilized to calculate the radiation environment internal and external to the Nuclear Subsystem, respectively. Many other options are available than shown in this schematic, but this particular scheme was selected for this particular study. Referring to Figure 1-3, the starting point of the Nuclear Subsystem analysis is the SATURN code. The MSFC fifty-two group macroscopic neutron cross section library data along with the atom densities for each geometric region are input to the SATURN problem. The SATURN code placed on

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*BATH is the NERVA reference design shield material consisting of boron carbide, aluminum, and titanium hydride.

tape, 52 group macroscopic neutron, P_o, transport, region dependent cross sections for input to the ANISN-W code. Two ANISN-W problems were run--one describing the geometry of the Nuclear Subsystem in the radial direction and one in the axial direction. ANISN-W then provided 52 group neutron spectra for all mesh in the axial and radial geometries on two separate tapes. These two tapes along with the region dependent atom densities and the MSFC basic data library tapes were input to the APPROPOS code.

The APPROPOS code performs two major functions: (1) 16 group macroscopic, region dependent, P_o, transport corrected neutron cross sections (with upscatter removed) are provided as punched card output for input to the DOT-IIW neutron problems; the 16 group neutron cross sections were spectrally-weighted by region using the 52 group fluxes input from ANISN; (2) 13 group, P_l, macroscopic, region dependent photon cross sections are provided as punched card output for input to the DOT-IIW photon problem, and, (3) reaction rate data and other basic data are provided as punched card output for input to the NAGS data processing code.

Two neutron DOT-IIW problems were run to analyze the Nuclear Subsystem. The first problem was run as a fixed source problem. The fission source spatial distribution input to DOT-IIW was obtained from the axial and radial ANISN-W eigenvalue problems. The geometry for this problem extended in the axial direction from the bottom of the hot end hardware region to a few mean free paths into the BATH shield region (see Figure 1-2). A boundary source from this problem was input to the second DOT-IIW neutron problem.

This second problem extended in the axial direction from the bottom of the aluminum shield plate to the top of the pressure vessel dome. Both neutron problems employed an S_8 angular quadrature. Of course, both problems provided: (1) scalar fluxes in each mesh cell in the geometry, and (2) surface angular leakage tapes. The scalar flux tapes were input to the CHEAPER data processing code. This code combined the two scalar flux tapes into a mesh cell description for input to the NAGS code. The NAGS code provided: (1) the photon source data by mesh cell on tape for input to the DOT-IIW photon geometry problem, and (2) photon source data on punched cards for input to the KAP-VI point kernel program. The S_8 quardrature photon DOT-IIW problem provides the photon distribution internal to the Nuclear Subsystem, as well as, the angular leakage at the surface of the entire NSS geometry.

Figure 1-4 illustrates the technique employed to calculate the radiation environment external to the Nuclear Subsystem and the dose rate at the crew location. The radiation environment external to the NSS and at the crew locations were calculated by two different techniques. The first technique employed the MAP code, whereas, the second technique employed the KAP-VI code. The photon surface leakage flux tape from the DOT-IIW problem was input to the MAP code which calculated the photon levels on a meridian ring external to the NSS. These meridian ring flux data were input as punched card data to the SCAP code. The SCAP code calculates the direct and single scattered contributions of the NSS sources at the crew location. The punched NSS sources from the NAGS code were input to the KAP-VI point kernel code which also calculated the photon levels on a meridian ring external to the NSS. The radiation levels on the meridian were also input to the SCAP code as punched card data. The SCAP code was run with various levels of LH_2 in the propellant tanks--this yields dose rate versus time data. This data is then integrated as a function of time to obtain the crew dose.

The energy and spatial distribution of sources in the nozzle, skirt, and skirt-extension were obtained from the March, 1970, Common Radiation Analysis Model (CRAM). These sources were input to the KAP-VI code to calculate: (1) the direct radiation at the crew location, and (2) the radiation levels on the meridian ring due to these sources. The latter data were then input to the SCAP code to obtain the scattered dose contribution.

The energy and spatial distribution of the photon sources in the pump discharge line (PDL) were also obtained from the CRAM. These sources were input directly to the SCAP code which calculated the direct and scattered dose components at the crew location.

The neutron surface leakage fluxes from the DOT-IIW problems were input to the MAP code to calculate the neutron fluxes on a meridian ring external to the NSS. The meridian ring neutron fluxes were input to the LHAP code to determine the contribution to the crew due to the secondary gamma ray source in the liquid hydrogen propellant.

The subsequent sections of this volume describe each step of these procedures in more detail.

FIGURE 1-1

OVERALL GEOMETRY FOR SEMINAR/WORKSHOP PROBLEMS

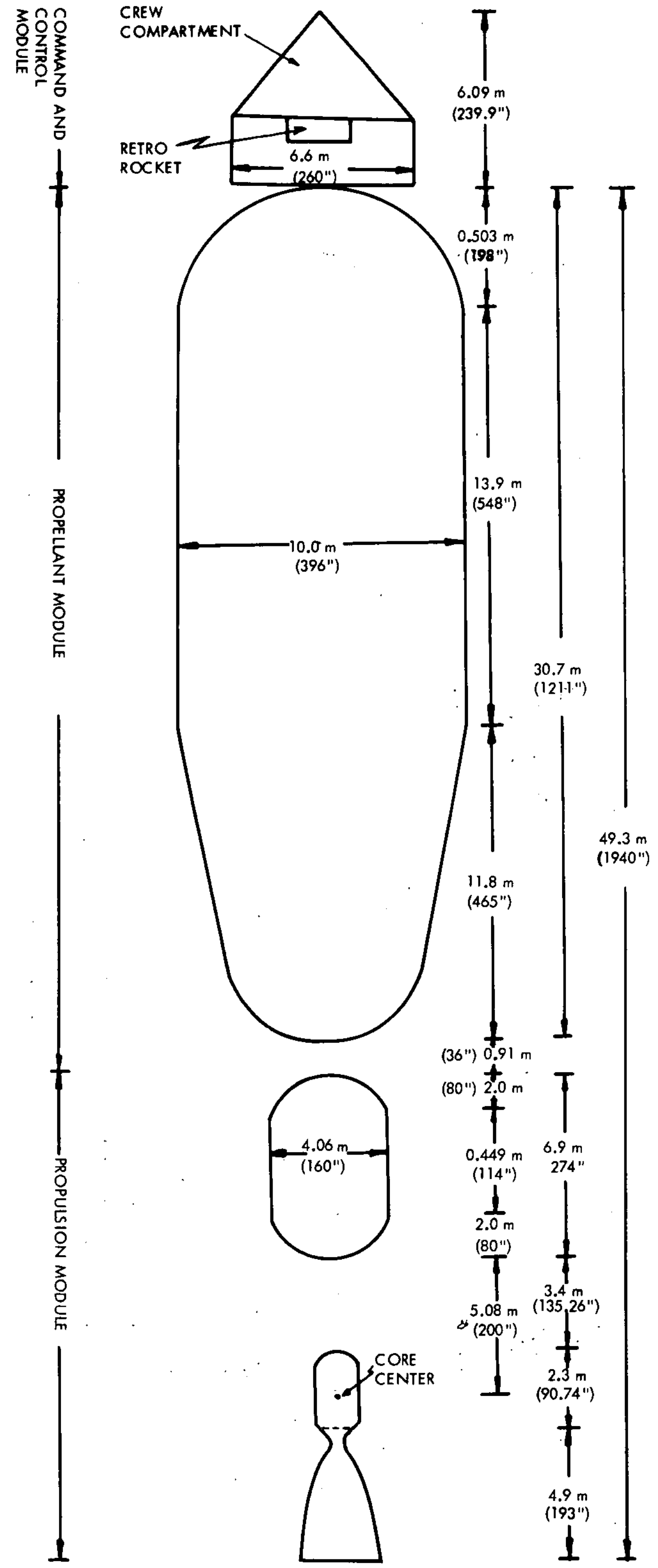
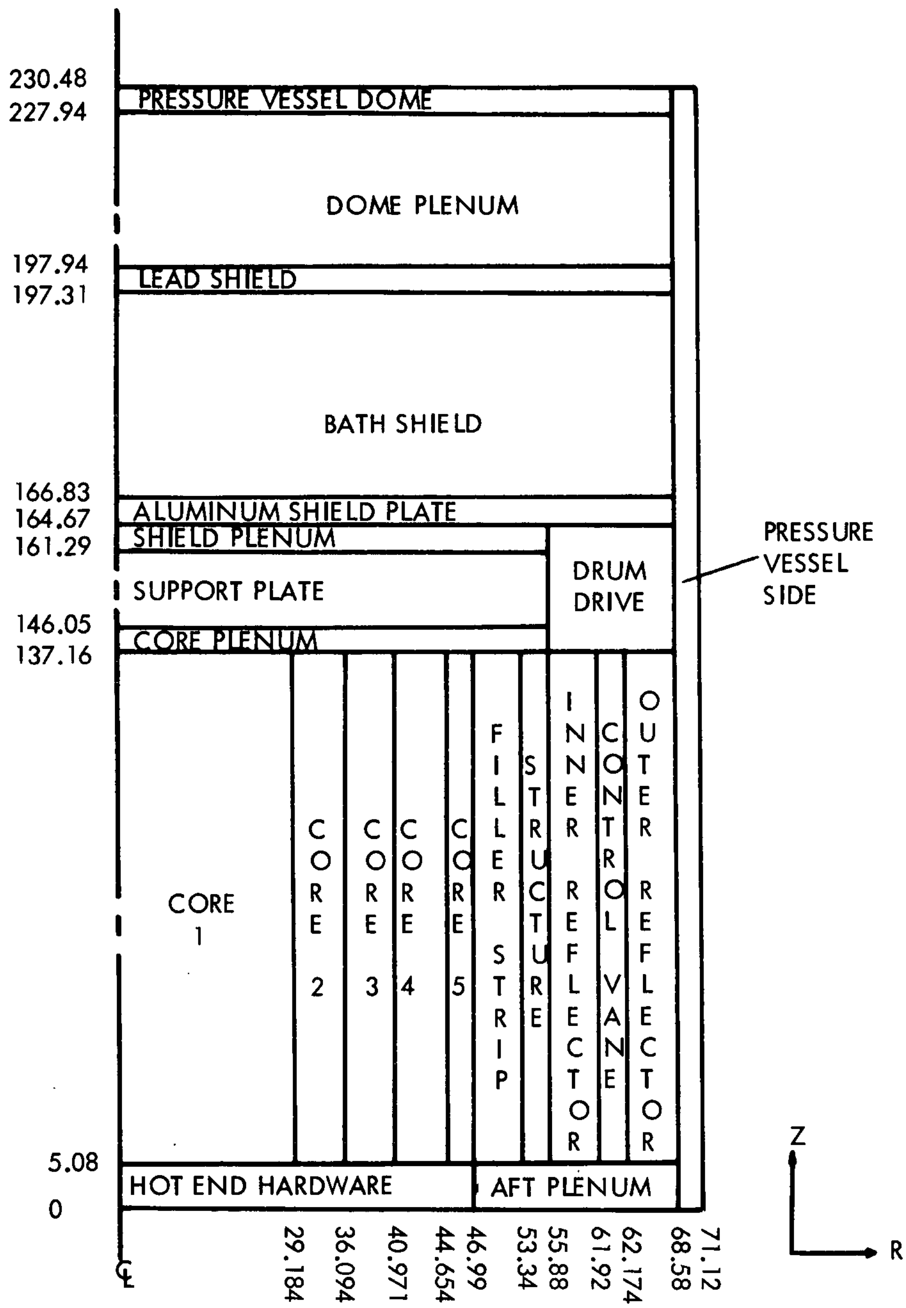


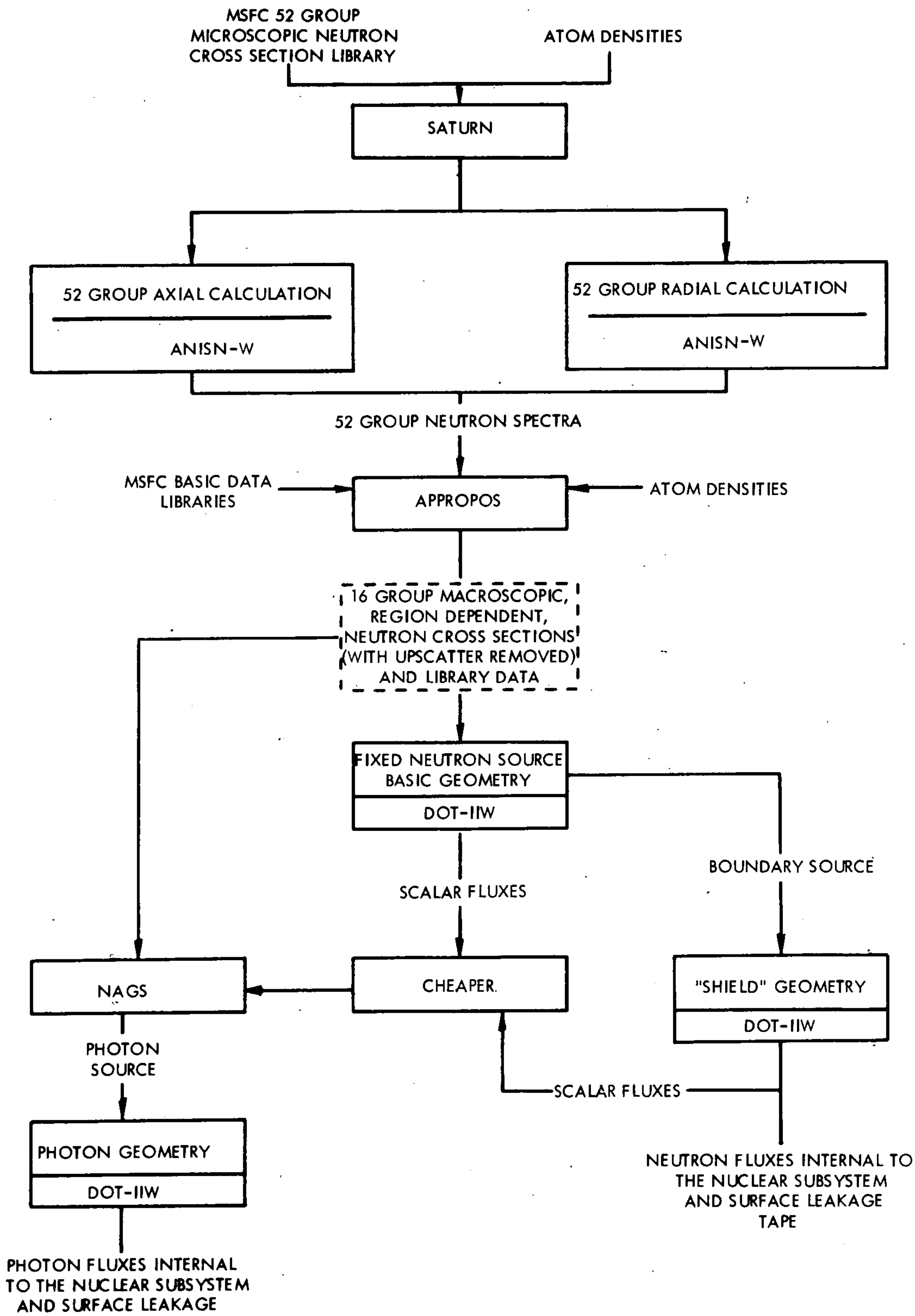
FIGURE 1-2

NUCLEAR SUBSYSTEM R-Z GEOMETRY MODEL
FOR THE SEMINAR/WORKSHOP



NOTE: DRAWING NOT TO SCALE. DIMENSIONS IN CENTIMETERS.

FIGURE 1-3. ANALYTICAL PROCEDURE FOR CALCULATING THE RADIATION ENVIRONMENT INTERNAL TO AND ON THE SURFACE OF THE NUCLEAR SUBSYSTEM



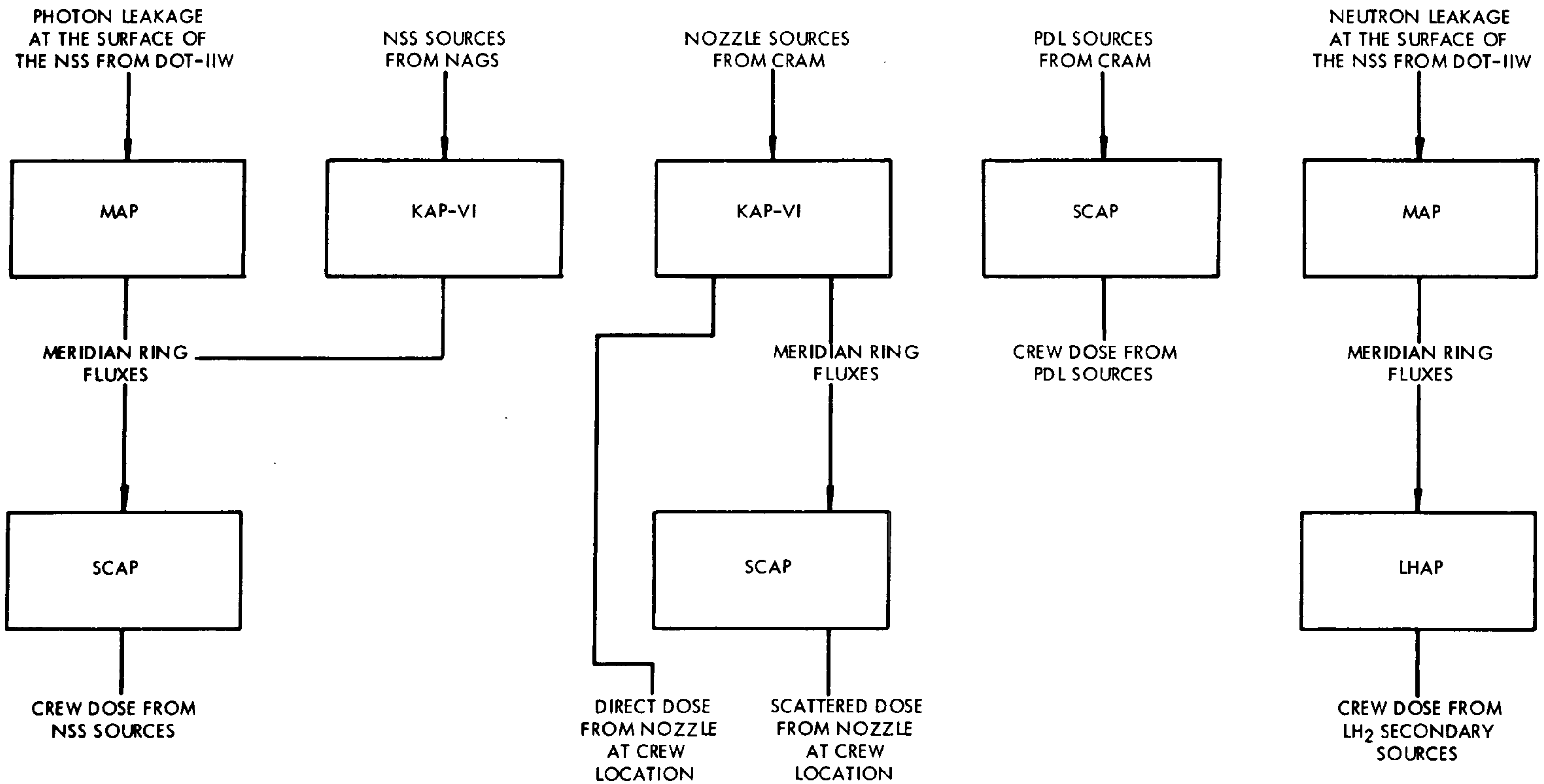


FIGURE 1-4. ANALYTICAL PROCEDURE FOR CALCULATING EXTERNAL ENVIRONMENT AND CREW DOSE

2.0 Basic Data Libraries

The analysis of the radiation environment due to a nuclear propelled vehicle requires not only the computer codes to calculate the radiation transport but also the basic nuclear data for use in the codes. This requirement led to the development of a basic neutron and photon cross section library as an integral part of the computer code package supplied to MSFC. This basic data library consists of six Master Libraries which are placed on magnetic tapes for use in the MSFC computer codes. In addition, the punched card data required to generate some of these libraries is supplied in the MSFC code package. The six Master Libraries in the MSFC computer code package are listed in Table 2.1. These libraries are multigroup and pointwise cross section data for use in the discrete ordinate transport and point kernel methods supplied to MSFC. The contents of each library and the use of the libraries in the MSFC codes are described in the following sections. A detailed description of the libraries is in Volume 2 of WANL-PR(LL)-034. In addition, the GAMLEG-W code for generation of photon cross section libraries is described in the following sections.

2.1 Neutron Cross Section Library

The neutron cross section library consists of multigroup data for use in the SATURN, ANISN-W, APPROPOS, and DOT-IIW codes. These data are spectrally weighted data for the principal elements or isotopes which are constituents of nuclear rocket reactor materials. There are 32 specific elements or isotopes with additional sets of hydrogen cross section data which account for a wide range of temperature.

Each element or isotope data has been spectrally weighted over four representative flux and current spectra to provide 143 sets of transport corrected data and 445 sets of P_1 data. These neutron cross section libraries are 52 group data with a total of 32 groups for the energy range 1.86 eV to 10.0 MeV and 20 groups for the energy range from 0.0 eV to

1.86 eV. The spatially dependent spectra used in weighting are described in Volume 1 of this report and are obtained from WANL analyses of the NERVA nuclear subsystem. The P_l scattering data is limited to P_1 data except for 16 elements or isotopes where P_3 data is provided. The transport corrected and P_l data comprise Master Libraries 1 and 2 of the basic data library.

Master Library 3 is a companion to either Master Libraries 1 and 2. The contents of Master Library 3 are the neutron reaction cross sections for neutron radiative capture, neutron fission, neutron inelastic scatter and neutron kinetic energy deposition. These data are weighted over the same spectra as Master Libraries 1 and 2 and are used in the APPROPOS code for the calculation of data to be used in the photon source calculations, or if desired, neutron kinetic energy deposition calculations.

Master Libraries 1, 2, and 3 are supplied in the MSFC computer code package as magnetic tape data. The Master Libraries 1 and 2 are intended for the following:

1. As input to the SATURN code for preparation of macroscopic 52 group data for use in the ANISN-W code and the calculation of 52 group neutron flux distribution,

2. As direct input to the ANISN-W code and the calculation of 52 group neutron flux distributions,

3. As input to the APPROPOS code for preparation of 16 group neutron cross sections for use in ANISN-W, DOT-IIW, NAGS, or

4. As input to the APPROPOS code for preparation of 29 group coupled neutron-photon cross sections for use in ANISN-W or DOT-IIW.

Master Library 3 is supplied in the MSFC computer code package as magnetic tape data. This library is intended for use in the APPROPOS code to prepare 16 group reaction cross section data for use in NAGS or neutron-photon coupling cross sections in 29 group cross sections. In addition, the APPROPOS code will calculate neutron kinetic energy deposition cross sections in 29 groups using the 16 group reaction rate data.

The user's manuals of each code describe the use of the Master Libraries and the tape assignments given to these data tapes. The following sections on each code will further describe the use of these tapes.

2.2 Photon Cross Section Library

Photon cross sections in the MSFC Master Libraries exist as the basic pointwise cross sections and a multigroup cross section library. The pointwise data is used in the GAMLEG-W, KAP-VI, SCAP, MAP, and LHAP codes and the multigroup data is used in the SATURN, APPROPOS, ANISN-W, or DOT-IIW codes. The multigroup data is supplied for 51 elements which are constitutents of nuclear rocket reactor materials.

The pointwise cross section data consists of pair production, and photoelectric cross sections in units of barns per atom at energy values in the range of 0.01 MeV to 20.0 MeV. These data are used in the KAP-VI, SCAP, LHAP, and MAP codes as pointwise data where each of these codes perform logarithmic interpolation to the desired energy values. In the GAMLEG-W code the pointwise data is spectrally averaged over flux or source spectra to provide group averaged data. In each of the codes the Compton scatter cross sections are solved analytically from the Klein-Nishina equation for photon inelastic scattering with a free electron. The MSFC codes consider only the pair production, photoelectric, and Compton scatter events of photons.

The pointwise cross section data is supplied to MSFC as punched cards for input to the GAMLEG-W code. The GAMLEG-W code prepares an output magnetic tape which is the Master Library 5. The function of this tape is described in the GAMLEG-W user's manual and this tape is used in the KAP-VI, SCAP, LHAP, and MAP codes.

The multigroup photon cross section data tape is designated as Master Library 4. This data tape is obtained by averaging the pointwise and Compton scatter data in the GAMLEG-W code.

The Master Library 4 contains P_9 photon transport cross sections in 13 groups spanning the energy range from 0.2 to 9.5 MeV. These cross sections are intended for use with photon sources in units of MeV/cm^3-second to calculate the photon flux in units of MeV/cm^2-second. The GAMLEG-W code also has the capability to produce cross sections, if desired, for use with photon sources in units of particle flux.

2.3 Other Basic Data Libraries

In addition to the neutron and photon cross section data described above, the MSFC libraries contain the data necessary to calculate the photon sources due to neutron reactions. This basic library is described in detail in Section 6.0 of Volume 2 of WANL-PR(LL)-034. These data include:

1. Spectrum of prompt gamma ray energy from U^{235} fission,
2. Spectrum of U^{235} fission product decay gamma ray energy as a function of reactor run time,
3. Spectrum of gamma ray energy from neutron radiative capture, and neutron inelastic scatter.

The above data are provided in the 13 photon groups, the neutron inelastic data are provided for the 16 neutron group structure. These basic data libraries are provided to MSFC as punched card data and certain portions are on magnetic tape for use in the APPROPOS code.

2.4 The GAMLEG-W Code

The GAMLEG-W code provides the capability to calculate multigroup photon cross sections for use in the ANISN-W or DOT-IIW codes. The code is capable of providing multigroup cross sections in a maximum of 100 groups with the scatter transfer cross sections represented as a Legendre expansion of arbitrary order (P_l). The code performs a numerical integration of the pair production, photoelectric and Compton scatter cross sections using an input specified weighting function. The code is capable of providing either energy or particle flux solutions. Scatter transfer cross sections are obtained from the Klein-Nishisa equation for photon inelastic scattering with a free electron.

The GAMLEG-W code accepts the Master Library 5 magnetic tape as input and provides as output the Master Library 4. If Master Library 5 is input as punched cards, then Master Library 5 is provided as output. Master Library is for direct use in KAP-VI, SCAP, LHAP, MAP or another GAMLEG-W problem and Master Library 4 is for use in ANISN-W, DOT-IIW, APPROPOS, or SATURN.

In the MSFC S/W analysis the use of GAMLEG-W to produce the library tapes is only demonstrated since the Master Libraries 4 and 5 were in existence at MSFC. In the following discussion the setup of GAMLEG-W to produce these libraries is described.

2.4.1 Input Data Description

Input data for the GAMLEG-W code are subdivided into the following five sets of data:

1. Problem descriptive title
2. Problem specifications and options
3. Flux or source weighting spectrum
4. Energy group structure, and
5. Element data

Input data in each data set is entered in a fixed FORTRAN format.

The GAMLEG-W code user's manual is published as a portion of a separate document (WANL-PR(LL)-034, Volume 3, Section 2.0). It is assumed that the reader will utilize this manual during the discussion of the workshop problem input data in the following paragraphs.

The specific use of GAMLEG-W to produce multigroup photon cross sections is described below. A listing of this input deck is in Table 2-2.

Data Set 1 - Problem Descriptive Title

The initial input to the GAMLEG-W code is a single card containing the appropriate title for the problem. As noted in the sample problem title only P_3 cross sections are calculated in the demonstration problem.

Data Set 2 - Problem Specifications and Options

Data Set 2 contains eleven input values which are entered in a FORTRAN format of (11I5). In the S/W problem these are:

1. Number of energy group limits to define the energy groups, IG. This value is input as 14 for the 13 group structure of Master Library 4.

2. Number of integration intervals per group, N. In the S/W problem the number of integration points is input as 30. In the GAMLEG-W code the spectral weighting of group cross sections will be over N points per group and the scatter transfer cross section calculation is over 2*N points.

3. Order of Legendre expansion of scatter transfer cross sections, NMAX. This is input as the P_l order plus 1 or 4 for the P_3 S/W problem.

4. Weighting function input option, KON. GAMLEG-W has the option of particle or energy, flux or source weighting. In the S/W problems a source-energy weighting function is input and KON is input as 1.

5. Number of cross section sets to be placed on the Master Library 4 tape, NMAT. This is the total number of sets to be placed on the output multigroup cross section tape. NMAT is input as 4*51 or 204 for the S/W problem.

6. Tape identification number to be placed on the output tape, IDT. This input value for IDT for the S/W problem is +3.

7. Punched card output option, NPUNCH. GAMLEG-W has the capability to provide punched cards of the multigroup cross sections. This data is punched in a 6E12.5 format with the P_l data for all elements punched in sequence followed by the P_{l+1} data. In the S/W problems, no punched cards are desired and NPUNCH is input.

8. Compton scatter loss calculation option, NODD. In the preparation of multigroup cross sections the lower limit of the energy range may be high enough such that a significant fraction of particles or energy can scatter below this energy. In GAMLEG-W the scatter beyond this limit can be included in the absorption cross section. In the preparation of Master Library 4 the option, NODD = 0, is used to calculate this data.

9. Library tape input option, NREAD. If the Master Library tape 5 is available, then GAMLEG-W can read this tape instead of requiring input data in Data Set 4. This option, NREAD = 0, is not used in the S/W problems and punched card input is provided in the input deck.

10. Pair production calculation option, NPP. The inclusion of a pair production event as an absorption or as an absorption plus the production of two 0.511 MeV photons is available in GAMLEG-W. The S/W problem uses the absorption plus production of two 0.511 MeV photons and NPP is input as 1.

11. Output scatter-transfer cross section option, NPF. The Master Library 4 contains photon cross sections for energy flux cross sections and NPF is input as 0.

Data Set 3 - Flux or Source Weighting Spectrum

In the S/W problem and in the generation of Master Library 4, the energy source spectrum option is used to weight the pointwise cross sections to 13 group data. The weighting data is the U^{235} fission prompt gamma ray spectrum. The first card of input in Data Set 3 is the number of points in the input, IF. This value is input in columns 1-5 of the first card of Data Set 3. The input data has 105 input values. The second set of data is the energy point values of the spectrum in order of decreasing energy.

The spectrum spans the range of 9.500001 MeV to 0.01 MeV in a (6E12.5) FORTRAN format. Following the energy values input is the source spectrum at each of the energy points in a (6E12.5) FORTRAN format.

The weighting function data must span the energy range of the multigroup energy structure and must be in decreasing energy.

Data Set 4 - Energy Group Structure

The next set of GAMLEG-W input data is the energy group limits. This data is input in units of MeV and consists of fourteen values to define the 13 groups. The energy range of Master Library 4 is from 9.5 MeV to 0.01 MeV.

Data Set 5 - Element Data

The final set of GAMLEG-W input data is the element pointwise pair production and photoelectric cross sections. The first card of this data is the number of sets of element data, IZ. In Master Library 5 these are 51 sets of data and is input as 51 in columns 1-5 of the first card.

The remaining card input to Data Set 5 is repeated for each element and only the hydrogen data is listed in Table 2-2. The first card of each set of element data is a title card identifying the data. The second card contains three input quantities. In columns 1-5 the number of energy points in the cross section data, IA, is input. In columns 6-15 and 16-25 the atomic number, Z, and the atomic mass units, AMM, of the element are input. As shown in Table 2-2 the hydrogen data has 27 energy points, an atomic number of 1.0, and 1.00797 atomic mass units.

Following this, the energy point values in units of MeV are input in a (6E12.5) FORTRAN format. This data is followed by the pair production cross section data for all energy points and the photoelectric cross section data for all energy points. The units of this input are barns per atom (cm^2/atom x 10^{24}). The energy values and cross section data are input in the order of increasing photon energy.

2.4.2 Problem Setup Description

Section 2.4 of the GAMLEG-W user's manual describes the tape assignments and running time estimates for a GAMLEG-W problem. In the S/W problem the required tapes are two save tapes mounted on tape units 10 and 11. The multigroup cross section tape for use in ANISN-W and DOT-IIW (Master Library 4) is prepared on tape 10 and the pointwise cross section tape for use in KAP-VI, SCAP, LHAP and MAP is prepared on tape 11.

2.4.3 Output Data Description

Output from a GAMLEG-W problem consists of printed, punched card, and tape output. Section 2.5 of the GAMLEG-W user's manual describes the printed, punched card and tape output in detail and the S/W problem are almost identical to the GAMLEG-W sample problem.

2.5 Techniques for Preparing Multigroup Cross Sections

In the MSFC code package the ANISN-W code and APPROPOS code can be used to prepare multigroup cross section sets for the 52 group Master Libraries 1 and 2. The spectra cross section weighting techniques of ANISN-W and APPROPOS are identical if flux weighting is used. The APPROPOS code has the capability to produce neutron, photon, or coupled neutron-photon data simultaneously. With the linkage of APPROPOS to the NAGS code the most advantageous use of the MSFC code package is the use the APPROPOS code as the cross section weighting procedure. The use of APPROPOS for the S/W is described in Section 5.0 and the techniques of using ANISN-W are described in Section 4.0. A description of the use of ANISN-W and APPROPOS in multigroup cross section preparation is in Section 5.0 of Volume 2 of WANL-PR(LL)-034.

TABLE 2-1

SUMMARY OF MASTER LIBRARIES

Master Library Library No.	Description
1	Microscopic, 52 Group, Transport Corrected, Neutron Cross Section Sets for Use in the APPROPOS, ANISN-W, DOT-IIW Codes
2	Microscopic, 52 Group, P_l ($l \leq 3$), Neutron Cross Section Sets for Use in the APPROPOS, ANISN-W, and DOT-IIW Codes
3	Microscopic, 52 Group, Neutron Reaction Rate Cross Section Sets for Use in the APPROPOS Code
4	Microscopic, 13 Group, P_l ($l \leq 9$), Gamma Ray Cross Section Sets for Use in the APPROPOS, ANISN-W, and DOT-IIW Codes
5	Pair-Production and Photo-Electric, Pointwise, Photon Cross Sections for Use in the GAMLEG-W, KAP-VI, SCAP, MAP, and LHAP Codes
6	Photon Production Data Due to Neutron Radiative Capture and Inelastic Scatter, Selected Element or Isotope Nuclear Parameters, and Other Related Data

TABLE 2-2. INPUT DATA LISTING FOR THE GAMLEG-W PHOTON CROSS SECTION GENERATION PROBLEM

```
S/W GAMLEG-W  PROBLEM, 13 GROUP PHOTON CROSS SECTIONS, P(3)
  14   30      4     1  204   13     0      0      0     1     0
 105
9.500001     9.4         9.3         9.2         9.1         9.0        E-1
8.9          8.8         8.7         8.6         8.5         8.4        E-2
8.3          8.2         8.1         8.0         7.9         7.8        E-3
7.7          7.6         7.5         7.4         7.3         7.2        E-4
7.1          7.0         6.9         6.8         6.7         6.6        E-5
6.5          6.4         6.3         6.2         6.1         6.0        E-6
5.9          5.8         5.7         5.6         5.5         5.4        E-7
5.3          5.2         5.1         5.0         4.9         4.8        E-8
4.7          4.6         4.5         4.4         4.3         4.2        E-9
4.1          4.0         3.9         3.8         3.7         3.6        E-10
3.5          3.4         3.3         3.2         3.1         3.0        E-11
2.9          2.8         2.7         2.6         2.5         2.4        E-12
2.3          2.2         2.1         2.0         1.9         1.8        E-13
1.7          1.6         1.5         1.4         1.3         1.2        E-14
1.1          1.0         0.9         0.8         0.7         0.6        E-15
0.5          0.4         0.32        0.30        0.2         0.1        E-16
0.09         0.08        0.07        0.06        0.05        0.04       E-17
0.03         0.02        0.01                                           E-18
     7.03-5      8.93-5      1.21-4      1.84-4      2.82-4      4.14-4 F-1
     6.23-4      7.92-4      1.26-3      1.68-3      2.17-3      2.94-3 F-2
     3.98-3      5.41-3      7.13-3      9.20-3      1.18-2      1.56-2 F-3
     1.92-2      2.36-2      2.62-2      3.18-2      3.43-2      3.53-2 F-4
     3.34-2      3.15-2      2.97-2      2.72-2      2.68-2      2.84-2 F-5
     3.25-2      3.84-2      4.41-2      4.96-2      6.10-2      7.20-2 F-6
     7.67-2      9.28-2      1.03-1      1.12-1      1.26-1      1.30-1 F-7
     1.38-1      1.25-1      1.12-1      1.10-1      1.27-1      1.44-1 F-8
     1.88-1      2.30-1      2.52-1      2.77-1      3.01-1      3.32-1 F-9
     3.69-1      3.80-1      4.10-1      4.56-1      4.81-1      5.04-1 F-10
```

TABLE 2-2 (CONT)

```
     5.25-1      5.44-1      5.94-1      6.40-1      7.13-1      7.80-1   F-11
     8.41-1      9.24-1      9.72-1      1.09-0      1.22-0      1.32-0   F-12
     1.43-0      1.50-0      1.60-0      1.66-0      1.71-0      1.78-0   F-13
     1.87-0      1.92-0      2.10-0      2.80-0      2.99-0      2.88-0   F-14
     3.08-0      3.00-0      3.33-0      3.68-0      3.64-0      4.02-0   F-15
     4.50-0      4.40-0      5.12-0      3.30-0      1.63-0      8.15-1   F-16
     7.33-1      6.52-1      5.70-1      4.89-1      4.08-1      3.26-1   F-17
     2.44-1      1.63-1      8.15-2                                       F-18
     9.5         7.5         7.0         6.0         5.0         4.0      DE-1
     3.0         2.6         2.2         1.8         1.35        0.9      DE-2
     0.4         0.1                                                      DE-3
  51
 HYDROGEN
  27 1.0          1.00797
.01           .015          .02          .03          .04          .05          E MEV
.06           .08           .1           .15          .2           .3           E MEV
.4            .5            .6           .8           1.0          1.5          E MEV
2.0           3.0           4.0          5.0          6.0          8.0          E MEV
10.0          15.0          20.0                                                E MEV
0.0           0.0           0.0          0.0          0.0          0.0        PP 1 H
0.0           0.0           0.0          0.0          0.0          0.0        PP 1 H
0.0           0.0           0.0          0.0          0.0          4.4     -5 PP 1 H
1.81       -4 5.54       -4 9.89      -4 1.42      -3 1.84      -3 2.62    -3 PP 1 H
3.28       -3 4.62       -3 5.63      -3                                      PP 1 H
1.04       -2 2.0        -3 0.0          0.0          0.0          0.0        PE 1 H
0.0           0.0           0.0          0.0          0.0          0.0        PE 1 H
0.0           0.0           0.0          0.0          0.0          0.0        PE 1 H
0.0           0.0           0.0          0.0          0.0          0.0        PE 1 H
0.0           0.0           0.0                                               PE 1 H
```

3.0 The SATURN Code

In certain calculations using the ANISN-W and DOT-IIW discrete ordinates transport codes with a large number of input cross section data, execution of the calculation is sometimes terminated because of insufficient core storage to process the cross section data. To alleviate this situation, the SATURN code was developed. SATURN processes P_l or transport corrected cross section data using a minimum amount of core storage to produce multigroup cross section data tapes in two formats for use in the ANISN-W or DOT-IIW codes. The two formats are the normal, group-dependent data tape or the specially prepared, group-independent data tape.

The SATURN code is an auxiliary code and should only be used for those situations where the DOT-IIW or ANISN-W codes cannot process the cross section data or for problems that require special, transverse leakage corrections, or group-independent tapes.

3.1 Options Available in SATURN

The data processing functions and options performed by the SATURN code are as follows:

(1) Preparation of group-dependent and/or group-independent cross section data on magnetic tape or disk file and/or punched cards,

(2) Inclusion of transverse leakage corrections to the macroscopic, cross section data,

(3) Preparation of macroscopic cross sections using mixing table operations,

(4) Adjoint reversal of the cross section data, and

(5) Output tape labeling and relabeling.

These operations are performed in the SATURN code as a sequence of logical steps to minimize the core storage required to prepare cross section data.

In the MSFC seminar/workshop problem discussed in this section, options 1 and 3 were utilized. In option 1, group-dependent cross section data were placed on tape for input to the axial and radial ANISN problems.

3.2 Input Data Description

Input data for the SATURN code are subdivided into four data sets:

(1) Overall problem storage allocation, problem descriptive title, and problem size specifications and options,

(2) Problem data,

(3) Output tape cross section set label data, and

(4) Cross section data.

The first data set is entered as five cards of input under a fixed FORTRAN format for each dard, the third data set is entered as three cards of input under a fixed, FORTRAN format for each card. The second and fourth data set are entered under FIDO input subroutine control and can be written in one of three FORTRAN type format capabilities with data operations.

A listing of the input data cards for the radial and axial SATURN workshop problems are provided in Tables 3-1 and 3-2, respectively.

The SATURN program users manual is published as a separate document (WANL-PR(LL)-034, Volume 5). It is assumed that the reader will utilize the SATURN user's manual during the discussion of the input data to follow.

However, before preparing input data for SATURN, it is necessary to have complete knowledge of the problem to be analyzed, because SATURN is essentially the starting point of the entire discrete ordinates analysis.

Figure 3-1 illustrates the R-Z geometry model of the Nuclear Subsystem. Table 3-3 describes each region in the geometry and provides element atom densities subsequently input to the SATURN problems.

From the atom density table, the element tape identification input data are developed. This data is presented in Table 3-4. For each element in each region in Table 3-4, two pieces of data are shown. For example, the values of 4019 and 38 apply to hydrogen in region 1. The first value (4019) applies to tape identification number for the transport corrected cross section set -- these values are determined from Table previously described in Section 2 of this report. The integer 1 in 4019 refers to the spectrum over which the cross section data is weighted. The integer one refers to the core center spectrum. Core center spectra cross sections were selected for core regions 1 and 2 and the cluster hardware (region 2) of the seminar problem. Core edge spectra cross sections were employed for core regions 3, 4 and 5. Reflector spectra cross sections were employed for the following regions: filler strip, structure, inner and outer reflector, pressure vessel side, and the plenum-hardware (region 13). Shield spectra cross sections were employed for the remaining regions, except the control vane (region 9). The control vane region is a special case in which appropriate cross sections are employed as shown in Table 3-4.

The second piece of data for each element in each region is called the "component material number". This number must be numerically sequenced according to the tape identification numbers. For example, in the seminar problem, the first material read from tape is 0139 (aluminum in region 7). Thus, this is given the component material number of one. The tape identification number next in sequence is 0149, which is given a value of 2, etc, up to the last tape identification number of 4049 which is given a value of 41. Since 41 is the last numerical value used in the element table, the material designation for mixing the cross sections into a region must begin with a value of 42. (The value 42 will subsequently be used in the SATURN input.)

To facilitate description of the SATURN input data, Table 3-1 is a listing of the cards input for the radial SATURN problem, and Table 3-2 lists the axial problem. Two SATURN problems were required for the R-Z geometry (shown on Figure 3-1) because of the core storage limitations of the UNIVAC-1108. If appropriate storage were available, one SATURN problem would have sufficed.

3.2.1 Data Set 1 - Storage, Title, Specifications and Options

The initial input quantity for SATURN is MAXCOR, i.e., the maximum number of core locations available for SATURN input data. On the MSFC UNIVAC-1108, this value is 51000_{10}, and is input on the first card of the data deck.

The second input card of Data Set 1 is imply an appropriate title card.

The third card of this set contains four pieces of input data:

(1) The number of input cross section sets from cards and tape; in both the radial and axial problem this value is 41. This value can be determined from Table 3-4; notice that the highest assigned value is 41 for hydrogen in region 14.

(2) Number of mixtures to be formed; in the radial SATURN this value is 11 and in the axial SATURN this value is 12. Actually this supplies cross section data for the total of 22 regions shown in Figure 3-1. It should be noted that data for Core Region 1 is supplied "twice" by SATURN so that the axial and radial ANISN problems can be run.

(3) The third word is input as a zero in both problems because this problem did not use the transverse leakage optional calculation.

(4) The mixing table length; this is 86 for the radial case and 74 for the axial case. The mixing table length is the total number of entries from Table 3-4 for each problem. For a specific region, this is the number of elements entered plus one for the initialization quantity.

The fourth input card of Data Set 1 contains five words describing the cross section set specifications and is the same for both the radial and axial problems as follows:

(1) The number of energy groups; this value is 52 for the workshop problem.

(2) Table length without the total upscatter cross section position; this value is 74 and is determined as follows for this specific set of cross sections:

Position	Cross Section
1	σ_a
2	$\nu\sigma_f$
3	σ_t
4-22	19 upscatter positions (for 20 thermal groups)
23	σ_{gg}
24-74	51 down scatter positions (for 52 total groups)

(3) The position of σ_t in the cross section table, which is 3 as shown above,

(4) The position of within-group scatter (σ_{gg}) which is 23 as shown above,

(5) Cross section output format which is input as zero, requesting the "forward" output.

The fifth input card of Data Set 1 contains six words describing the calculation options and is the same for both the radial and axial problems as follows:

(1) ICODE is input as zero requesting the ANISN-W option which provides the total upscatter cross section in table position IHP+1.

(2) IBTY is input as zero, i.e., no transverse leakage corrections.

(3) ITAPE is input as 2, i.e., cross section library tape is input on Tape 16.

(4) ITYPE is input as 1, requesting group-independent cross section output data on Tape 14, and group-dependent cross sections output data on Tape 12. Group-dependent data are placed on tape as follows: all groups for one material in each record. Group-independent data are placed on tape as follows: one group for all materials in each record.

(5) ICARDS is input as 1, requesting punched card output.

(6) ILABL is input as zero, indicating that the labeling or relabeling option is not used.

3.2.2 Data Set 2 - Problem Description Data

The 1$, 2*, and 3$ arrays are not required as input to the workshop problem because no transverse leakage operation is performed.

The 4$ array consists of the mixing material numbers in the mixing table. The first card of this array in the radial problem contains the information: 11 "repeats" of 42. The value of 42 is the next value following 41 in Table 3-4; hence, the mixing material numbers begin with 42, and continue through to 52 since there are 11 zone (or material) mixtures to be formed in the radial problems. In the axial problem, these values range from 42 through 53 since there are twelve zones (or material) mixtures to be formed. Eleven repeats of 42 are required on the first card of this array since ten elements (H, C, Mn, Cr, Ni, Fe, Ta, Zr, U^{235} and U^{238}) are to be mixed into "composition" 42. The eleventh position (ten elements plus one) is the initialization position. There is a one to one correspondence between the 4$ card input array and the title card array (the last set of input cards); hence, the remainder of the 4$ array input is self-explanatory.

The next input to Data Set 2 is the 5$ array containing the component material numbers in the mixing table. The component material numbers are given in Table 3-4 as the second column under each element for each region. For example, for Core Region 1 (material number 42), the component material numbers are 38 for hydrogen, 5 for carbon, 18 for manganese, etc. The first word in each component material must be the initialization value of 0. Hence, the first card of the 5$ array is 0, 38, 5, 18, etc.

The next input data is entered in the 6 U array which, in the seminar/workshop problem, are the atom densities corresponding to each component material in each mixture material (or zone). The initialization quantity is input as 0.0 followed by the atom densities which are given in Table 3-4. The only exception in the 6 U array is the atom density value input for the vane region, mixture material 50. Here the atom density is input as unity (1.0) because the cross sections on the tape have already been properly adjusted to provide the proper absorptions in the R-Z geometry. (These data were developed from detailed R-θ problems in which the control vanes were explicitly mocked up.)

The last set of input to Data Set 2 is the 9$ array which are the cross section sets to be read from Tape 16. These data must be in ascending order, starting with the lowest number to be read from tape. From Table 3-4 one can note that the order is the same as the component material order with one corresponding to Tape No. 0139 for aluminum. A total of 41 values must be entered in the 9$ array.

A terminate card must follow the last card in the 9$ array.

3.2.3 Data Set 3 - Label Data

Since ILABL was input as zero, cards 1 and 2 of Data Set 3 are not required as input. However, card 3 of Data Set 3 is required as input since IMIX is greater than zero. Columns 19 through 24 contain the cross section set identification number to be placed on the group dependent output tape. Columns 25 through 72 contain a descriptive identification title. A title card must be input for each material set (or zone set) of cross sections.

This completes the input data required for the seminar/workshop problem.

Stacked problems would begin with card number 2 in Data Set 1; however, Tapes 12 and 14 are rewritten for stacked problems.

3.2.4 Problem Setup Description

Details describing the set up of the tape requirements for the SATURN code is presented on Page 5-27 of the SATURN user's manual.

3.3 Output Data Description

Output from a SATURN problem consists of printed and punched output and two binary tapes. The following sections briefly describe each form of output.

3.3.1 Printed Output

The first output section printed by the SATURN code is a description of the overall problem parameters contained in Data Set 1. The second output section is an edit of the input arrays contained in Data Set 2 including the material numbers read from tape, the mixture numbers, component material numbers and atom densities.

The next section lists the microscopic cross sections for each cross section set read from tape. In the seminar problem, there are 52 groups printed out for each set.

Following this set, are the microscopic group-independent cross sections for each set read from tape plus the macroscopic data for each mixture. All data are printed first for group 1, then for group 2, etc., up to group 52.

The last set of data printed out for the seminar problem are the macroscopic group-dependent cross sections for each mixture (or zone).

3.3.2 Punched Output

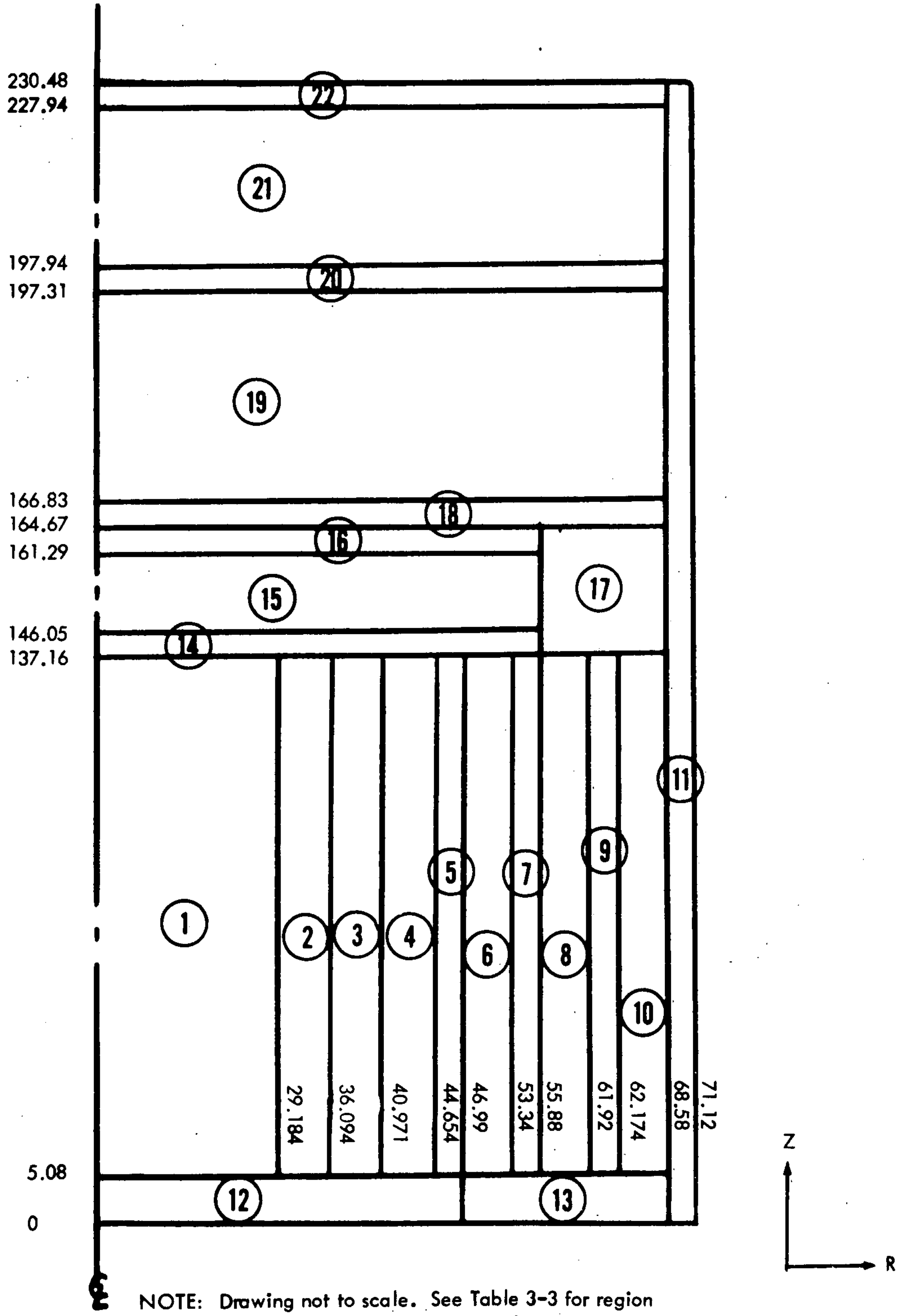
Punched card output from SATURN is only obtained if ICARDS = 1 in Data Set 1, and a group-dependent tape is generated. These cards, which are punched in 6E 12.5 format, are the macroscopic data for each mixture (or zone). For each mixture the cards are punched as a function of table position for group 1, group 2, etc., up to group 52 for the seminar problem.

3.3.3 Tape Output

Two binary tapes can be generated as output data: a group-dependent and a group-independent cross section tape. Both tapes are described on Page 5-109 of the SATURN user's manual. In the seminar/workshop problem, the group dependent tapes (from the axial and radial SATURN problems) were input to the ANISN problems.

FIGURE 3-1

NUCLEAR SUBSYSTEM R-Z GEOMETRY MODEL
FOR THE SEMINAR/WORKSHOP



NOTE: Drawing not to scale. See Table 3-3 for region description. Dimensions in centimeters.

TABLE 3-1

INPUT DATA LISTING FOR THE RADIAL SATURN PROBLEM

```
         51000
SATURN FOR MSFC NSS MODEL  16 ELEMENTS - 11 ZONES FOR RADIAL CASE
            41        11        0        86
            52        74        3        23        0
             0         0        2         1        1        0
 4$
11R         42
11R         43
11R         44
11R         45
11R         46
 3R         47
 7R         48
 8R         49
 2R         50
 8R         51
 3R         52
 5$
             0        38        5        18        9       21 42
            13        25       35        31       33          42
             0        38        5        18        9       21 43
            13        25       35        31       33          43
             0        39        6        19       10       22 44
            14        26       36        32       34          44
             0        39        6        19       10       22 45
            14        26       36        32       34          45
             0        39        6        19       10       22 46
            14        26       36        32       34          46
             0        40        7                             47
             0        40       11        23       15        1 48
            28                                                48
             0        40       11        23       15        1 49
            28         3                                      49
```

TABLE 3-1 (Cont)

```
          0          37                                                    50
          0          40          11          23          15              1 51
         28           3                                                    51
          0          40           1                                        52
6U
  0.0          .000342     .04461      .0000137    .0001418    .0002039    42
   .0004805     .00001      .007325     .0007942   .00005767               42
  0.0          .000342     .04474      .0000149    .0001542    .0002218    43
  .0005226     .00001      .007311     .000992     .00007203               43
  0.0          .000342     .04468      .0000144    .0001495    .000215     44
  .0005066     .00001      .007314     .001065     .00007731               44
  0.0          .000342     .04488      .0000165    .000171     .0002458    45
  .0005791     .00001      .007283     .001026     .00007447               45
  0.0          .000342     .04542      .0000216    .0002238    .0003219    46
  .0007584     .00001      .007217     .0007736    .00005618               46
  0.0          .0000285    .05578                                          47
  0.0          .000299     .0003446    .0005278    .00117      .05842      48
  .00005322                                                                48
  0.0          .00151     .0001862    .0002851    .000632     .004998     49
  .00002875    .07969                                                      49
  0.0          1.0                                                         50
  0.0          .00151      .000574     .0008791    .001949     .005312     51
  .00008864    .08085                                                      51
  0.0          .00158      .0502                                           52
9S
        0139        0149        0239        0349        0619        0629
        0639        0649        0719        0729        0739        0749
        1819        1829        1839        1849        1949        2419
        2429        2449        2619        2629        2639        2649
        3219        3229        3319        3339        3349        3449
        3519        3529        3619        3629        3719        3729
        3839        4019        4029        4039        4049
 T
                  1 CORE 1                          PO,MACRO,52 GROUPS
                  2 CORE 2                          PO,MACRO,52 GROUPS
                  3 CORE 3                          PO,MACRO,52 GROUPS
                  4 CORE 4                          PO,MACRO,52 GROUPS
                  5 CORE 5                          PO,MACRO,52 GROUPS
                  6 F.S. + LAT. SUP.                PO,MACRO,52 GROUPS
                  7 STRUCTURE                       PO,MACRO,52 GROUPS
                  8 BE REFL.                        PO,MACRO,52 GROUPS
                  9 VANE                            PO,MACRO,52 GROUPS
                 10 BE REFL                         PO,MACRO,52 GROUPS
                 11 PRESSURE VESSEL                 PO,MACRO,52 GROUPS
```

TABLE 3-2

INPUT DATA LISTING FOR THE AXIAL SATURN PROBLEM

```
        51000
 SATURN FOR MSFC NSS MODEL  16 ELEMENTS - 12 ZONES FOR AXIAL CASE
           41       12        0       74
           52       74        3       23        0
            0        0        2        1        1        0
 4$
11R        42
 9R        43
 8R        44
 8R        45
 8R        46
 6R        47
 8R        48
 3R        49
 6R        50
 3R        51
 2R        52
 2R        53
 5$
            0       38        5       18        9       21 42
           13       25       35       31       33          42
            0       38        5       18        9       21 43
           13       27       30                            43
            0       40       20       12       24       16 44
            2       29                                     44
            0       41       20       12       24       16 45
           29        4                                     45
            0       41       20       12       24       16 46
            2       29                                     46
            0       41       20       12       24       16 47
            0       41       20       12       24       16 48
            2       29                                     48
            0       41        2                            49
```

TABLE 3-2 (Cont)

```
               0             41             8             2            29            4 50
               0             41            17                                          51
               0             41                                                        52
               0              2                                                        53
6*
  0.0          .000342       .04461       .0000137      .0001418      .0002039       42
   .0004805     .00001        .007325      .0007942     .00005767                    42
  0.0          .000955       .00647       .0000829      .00086        .00128       43
  .00298       .000126       .00765                                                 43
  0.0          .00587        .000363      .000409       .000596       .00288         44
  .0229        .0000601                                                             44
  0.0          .00334        .000262      .00261        .00157        .00904         45
  .00621       .000252                                                              45
  0.0          .00561        .000161      .00162        .000813       .00554         46
  .03147       .0000126                                                             46
  0.0          .00501        .000208      .00207        .000934       .00708         47
  0.0          .00579        .000127      .000624       .000534       .00244         48
  .00368       .0000377                                                             48
  0.0          .000657       .0507                                                  49
  0.0          .0182         .00142       .0369         .00992        .00568         50
  0.0          .000657       .0275                                                  51
  0.0          .00776                                                               52
  0.0          .0610                                                                53
9$
        0139          0149          0239          0349          0619          0629
        0639          0649          0719          0729          0739          0749
        1819          1829          1839          1849          1949          2419
        2429          2449          2619          2629          2639          2649
        3219          3229          3319          3339          3349          3449
        3519          3529          3619          3629          3719          3729
        3839          4019          4029          4039          4049
T
               1 CORE 1                          P0,MACRO,52 GROUPS
               2 CHESH                           P0,MACRO,52 GROUPS
               3 PLENUM(AFT END.                 P0,MACRO,52 GROUPS
               4 CORE PLENUM                     P0,MACRO,52 GROUPS
               5 SUPPORT PLATE                   P0,MACRO,52 GROUPS
               6 SHIELD PLENUM                   P0,MACRO,52 GROUPS
               7 DRUM DRIVE                      P0,MACRO,52 GROUPS
               8 SHIELD PLATE                    P0,MACRO,52 GROUPS
               9 BATH SHIELD                     P0,MACRO,52 GROUPS
              10 LEAD SHIELD                     P0,MACRO,52 GROUPS
              11 DOME PLENUM                     P0,MACRO,52 GROUPS
              12 PRESSURE VESSEL                 P0,MACRO,52 GROUPS
```

TABLE 3-3

ELEMENT ATOM DENSITIES (N/cc)* FOR THE NUCLEAR SUBSYSTEM MODEL FOR THE MSFC SEMINAR WORKSHOP

Region No.	Region Description	H	C	Mn	Cr	Ni	Fe	Ta	Al	Zr	U^{235}	U^{238}	Ti	Be	Pb	B	W
1	Core 1	.000342	.04461	.0000137	.0001418	.0002039	.0004805	.00001	-	.007325	.0007942	.00005767	-	-	-	-	-
2	Core 2	.000342	.04474	.0000149	.0001542	.0002218	.0005226	.00001	-	.007311	.000992	.00007203	-	-	-	-	-
3	Core 3	.000342	.04468	.0000144	.0001495	.000215	.0005066	.00001	-	.007314	.001065	.00007731	-	-	-	-	-
4	Core 4	.000342	.04488	.0000165	.000171	.0002458	.0005791	.00001	-	.007283	.001026	.00007447	-	-	-	-	-
5	Core 5	.000342	.04542	.0000216	.0002238	.0003219	.0007584	.00001	-	.007217	.0007736	.00005618	-	-	-	-	-
6	Filler Strip	.0000285	.05578	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	Structure	.000299	-	-	.0003446	.0005278	.00117	-	.05842	-	-	-	.0005322	-	-	-	-
8	Inner Reflector	.00151	-	-	.0001862	.0002851	.000632	-	.004998	-	-	-	.00002875	.07969	-	-	-
9	Vane	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	Outer Reflector	.00151	-	-	.000574	.0008791	.001949	-	.005312	-	-	-	.00008864	.08085	-	-	-
11	Pressure Vessel Side	.00158	-	-	-	-	-	-	.0502	-	-	-	-	-	-	-	-
12	Cluster Hardware	.000955	.00647	.0000829	.000860	.00128	.00298	-	-	-	-	-	.000126	-	-	-	.00765
13	Plenum and Hardware	.00587	-	.000363	.000409	.000596	.00288	-	.0229	-	-	-	.0000601	-	-	-	-
14	Core Plenum	.00334	-	.000262	.00261	.00157	.00904	-	-	-	-	-	.00621	-	-	.000252	-
15	Support Plate	.00561	-	.000161	.00162	.000813	.00554	-	.03147	-	-	-	.0000126	-	-	-	-
16	Shield Plenum	.00501	-	.000208	.00207	.000934	.00708	-	-	-	-	-	-	-	-	-	-
17	Drum Drive	.00579	-	.000127	.000624	.000534	.00244	-	.00368	-	-	-	.0000377	-	-	-	-
18	Aluminum Shield Plate	.000657	-	-	-	-	-	-	.0507	-	-	-	-	-	-	-	-
19	BATH Shield	.0182	.00142	-	-	-	-	-	.0369	-	-	-	.00992	-	-	.00568	-
20	Lead Shield	.000657	-	-	-	-	-	-	-	-	-	-	-	-	.0275	-	-
21	Dome Plenum	.00776	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	Pressure Vessel	-	-	-	-	-	-	-	.0610	-	-	-	-	-	-	-	-

* $\times 10^{24}$

TABLE 3-4

ELEMENT TAPE IDENTIFICATION DATA FOR INPUT TO SATURN

Region No.*	Region Description	H		C		Mn		Cr		Ni		Fe		Ta		Al		Zr		U^{235}		U^{238}		Ti		Be		Pb		B		W	
1	Core 1	4019	38	0619	5	2419	18	0719	9	2619	21	1819	13	3219	25	-	-	3719	35	3519	31	3619	33	-	-	-	-	-	-	-	-	-	-
2	Core 2	4019	38	0619	5	2419	18	0719	9	2619	21	1819	13	3219	25	-	-	3719	35	3519	31	3619	33	-	-	-	-	-	-	-	-	-	-
3	Core 3	4029	39	0629	6	2429	19	0729	10	2629	22	1829	14	3229	26	-	-	3729	36	3529	32	3629	34	-	-	-	-	-	-	-	-	-	-
4	Core 4	4029	39	0629	6	2429	19	0729	10	2629	22	1829	14	3229	26	-	-	3729	36	3529	32	3629	34	-	-	-	-	-	-	-	-	-	-
5	Core 5	4029	39	0629	6	2429	19	0729	10	2629	22	1829	14	3229	26	-	-	3729	36	3529	32	3629	34	-	-	-	-	-	-	-	-	-	-
6	Filler Strip	4039	40	0639	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	Structure	4039	40	-	-	-	-	0739	11	2639	23	1839	15	-	-	0139	1	-	-	-	-	-	-	3339	28	-	-	-	-	-	-	-	-
8	Inner Reflector	4039	40	-	-	-	-	0739	11	2639	23	1839	15	-	-	0139	1	-	-	-	-	-	-	3339	28	0239	3	-	-	-	-	-	-
9	Vane**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	Outer Reflector	4039	40	-	-	-	-	0739	11	2639	23	1839	15	-	-	0139	1	-	-	-	-	-	-	3339	28	0239	3	-	-	-	-	-	-
11	Pressure Vessel Side	4039	40	-	-	-	-	-	-	-	-	-	-	-	-	0139	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	Cluster Hardware	4019	38	0619	5	2419	18	0719	9	2619	21	1819	13	-	-	-	-	-	-	-	-	-	-	3319	27	-	-	-	-	-	-	3449	30
13	Plenum and Hardware	4039	39	-	-	2449	20	0749	12	2649	24	1849	16	-	-	0149	2	-	-	-	-	-	-	3349	29	-	-	-	-	-	-	-	-
14	Core Plenum	4049	41	-	-	2449	20	0749	12	2649	24	1849	16	-	-	-	-	-	-	-	-	-	-	3349	29	-	-	-	-	0349	4	-	-
15	Support Plate	4049	41	-	-	2449	20	0749	12	2649	24	1849	16	-	-	0149	2	-	-	-	-	-	-	3349	29	-	-	-	-	-	-	-	-
16	Shield Plenum	4049	41	-	-	2449	20	0749	12	2649	24	1849	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	Drum Drive	4049	41	-	-	2449	20	0749	12	2649	24	1849	16	-	-	0149	2	-	-	-	-	-	-	3349	29	-	-	-	-	-	-	-	-
18	Aluminum Shield Plate	4049	41	-	-	-	-	-	-	-	-	-	-	-	-	0149	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	BATH Shield	4049	41	0649	8	-	-	-	-	-	-	-	-	-	-	0149	2	-	-	-	-	-	-	3349	29	-	-	-	-	-	-	-	-
20	Lead Shield	4049	41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1949	17	-	-	-	-
21	Dome Plenum	4049	41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	Pressure Vessel Dome	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0149	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*See Figure 3-1 for region location.

**Data for the Vane Region: 3839/37

4.0 The ANISN-W Code

In the radiation and shielding analysis of nuclear systems, the one dimensional discrete ordinates transport code, ANISN-W, serves as a basis for many different types of calculations. The ANISN-W code is used to predict criticality, fuel loading, reactor size, power distribution, parametric shield design, shield performance, flux distribution in energy and space, and multigroup cross section preparation. The ANISN-W code has been designed to provide these capabilities in a single, flexible, yet efficient code with a maximum use of magnetic tapes to provide data for subsequent analyses with other codes such as APPROPOS, or DOT-IIW. ANISN-W accepts input from magnetic tape prepared by SATURN or APPROPOS or from the MSFC Master Libraries 1, 2 and 4 magnetic tapes.

The ANISN-W code has been utilized in the detailed analysis of the nuclear propelled stage as a method of providing the power distribution in the nuclear subsystem and the spatially dependent neutron spectra for use in multigroup neutron cross section preparation using the APPROPOS code.

4.1 General Description of the ANISN-W Code

The ANISN-W code provides the capability to solve the one dimensional (slab, sphere, or cylinder geometry), energy dependent, linear Boltzmann transport equation. The code uses the discrete ordinates method employing a diamond (or step) difference solution technique. A multigroup representation of particle energy and a general anisotropic scattering approximation (i.e., Legendre polynomial expansion of the scattering cross sections) is used. The code provides for the forward or adjoint, homogeneous or inhomogeneous solutions. Inhomogeneous solutions may have fixed distributed volume sources, or a specified angular dependent shell source at any or all mesh intervals. Subcritical multiplication due to the presence of fissionable material may be included in the inhomogeneous problems. The homogeneous solution provides the eigenvalue or multiplication factor of the system. In addition, the capability to perform time absorption calculations and searches of material concentration, outer radius, zone thickness, or buckling to provide a desired eigenvalue or multiplication factor is provided. The system boundary conditions available are vacuum, reflective, periodic, white, or albedo.

In the MSFC seminar/workshop analysis only limited use of the ANISN-W code capabilities is demonstrated. The linkage of the ANISN-W code with the neutron and photon cross section preparation techniques and the use of the ANISN-W output results to define the two dimensional power distribution in the nuclear subsystem are the two principal uses of the ANISN-W code. In the following discussion the ANISN-W input and output to produce the desired S/W use of ANISN-W is described.

4.2 Input Data Description

Input data for the ANISN-W code are subdivided into the following seven sets of data:

1. Problem core memory allocation,
2. Problem descriptive title and CPU time estimate,
3. Problem specifications, options, and constants,
4. Cross section data,
5. Fixed distributed or shell source data,
6. Flux or fission distribution guess data,
7. Geometry, discrete ordinate quadrature, mesh description and other miscelleneous data.

The flexibility of the code in solving a variety of different types of problems and the complexity of some input data arrays complicates the preparation of input for the ANISN-W code. However, the use of a flexible input data routine (FIDO) provides for many shortcuts in preparing the input for the ANISN-W code. The input formats for integer (fixed point) and real (floating point) data are described in detail in Section 2.2.1 of Volume 4 of WANL-PR-(LL)-034.

Of the data sets described above, Sets 1 and 2 are entered under a fixed FORTRAN format, and sets 3 through 7 utilize the FIDO subroutine to read input. The FIDO routine will accept data in one of three FORTRAN formats with the most general capability having an input data operations declared by letter code. The use of certain input data techniques in FIDO will be demonstrated in the ANISN-W workshop problem described in following sections and the use of FIDO in the DOT-IIW, MAP, SCAP, LHAP codes will illustrate the use of FIDO.

The ANISN-W code user's manual is published as a separate document (WANL-PR-(LL)-034, Volume 4). It is assumed that the reader will utilize this manual during the discussion of the workshop problem input data in the following sections.

In the discussion that follows the specific use of the ANISN-W code to prepare spatially dependent neutron flux spectra for use in multigroup cross section preparation is described.

4.2.1 Input Data Preparation

Data Set 1 - Problem Core Memory Allocation

The initial input quantity for the ANISN-W code is the quantity LIM1, i.e., the maximum number of core memory locations available for data of an ANISN-W problem. On the MSFC UNIVAC-1108, this value is currently 48000_{10} which is compatible with the available $65,000_{10}$ core memory size of the MSFC UNIVAC-1108 computer system. The user of ANISN-W can determine the problem core memory storage requirements from the problem input data and the equations described in Section 2.2.3. The ANISN-W code will determine if the problem will fit in the available core (LIM1) and will automatically select tapes or FASTRAND for cross section or flux data storage by group, if necessary. The user may also select the use of tape or FASTRAND by input quantities but this mode of operation is not recommended since the running times of a problem increase significantly (see Section 4.2.2).

Problem Descriptive Title and CPU Time Estimate

The second data set for an ANISN-W problem contains the appropriate title describing the problem and the CPU time estimate. The CPU time estimate if entered as 0.0 is ignored. However, if the CPU time estimate is entered as greater than 0.0, the ANISN-W code will provide a complete printout after the last complete outer iteration. The code determines the CPU time per outer iteration at the completion of each outer iteration and if insufficient time remains to complete another outer iteration the job is terminated (forced convergence). In the ANISN-W Seminar/Workshop problems time estimates of 600.0 seconds (radial) and 1200.0 seconds (axial) were used. An estimate of the CPU time per outer iteration can be obtained from the multiple of the number of mesh intervals (IM), number of angles (MM, MM equals ISN + 1 for slab or sphere geometry or ISN * (ISN + 4)/4 for cylinder geometry), number of groups (IGM), and the number of inner iterations (IIM). This multiple (IM*MM*IGM*IIM) divided by 1720 (1000 if IDAT1 > 0) angular flux solutions per second provides the seconds per outer iteration. The user can then determine the maximum number of outer iterations in the CPU time alloted or use the CPU time estimate to terminate the job automatically.

C.2

Problem Specifications, Options, and Constants

Each ANISN-W problem requires a total of 36 integer (fixed point) input values and 14 real (floating point) input values. These data are entered in the 15$ and 16* arrays of the ANISN-W input and define the overall problem parameters. The 36 values of the 15$ array as listed in Tables 4-1 and 4-2 are as follows:

1. The problem identification number, 1 for the radial and 2 for the axial problem.
2. The flux solution option, ITH. In both S/W problems the forward solution option (ITH = 0) is selected.
3. The anistropic scattering approximation, ISCT. Since the Master Library 1 containing transport corrected cross sections is used in SATURN to produce 52 group macroscopic cross sections ISCT is input as 0.
4. The order of angular quadrature to be solved, ISN. In both S/W problems the S_n order of 4 is used. (In the sample problem output produced at MSFC the diffusion solution is used to conserve computer time and the input quantity ISN was entered as 2.)
5. The geometry parameter, IGE. This quantity is 2 for the radial S/W problem and 4 for the axial problem.
6. The left boundary condition of the problem, IBL. In the radial problem, the left boundary, i.e., the reactor centerline, has a reflective boundary (IBL = 1). In the axial problem, the left boundary, which is the bottom of the NSS or CHESH region, is a vacuum boundary (IBL = 0).

7. The right boundary condition, IBR. In the radial problem the right boundary, i.e., the pressure vessel surface, is a vacuum boundary (IBL = 0). In the axial problem, the right boundary, which is the top of the NSS or pressure vessel dome, is a vacuum boundary (IBL = 0).

8. Number of zones in the problem geometry, IZM. The radial problem geometry as shown in Figure 4-1 has 11 zones (IZM = 11) and the axial problem geometry as shown in Figure 4-2 has 10 zones (IZM = 10).

9. Number of mesh intervals in the problem geometry, IM. The radial problem is subdivided into 40 mesh intervals and the axial problem is subdivided into 87 mesh intervals. The number of mesh intervals in the ANISN-W problems were set the same as the DOT-IIW problem described in Section 6.0 in order to provide the fission distribution as a function of radius and height for use as a fixed distributed source in the DOT-IIW problem.

10. Calculation type, IEVT. In the use of ANISN-W for the S/W eigenvalue (k_{eff}) calculation (IEVT = 0) is used for both problems. This provides the fission distribution in the reactor core for use in synthesizing the two dimensional fission distribution as a fixed source in DOT-IIW.

11. The number of neutron groups, IGM. The S/W use of ANISN-W is to calculate zone neutron spectra for cross section weighting in APPROPOS. The Master Library 1 with 52 groups (IGM = 52) is used in both problems.

12. The position of the total or transport cross sections in the input cross section data, IHT. The value of IHT in the Master Libraries 1 and 2 is 3. See Section 3.0 for a description of the cross section table.

13. The position of the within-group scatter cross section in the cross section data, IHS. The value of IHS in the Master Libraries 1 and 2 is 23. See Section 3.0 for a description of the cross section table.

14. The total number of table positions in the cross section data, IHM. The value of IHM for Master Libraries 1 and 2 is 74. See Section 3.0 for a description of the cross section table.

15. Cross section mixing table length, MS. In the S/W ANISN-W problems, macroscopic cross sections are obtained from the SATURN code and no mixing table is used in either ANISN-W problem (MS = 0). This procedure is used since microscopic cross section mixing in ANISN-W would require 200,096 core memory locations for the radial problem and 203,944 core memory locations for the axial problem. The SATURN code provides the capability to do the mixing in less than 65,000 core memory locations. However, the use of mixing tables in ANISN-W is similar to the SATURN input except for the case of concentration searches.

16. Number of cross section sets from cards, MCR. In the S/W problems, only one (MCR = 1) set of cross section data is input from cards and the remainder are from the SATURN-produced magnetic tape. In the ANISN-W code, cross sections from cards are set numbers, 1 to MCR.

17. Number of cross section sets from tape, MTP. The S/W problems use the SATURN produced cross section tapes. In the radial ANISN-W problem a total of 11 sets of data (MCR = 11) are read from tape and in the axial ANISN-W problem a total of 10 sets of data (MCR = 10) are read from tape. These data are macroscopic data for each zone.

18. Total number of material cross section sets in the problem, MT. In the S/W problems no mixing table is required, hence a total of 12 sets of data are in the radial problem (MCR + MTP = 12) and a total of 11 sets of data are in the axial problem (MCR + MTP = 11).

19. Density factor input option, IDFM. This ANISN-W capability allows the user to vary the material concentration by mesh interval. The user may input a multiplicative factor by mesh interval in a data array. In the S/W problems each zone material is constant and therefore IDFM is set to 0.

20. Parametric eigenvalue input option, IPVT. In the ANISN-W code, search options can be used (see the IEVT options) to provide a system which gives a desired eigenvalue (k_0). Also the user can input the value of α_0 for use in time absorption calculations. In the S/W use of ANISN-W, IPVT = 0.

21. Fixed distributed source input option, IQM. In the S/W use of ANISN-W the fixed distributed source option (IEVT = 0) is not used. Therefore IQM is set to 0. However, if a fixed distributed source calculation is desired the user may select the option of entering the distributed source on cards or the user can read the fixed distributed source from tape 9 with the interval range of input specified in the 17$ array. The NAGS code can be used to generate the fixed distributed source tape.

22. Shell source input option, IPM. In the S/W use of ANISN-W, the shell source option is not used (IPM = 0). However, if a shell source calculation is desired the user may select the option of entering the shell source from cards or tape. Input of the shell source from tape is restricted to a single interval of angular dependent data from a flux output tape of a previous ANISN-W tape.

23. Interval number which contains the shell source, IPP. The option IPM is not used in the S/W problem; therefore, IPP is entered as 0.

24. Maximum number of inner iterations per group, IIM. In the S/W problems the value of IIM is set to 50. A value of IIM ≥ 20 is always recommended since the ANISN-W code has internal controls which will stabilize the space point scaling technique used to accelerate the group flux solution. These stabilizing techniques occur after 20 inner iterations and eliminate group flux solution oscillations due to the use of diamond difference and step function difference techniques on successive iterations of the same angular flux calculation.

25. Printed and punched output option, ID1. In the S/W problems the printout of angular fluxes or punched card output is not requested (ID1 = 0). In the current version of ANISN-W on the MSFC computer, the ID1 options have been altered. The option (ID1 = 2) does not provide the zone leakage and zone integral fluxes as punched output but the zone average fluxes are always provided on punched cards. These cards are useable as input to the APPROPOS code. The remaining options of ID1 are unaltered.

26. Cross Section Input Option, ID2. In the S/W problems the cross sections used in ANISN-W are group dependent data produced by SATURN on tape 12. This tape consists of cross sections for all groups of each material in one logical record on the input tape. In certain instances the core memory required to read cross sections into ANISN-W exceeds the LIM1 specifications. In this instance the SATURN code provides a group independent tape with all materials for one group in a logical record on the input tape. This tape is produced on tape 14 of SATURN. In using this SATURN tape the input value of ID2 is set to 1.

27. Activity calculation option, ID3. The use of the activity calculation option in the S/W problems provides 16 group flux data for comparison to the two dimensional DOT-IIW results. The input value of ID3 is 16 and the cross section data from cards contains the constants to provide sixteen group data for the activity calculation.

28. Activity calculation by interval option, ID4. In the S/W problems the activity calculation by interval is desired (ID4 = 1). This option provides a radial midplane or axial centerline flux transverses for comparison to DOT-IIW results. An additional option provided by ID4, but not described in the users manual: (ID4 = -1) will punch the activities by mesh interval.

29. Maximum number of outer iterations, ICM. The S/W problems are eigenvalue (k_{eff}) calculations and require outer iterations. In the S/W problems a maximum of 50 outer iterations (ICM = 50) is specified and the CPU time estimate entered in Data Set 2 is used to terminate the problems at a time limit if necessary. In general, less than 20 outer iterations are required and in the S/W problems only 5 and 13 outer iterations were required to achieve the convergence desired in the radial and axial problems.

30. Core memory storage allocation option, IDAT1. In the S/W problems the input value of IDAT1 is 0. With a storage allocation (LIM1) of 48000_{10} on the MSFC UNIVAC-1108 computer, the ANISN-W code will determine that the option IDAT1 = 1, which places cross sections and fixed sources on tape, is necessary.

The disadvantage of running a problem with IDAT1 >0 is that the CPU time will increase by up to a factor of 1.7 over a problem run with IDAT1 = 0.

31. Diffusion theory solution option, IDAT2. In the S/W problems the diffusion theory option is not used (IDAT2 = 0). In order to conserve computer time at MSFC, the demonstration problem run at MSFC uses the diffusion theory option for all outer iterations. This reduces the time required for each outer iteration by a factor of 2-4. In this case IDAT2 is set to 50, the same value as ICM.

32. Cross section flux weighting option, IFG. The S/W analysis procedure uses the APPROPOS code to perform the flux weighting of cross sections. In the ANISN-W problems the flux weighting option is not used (IFG = 0). The capability to flux weight cross sections in ANISN-W is duplicated in APPROPOS except that the P_l data can only be current or flux moment weighted in ANISN-W. The use of current or flux moment weighting is not recommended in problems where spatially varying fluxes occur since the sign of the current and/or flux moments can change.

33. Flux solution option, IFLU. The recommended option to use is the mixed mode of solution (IFLU = 0). This flux solution option uses the linear diamond difference method until a negative angular flux solution is obtained. If the solution is negative then the angular flux solution is recalculated with the step function mode. As discussed earlier, the input quantity IIM should be greater than 20 since ANISN-W controls the use of linear or step function following the 20th iteration such that the angular flux is always solved by the same technique.

34. Fission or flux guess input option, IFN. In the S/W problems a uniform flux guess was used (IFN = 1).

35. Cross section print option, IPRT. For the S/W problems, (IPRT = 0) to print the cross sections is used. Since the cross sections are printed in the SATURN problem the option (IPRT = 1) would reduce the printed output by one-half.

36. P_l scattering coefficient calculation option, IXTR. Since both S/W problems are P_0 calculations (isotropic scattering) the input value of IXTR = 0.

The second section of the Data Set 3 contains the real (floating point) data. This data is the 16* array and contains 14 pieces of data defining convergence parameters, system dimensions, and problem normalization. The input required for the S/W problems are as follows:

1. Eigenvalue guess, EV. For the S/W problems, the input value of EV is 0.0. This input, EV, is only required in search calculations, IEVT greater than 2, to provide an initial starting point for the search of radius, concentration, zone thickness, or buckling. (See Section 2.3.11 for details.)

2. Eigenvalue guess modifier, EVM. The input value of EVM is 0.0 since the S/W problems are eigenvalue problems. A non-zero value of EVM is only necessary for search calculation, IEVT greater than 2. (See Section 2.3.11 for details.)

3. Convergence criteria for eigenvalue and upscatter convergence, EPS. The input value of EPS for both S/W problems was 0.001. This loose convergence is used to conserve computer time and normally would be smaller.

4. Transverse leakage parameter (buckling factor), BF. The input value of BF in the S/W problems is 0.0. The ANISN-W code assigns a small value 1.0×10^{-30} if BF is input as 0.0 to insure that division by zero is not performed. In the ANISN-W code the value of BF determines the extrapolation distance to be added to the input value of DY or DZ. In the S/W problems the value of DYand DZ are estimated transverse dimensions with extrapolation added. If DY and DZ were actual dimensions, the value of BF could be entered as 2.*0.7104 or 1.4208 to provide a group dependent extrapolation distance δ of $1.4208/\Sigma_{tr}$, where Σ_{tr} is the transport cross section of the material at the reactor boundary.

5. Transverse dimension for buckling correction, DY. The input value of the transverse dimension in the radial S/W problem is 148.6 centimeters. This value is a NERVA value derived from axial problems and is obtained from fitting the axial fission distribution with a cosine function and extrapolating the cosine to a zero value. The actual core height is 132.08 centimeters which results in an effective extrapolation distance of 16.52 centimeters. In the axial S/W problem the input value of DY is 131.0 centimeters. This value is derived from the extrapolated radius of 70.91 centimeters and the ANISN-W equations as follows:

$$B^2 = \left(\frac{\pi}{DY + \frac{BF}{\Sigma_{tr}}} \right)^2 + \left(\frac{\pi}{DZ + \frac{BF}{\Sigma_{tr}}} \right)^2$$

Since the radial buckling is defined as,

$$B_R^{\ 2} = \left(\frac{2.405}{R + \frac{BF}{\Sigma_{tr}}} \right)^2$$

the substitution of DY and DZ into the ANISN-W equation results in the proper value of B_R^2 in the second equation.

6. Transverse dimension for buckling correction, DZ. The input value of DZ for the radial ANISN-W problem is 0.0. In the axial S/W problem the input value is of DZ is the same as DY and is described above.

7. Transverse dimension for void streaming correction, DFM1. The input value of DFM1 is 0.0 for both S/W problems. If a radial void zone is present in a problem, the ANISN-W user may input the physical height of the void region as DFM1 and the ANISN-W code will approximate the leakage out of the void. (See Section 2.3.13 for details.)

8. Problem normalization factor, XNF. The input value of XNF for both S/W problems is 1.0. This normalizes the output of the code to 1.0 source neutron. If an absolute normalization is desired the input value of XNF would be the number of source neutrons to produce the desired fission power.

9. Parametric eigenvalue for time absorption or search calculations, PV. Since the S/W problems are eigenvalue type problems, the input value of PV is 0.0. In time absorption calculations, IEVT = 2, the input value of PV is α_0; in the search calculation, the input value of PV is the desired eigenvalue (k_o) of the system).

10. Relaxation factor on convergence parameters, RYF. The input value of RYF for both S/W problems is 0.5.

11. Pointwise flux convergence criterion XLAL. In the S/W problems, the value of XLAL is 0.001. This value is equal to EPS and should generally be equal to or smaller than EPS.

12. Convergence parameter for search calculations, XLAH. The input value of XLAH for the S/W problems is 0.0. In search calculations, XLAH = 0.05, is recommended.

13. Eigenvalue change criteria for search calculation, EQL. The input value for the S/W problems is 0.0. For search calculations EQL is normally input as 2.0*EPS.

14. New parameter modifier, XNPM. The input value of XNPM for the S/W problems is 0.0. In search calculations a value of less than 1.0, e.g., 0.75, is recommended in order to damp out oscillations in the parameter being searched on.

As shown in Tables 4-1 and 4-2 the 15$ and 16* arrays are followed be a single terminate (T) card.

Cross Section Data

Cross section input data to the ANISN-W code consists of two types of data. The input data described previously defines the type of cross section data input to an ANISN-W problem. If the input value of MTP is greater than 0 then the tape identification numbers are input in the 13$ array. In the S/W problems the 13$ arrays are the tape identification numbers of cross section sets placed on tape by the SATURN code. In Figures 4-1 and 4-2 the cross section set numbers and corresponding zone numbers are shown. It should be noted that the ANISN-W code assigns cross section sets from tape following the cross section sets from cards. In the S/W problems, a single cross section set from cards is used and therefore the first set read from tape will be cross section set 2 of the ANISN-W problem. This correspondence is shown in Figures 4-1 and 4-2.

The second portion of the cross section data is the data from cards. These data is entered as the 14* or 14U array. In the seminar/workshop problems a single set of data are entered. This requires a total of 3848 pieces of data (52 groups by 74 table positions). The set of data entered in the S/W problems is the data necessary to provide 16 group fluxes for comparison to the DOT-IIW results. This data is used in the activity calculation of ANISN-W. As listed in Table 4-1 the 14* array describes a table of cross sections by column such that when the first 16 rows are multiplied by the 52 group fluxes the 16 group fluxes are obtained.

As shown in the listings in 4-1 and 4-2 the 13$ and 14U arrays are followed by a single terminate (T) card.

Fixed Distributed or Shell Source Data

In the S/W problems, no fixed distributed or shell source data are required since IEVT is not equal to 0. Therefore, the 17*, 17$, 18*, or 18$ arrays followed by a terminate (T) card are not in the input decks as listed in Table 4-1 and 4-2. If a fluxed distributed source or shell source is input the user has the option of entering data from tape or cards. The fixed distributed source data from cards is entered for group 1, intervals 1 through IM, followed by group 2 data, intervals 1 through IM, for IGM groups. If magnetic tape input is requested then each logical record on tape 9 should contain IM values of source data. The user can specify the interval range of data to be used in the problem by the 17$ array.

A similar capability of entering shell source data is provided. Shell source data is always entered as data at the right boundary of the mesh intervals. In the case where data is entered on cards the 18* array should contain the data for group 1, all angles and all intervals, followed by group 2, all angles and intervals, etc. If the data is entered from tape, the input tape 9 is in the format of the angular flux output tape from an ANISN-W problem. The user can specify the interval data on tape 9 to be used as the shell source data and the input value of IPP specifies the interval at which the shell source is to be used in the current ANISN-W problem.

The 17*, 17$, 18* and 18$ arrays, if required, as input are followed by a single terminate (T) card.

Flux or Fission Distribution Guess Data

In the S/W problems the option to specify a flux distribution guess is specified. As shown in Tables 4-1 and 4-2 the 3* array is filled with a uniform guess of 1.0. The ANISN-W code will normalize this data to a total of one source neutron in the problem. In certain types of problems, a flux guess of 0.0 is recommended. For example, in a fixed distributed source problem with fissions, a flux guess of 0.0 is recommended.

The 2* or 3* arrays are followed by a single terminate (T) card.

Geometry, Discrete Ordinate Quadrature, and Other Miscellaneous Data

The remainder of the ANISN-W problem data are entered as a group of data with each set of data proceeded by the array number

1* Array

The 1* array is the fission spectrum, χ_g, data. This data is the fraction of neutrons born in each group and the sum of χ_g's over all groups should be 1.0. The data listed in Tables 4-1 and 4-2 are U^{235} fission spectrum data in the group structure listed in Table 3-3, Volume 2, WANL-PR(LL)-034. In eigenvalue problems, the χ_g array is always required. In fixed source problems the χ_g array may be entered as 0.0 to eliminate source neutrons in fissionable regions.

4* Array

The 4* array are the mesh line coordinates defining the mesh intervals. The mesh intervals in ANISN-W were the same as the DOT-IIW in order to provide for easy comparison of flux values. The mesh line coordinates used are listed in Tables 4-1 and 4-2 and were obtained from the neutron DOT-IIW problems described in Section 6.0.

5* Array

The representative group velocities are entered in the 5* array. For all problems except time absorption calculations, (IEVT = 2) the 5* array should be entered as 1.0's. In the S/W problems the 5* array is entered as 1.0's.

6* and 7* Arrays

The discrete ordinate angular quadrature weights and direction cosines are entered in the 6* and 7* arrays. For the radial S/W problem, S_4 quadrature data from Table 2-2 of the ANISN-W user's manual is used. For the axial S/W problem the S_4 quadrature data from Table 2-1 of the ANISN-W user's manual is used.

8$ Array

The 8$ array is used to define zones by mesh interval. A total of 40 values are required for the radial S/W problem and 87 values are required for the axial S/W problem.

9$ Array

Input in the 9$ array defines the material numbers by zone. In the radial S/W problem, 11 zones are defined in the 8$ array and 11 entries are required in the 9$ array. The input values of 9$ are the cross section set numbers as listed in Figure 4-1. In the axial S/W problem, 10 zones are defined in the 8$ array and 10 entries are required in the 9$ array. The input values of the 9$ array are the cross section set numbers as listed in Figure 4-2. In the axial S/W problem the inclusion of the transverse leakage (buckling) correction in low density zones can lead to anomalous results. In ANISN-W, the input of a negative entry in the 9$ array excludes the calculation of the correction for that zone. As listed in Table 4-2 the third, fifth, and ninth zones are hydrogen plena and are excluded from the transverse leakage calculation by input of a negative number.

10$, 11$, 12* Arrays

The cross section mixing table in ANISN-W is specified in the 10$, 11$ and 12* arrays. In the S/W problems no mixing table is used since the SATURN code is used to provide macroscopic cross sections. The SATURN code input described in Section 3.0 includes a mixing table similar to an ANISN-W mixing table. A detailed description of the use of the mixing table is described in Section 2.3.6 of the ANISN-W user's manual. Concentration search ANISN-W problems (IEVT = 3) require a specific type of mixing table. The user must specify the mixture to be altered to achieve the desired eigenvalue, PV.

19$ Array

In the ANISN-W code the user may specify the order of the anisotropic scattering approximation by zone. In the S/W problems transport corrected cross section data is input and the input quantity ISCT is input equal to 0. Therefore, no 19$ array is required. However, if ISCT is greater than 0 then the 19$ array is required input and the cross section data for each zone must be in a specific order, i.e., P_0, P_1, ·; P_l for the zone specified as having cross sections of order l.

20* Array

In the S/W problems the 20* array, radius modifiers by zone, is not required input. The 20* array is only required when a zone thickness search calculation, IEVT = 4, is specified. In this type of problem the user specifies which zones to be varied to achieve the desired eigenvalue, PV. The input of an 0.0 for a zone will result in a zone thickness not being changed in the search for a system to provide the desired result, PV.

21* Array

In the S/W problem the 21* array, density factors by interval, are not required input. These factors specified by the IDFM option in the 15$ array are input for each interval. These factors are multiplicative factors applied to the cross sections in the interval.

22$ and 23$ Arrays

The 22$ and 23$ arrays define the activity calculations to be performed by the ANISN-W code. In the S/W problems the activity cross sections were input in the 14U array described earlier. The activity cross sections input in the 14U array consisted of sixteen sets of data which when multiplied by the 52 group fluxes produce the 16 group fluxes for comparison to DOT-IIW results. The 22$ array of the S/W problem input defines the activity cross section set as set 1. The sign (-) of the values of 22$ designate that the activities are to be calculated for all mesh intervals. The 23$ array input to the S/W problem defines the table positions of each activity. In the S/W problem the table positions 1 through 16 define the 52 group activities required to produce 16 group fluxes. The other capabilities in the activity calculations are described in Section 2.3.5 of the ANISN-W user's manual.

24$ Array

The user of ANISN-W can specify the use of a diffusion theory solution or infinite media solution through the use of the input quantity IDAT2 and the 24$ array. In the S/W problems an S_4 solution was used, IDAT2 was equal to 0, and the 24$ array was not required. In the ANISN-W problem run at MSFC the input of IDAT2 = 50, and the input of the 24$ array as all 1's results in a diffusion theory flux solution. This technique was used at MSFC to conserve computer time.

25* and 26* Arrays

In the S/W problems the albedo boundary conditions, IBL or IBR = 3, are not specified and the 25* or 26* array is not entered. If this option is used the albedo is the fraction of neutrons or photons leaving the boundary which are returned isotropically to the system. The user specifies this fraction for each group.

<u>27$ Array</u>

In the S/W problems, the cross section weighting option, IFG, is equal to 0 since the APPROPOS code is used to prepare 16 group neutron cross sections. The APPROPOS code has a similar capability to the ANISN-W code to perform cross section weighting, however, APPROPOS is also used to prepare photon cross sections for use in DOT-IIW. The ANISN-W user's manual described the use of this option in detail.

<u>34* Array</u>

The S/W problems use transport corrected cross section data and the 34*, P_l scattering coefficients, is not required. Normally, these data are not required in P_l calculations since the option, IXTR, is input equal as 0 to internally calculate these data.

The above data arrays are input as a group of input and are followed by a single terminate (T) card.

4.2.2 Problem Size Determination

Section 2.2.3 of the ANISN-W user's manual describes how to determine the core memory locations required for an ANISN-W problem. In the equations, the IDAT1 option specifies the cross section, flux and fixed source storage. If the problem requires more storage than the LIM1 allocation the code will process the cross sections, fluxes, and sources from tape or FASTRAN. If IDAT1 equals 1 or 2 an additional requirement is that a sufficient core memory be available to process the cross sections through core. There are (IHM + 1)*IGM*ML+MTP+240 locations required to read cross sections. If this exceeds the LIM1 value then the user must use the SATURN code to load a group independent tape and set ID2 equal to 1 in the ANISN-W input deck.

4.2.3 Quadrature Sets

In the S/W problems the S_4 quadrature data was obtained from Tables 2-1 and 2-2 of the ANISN-W user's manual. A description of the discrete ordinate quadrature sets required for ANISN-W input are described in Sections 2.2.4 of the ANISN-W user's manual. The DOQ code, described in Section 6.0, can also be employed to generate quadrature sets for the ANISN-W code.

4.2.4 Mesh Spacing Requirements

The mesh intervals in the ANISN-W S/W problems were based on the DOT-IIW neutron transport S/W problem setup. Some guidelines for determining mesh intervals are outlined in Section 2.2.5 of the ANISN-W users manual. When these criteria are exceeded the group flux solutions may be slow in converging and anomolous results may result from an excessive use of the step function negative flux fix up technique.

4.2.5 Problem Setup Description

Section 2.4 of the ANISN-W users manual describes the tape assignments and running time estimates for an ANISN-W problem. In the S/W problems the required tapes are a cross section tape on tape unit 14 and a save tape on tape unit 17. The cross section tape is from the SATURN S/W problem and the save tape is the output flux tape for use in APPROPOS.

In addition to the above problem setup requirements the MSFC user may be required to designate the amount of FASTRAN to save for use in an ANISN-W problem. If the ANISN-W problem requires the use of FASTRAN the amount of data on FASTRAN is as follows:

Tape 3 and 4: If IDAT1 $\geq$ 1, then 2 records for each group, 2*IGM records, with the first record for each group containing the cross sections for the group, a maximum (IHM + 1)*ML values, and the second record for each group containing the fixed and shell source data, IM values if IQM > 0 plus MM*IPM values if shell source is present.

Tape 8 and 10: If IDAT1 = 2, then 2 records for each group, 2*IGM records, with the first record for each group containing fluxes and boundary angular fluxes, IM + MM values, and the second record containing the currents and flux moments of a P_l calculation, IM*ISCT value for slab or sphere problems or IM * [ISCT *(ISCT + 4)]/4 values for the cylinder problem.

Tape 17: See Section 2.5.2 of the ANISN-W user's manual.

The remainder of tape units used in ANISN-W problems do not normally require FASTRAN since a tape would be mounted for input or output data.

4.3 Output Data Description

Output from an ANISN-W problem consists of printed, punched, and magnetic tape output. The following sections briefly describe each type of output from the S/W problem. In addition, Section 2.5 of the ANISN-W user's manual describes the output of the ANISN-W code. The units of the output from ANISN-W are also described in Section 2.5.

4.3.1 Printed Output

The first printed output section of ANISN-W problems is the edit of the input routine FIDO. The arrays by number, e.g., 15$, 16*, 13$, etc., are read and the number of entries input in each array is printed. If the wrong number of input values are read for any array, the array is printed and the edit is continued. Of special note in this input edit is the number of locations required for the problem and the number of to read cross sections.

The next section of printed output is an organized printout of the input data. This printout is followed by the cross sections printout if IPRT = 0. In the S/W problems the cross section data is on tape by group and therefore the printout of cross sections are a table of data by position and materials for each group. If cross sections are in core memory the cross section printout is by material as table of data by position and group.

The next section of output is the outer iteration monitor. Included in this is the outer iteration number, the cumulative sums of inner iterations (i.e., the number of inner iterations for each group solution summed over all groups), the upscatter ratio (the ratio of total upscatter source for successive outer iterations), the eigenvalue (k_{eff}), the source ratio for successive outer iterations (λ_1), and the scatter ratio for successive outer iterations (λ_2). Preceding the final monitor line the group flux convergence for each group is printed. This includes the number of inner iterations performed for each group in the final outer iteration, the maximum flux deviation (i.e., the fractional change of flux in the last two inner iterations, and the mesh interval at which the maximum flux deviation occurred.

Following the iteration monitor the geometry data by interval is printed. The zone number, mesh line coordinate, mesh interval midpoint, area, volume, and calculated fission density are printed.

The next section of output is the activities if requested by ID3 > 0. Activity results include the volume integral activity by zone, volume averaged activity by zone, and if ID4 ≠ 0, then the mesh interval activities are printed. As discussed later, if ID4 < 0, then mesh interval activities are punched output.

The next section of printed output is the 52 group fluxes by mesh interval. These are followed by the summary balance tables by zone and the system balance table.

This completes the printed output from the S/W problems. Section 2.5 of the ANISN-W user's manual describes other forms of optional printed output.

4.3.2 Tape Output

The ANISN-W code prepares an output tape for use in the APPROPOS or NAGS codes or as input to another ANISN-W problem. In the S/W problems this tape must be saved for use in the APPROPOS code to calculate zone spectra. The contents of this tape is described in Table 2-5 of the ANISN-W user's manual. The tape contains 11 plus 4*IGM records of data. In the linkage of ANISN-W and APPROPOS at MSFC, the radial and axial ANISN-W tapes must be combined before they are input to APPROPOS. One technique is to use the UNIVAC-1108 tape copy routines or a second method is to run both ANISN-W problems in the same job (i.e., stacked cases). This stacked case job will place the output from both cases on the same tape.

A second output tape from ANISN-W is the spectral weighted cross sections if this option (IFG > 0) is used. This tape is compatible with ANISN-W or DOT-IIW. The sequence in which weighted cross sections are placed on tape are described in Section 2.5.2 of the ANISN-W user's manual.

4.3.3 Punched Card Output

Punched card output from the ANISN-W code consists of data obtained for all problems and optional punched card output controlled by user input. All data is punched in a 6E12.5 format with each set of data starting on a new card. Title and header cards are punched in an 80A1 format. The punched card data is as follows:

(1) Mesh interval activities with each activity starting a new set of cards

(2) Problem title card

(3) Flux Output Header Card (3U)

(4) Group scalar fluxes by mesh interval with each group starting a new set of cards

(5) 5 blank cards

(6) Zone average group fluxes with each zone starting a new set of cards

(8) Two blank cards

(9) Source neutron density header card (2U)

(10) Source neutron density by mesh interval.

Item 1 is only punched when ID4 < 0. Items 2, 3, 4, 9 and 10 are punched output when ID1 > 1. Items 5, 6 and 7 are obtained for each ANISN-W problem and Item 6 may be used as input to the APPROPOS code for spectral weighting data.

FIGURE 4-1

RADIAL ANISN PROBLEM

Radius (cm)	Zone	Mesh No.	Zone No.	Material Tape No.	Material ANISN No.
71.12		41			
	Pressure Vessel Side		11	11	12
68.58		39			
	Outer Refl.		10	10	11
62.174		35			
	Vane		9	9	10
61.92		33			
	Inner Refl.		8	8	9
55.88		30			
	Structure		7	7	8
53.34		28			
	Filler Strip		6	6	7
46.99		25			
	Core 5		5	5	6
44.654		22			
	Core 4		4	4	5
40.971		18			
	Core 3		3	3	4
36.094		15			
	Core 2		2	2	3
29.184		11			
	Core 1		1	1	2
0		1			

FIGURE 4-2

AXIAL ANISN PROBLEM

Axial Dimension (cm)	Zone	Mesh No.	ANISN Zone No.	Material Tape No.	Material ANISN No.
-230.48		88			
	Pressure Vessel Dome		10	12	11
-227.94		86			
	Dome Plenum		9	11	10
-197.94		76			
	Pb Shield		8	10	9
-197.31		74			
	BATH Shield		7	9	8
-166.83		43			
	Al Plate		6	8	7
-164.67		41			
	Shield Plenum		5	6	6
-161.29		38			
	Support Plate		4	5	5
-146.05		30			
	Core Plenum		3	4	4
-137.16		26			
	Core 1		2	1	2
-5.08		3			
	CHESH		1	2	3
0		1			

TABLE 4-1. LISTING OF THE ANISN-W CODE INPUT DATA FOR THE SEMINAR/WORKSHOP RADIAL GEOMETRY PROBLEM

```
          50000
RADIAL ANISN - MSFC MODEL - 52 GROUP MACRO FROM SATURN                 600.0
15$
          2          0          0          4          2          1
          0         11         40          1         52          3
         23         74          0          1         11         12
          0          0          0          0          0         35
          0          0         16          1         50          0
          0          0          0          1          0          0
16*
        0.0        0.0      0.001        0.0      148.6        0.0
        0.0        1.0        0.0        0.5      0.001        0.0
        0.0        0.0
  T
13$
          1          2          3          4          5          6
          7          8          9         10         11
14*
        1.0     0.040-     1.031Z                                     GP 1   1
40Z
        1.0     0.040-     1.031Z                                     GP 2   1
40Z
        1.0     0.040-     1.031Z                                     GP 3   1
40Z
        1.0     0.040-     1.031Z                                     GP 4   1
40Z
        1.0     0.040-     1.031Z                                     GP 5   1
40Z
        0.0     1.040-     1.031Z                                     GP 6   2
40Z
        0.0     1.040-     1.031Z                                     GP 7   2
40Z
 2Z     38-     1.031Z                                                GP 8   3
40Z
 2Z     40-     1.0        1.030Z                                     GP 9   4
40Z
 2Z     40-     1.0        0.0        1.029Z                          GP10   5
40Z
 2Z     40-     1.0 2Z                1.028Z                          GP11   6
40Z
 2Z     40-     1.0 2Z                1.028Z                          GP12   6
40Z
 2Z     40-     1.0 3Z                1.027Z                          GP13   7
40Z
```

TABLE 4-1 (CONT)

2Ƶ 40Ƶ	40-	1.0 4Ƶ	1.026Ƶ	GP14 8
2Ƶ 40Ƶ	40-	1.0 4Ƶ	1.026Ƶ	GP15 8
2Ƶ 40Ƶ	40-	1.0 5Ƶ	1.025Ƶ	GP16 9
2Ƶ 40Ƶ	40-	1.0 5Ƶ	1.025Ƶ	GP17 9
2Ƶ 40Ƶ	40-	1.0 6Ƶ	1.024Ƶ	GP18 10
2Ƶ 40Ƶ	40-	1.0 6Ƶ	1.024Ƶ	GP19 10
2Ƶ 40Ƶ	40-	1.0 6Ƶ	1.024Ƶ	GP20 10
2Ƶ 40Ƶ	40-	1.0 6Ƶ	1.024Ƶ	GP21 10
2Ƶ 40Ƶ	40-	1.0 6Ƶ	1.024Ƶ	GP22 10
2Ƶ 40Ƶ	40-	1.0 6Ƶ	1.024Ƶ	GP23 10
2Ƶ 40Ƶ	40-	1.0 6Ƶ	1.024Ƶ	GP24 10
2Ƶ 40Ƶ	40-	1.0 6Ƶ	1.024Ƶ	GP25 10
2Ƶ 40Ƶ	40-	1.0 7Ƶ	1.023Ƶ	GP26 11
2Ƶ 40Ƶ	40-	1.0 7Ƶ	1.023Ƶ	GP27 11
2Ƶ 40Ƶ	40-	1.0 7Ƶ	1.023Ƶ	GP28 11
2Ƶ 40Ƶ	40-	1.0 7Ƶ	1.023Ƶ	GP29 11
2Ƶ 40Ƶ	40-	1.0 7Ƶ	1.023Ƶ	GP30 11
2Ƶ 40Ƶ	40-	1.0 7Ƶ	1.023Ƶ	GP31 11
2Ƶ 40Ƶ	40-	1.0 7Ƶ	1.023Ƶ	GP32 11
2Ƶ 40Ƶ	40-	1.0 8Ƶ	1.022Ƶ	GP33 12
2Ƶ 40Ƶ	40-	1.0 8Ƶ	1.022Ƶ	GP34 12
2Ƶ 40Ƶ	40-	1.0 8Ƶ	1.022Ƶ	GP35 12

TABLE 4-1 (CONT)

```
 2Ƶ         40-       1.0 8Ƶ                1.022Ƶ                     GP36 12
40Ƶ
 2Ƶ         40-       1.0 8Ƶ                1.022Ƶ                     GP37 12
40Ƶ
 2Ƶ         40-       1.0 8Ƶ                1.022Ƶ                     GP38 12
40Ƶ
 2Ƶ         40-       1.0 8Ƶ                1.022Ƶ                     GP39 12
40Ƶ
 2Ƶ         40-       1.0 9Ƶ                1.021Ƶ                     GP40 13
40Ƶ
 2Ƶ         40-       1.0 9Ƶ                1.021Ƶ                     GP41 13
40Ƶ
 2Ƶ         40-       1.0 9Ƶ                1.021Ƶ                     GP42 13
40Ƶ
 2Ƶ         40-       1.0 9Ƶ                1.021Ƶ                     GP43 13
40Ƶ
 2Ƶ         40-       1.010Ƶ                1.020Ƶ                     GP44 14
40Ƶ
 2Ƶ         40-       1.010Ƶ                1.020Ƶ                     GP45 14
40Ƶ
 2Ƶ         40-       1.010Ƶ                1.020Ƶ                     GP46 14
40Ƶ
 2Ƶ         40-       1.011Ƶ                1.019Ƶ                     GP47 15
40Ƶ
 2Ƶ         40-       1.011Ƶ                1.019Ƶ                     GP48 15
40Ƶ
 2Ƶ         40-       1.011Ƶ                1.019Ƶ                     GP49 15
40Ƶ
 2Ƶ         40-       1.012Ƶ                1.018Ƶ                     GP50 16
40Ƶ
 2Ƶ         40-       1.012Ƶ                1.018Ƶ                     GP51 16
40Ƶ
 2Ƶ         40-       1.012Ƶ                1.018Ƶ                     GP52 16
40Ƶ
  T
 3*
  F 1.0
  T
 1*
   .00596423   .01705910   .03946822   .06877039   .09632454   .11411064
   .23139131   .18047802   .15218986   .07861765   .01248627   .00287858
   .0002611939R      0.0
 40
 0.0        3.0        6.0        9.0        12.0       15.0
```

TABLE 4-1 (CONT)

```
 18.0        21.0        25.0        27.0        29.184      30.0
 32.0        34.0        36.094      38.0        40.0        40.971
 42.0        43.0        44.0        44.654      45.0        46.0
 46.99       49.0        51.0        53.34       54.0        55.88
 57.5        60.0        61.92       62.05       62.174      63.0
 65.0        67.0        68.58       70.5        71.12
 6*
   0.0         .1666666    .1666666    0.0         .1666667    .1666667
   .1666667    .1666667
 7*
   -.4950046   -.3500212   +.3500212   -.9367418   -.8688903   -.3500212
   +.3500212   +.8688903
 8$
10R           1 4R        2 3R        3 4R        4 3R        5 3R        6
 2R           7 3R        8 2R        9 4R       10 2R       11
 9$
              2           3           4           5           6           7
              8           9          10          11          12
22$
16R          -1
23$
              1           2           3           4           5           6
              7           8           9          10          11          12
             13          14          15          16
  T
```

TABLE 4-2. LISTING OF THE ANISN-W CODE INPUT DATA FOR THE SEMINAR/WORKSHOP AXIAL GEOMETRY PROBLEM

```
         50000
AXIAL ANISN - MSFI MODEL - 52 GROUP MACRO FROM SATURN                   1200.0
15$
          1           0           0           4           1           0
          0          10          87           1          52           3
         23          74           0           1          10          11
          0           0           0           0           0          35
          0           0          16           1          50           0
          0           0           0           1           0           0
16*
        0.0         0.0       0.001         0.0       131.0       131.0
        0.0         1.0         0.0         0.5       0.001         0.0
        0.0         0.0
  T
13$
          1           2           4           5           6           8
          9          10          11          12
14*
        1.0      0.040-      1.031Z                                         GP 1   1
40Z
        1.0      0.040-      1.031Z                                         GP 2   1
40Z
        1.0      0.040-      1.031Z                                         GP 3   1
40Z
        1.0      0.040-      1.031Z                                         GP 4   1
40Z
        1.0      0.040-      1.031Z                                         GP 5   1
40Z
        0.0      1.040-      1.031Z                                         GP 6   2
40Z
        0.0      1.040-      1.031Z                                         GP 7   2
40Z
 2Z              1.031Z                                                     GP 8   3
40Z
 2Z        40-   1.0         1.030Z                                         GP 9   4
40Z
 2Z        40-   1.0         0.0         1.029Z                             GP10   5
40Z
 2Z        40-   1.0 2Z                  1.028Z                             GP11   6
40Z
 2Z        40-   1.0 2Z                  1.028Z                             GP12   6
40Z
 2Z        40-   1.0 3Z                  1.027Z                             GP13   7
40Z
```

TABLE 4-2 (CONT)

2Ƶ 40Ƶ	40-	1.0 4Ƶ	1.026Ƶ	GP14 8
2Ƶ 40Ƶ	40-	1.0 4Ƶ	1.026Ƶ	GP15 8
2Ƶ 40Ƶ	40-	1.0 5Ƶ	1.025Ƶ	GP16 9
2Ƶ 40Ƶ	40-	1.0 5Ƶ	1.025Ƶ	GP17 9
2Ƶ 40Ƶ	40-	1.0 6Ƶ	1.024Ƶ	GP18 10
2Ƶ 40Ƶ	40-	1.0 6Ƶ	1.024Ƶ	GP19 10
2Ƶ 40Ƶ	40-	1.0 6Ƶ	1.024Ƶ	GP20 10
2Ƶ 40Ƶ	40-	1.0 6Ƶ	1.024Ƶ	GP21 10
2Ƶ 40Ƶ	40-	1.0 6Ƶ	1.024Ƶ	GP22 10
2Ƶ 40Ƶ	40-	1.0 6Ƶ	1.024Ƶ	GP23 10
2Ƶ 40Ƶ	40-	1.0 6Ƶ	1.024Ƶ	GP24 10
2Ƶ 40Ƶ	40-	1.0 6Ƶ	1.024Ƶ	GP25 10
2Ƶ 40Ƶ	40-	1.0 7Ƶ	1.023Ƶ	GP26 11
2Ƶ 40Ƶ	40-	1.0 7Ƶ	1.023Ƶ	GP27 11
2Ƶ 40Ƶ	40-	1.0 7Ƶ	1.023Ƶ	GP28 11
2Ƶ 40Ƶ	40-	1.0 7Ƶ	1.023Ƶ	GP29 11
2Ƶ 40Ƶ	40-	1.0 7Ƶ	1.023Ƶ	GP30 11
2Ƶ 40Ƶ	40-	1.0 7Ƶ	1.023Ƶ	GP31 11
2Ƶ 40Ƶ	40-	1.0 7Ƶ	1.023Ƶ	GP32 11
2Ƶ 40Ƶ	40-	1.0 8Ƶ	1.022Ƶ	GP33 12
2Ƶ 40Ƶ	40-	1.0 8Ƶ	1.022Ƶ	GP34 12
2Ƶ 40Ƶ	40-	1.0 8Ƶ	1.022Ƶ	GP35 12

TABLE 4-2 (CONT)

```
  2Z         40-      1.0 8Z                 1.022Z               GP36 12
 40Z
  2Z         40-      1.0 8Z                 1.022Z               GP37 12
 40Z
  2Z         40-      1.0 8Z                 1.022Z               GP38 12
 40Z
  2Z         40-      1.0 8Z                 1.022Z               GP39 12
 40Z
  2Z         40-      1.0 9Z                 1.021Z               GP40 13
 40Z
  2Z         40-      1.0 9Z                 1.021Z               GP41 13
 40Z
  2Z         40-      1.0 9Z                 1.021Z               GP42 13
 40Z
  2Z         40-      1.0 9Z                 1.021Z               GP43 13
 40Z
  2Z         40-      1.010Z                 1.020Z               GP44 14
 40Z
  2Z         40-      1.010Z                 1.020Z               GP45 14
 40Z
  2Z         40-      1.010Z                 1.020Z               GP46 14
 40Z
  2Z         40-      1.011Z                 1.019Z               GP47 15
 40Z
  2Z         40-      1.011Z                 1.019Z               GP48 15
 40Z
  2Z         40-      1.011Z                 1.019Z               GP49 15
 40Z
  2Z         40-      1.012Z                 1.018Z               GP50 16
 40Z
  2Z         40-      1.012Z                 1.018Z               GP51 16
 40Z
  2Z         40-      1.012Z                 1.018Z               GP52 16
 40Z
   T
  3*
   F 1.0
   T
  1*
   .00596423   .01705910   .03946822   .06877039   .09632454   .11411064
   .23139131   .18047802   .15218986   .07861765   .01248627   .00287858
   .0002611939R     0.0
  4U
  0.0         2.0         5.08        6.0         8.0         13.0
```

```
 18.0       23.0       28.0       33.0       38.0       43.0
 48.0       53.0       58.0       64.0       74.0       84.0
 94.0       104.0      114.0      122.0      130.0      134.0
 136.0      137.16     140.0      142.0      144.0      146.05
 147.0      149.0      151.0      153.0      155.0      157.0
 159.0      161.29     162.0      163.0      164.67     166.0
 166.83     168.0      169.0      170.0      171.0      172.0
 173.0      174.0      175.0      176.0      177.0      178.0
 179.0      180.0      181.0      182.0      183.0      184.0
 185.0      186.0      187.0      188.0      189.0      190.0
 191.0      192.0      193.0      194.0      195.0      196.0
 197.0      197.31     197.625    197.94     200.94     203.94
 206.94     209.94     212.94     215.94     218.94     221.94
 224.94     227.94     229.21     230.48
 5*
  F 1.0
 6*
   0.0         .1666667    .3333333    .3333333    .1666667
 7*
   -.9367418   -.8688903   -.3500212   +.3500212   +.8688903
 8$
 2R          123R        2 4R        3 8R        4 3R        5 2R        6
31R          7 2R        810R        9 2R       10
 9$
             3           2          -4           5          -6           7
             8           9         -10          11
22$
16R         -1
23$
             1           2           3           4           5           6
             7           8           9          10          11          12
            13          14          15          16
  T
```

5.0 The APPROPOS Code

In radiation analysis, an efficient technique for preparing multigroup, cross-section data in the required format for discrete ordinate transport computer codes is required. The APPROPOS code provides this needed technique. APPROPOS prepares multigroup, simultaneous, neutron-photon cross section data and neutron reaction cross section data for radiation transport codes. The APPROPOS code processes multigroup, neutron cross section data and multigroup, neutron reaction cross section data (e.g., radiative capture, fission, inelastic scatter, and elastic scatter) to provide spectral-weighted, neutron cross section data in a reduced number of energy groups. These data are then processed with input specified elemental atom densities, gamma ray production data due to neutron reactions, and photon cross section data to provide macroscopic, coupled, neutron-photon cross section data, neutron cross section data, and photon cross section data. Output data from the APPROPOS code are placed on punched cards and/or magnetic tape for use in the ANISN-W, DOT-IIW, or NAGS codes.

5.1 Input Data Description

The input data for the APPROPOS code are divided into the following four sets of data:

1. Overall problem storage allocation, problem descriptive title, and problem size specifications and options;
2. Fine-group to broad-group cross section weighting data;
3. Library data; and
4. Composition data.

All input data for the APPROPOS code are entered in a fixed, FORTRAN format for each card. With the exceptions of the library data, all input data are entered in 6 fields per card where each field contains 12 columns. Integer data must be entered as right adjusted within each field. Floating point data may be written with or without an exponent and with or without a decimal point.

A listing of the input cards for the APPROPOS seminar/workshop problem is given in Table 5-1.

The APPROPOS program user's manual is published as a separate document (WANL-PR(LL)-034, Volume 3). It is assumed that the reader will utilize the APPROPOS user's manual during the description of the input data which follows.

5.1.1 Data Set 1 - Problem Size Specifications and Options

The initial quantity input to the APPROPOS code is MAXCOR, i.e., the maximum number of core locations available for APPROPOS data. On the MSFC UNIVAC-1108, this value is 35000_{10} and is input on the first card of the data deck.

The second input card of Data Set 1 is an appropriate title card.

The third card contains six pieces of input data describing the neutron broad-group (output group) structure:

(1) The total number of neutron broad groups, which is 16 for the MSFC code package. (The energy group structure for the 16 neutron broad groups is defined on Table 5-1, Page 5-4 of WANL-PR(LL)-034, Volume 2.)

(2) The number of fast neutron broad groups which is 11 for the 16 group structure.

(3) The number of neutron broad groups with neutron inelastic scatter gamma ray production data, which is 6 for the MSFC code package.

(4) Number of neutron broad groups with neutron radiative capture gamma ray production data; this value is input as 1 because only one set of capture gamma ray spectra (per element) are available in the library which are assumed to apply for all neutron groups.

(5) Neutron broad-group table length of transport code cross section output data; for the MSFC code package, this value is 13 as follows:

Position	Cross Section
1	σ_a
2	$\nu\sigma_f$
3	σ_t
4	σ_{gg}
5-13	9 downscatter positions (for 16 total broad groups)

In the above table, the absence of upscatter positions is noted. One of the functions performed by the APPROPOS code is to remove upscatter from the cross sections that are input to the DOT-IIW code so that the DOT problem can be run efficiently.

(6) P_l scattering approximations for neutron cross section output data; this value is input as zero which provides for transport corrected output cross sections. (Due to core storage limitations, the DOT-IIW problem, which is subsequently run in this seminar, is too large to permit use of a higher scatter approximation in the cross sections.)

Card 4 of Data Set 1 contains three pieces of data describing the gamma ray output group structure:

(1) The total number of gamma ray groups which is 13; the gamma ray group structure is given in Table 4-3, Page 4-9 of WANL-PR(LL)-034, Volume 2.

(2) Gamma ray table length of transport code cross section output data which is 16 for the MSFC code package as follows:

Position	Cross Section
1	σ_a
2	$\sigma_f = 0.0$
3	σ_t
4	σ_{gg}
5-16	12 downscatters (for 13 total photon groups)

(3) P_l scattering approximations for gamma ray cross section output data; this value is 1 for the seminar/workshop problem, i.e., a P_1 scattering approximation is used in the DOT-IIW problem.

Input card 5 contains six pieces of data to describe the library, composition, element, and weighting spectra specifications:

(1) Number of sets of element data in the gamma ray production library (if NAPL is input as a 0 or 1, i.e., the APPROPOS library data is input as cards rather than tape); the input value is 38, i.e., 38 sets of element data. Table 3-3, Page 3-26 of the APPROPOS user's manual lists these elements.

(2) Number of different elements in the entire problem. This value 16, can be determined by counting the number of different elements in the problem as given in Table 3-3 of Section 3 of this report.

(3) Maximum number of elements that will be entered in any given composition. This value, 10, can be determined from Table 3-3 of Section 3 of this report for Core Region 1.

(4) Total number of compositions in the problem. This value of 22 is the same as the total number of regions presented in Figure 3-1 of Section 3.

(5) Total number of spectra to be used in the spectral weighting of the microscopic fine group spectra. This value is 21 for the seminar/workshop problem. Recall that there were 11 regions in the radial ANISN problem and 10 in the axial problem, or a total of 21. All 21 region spectra are employed in the APPROPOS problem.

(6) Source of the APPROPOS library data. For the workshop problem, NAPL is input as 1, i.e., the library data for the 38 elements is input on cards and is placed behind the reaction rate data on Tape 10.

Input Card 6 contains six pieces of data defining the code logic specifications:

(1) The transport code cross section output data option; this quantity was input as 3 to provide both neutron and gamma ray cross section data, but not the coupled neutron-photon data.

(2) The flux spectra input option, which is input as 5, i.e., that the output fluxes from the two ANISN-W problems are input on Tapes 17 and 18.

(3) The output data option, which is input as zero. This option provides the library and composition data for NAGS, as well as the transport cross sections for DOT-IIW on punched cards.

(4) The output data print option input as zero, i.e., the "short" printout defined on Page 3-9 of the APPROPOS user's manual.

(5) The number of upscatter cross section positions in the final, coupled neutron-photon transport cross section data, which is input as zero for the seminar problem because upscatter was removed as part of the APPROPOS calculation.

(6) The number of downscatter cross section positions in the final, coupled neutron-photon transport cross section data. This value is 28 (number of photon plus neutron groups minus 1, i.e., 13+16 -1) in the workshop problem. (NOTE: Since NOD was input as zero, the coupled set was not printed out.)

5.1.2 Data Set 2 - Cross Section Weighting Data

On input card 7, six pieces of data are entered to define the broadgroup neutron cross section weighting and collapsing specifications:

(1) The number of sets of microscopic, element data to be read from Tape 8 and Tape 10. This quantity is 120 in the seminar problem. Before this quantity can be determined, two data tables should be set up. The first of these is presented in Table 5-2. In Table 5-2, APPROPOS spectra numbers are assigned to each of the ANISN output regions. The ANISN regions are described in Table 5-2; there are eleven regions in the radial problems and ten regions in the axial problem. The APPROPOS spectra numbers were assigned sequentially from 1 to 21 as shown in Table 5-2. The second set of data which should be set up in tabular form is presented in Table 5-3. This table is very similar to Table 3-4 described previously for input to the SATURN code. Two pieces of data are given for each element in each region. The first piece of data is the same as was previously input to the SATURN code, which is the element tape cross section identification number. The second number is the spectra number (from Table 5-2)--this identifies the spectra to be used for weighting the element cross section in each region. With the exception of regions 13 and 17, the assignment of the spectra numbers is self-evident. In regions 13 and 17, spectra No. 10 was used--this spectra is that for the outer reflector regions. It was felt that this spectra is the closest (of these available) representation of the spectra in regions 13 and 17. To determine the value of the input quantity NMC, one simply counts the total number of different combined entries on Table 5-3. An entry should not be counted twice: for example, although element 0149 and spectra 10 were assigned to region 13 and 17, the combination of 0149 and 10 should only be counted once as input.

(2) The total number of fine groups in the microscopic neutron cross section libraries read from Tape 8 and Tape. This value is 52 for the seminar problem.

(3) Number of fast groups in the fine-group neutron cross section libraries, which is 32 for the 52 group set.

(4) Position of Σ_t of Σ_{tr} in the fine-group transport cross section library--this input quantity is 3, as described in Section 3 of this report.

(5) Position of Σ_{gg} in the fine-group transport cross section library data--this input quantity is 23 as described in Section 3 of this report.

(6) The number of table positions in the fine-group transport cross section library data--this quantity in input as -74. The table length of 74 was described previously in Section 3 of this report. The minus sign preceding the input value triggers the upscatter removal option using the fine-group spectra-weighting data.

Input Card 8 contains three pieces of data describing the broad-group data:

(1) Position of Σ_{gg} in the broad-group (i.e., 16 group, with 11 fast and 5 thermal groups) structure before upscatter removal but after group-collapsing. This input quantity is 8 and can be determined as follows:

Position	Cross Section
1	σ_a
2	$\nu\sigma_f$
3	σ_t
4-7	4 upscatter positions (for 5 thermal groups)
8	σ_{gg}
9-17	9 downscatter positions (for 11 fast groups)

(2) Number of table positions in the broad-group structure before upscatter removal but after group-collapsing. This input quantity is 17 as shown in the preceding table.

(3) Transport cross section weighting option. In the seminar problem, the linear weighting option was selected by inputting NRW as zero.

Input Card 9 defines the broad-group (16 group) numbers as a function of fine-group (52 group) numbers. A total of 52 numbers are entered on Card 9. The fine-group to broad-group number correspondence is defined in Table 3-2 on Page 3-23 of the APPROPOS user's manual.

Card 10 describes the identification numbers for the spectra input from Tapes 17 and 18 in the seminar problem, since NLIB was entered as 5 on Card 6. The Tape ID numbers for Tape 17 precede those for Tape 18 and reflect the ANISN-W zones. These input values are entered sequentially from 1 to 21 as previously described in Table 5-2.

Cards 11 and 12 are not required as input to the seminar problem because the spectra are not read into APPROPOS as input cards.

5.1.3 Data Set 3 - Library Data

Card 13 of data set 3 describes the microscopic library tape identification numbers. Card 13 must be repeated for NMC sets of data--in the seminar problem NMC is 120. Four pieces of data are entered on each card 13 input to the problem.

The first number of each card is the identification number of the fine-group microscopic library, neutron transport cross section elemental data input from Tape 8. These ID numbers are listed in Table 5-3 for each element in each region.

The second number input on each Card 13 is the identification number of the corresponding fine group, microscopic library neutron reaction cross section elemental data from Tape 10. For the seminar problem, this ID number is identical to the neutron transport cross section number.

The third number input on each Card 13 identifies the spectrum over which the fine-group data are to be weighted. These spectra ID numbers were previously described in Table 5-3.

The fourth number input in each Card 13 is the P_l scattering approximation of the fine group neutron transport library data. For the seminar problem a minus one is entered which identifies a P_0 transport-corrected cross section set.

Because the fine-group library data tapes are read only once by the program, the identification parameters described above must be entered in the sequential order in which they appear on the tape, i.e., the lowest number is first. Referring to the input data listing given in Table 5-1, it is noted that element 0139 is the lowest numbered and is entered first, followed by 0149, etc. Since element 0139 data is to be weighted over more than one spectra, a separate card is used to describe each spectra weighting. Element 0139 is entered on four different cards since data for this element are to be weighted over spectra numbers 7, 8, 10 and 11.

The data Card 13 is simply set up by following the data presented in Table 5-3 for all regions and elements in the seminar problem.

The one exception to the above tabulation is the element 3839 for the vane region. On Card 13 for element 3839 the corresponding reaction rate data ID number is input as zero because no reaction rate data exists on the input library tape for the vane prescription data.

Card 14 contains a normalization constant for use in energy deposition calculations. This value is 1.603×10^{-13} watt-sec/Mev.

Card 15 provides the GAM identification numbers for each different element in the problem. These ID numbers must be input in order of increasing GAM number. There are 16 entries on Card 15 corresponding to the 16 elements listed in Table 5-3. The GAM ID numbers of all elements in the Master Data Library are given in Table 3-3, Page 3-26 of the APPROPOS user's manual.

Since NAPL was input on Card 5 as a one, Cards 16 through 20 must be supplied for each element in the library. (It should be noted that the element library data read in at this point in the program are an updated improved version of the data available on tape at MSFC. At the time this APPROPOS problem was run, the updated library had not been placed in operation on Tape at MSFC. Future problems can be run at MSFC by inputting these data from tape rather than from the cards used in the seminar problem.)

In Table 5-1, the library data for each element are separated by a solid line to facilitate reading the input data listing.

Five pieces of data are input on Card 16 for each element (or isotope in the library):

(1) The GAM identification number for the element or isotope,

(2) The atomic mass of the element or isotope,

(3) The energy in Mev of the emitted alpha particle in the n, α reaction (input as 0.0 if no reaction exists). This is actually the fourth printed word on each element card. The third printed word on each element card is read-over and is no longer used by the program. The third data word previously described the average energy loss per elastic collision, which is now included as part of the elastic scattering cross section matrix for each element.

(4) The identification number of the element or isotope on the GAMLEG-W photon transport cross section tape (these ID numbers can be obtained from Table 4-1, Page 4-7, WANL-PR(LL)-034, Volume 2).

(5) The element or isotope name.

Card 17 describes the energy (in Mev) emitted for an n, γ reaction. There are thirteen values of Γ(n, γ) entered for each element.

Card 18 describes the energy (in Mev) due to an inelastic gamma ray event (n, n', γ). There are 78 values in this array for the 13 possible gamma ray groups and the 6 allowed fast neutron groups.

Card 19 describes the sixteen values (for each neutron group) of the n, α reaction cross section for each element.

Card 20 describes the thirteen values (for each gamma ray group) of the gamma ray mass energy absorption coefficient (cm^2/gm) for each element.

Data Cards 17 through 20 are clearly marked for the element hydrogen in the APPROPOS data listing in Table 5-1.

Since NLIB was not input as zero, Cards 21 through 24 are not required as input.

Cards 16 through 20 are repeated for each element as clearly marked on the listing in Table 5-1. Data are entered for a total of 38 elements.

Cards 25 through 29 are input directly following the element library data.

Card 25 contains 13 values (one for each gamma ray group entered in order of decreasing energy) describing the prompt gamma ray energy spectrum. (See Table 6-1, Page 6-3, Volume 2 of WANL-PR(LL)-034.)

Card 26 contains 13 values (one for each gamma ray group entered in order of decreasing energy) describing the decay energy spectrum. The library contains data applicable at the end of a 60 minute reactor run. Data for other run times are available from Table 6-2, Page 6-4, Volume 2 of WANL-PR(LL)-034.

Card 27 contains 16 values (one for each neutron group entered in order of decreasing energy) of neutron flux to dose rate conversion factors. The library data yields the dose rate in units of Rem/hour. Other conversion factors are given in Table 6-3, Page 6-5 of Volume 2, WANL-PR(LL)-034.

Card 28 gives the upper lethargy bounds of the 16 neutron energy group structure as defined in Table 5-1, Page 5-4, Volume 2, WANL-PR(LL)-034.

Card 29 contains 13 values (one for each gamma ray group entered in order of decreasing energy) of gamma ray flux to dose rate conversion factors. The library data yields the dose rate in units of R/hour. Other conversion factors are given in Table 6-4, Page 6-6, Volume 2, WANL-PR(LL)-034.

5.1.4 Data Set 4 - Composition Data

Data Cards 30, 31 and 32 are input in Data Set 4 for each composition (or zone) in the problem.

The first four pieces of data on Card 30 describe the left and right mesh boundary line number and the bottom and top mesh boundary line numbers of the region defined in the NAGS problem. These four parameters are used only in the NAGS code to process the data and are not required when running the DOT-IIW or ANISN codes. Since the NAGS problem had not been set-up at the time the APPROPOS problem was run, these four values were input as zero for the seminar problem.

The fifth word input on Card 30 is the identification number of the composition for labeling the output cross section. To obtain a unique cross section output tape ID number for each set, the user should allow for 3*(NPL+1) numbers between each composition when NDD is input as 3, as is the case in the seminar problem. In the seminar problem, the ID number was sequenced in units of 10 for convenience, i.e., 10, 20, 30, etc., up to 220, corresponding to core regions 1, 2, 3, etc., up to the pressure vessel dome.

The last number input on Card 30 is simply the total number of elements (or isotopes) in the composition. This number can be obtained by counting the number given in Table 5-3.

Card 31 contains four pieces of data as follows:

(1) The first word is an indicator; this indicator is entered as a one for all except the last composition. For the last composition a value of 4 is entered.

(2) The second and third words are entered as zeros since these indicators are not yet operational,

(3) A descriptive title for the composition of interest.

Card 32 must be supplied for each element or isotope in the composition. Each Card 32 contains four pieces of data as follows:

(1) The GAM ID number for the element which can be obtained from Table 3-3, Page 3-26 of the APPROPOS user's manual.

(2) The atom density of the element. These data are presented in Table 3-3 of Section 3 of this report.

(3) The identification number of the microscopic library broad-group element on an internal scratch file. These must be input in ascending order from tape and are given in Table 5-2. The number to be entered for carbon for core Region 1 is 061901 when the 0619 is the element library number and 01 refers to the spectrum number.

(4) The P_l neutron scattering approximation. Since a P_0 transport corrected set was used in the seminar problem, this value is entered as a zero.

5.1.5 Problem Setup Information

Section 3.4 of the APPROPOS user's manual describes in detail how to set-up the APPROPOS problem on the MSFC UNIVAC-1108 computer.

5.2 Output Data Description

Computer output from an APPROPOS calculation consists of printed, punched, and tape output data. The following sections briefly describe each type of output data.

5.2.1 Printed Output

The first output data section contains the overall problem parameters in Data Sets 1 and 2. Next are listed the number of cross section sets to be weighted (from each input spectra tape) and the amount of core storage required for this calculation. This is followed by a listing of the correspondence between the neutron fine-group and broad-group structures.

Then follows a listing of the weighting spectra. First the 52 fine-group are listed followed by the collapsed 16 broad-group data for each region in the problem.

Next, the problem title card and the amount of core storage required for the remainder of the calculations is printed. The element identification list for the library is printed, followed by the element identification list for the specified problem.

The library data input on Cards 25 to 29 in Data Set 3 are printed next. These data are followed by a printout of the Master Library data for each element in the problem.

The next section lists the composition parameters input on data Cards 30 to 32 for each composition. The 16 broad-group cross sections for each element in each composition are listed and labeled.

The macroscopic P_0 neutron cross sections are printed, followed by the macroscopic P_0 and P_1 photon cross sections. Notice that the P_1 set is given a number <u>one greater than</u> the P_0 set.

Finally, the output tape is rewound and read to obtain a complete listing of the contents of the transport cross section tape.

5.2.2 Punched Output

Four sets of data are punched on cards by the APPROPOS code. These are:

(1) The 16 fine-group flux spectra for each zone in the ANISN-W calculation,

(2) The 52 broad-group fluxes by mesh interval (defined from the ANISN-W tape data),

(3) Library and composition data for input to the NAGS code, and

(4) Transport cross sections for input to the DOT-IIW and ANISN-W codes.

The fine-group flux spectra are the integral fluxes by zone. These data are punched on cards in a FORTRAN (6E12.5) format. Each flux spectra begins on a new card.

The broad-group fluxes are punched out on cards by mesh interval. Each energy group of data begins on a new card. Again, a (6E12.5) format is used. These data are proceeded by a 3U card (containing a 3 punched in column 2 and a U punched in column 3) and followed by a T card (containing a T in column 3). These data are applicable as flux guess data for the ANISN-W and DOT-IIW codes; their use could save a factor of 1.5 or more in running time in these codes for eigenvalue calculations.

The library data for the NAGS code are punched on cards next. The parameter, NAA and the arrays, GPF, GDF, DOSEG, DOSEN and UGB are punched on cards using a (6E12.5) format, as well. Each array begins on a new card. The code then punches out the arrays, ID, AMU, GNA, and LABEL, on one card as well as the arrays, GI, GA, SE, SNA, and URHO, each beginning on a new card. Again, the (6E12.5) FORTRAN format is used.

The composition data for the NAGS code are also punched out on cards. The composition title is furst output, followed by the parameters, IS, JS, JF, NELE, and IND, in a (613) format, followed by NID (1, n) and ADEN (n) in an (13, E12.5) format. These data are then followed by SF, SA, SE, and SI arrays, where region-dependent data in a broad-group structure are provided. Each of these four arrays begins on a new card and a (6E12.5) format is used.

Finally, if NTRIG = 0, the coupled, the neutron, and/or the photon transport cross sections (depending on NOD) are punched out on cards in a (6E12.5) FORTRAN format.

5.2.3 Tape Output

From the punched card output description given above, it is obvious that thousands of cards could be output from one APPROPOS problem. It is a somewhat tedious job to sort the cards for input to NAGS, DOT-IIW or ANISN-W. Hence, tape output is the recommended procedure.

However, the seminar APPROPOS problem was run on the WANL CDC 6600 and the tape output could not be transmitted to the MSFC UNIVAC-1108 on which the DOT-IIW and NAGS problems were run. Thus, data transfer, in this case, was accomplished via punched card output.

The APPROPOS user's manual describes in detail the tape output data.

TABLE 5-1. INPUT DATA LISTING FOR THE APPROPOS PROBLEM

```
     35000                                                             1
APPROPOS FOR MSFC NSS MODEL USING 52 GROUP ANISN SPECTRA               2
        16        11         6         1        13         0           3
        13        16         1                                         4
        38        16        10        22        21         1           5
         3         5         0         0         0        28           6
       120        52        32         3        23       -74
         8        17         0                                         8
         1         1         1         1         1         2           9
         2         3         4         5         6         6           9
         7         8         8         9         9        10           9
        10        10        10        10        10        10           9
        10        11        11        11        11        11           9
        11        11        12        12        12        12           9
        12        12        12        13        13        13           9
        13        14        14        14        15        15           9
        15        16        16        16                               9
         1         2         3         4         5         6          10
         7         8         9        10        11        12          10
        13        14        15        16        17        18          10
        19        20        21                                        10
      0139      0139         7        -1                              13
      0139      0139         8        -1                              13
      0139      0139        10        -1                              13
      0139      0139        11        -1                              13
      0149      0149        10        -1                              13
      0149      0149        15        -1                              13
      0149      0149        17        -1                              13
      0149      0149        18        -1                              13
      0149      0149        21        -1                              13
      0239      0239         8        -1                              13
      0239      0239        10        -1                              13
      0349      0349        14        -1                              13
      0349      0349        18        -1                              13
      0619      0619         1        -1                              13
      0619      0619         2        -1                              13
      0619      0619        12        -1                              13
      0629      0629         3        -1                              13
      0629      0629         4        -1                              13
      0629      0629         5        -1                              13
      0639      0639         6        -1                              13
      0649      0649        18        -1                              13
      0719      0719         1        -1                              13
```

TABLE 5-1 (CONT)

0719	0719	2	-1	13
0719	0719	12	-1	13
0729	0729	3	-1	13
0729	0729	4	-1	13
0729	0729	5	-1	13
0739	0739	7	-1	13
0739	0739	8	-1	13
0739	0739	10	-1	13
0749	0749	10	-1	13
0749	0749	14	-1	13
0749	0749	15	-1	13
0749	0749	16	-1	13
1819	1819	1	-1	13
1819	1819	2	-1	13
1819	1819	12	-1	13
1829	1829	3	-1	13
1829	1829	4	-1	13
1829	1829	5	-1	13
1839	1839	7	-1	13
1839	1839	8	-1	13
1839	1839	10	-1	13
1849	1849	10	-1	13
1849	1849	14	-1	13
1849	1849	15	-1	13
1849	1849	16	-1	13
1949	1949	19	-1	13
2419	2419	1	-1	13
2419	2419	2	-1	13
2419	2419	12	-1	13
2429	2429	3	-1	13
2429	2429	4	-1	13
2429	2429	5	-1	13
2449	2449	10	-1	13
2449	2449	14	-1	13
2449	2449	15	-1	13
2449	2449	16	-1	13
2619	2619	1	-1	13
2619	2619	2	-1	13
2619	2619	12	-1	13
2629	2629	3	-1	13
2629	2629	4	-1	13
2629	2629	5	-1	13
2639	2639	7	-1	13
2639	2639	8	-1	13

TABLE 5-1 (CONT)

2639	2639	10	-1	13
2649	2649	10	-1	13
2649	2649	14	-1	13
2649	2649	15	-1	13
2649	2649	16	-1	13
3219	3219	1	-1	13
3219	3219	2	-1	13
3229	3229	3	-1	13
3229	3229	4	-1	13
3229	3229	5	-1	13
3319	3319	12	-1	13
3339	3339	7	-1	13
3339	3339	8	-1	13
3339	3339	10	-1	13
3349	3349	10	-1	13
3349	3349	14	-1	13
3349	3349	15	-1	13
3349	3349	18	-1	13
3449	3449	12	-1	13
3519	3519	1	-1	13
3519	3519	2	-1	13
3529	3529	3	-1	13
3529	3529	4	-1	13
3529	3529	5	-1	13
3619	3619	1	-1	13
3619	3619	2	-1	13
3629	3629	3	-1	13
3629	3629	4	-1	13
3629	3629	5	-1	13
3719	3719	1	-1	13
3719	3719	2	-1	13
3729	3729	3	-1	13
3729	3729	4	-1	13
3729	3729	5	-1	13
3839	0	9	-1	13
4019	4019	1	-1	13
4019	4019	2	-1	13
4019	4019	12	-1	13
4029	4029	3	-1	13
4029	4029	4	-1	13
4029	4029	5	-1	13
4039	4039	6	-1	13
4039	4039	7	-1	13
4039	4039	8	-1	13

TABLE 5-1 (CONT)

4039	4039	10	-1			13
4039	4039	11	-1			13
4049	4049	10	-1			13
4049	4049	14	-1			13
4049	4049	15	-1			13
4049	4049	16	-1			13
4049	4049	17	-1			13
4049	4049	18	-1			13
4049	4049	19	-1			13
4049	4049	20	-1			13
1.603-13						14
1	3	4	5	10	12	15
25	27	28	29	31	44	15
126	128	129	301			15

								Note
1	1.00797	5.0000E-01	0.		1	HYDROGEN		
0.0	0.0	0.0	0.0	0.0	0.0	0.0		Γ(N,γ)
2.223E+00	0.0	0.0	0.0	0.0	0.0			
0.	0.	0.	0.	0.	0.	0.		Γ(N,N';γ)
0.	0.	0.	0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.	0.		
0.								
0.	0.	0.	0.	0.	0.	0.		σ(N,α)
0.	0.	0.	0.	0.	0.	0.		
0.	0.							
.02566	.02670	.02836	.03065	.03393	.03784	.04122		μ/ρ
.04373	.04658	.05025	.05435	.06371	.10600			
3	9.0122	0.1798	0.		4	BERYLLIUM		
0.0	0.0	4.283E+00	1.200E-01	0.0	1.568E+00	0.0		
6.26 E-01	0.0	0.0	0.0	2.17 E-01	0.0			
0.	0.	0.	0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.	0.		

TABLE 5-1 (CONT)

```
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.
0.7767E-010.1002E 000.4531E-020.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.
 .01287    .01323    .01383    .01468    .01592    .01744    .01877
 .01978    .02097    .02253    .02432    .02850    .04740
   4  10.8110     0.154997   2.3110E 00            5         BORNAT
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.4780E 000.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.
5.31801-027.70081-026.19582-021.19102-012.76948-016.39794-011.30540+00
2.85791+008.14680+002.26453+015.54816+011.33639+022.73085+024.12887+02
6.34215+021.14195+03
 .01387    .01421    .01478    .01561    .01683    .01833    .01966
 .02068    .02188    .02347    .02533    .02967    .04936
   5  12.01115    0.141901   0.                    6         CARBON
 0.0       0.0       0.0       0.0       3.376E+00 1.193E+00 0.0
 0.0       0.0       0.0       3.75 E-01 0.0       0.0
 0.        0.        0.        0.        4.284E+00 0.        0.
 0.        0.        0.        0.        0.        0.        0.
 0.        0.        0.        0.        0.        0.        0.
 0.        0.        0.        0.        0.        0.        0.
 0.        0.        0.        0.        0.        0.        0.
 0.        0.        0.        0.        0.        0.        0.
 0.        0.        0.        0.        0.        0.        0.
 0.        0.        0.        0.        0.        0.        0.
 0.        0.        0.        0.        0.        0.        0.
 0.        0.        0.        0.        0.        0.        0.
 0.        0.        0.        0.        0.        0.        0.
```

TABLE 5-1 (CONT)

```
 0.
0.         0.         0.         0.         0.         0.         0.
0.         0.         0.         0.         0.         0.         0.
0.         0.
 .01552     .01585     .01642     .01725     .01848     .02002     .02134
 .02243     .02371     .02539     .02739     .03208     .05337
  10  235.0439     0.008438    0.                    49         U-235
 4.8      -4 3.5      -4 1.89     -2 7.02     -2 2.13     -1 5.06     -1 3.25     -1
 4.71     -1 6.04     -1 8.57     -1 1.108       1.71       7.25      -1
 0.         0.         0.         0.         1.486E-03 1.710E-02 4.296E-02
 1.162E-01 2.664E-01 6.172E-01 1.021E+00 1.169E+00 2.838E-01 0.
 0.         0.         0.         0.         0.         2.380E-04 3.681E-03
 2.880E-02 1.661E-01 4.762E-01 8.052E-01 2.598E-01 0.         0.
 0.         0.         0.         0.         0.         0.         0.
 1.987E-02 1.668E-01 5.009E-01 2.164E-01 0.         0.         0.
 0.         0.         0.         0.         0.         0.         0.
 2.461E-02 1.855E-01 2.000E-01 0.         0.         0.         0.
 0.         0.         0.         0.         0.         0.         0.
 9.486E-02 1.680E-01 0.         0.         0.         0.         0.
 0.         0.         0.         0.         0.         0.         9.474E-02
 1.678E-01
0.         0.         0.         0.         0.         0.         0.
0.         0.         0.         0.         0.         0.         0.
0.         0.
 .04279     .04156     .03994     .03804     .03570     .03351     .03232
 .03196     .03192     .03465     .04395     .1078      .4427
  12  238.0508     0.008332    0.                    49         U-238
0.         0.         0.         0.         0.1120E 000.4500E 000.1040E 00
0.2990E 000.6340E 000.7160E 000.6190E 000.1069E 010.6260E 00
 0.         0.         6.255E-03 1.418E-01 5.949E-01 3.746E-01 1.382E-01
 1.539E-01 1.704E-01 2.079E-01 2.040E-01 2.537E-01 1.975E-01 0.
 0.         0.         0.         0.         0.         1.469E-03 1.316E-02
 4.084E-02 1.045E-01 1.705E-01 2.787E-01 2.193E-01 0.         0.
 0.         0.         0.         0.         0.         0.         0.
 4.675E-03 5.353E-02 2.406E-01 1.936E-01 0.         0.         0.
 0.         0.         0.         0.         0.         0.         0.
 2.441E-03 1.220E-01 2.032E-01 0.         0.         0.         0.
 0.         0.         0.         0.         0.         0.         0.
 1.635E-02 2.895E-02 0.         0.         0.         0.         0.
 0.         0.         0.         0.         0.         0.         0.
 0.
0.         0.         0.         0.         0.         0.         0.
0.         0.         0.         0.         0.         0.         0.
0.         0.
```

TABLE 5-1 (CONT)

.04279	.04156	.03994	.03804	.03570	.03351	.03232	
.03196	.03192	.03465	.04395	.1078	.4427		
22 14.0067		0.124393	0.0	0	7	NITROGEN	
2.117	0.693	1.232	3.841	0.707	0.954	0.0	N
0.339	0.726	0.1	0.0	0.085	0.037		N
1.214E-01	5.272E-02	5.070E-01	7.673E-01	8.402E-01	1.838E-01	8.512E-02	
3.477E+00	2.419E+00	4.680E-01	7.392E-04	1.126E-04	2.771E-05	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.01603	.01633	.01686	.01763	.01877	.02020	.02150	N
.02252	.02376	.02541	.02739	.03208	.05340		N
23 15.9994		0.110731	0.		8	OXYGEN	
5.854E-03	3.563E-01	4.226E 00	0.0	0.0	0.0	2.441E-02	
0.0	6.448E-04	1.930E-03	8.34 E-07	0.0	0.0		
1.072E-03	1.238E-01	5.281E+00	0.	0.	0.	4.960E-03	
0.	9.655E-04	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.01656	.01683	.01730	.01800	.01907	.02042	.02165	
.02262	.02383	.02545	.02742	.03211	.05348		
24 24.312		0.075892	0.0		10	MAGNESIUM	
0.565	0.166	0.739	0.587	0.294	3.494	1.49	MG

TABLE 5-1 (CONT)

0.081	0.908	0.335	0.147	0.247	0.042		MG
0.	0.	0.	3.913E-04	1.548E-01	2.988E-02	1.122E-01	
3.395E-05	1.058E-01	1.015E+00	1.975E-02	8.849E-03	2.209E-03	0.	
0.	0.	0.	0.	0.	0.	0.	
2.282E-01	2.369E+00	6.863E-02	7.189E-02	2.141E-02	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	3.786E-01	5.745E-01	6.156E-02	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	MG
0.0	0.0	0.0	0.0	0.0	0.0	0.0	MG
0.0	0.0						MG
.01836	.01849	.01878	.01921	.01994	.02093	.02187	
.02266	.02372	.02518	.02707	.03173	.05312		
25 26.9815		0.068921	0.		11	ALUMINUM	
2.601	0.239	0.685	0.447	1.686	0.946	0.425	AL
0.27	0.173	0.112	0.055	0.049	0.039		AL
4.012E-03	3.241E-03	2.351E-02	7.183E-02	1.662E-01	2.179E-01	2.187E-01	
5.267E-01	4.435E-01	3.643E-01	3.211E-01	6.637E-02	1.632E-02	0.	
0.	0.	0.	0.	0.	0.	1.286E-01	
8.506E-02	2.814E-01	5.460E-01	8.795E-02	2.164E-02	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
1.576E-01	3.594E-01	1.924E-01	4.734E-02	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.							
0.1572E-010.		0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.01843	.01852	.01874	.01912	.01974	.02062	.02148	
.02222	.02321	.02461	.02644	.03102	.05204		
26 28.086		0.066398	0.0	0	12	SILICON	
0.174	0.511	0.879	0.233	3.166	2.952	0.048	SI
0.142	0.516	0.0	0.032	0.025	0.02		SI
0.	9.046E-03	2.095E-02	2.777E-02	3.258E-02	6.725E-02	6.561E-02	
1.483E-01	7.206E-01	8.383E-01	7.162E-03	3.889E-03	9.568E-04	0.	
0.	0.	0.	0.	0.	0.	8.184E-02	

C.3

TABLE 5-1 (CONT)

7.233E-01	9.019E-01	4.477E-02	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.01958	.01964	.01983	.02014	.02071	.02152	.02234	SI
.02307	.02406	.02546	.02735	.03211	.05401		SI
27	51.996	0.037027	0.		19	CHROMI	
4.893	0.977	0.877	0.708	0.216	0.363	0.095	CR
0.456	0.149	0.173	0.011	0.358	0.0		CR
5.418E-02	1.339E-02	7.656E-02	1.155E-01	3.100E-01	3.284E-01	1.100E-01	
8.639E-02	1.205E-01	3.234E-01	4.833E-01	2.764E-01	1.164E-01	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.02285	.02258	.02233	.02205	.02182	.02175	.02191	
.02222	.02285	.02388	.02558	.03054	.05485		
28	54.938	0.035115	0.		20	MANGAN	
0.0	2.724	0.712	1.666	0.792	0.543	0.122	MN
0.264	0.294	0.094	0.007	0.013	0.038		MN
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	

TABLE 5-1 (CONT)

0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.02297	.02269	.02242	.02209	.02178	.02165	.02175	
.02202	.02261	.02361	.02528	.03029	.05503		
29 55.847		0.034564	0.		21	IRON	
4.093	0.521	0.912	0.709	0.518	0.433	0.134	FE
0.079	0.052	0.191	0.066	0.087	0.052		FE
6.630E-03	3.489E-03	1.683E-02	6.865E-02	1.026E-01	5.815E-01	4.406E-01	
3.777E-01	4.102E-01	4.569E-01	4.084E-01	3.030E-01	7.454E-02	0.	
0.	0.	0.	0.	0.	7.121E-04	6.104E-04	
3.402E-02	6.296E-02	2.522E-01	2.648E-01	6.515E-02	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	2.387E-01	2.719E-01	6.688E-02	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.02398	.02366	.02333	.02294	.02254	.02233	.02239	
.02263	.02320	.02419	.02591	.03117	.05727		
30 58.9332		.034	0.		22	COBALT	
0.0	0.984	2.359	2.029	0.661	0.275	0.0216	CO
0.0	0.194	0.236	0.195	0.339	0.196		CO
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	

TABLE 5-1 (CONT)

0.							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.02394	.02362	.02328	.02288	.02246	.02217	.02216	
.02236	.02289	.02385	.02554	.03085	.05748		
31 58.710		0.032935	0.		23	NICKEL	
6.264	0.012	1.142	0.421	0.171	0.128	0.071	NI
0.052	0.089	0.012	0.036	0.107	0.024		NI
2.580E-03	1.418E-03	1.697E-02	5.161E-02	1.308E-01	2.283E-01	1.384E-01	
1.483E-01	1.380E-01	1.332E+00	3.864E-01	2.285E-01	7.639E-02	0.	
0.	0.	0.	0.	0.	0.	1.603E-03	
1.153E-02	1.247E+00	2.927E-01	1.037E-02	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.02546	.02507	.02464	.02417	.02368	.02330	.02323	
.02340	.02393	.02480	.02667	.03236	.06108		
32 63.54		0.030509	0.0		24	COPPER	
3.881	1.103	1.067	0.543	0.40	0.221	0.063	CU
0.047	0.038	0.040	0.031	0.158	0.157		CU
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.0							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						

TABLE 5-1 (CONT)

.02484	.02444	.02400	.02348	.02292	.02249	.02237	
.02249	.02297	.02388	.02559	.03119	.05872		
44 91.22		0.021453	0.0		27	ZIRCONIUM	
0.139	0.053	1.335	0.791	1.062	1.556	0.705	ZR
0.677	0.936	0.514	0.457	0.092	0.056		ZR
0.	0.	2.340E-02	1.177E-01	2.921E-01	5.190E-01	2.330E-01	
3.565E-01	3.443E-01	3.178E-01	2.481E-01	1.593E-01	3.919E-02	0.	
0.	0.	0.	0.	0.	0.	1.829E-01	
2.076E-01	2.719E-01	3.398E-01	2.181E-01	5.366E-02	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
1.435E-01	3.398E-01	2.181E-01	5.366E-02	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.02864	.02801	.02724	.02629	.02505	.02383	.02314	
.02293	.02308	.02374	.02563	.03402	.08001		
51 95.94		0.020419	0.0		29	MOLYBDENUM	
0.203	0.098	0.702	0.859	1.241	1.603	0.847	MO
0.803	0.828	0.716	0.263	0.569	0.018		
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.0							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.02952	.02879	.02787	.02680	.02550	.02419	.02342	
.02317	.02328	.02391	.02585	.03503	.08582		
69 107.87		0.018202	-0.		30	SILVER	
0.05	0.131	0.39	1.086	1.168	1.524	0.8	

TABLE 5-1 (CONT)

0.815	0.616	0.152	0.031	0.047	0.099		
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.03136	.03057	.02956	.02840	.02678	.02513	.02417	
.02379	.02379	.02438	.02661	.03816	.1036		
70	114.82	0.017120	-0.		32	INDIUM	
0.0	0.0	8.904E-02	8.727E-01	8.679E-01	4.400E-01	1.167E-01	
1.286E-01	1.283E+00	3.279E-01	1.874E+00	5.049E-01	2.205E-01		
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.03149	.03069	.02969	.02846	.02677	.02505	.02403	
.02362	.02357	.02415	.02645	.03889	.1095		
71	112.40	0.017481	-0.		31	CADMIUM	
0.208	0.069	0.358	1.313	1.333	1.914	1.121	CD
0.968	0.518	0.454	0.068	0.661	0.055		CD
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	

TABLE 5-1 (CONT)

0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.03117	.03037	.02935	.02814	.02649	.02482	.02384	
.02345	.02343	.02402	.02627	.03812	.1055		
119	157.25	0.012559	0.0		37	GADOLI	
0.036	0.03	0.373	0.672	1.018	1.782	1.087	GD
1.032	0.674	0.425	0.741	0.134	0.015		GD
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.03562	.03457	.03320	.03154	.02938	.02720	.02586	
.02525	.02499	.02578	.02945	.05292	.1872		
126	207.19	0.009561	0.0		45	LEAD	
0.0	6.930E+00	3.39 E-01	0.0	0.0	0.0	0.0	
0.0	0.0	0.0	0.0	0.0	0.0		
0.	6.922E-03	5.097E-02	3.921E-02	2.768E-01	3.291E-01	7.357E-01	
2.032E-01	1.473E-01	2.177E-01	2.221E-01	3.534E-01	4.036E-03	0.	
0.	0.	0.	0.	0.	6.554E-02	1.492E-02	
3.536E-02	6.559E-02	2.412E-01	6.000E-01	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	1.381E-01	4.070E-01	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	

TABLE 5-1 (CONT)

0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.04056	.03940	.03790	.03604	.03357	.03117	.02978	
.02921	.02896	.03054	.03753	.08373	.3361		
127 92.906		0.021071	0.		28	NIOBIUM	
.047	.120	.318	1.188	1.232	1.482	.672	
.699	.697	.400	.144	.093	.120		
0.	0.	0.	0.	0.	0.	0.	
0.	0.1920E 010.		0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.1920E 010.		0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.1080E 010.		0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.7410E 000.		0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.02929	.02862	.02781	.02676	.02545	.02419	.02345	
.02321	.02334	.024	.02594	.03436	.08336		
128 4.7900E 01		0.040063	0.		17	TITANIUM	
0.015	0.022	5.641	0.133	0.539	0.431	0.077	TI
0.049	0.094	1.131	0.031	0.013	0.092		TI
1.214E-02	1.001E-02	3.862E-02	1.480E-01	3.314E-01	3.785E-01	1.004E-01	
4.720E-02	3.703E-02	3.210E-01	9.925E-01	3.751E-03	3.491E-04	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	5.768E-02	1.051E+00	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	1.169E+00	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	

TABLE 5-1 (CONT)

0.							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.02176	.02157	.02142	.02127	.02120	.02129	.02156	
.02194	.02263	.02371	.02539	.03013	.05310		
129	180.948	0.010932	0.0		41	TANTAL	
0.027	0.025	0.074	0.34	0.903	1.413	0.808	TA
0.872	0.829	0.476	0.119	0.139	0.04		TA
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.03835	.03722	.03576	.03394	.03156	.02918	.02775	
.02712	.02682	.02793	.03302	.06676	.2580		
130	6.01512	0.244458	4.784		3	LI-6	
0.	2.541	1.966	0.	1.670	0.	0.940	LI6 NG 1
0.	0.	0.	0.	0.139	0.		LI6 NG 2
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	

0.0
1.114 -01 2.148 -01 2.850 -01 5.459 -01 1.588 +00 8.275 -01 1.545 +00 LI-6
3.528 +00 9.187 +00 2.569 +01 7.017 +01 1.600 +02 3.310 +02 5.015 +02
7.342 +02 1.408 +03

TABLE 5-1 (CONT)

```
 .01208    .01247    .01311    .01399    .01527    .01682    .01818
 .01920    .02038    .02193    .02369    .02776    .04617
 131  7.01600      0.132374   0.0                  3         LI-7
 0.        0.        0.        0.        0.        0.        0.        LI7 NG 1
 0.        1.616     0.        0.404     0.        0.                  LI7 NG 2
 .195     0.        0.        0.        0.        0.        0.        5C1 LI7
 0.       0.        0.        2.7       4.35      0.        .195      5C2 LI7
 0.       0.        0.        0.        0.        0.        0.        5C3 LI7
 0.       0.        2.7       4.35      0.        .195      0.        5C4 LI7
 0.       0.        0.        0.        0.        0.        0.        5C5 LI7
 0.       2.7       4.35      0.        .487      0.        0.        5C6 LI7
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
 0.0
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
 0.0       0.0
 .01208    .01247    .01311    .01399    .01527    .01682    .01818
 .01920    .02038    .02193    .02369    .02776    .04617
 133  10.01294     0.165115   2.3110E 00           5         BOR-10
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.4780E 000.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.        0.        0.        0.        0.        0.        0.
0.
0.2513E 000.2994E 000.2013E 000.5353E 000.2109E 010.5504E 010.7509E 01
0.1083E 020.2483E 020.9314E 020.2759E 030.4968E 030.6411E 030.9175E 03
0.1738E 040.5071E 04
 .01387    .01421    .01478    .01561    .01683    .01833    .01966
 .02068    .02188    .02347    .02533    .02967    .04936
 134  181.9483     0.010873   0.0                  42        W-182
 0.586     0.586     0.586     0.586     0.586     0.586     0.586     TU182
```

0.893	0.537	0.404	0.23	0.021	0.0		TU182
0.	0.	0.	3.464E-02	1.040E-01	3.214E-01	1.467E-01	
4.293E-01	7.691E-01	1.037E+00	1.337E+00	6.224E-01	4.743E-02	0.	
0.	0.	0.	0.	0.	0.	2.135E-02	
2.177E-01	4.182E-01	8.053E-01	4.182E-01	5.846E-02	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
1.145E-02	1.701E-01	2.254E-01	1.071E-01	0.	0.	0.	
0.	0.	0.	0.	0.	0.	1.077E-03	
1.601E-02	1.988E-01	1.328E-01	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
1.886E-01	1.303E-01	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.03866	.03752	.03603	.03421	.03182	.02943	.02799	
.02735	.02704	.02817	.03342	.06844	.2656		
135	182.9503	0.010814	0.0		42	W-183A	
0.506	0.506	0.506	0.506	0.506	0.506	0.506	TU183
1.66	0.999	0.752	0.426	0.039	0.0		TU183
0.	0.	0.	3.464E-02	1.040E-01	3.214E-01	1.467E-01	
4.293E-01	7.691E-01	1.037E+00	1.337E+00	6.224E-01	4.743E-02	0.	
0.	0.	0.	0.	0.	0.	2.135E-02	
2.177E-01	4.182E-01	8.053E-01	4.182E-01	5.846E-02	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
1.145E-02	1.701E-01	2.254E-01	1.071E-01	0.	0.	0.	
0.	0.	0.	0.	0.	0.	1.077E-03	
1.601E-02	1.988E-01	1.328E-01	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
1.886E-01	1.303E-01	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.03866	.03752	.03603	.03421	.03182	.02943	.02799	
.02735	.02704	.02817	.03342	.06844	.2656		
136	182.9503	0.010814	0.0		42	W-183B	
0.506	0.506	0.506	0.506	0.506	0.506	0.506	TU183
1.66	0.999	0.752	0.426	0.039	0.0		TU183
0.	0.	0.	3.464E-02	1.040E-01	3.214E-01	1.467E-01	
4.293E-01	7.691E-01	1.037E+00	1.337E+00	6.224E-01	4.743E-02	0.	
0.	0.	0.	0.	0.	0.	2.135E-02	

TABLE 5-1 (CONT)

2.177E-01	4.182E-01	8.053E-01	4.182E-01	5.846E-02	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
1.145E-02	1.701E-01	2.254E-01	1.071E-01	0.	0.	0.	
0.	0.	0.	0.	0.	0.	1.077E-03	
1.601E-02	1.988E-01	1.328E-01	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
1.886E-01	1.303E-01	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.03866	.03752	.03603	.03421	.03182	.02943	.02799	
.02735	.02704	.02817	.03342	.06844	.2656		
137	183.9510	0.010755	0.0		42	W184	
0.412	0.412	0.412	0.412	0.412	0.412	0.412	TU184
1.226	0.738	0.556	0.317	0.029	0.0		TU184
0.	0.	0.	3.464E-02	1.040E-01	3.214E-01	1.467E-01	
4.293E-01	7.691E-01	1.037E+00	1.337E+00	6.224E-01	4.743E-02	0.	
0.	0.	0.	0.	0.	0.	2.135E-02	
2.177E-01	4.182E-01	8.053E-01	4.182E-01	5.846E-02	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
1.145E-02	1.701E-01	2.254E-01	1.071E-01	0.	0.	0.	
0.	0.	0.	0.	0.	0.	1.077E-03	
1.601E-02	1.988E-01	1.328E-01	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
1.886E-01	1.303E-01	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.03866	.03752	.03603	.03421	.03182	.02943	.02799	
.02735	.02704	.02817	.03342	.06844	.2656		
138	185.9544	0.010641	0.0		42	W-186	
0.417	0.417	0.417	0.417	0.417	0.417	0.417	TU186
1.088	0.655	0.491	0.281	0.026	0.0		TU186
0.	0.	0.	3.464E-02	1.040E-01	3.214E-01	1.467E-01	
4.293E-01	7.691E-01	1.037E+00	1.337E+00	6.224E-01	4.743E-02	0.	
0.	0.	0.	0.	0.	0.	2.135E-02	
2.177E-01	4.182E-01	8.053E-01	4.182E-01	5.846E-02	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
1.145E-02	1.701E-01	2.254E-01	1.071E-01	0.	0.	0.	
0.	0.	0.	0.	0.	0.	1.077E-03	

TABLE 5-1 (CONT)

1.601E-02	1.988E-01	1.328E-01	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
1.886E-01	1.303E-01	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.03866	.03752	.03603	.03421	.03182	.02943	.02799	
.02735	.02704	.02817	.03342	.06844	.2656		
139	32.064	0.058659	0.0	0	14	SULFUR	
0.502	0.119	0.0544	3.449	0.845	1.077	0.694	
1.144	0.0608	0.0442	0.00374	0.504	0.0		
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.							
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.						
.02060	.02059	.02072	.02092	.02131	.02194	.02262	S
.02326	.02420	.02555	.02741	.03222	.05461		S
300	6.9390	0.220189	4.784		3	LITHIUM	
0.	0.1885	0.1458	0.	0.1239	0.	0.0697	LI NG 1
0.	1.496	0.	0.374	0.0103	0.	7	LI NG 2
.195	0.	0.	0.	0.	0.	0.	
0.	0.	0.	2.7	4.35	0.	.195	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	2.7	4.35	0.	.195	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	2.7	4.35	0.	.487	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	

TABLE 5-1 (CONT)

```
0.0
8.265   -3 1.593   -2 2.114   -2 4.050   -2 1.178   -1 6.140   -2 1.146   -1
2.617   -1 6.816   -1 1.906      5.206      1.187   +1 2.456   +1 3.721   +1
5.447   +1 1.044   +2
.01208     .01247     .01311     .01399     .01526     .01682     .01817         LI
.01919     .02038     .02192     .02368     .02775     .04616                    LI
301  183.85      0.010761   0.0                       42          TUNGSTEN
0.04       0.089      0.608      0.721      0.858      1.178      0.636       TU
0.69       0.538      0.221      0.06       0.083      0.027                  TU
0.         0.         0.         3.464E-02 1.040E-01 3.214E-01 1.467E-01
4.293E-01 7.691E-01 1.037E+00 1.337E+00 6.224E-01 4.743E-02 0.
0.         0.         0.         0.         0.         0.         2.135E-02
2.177E-01 4.182E-01 8.053E-01 4.182E-01 5.846E-02 0.         0.
0.         0.         0.         0.         0.         0.         0.
1.145E-02 1.701E-01 2.254E-01 1.071E-01 0.         0.         0.
0.         0.         0.         0.         0.         0.         1.077E-03
1.601E-02 1.988E-01 1.328E-01 0.         0.         0.         0.
0.         0.         0.         0.         0.         0.         0.
1.886E-01 1.303E-01 0.         0.         0.         0.         0.
0.         0.         0.         0.         0.         0.         0.
0.
0.         0.         0.         0.         0.         0.         0.
0.         0.         0.         0.         0.         0.         0.
0.         0.
.03866     .03752     .03602     .03421     .03181     .02943     .02799         W
.02735     .02704     .02817     .03342     .06844     .2656                     W
0.3000E-020.1500E-010.4000E-010.1110E 000.2520E 000.5590E 000.3630E 00   PROMPT
0.5030E 000.7080E 000.9470E 000.1389E 010.2053E 010.1235E 01              PROMPT
0.         0.         0.         0.0427     0.2302     0.587      0.369        60M
0.500      0.587      0.851      1.009      1.152      0.267                    60M
   1.200-4    1.050-4    8.800-5    6.350-5    3.250-5    1.030-5    1.150-6  N REM/HR
   1.730-7    2.100-8    9.000-9    1.900-8    5.620-8    1.000-7    1.000-7  N REM/HR
   1.000-7    1.000-7                                                         N REM/HR
0.0        1.25       2.0        2.5        3.25       4.5        6.5
7.5        9.75       11.75      13.75       15.5       17.3       18.2
18.9       20.0
   1.063-6    1.083-6    1.116-6    1.166-6    1.240-6    1.332-6    1.417-6  G  R/HR
   1.504-6    1.564-6    1.673-6    1.803-6    2.112-6    3.516-6             G  R/HR
           0          0          0          0         10         10
           1          0          0    CORE REGION 1 - SPECTRUM 1 RADIAL
           5   0.04461        061901          0
          27   0.0001418      071901          0
          29   0.0004805      181901          0
          28   0.0000137      241901          0
```

TABLE 5-1 (CONT)

31	0.0002039	261901	0		
129	0.00001	321901	0		
10	0.0007942	351901	0		
12	0.00005767	361901	0		
44	0.007325	371901	0		
1	0.000342	401901	0		
0	0	0	0	20	10
1	0	0	CORE REGION 2 - SPECTRUM 2 RADIAL		
5	0.04474	061902	0		
27	0.0001542	071902	0		
29	0.0005226	181902	0		
28	0.0000149	241902	0		
31	0.0002218	261902	0		
129	0.00001	321902	0		
10	0.000992	351902	0		
12	0.00007203	361902	0		
44	0.007311	371902	0		
1	0.000342	401902	0		
0	0	0	0	30	10
1	0	0	CORE REGION 3 - SPECTRUM 3 RADIAL		
5	0.04468	062903	0		
27	0.0001495	072903	0		
29	0.0005066	182903	0		
28	0.0000144	242903	0		
31	0.000215	262903	0		
129	0.00001	322903	0		
10	0.001065	352903	0		
12	0.00007731	362903	0		
44	0.007314	372903	0		
1	0.000342	402903	0		
0	0	0	0	40	10
1	0	0	CORE REGION 4 - SPECTRUM 4 RADIAL		
5	0.04488	062904	0		
27	0.000171	072904	0		
29	0.0005791	182904	0		
28	0.0000165	242904	0		
31	0.0002458	262904	0		
129	0.00001	322904	0		
10	0.001026	352904	0		
12	0.00007447	362904	0		
44	0.007283	372904	0		
1	0.000342	402904	0		
0	0	0	0	50	10
1	0	0	CORE REGION 5 - SPECTRUM 5 RADIAL		

TABLE 5-1 (CONT)

5	0.04542	062905	0		
27	0.0002238	072905	0		
29	0.0007584	182905	0		
28	0.0000216	242905	0		
31	0.0003219	262905	0		
129	0.00001	322905	0		
10	0.0007736	352905	0		
12	0.00005618	362905	0		
44	0.007217	372905	0		
1	0.000342	402905	0		
0	0	0	0	60	2
1	0	0	FILLER STRIP - SPECTRUM 6		RADIAL
5	0.05578	063906	0		
1	0.0000285	403906	0		
0	0	0	0	70	6
1	0	0	STRUCTURE - SPECTRUM 7		RADIAL
25	0.05842	013907	0		
27	0.0003446	073907	0		
29	0.00117	183907	0		
31	0.0005278	263907	0		
128	0.00005322	333907	0		
1	0.000299	403907	0		
0	0	0	0	80	7
1	0	0	BE INNER REFL.-SPECTRUM 8		RADIAL
25	0.004998	013908	0		
3	0.07969	023908	0		
27	0.0001862	073908	0		
29	0.000632	183908	0		
31	0.0002851	263908	0		
128	0.00002875	333908	0		
1	0.00151	403908	0		
0	0	0	0	90	1
1	0	0	VANE - SPECTRUM 9		RADIAL
0	1.0	383909	0		
0	0	0	0	100	7
1	0	0	BE OUTER REFL.-SPECTRUM 10		RADIAL
25	0.005312	013910	0		
3	0.08085	023910	0		
27	0.000574	073910	0		
29	0.001949	183910	0		
31	0.0008791	263910	0		
128	0.00008864	333910	0		
1	0.00151	403910	0		
0	0	0	0	110	2

TABLE 5-1 (CONT)

```
  1            0           0   PRESS.VESS.SIDE-SPECTRUM 11RADIAL
 25  0.0502           013911          0
  1   0.00158         403911          0
  0            0           0          0        120          8
  1            0           0   CHESH- SPECTRUM 12         AXIAL
  5  0.00647          061912          0
 27  0.000860         071912          0
 29  0.00298          181912          0
 28  0.0000829        241912          0
 31  0.00128          261912          0
128  0.000126         331912          0
301  0.00765          344912          0
  1   0.000955        401912          0
  0            0           0          0        130          7
  1            0           0   AFT PLENUM- SPECTRUM 10    RADIAL
 25  0.0229           014910          0
 27  0.000409         074910          0
 29  0.00288          184910          0
 28  0.000363         244910          0
 31  0.000596         264910          0
128  0.0000601        334910          0
  1   0.00587         403910          0
  0            0           0          0        140          7
  1            0           0   CORE PLENUM - SPECTRUM 14   AXIAL
  4  0.000252         034914          0
 27  0.00261          074914          0
 29  0.00904          184914          0
 28  0.000262         244914          0
 31  0.00157          264914          0
128  0.00621          334914          0
  1   0.00334         404914          0
  0            0           0          0        150          7
  1            0           0   SUPPORT PLATE - SPECTRUM 15  AXIAL
 25  0.03147          014915          0
 27  0.00162          074915          0
 29  0.00554          184915          0
 28  0.00161          244915          0
 31  0.000813         264915          0
128  0.0000126        334915          0
  1   0.00561         404915          0
  0            0           0          0        160          5
  1            0           0   SHIELD PLENUM - SPECTRUM 16 AXIAL
 27  0.00207          074916          0
 29  0.00708          184916          0
```

TABLE 5-1 (CONT)

28	0.000208	244916	0		
31	0.000934	264916	0		
1	0.00501	404916	0		
0	0	0	0	170	7
1	0	0	DRUM DRIVE -	SPECTRUM 10RADIAL	
25	0.00368	014910	0		
27	0.000624	074910	0		
29	0.00244	184910	0		
28	0.000127	244910	0		
31	0.000534	264910	0		
128	0.0000377	334910	0		
1	0.00579	404910	0		
0	0	0	0	180	2
1	0	0	SHIELD PLATE - SPECTRUM 17 AXIAL		
25	0.0507	014917	0		
1	0.000657	404917	0		
0	0	0	0	190	5
1	0	0	BATH SHIELD - SPECTRUM 18 AXIAL		
25	0.0369	014918	0		
4	0.00568	034918	0		
5	0.00142	064918	0		
128	0.00992	334918	0		
1	0.0182	404918	0		
0	0	0	0	200	2
1	0	0	LEAD SHIELD - SPECTRUM 19 AXIAL		
126	0.0275	194919	0		
1	0.000657	404919	0		
0	0	0	0	210	1
1	0	0	DOME PLENUM - SPECTRUM 20 AXIAL		
1	0.00776	404920	0		
0	0	0	0	220	1
4	0	0	PRESS.VESS.DOME - SPEC 21 AXIAL		
25	0.0610	014921	0		

TABLE 5-2

ASSIGNMENT OF APPROPOS SPECTRA NUMBERS

APPROPOS Spectra Number	ANISN Problem Description		
	Region Number	Geometry	Description
1	1	Radial	Core Region 1
2	2	Radial	Core Region 2
3	3	Radial	Core Region 3
4	4	Radial	Core Region 4
5	5	Radial	Core Region 5
6	6	Radial	Filler Strip
7	7	Radial	Structure
8	8	Radial	Inner Reflector
9	9	Radial	Vane
10	10	Radial	Outer Reflector
11	11	Radial	Pressure Vessel Side
12	1	Axial	Cluster Hardware
13	2	Axial	Core 1
14	3	Axial	Core Plenum
15	4	Axial	Support Plate
16	5	Axial	Shield Plenum
17	6	Axial	Aluminum Shield Plate
18	7	Axial	BATH Shield
19	8	Axial	Lead Shield
20	9	Axial	Dome Plenum
21	10	Axial	Pressure Vessel Dome

TABLE 5-3

ELEMENT TAPE AND SPECTRA IDENTIFICATION DATA FOR INPUT TO APPROPOS

Region No.*	Region Description	H		C		Mn		Cr		Ni		Fe		Ta		Al		Zr		U^{235}		U^{238}		Ti		Be		Pb		B		W	
1	Core 1	4019	1	0619	1	2419	1	0719	1	2619	1	1819	1	3219	1	-	-	3719	1	3519	1	3619	1	-	-	-	-	-	-	-	-	-	-
2	Core 2	4019	2	0619	2	2419	2	0719	2	2619	2	1819	2	3219	2	-	-	3719	2	3519	2	3619	2	-	-	-	-	-	-	-	-	-	-
3	Core 3	4029	3	0629	3	2429	3	0729	3	2629	3	1829	3	3229	3	-	-	3729	3	3529	3	3629	3	-	-	-	-	-	-	-	-	-	-
4	Core 4	4029	4	0629	4	2429	4	0729	4	2629	4	1829	4	3229	4	-	-	3729	4	3529	4	3629	4	-	-	-	-	-	-	-	-	-	-
5	Core 5	4029	5	0629	5	2429	5	0729	5	2629	5	1829	5	3229	5	-	-	3729	5	3529	5	3629	5	-	-	-	-	-	-	-	-	-	-
6	Filler Strip	4039	6	0639	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	Structure	4039	7	-	-	-	-	0739	7	2639	7	1839	7	-	-	0139	7	-	-	-	-	-	-	3339	7	-	-	-	-	-	-	-	-
8	Inner Reflector	4039	8	-	-	-	-	0739	8	2639	8	1839	8	-	-	0139	8	-	-	-	-	-	-	3339	8	0239	8	-	-	-	-	-	-
9	Vane**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	Outer Reflector	4039	10	-	-	-	-	0739	10	2639	10	1839	10	-	-	0139	10	-	-	-	-	-	-	3339	10	0239	10	-	-	-	-	-	-
11	Pressure Vessel Side	4039	11	-	-	-	-	-	-	-	-	-	-	-	-	0139	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	Cluster Hardware	4019	12	0619	12	2419	12	0719	12	2619	12	1819	12	-	-	-	-	-	-	-	-	-	-	3319	12	-	-	-	-	-	-	3449	12
13	Plenum and Hardware	4039	10	-	-	2449	10	0749	10	2649	10	1849	10	-	-	0149	10	-	-	-	-	-	-	3349	10	-	-	-	-	-	-	-	-
14	Core Plenum	4049	14	-	-	2449	14	0749	14	2649	14	1849	14	-	-	-	-	-	-	-	-	-	-	3349	14	-	-	-	-	0349	14	-	-
15	Support Plate	4049	15	-	-	2449	15	0749	15	2649	15	1849	15	-	-	0149	15	-	-	-	-	-	-	3349	15	-	-	-	-	-	-	-	-
16	Shield Plenum	4049	16	-	-	2449	16	0749	16	2649	16	1849	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	Drum Drive	4049	10	-	-	2449	10	0749	10	2649	10	1849	10	-	-	0149	10	-	-	-	-	-	-	3349	10	-	-	-	-	-	-	-	-
18	Aluminum Shield Plate	4049	17	-	-	-	-	-	-	-	-	-	-	-	-	0149	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	BATH Shield	4049	18	0649	18	-	-	-	-	-	-	-	-	-	-	0149	18	-	-	-	-	-	-	3349	18	-	-	-	-	-	-	-	-
20	Lead Shield	4049	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1949	19	-	-	-	-
21	Dome Plenum	4049	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	Pressure Vessel Dome	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0149	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*See Figure 3-1 for region location.

**Data for the Vane Region: 3839/9.

6.0 The DOT-IIW Code

In the radiation shielding analysis of nuclear systems, the two dimensional discrete ordinates transport code, DOT-IIW, serves as a basis for many different types of calculations. The DOT-IIW code is used to predict criticality, fuel loading, reactor size, power distribution, shield performance, and flux distribution in space and energy. The DOT-IIW code has been designed to provide these capabilities in a single, flexible, yet efficient code with a maximum use of magnetic tapes to provide data for subsequent use in codes such as NAGS or MAP or subsequent DOT-IIW problems. DOT-IIW accepts input from magnetic tape prepared by SATURN, APPROPOS, ANISN-W, or MAP or previous DOT-IIW problems.

The DOT-IIW code has been utilized in the detailed analysis of the nuclear propelled stage as the method to provide neutron and photon flux distributions in the nuclear subsystem and angular dependent surface leakage from the nuclear subsystem for use in analysis of the radiation environment of the nuclear stage.

6.1 General Description of the DOT-IIW Code

The DOT-IIW code provides the capability to solve the two dimensional (x-y, r-z, or r-θ), energy dependent, linear Boltzmann equation. The code uses the discrete ordinate method employing a diamond, step function, or weighted diamond difference solution technique. A multigroup representation of particle energy and a general anistropic scattering approximation (i.e., Legendre expansion of the scattering cross section) is used. The code provides for forward or adjoint, homogeneous or inhomogeneous solutions. Inhomogeneous solutions may have fixed distributed volume sources or a fixed angular dependent boundary source at the top or right boundary of the geometry. Subcritical multiplication due to the presence of fissionable materials may be included in the inhomogeneous problems. The homogeneous solution provides the eigenvalue or multiplication factor of the system. In addition, the capability to perform time absorption calculations and searches of material concentration and zone thickness to provide a desired eigenvalue or multiplication factor is provided. The system boundary conditions available are vacuum, reflective, periodic, fixed source, white, or albedo.

In the MSFC seminar/workshop analysis the DOT-IIW code is used to calculate neutron and photon flux distributions in the nuclear subsystem (NSS) and the neutron and photon angular dependent leakage from the NSS. The DOT-IIW code uses as input the punched card data from the APPROPOS code and the fission distribution data from the ANISN-W code. Output data for the DOT-IIW code is used in the NAGS calculation of photon source distributions in the NSS and in the MAP calculation of neutron and photon fluxes at the meridian ring. In the S/W application of DOT-IIW the punched card input is used since the APPROPOS problem was run at WANL and the DOT-IIW problems run at MSFC. The linkage of DOT-IIW to NAGS and MAP is by magnetic tape. The following discussion contains a description of the DOT-IIW input and output to produce the desired S/W uses of the DOT-IIW code.

6.2 Input Data Description

Input data to the DOT-IIW code are subdivided into the following nine sets of data:

1. Overall problem core memory allocation and tape assignments,
2. Problem specifications, options, and constants,
3. Cross section data,

4. Input flux guess data,
5. Fixed distributed source data,
6. Fixed boundary source data,
7. Angular quadrature direction cosine data,
8. Angular quadrature direction weight data,
9. Geometry, mesh description and other miscellaneous data.

The flexibility of the DOT-IIW code in solving a variety of different types of problems and the complexity of some input data arrays complicates the preparation of input for the DOT-IIW code. In the S/W problems the use of the input data subroutine (FIDO) to reduce the input data preparation effort is demonstrated. The input formats for integer (fixed point) and real (floating point) data are described in detail in Section 2.2.1 of Volume 5, WANL-PR(LL)-034.

Of the nine data sets described above, Sets 1 and 2 are entered using a fixed FORTRAN format and Sets 3 through 9 utilize the FIDO subroutine to read input. The FIDO subroutine will accept data in one of three FORTRAN formats with the most general capability having an input data operation declared by a letter code. The use of certain input data techniques using FIDO will be demonstrated in the DOT-IIW S/W problems described in the following sections and the use of FIDO in the SATURN, ANISN-W, MAP, SCAP, and LHAP codes will illustrate other input data preparation techniques.

The DOT-IIW code user's manual is published as a separate document (WANL-PR(LL)-034, Volume 5). It is assumed that the reader will utilize this manual during the discussion of the S/W problem input data in the following sections.

In the discussion that follows the specific use of DOT-IIW to calculate the neutron flux distributions and photon flux distributions using multiple DOT-IIW problems is described.

The method used involves a DOT-IIW calculation of the multigroup neutron flux distribution in the reactor portion of the NSS, a DOT-IIW calculation of the multigroup neutron flux distribution in the shield portion of the NSS using a boundary source from the previous DOT-IIW problem, a CHEAPER calculation to combine the output flux tapes from the two DOT-IIW calculations, a NAGS calculation of the photon source distribution using the neutron flux data from CHEAPER, and a DOT-IIW calculation of the photon flux distribution in the NSS.

The problems to be analyzed are derived from the R-Z geometry model of the nuclear subsystem (NSS) illustrated in Figure 3-1. For the neutron transport analysis, this model is subdivided into two sections as illustrated in Figures 6-1 and 6-2. The portion of the NSS shown in Figure 6-1 illustrates the reactor core portion of the NSS and only a portion of the BATH shield region is included. The second portion of the NSS model illustrated in Figure 6-2 overlaps the BATH shield region shown in Figure 6-1 and includes the upper portion of the NSS. This coupled approach to the analysis is used to provide a sufficient number of mesh intervals in the mesh cell description of the NSS and also to demonstrate the use of the angular dependent boundary source option in DOT-IIW. In determining the radial and axial mesh intervals which subdivide the geometries shown in Figures 6-1 and 6-2 the radial mesh was the same for both geometries. The number of radial mesh intervals was determined on the basis of the maximum size of a DOT-IIW problem on the MSFC UNIVAC-1108 computer. With the $65{,}000_{10}$ are memory locations at MSFC; the DOT-IIW code allows a maximum of $43{,}000_{10}$ data locations. The guidelines described in 2.2.5 of the DOT-IIW user's manual and previous experience in using DOT-IIW, were used to determine the mesh lines coordinates shown in Tables 6-1 through 6-4. As listed, the region boundaries shown in Figures 6-1 and 6-2 are included. Of particular importance is the choice of a fine mesh interval description at the surface of the highly absorbing BATH shield region. This procedure is used to insure that an adequate flux solution for the thermal or low energy neutron groups is obtained. In the neutron problems a more detailed mesh description is used. Tables 6-1 through 6-3 are a listing of the mesh line coordinates of the neutron transport problems. The mesh lines deleted for the photon problem using the NAGS code are noted in Tables 6-1 through 6-3 by asterisks. Table 6-4 is a listing of the axial mesh lines of the photon transport problem. The technique to delete mesh lines is in the NAGS code and involves the integration over the fine mesh of the neutron problems to the coarse mesh of the photon problem. The mesh line deletion in the photon problem is necessary since a P_1 scattering approximation is used and therefore more core memory locations are required to store the DOT-IIW calculated results.

To assist in the description of the DOT-IIW input data Tables 6-5, 6-6, 6-7 are listings of the card input for the three DOT-IIW problems. The input required for each problem will be discussed simultaneously in the following sections.

6.2.1 Problem Card Input Description

Data Set 1 - Overall Problem Core Memory Allocation and Tape Assignments

The initial input card for the DOT-IIW code includes the quantity ISIZE, i.e., the maximum number of core memory locations available for data in a DOT-IIW prob-problem, the tape assignments for the DOT-IIW problem, and the input boundary source tape parameters, if required. On the MSFC UNIVAC-1108, the current maximum value of ISIZE is $43,000_{10}$ locations which is compatible with the available $65,000_{10}$ core memory size of the MSFC UNIVAC-1108 computer system. The user of the DOT-IIW code can determine the problem core memory storage requirements from the problem input data and the equations described in Section 2.2.3 of the DOT-IIW user's manual. A technique which can be used is to set up the initial portion of a DOT-IIW deck through

Data Set 2 and run the problem for a 60 second run. The DOT-IIW code will printout the core memory required for the problem. In the S/W problems the two neutron problems were run with a ISIZE of $40,000_{10}$ and these problems used $31,007_{10}$ and $29,449_{10}$ locations. The photon problem was run with a value of ISIZE of $43,000_{10}$ and used $42,047_{10}$ locations.

The tape assignments on the initial input card of all three DOT-IIW S/W problems are,

1. The punched card input tape drive, NINP, is input as 5,
2. The printed output data tape drive, NOUT, is input as 6,
3. A scratch tape drive, NCR1, is input as 1,
4. A scratch tape drive, NSCRAT, is input as 2,
5. The fixed distributed source input tape drive, NBSO, is input as 8,
6. A scratch tape drive, NFLUX1, is input as 3,
7. The angular flux output tape, NAFT, is input as 4.

The remainder of input data on the initial data card concerns the input of a boundary source tape and are entered as 0's for the reactor neutron and photon problems.

The second DOT-IIW problem, shield neutron, is a boundary source problem and the top boundary source input tape is mounted on tape drive 9. The boundary source tape is from the first DOT-IIW problem.

The following discussion pertains only to the second DOT-IIW problem (shield portion of the NSS).

The input values on the initial data card for the shield neutron problem are:

1. The input boundary source option, IBXS, is input as 1 to signify that a data tape is on tape drive 9,

2. The number of radial mesh intervals in the input boundary source data tape, IMOLD, is input as 40. This value is from the first DOT-IIW problem,

3. The number of axial mesh intervals in the input boundary source data tape, IMOLD, is input as 3. This value is determined by the output data option, of the first problem. This is described in Data Set 2. The 3 signifies that only three axial mesh intervals of angular flux data were placed on the output tape of the first problem,

4. The specific axial mesh interval data to be used as the input boundary source, JMLEV, is input as 2.

5. The direction of the boundary source data to be used as the input boundary source, IDIR, is input as 1. This signifies that the downward directed angular flux will be used as a boundary source. This is used since the DOT-IIW problems are inverted when run and therefore the downward directed flux is that flux directed toward the shield.

6. The starting radial mesh interval to be used from the input boundary source, NA. The DOT-IIW code will use only the mesh interval data of mesh intervals NA through NC. In the S/W problem the value of NA is 1.

7. The ending mesh interval to be used from the input boundary source, NC. In the S/W problem the value of NC is 40.

Data Set 2 - Problem Specifications, Options, and Constants

The second input data set for a DOT-IIW problem consists of the appropriate title and nine cards of integer or real data defining the problem setup. The listings in Table 6-5, 6-7, 6-8 illustrate the title cards for the three DOT-IIW problems and the 54 input values required in Data Set 2.

The 54 input values required for the DOT-IIW problems are as follows:

1. Problem identification number, AO1. This is input as 1 for the reactor portion neutron transport problem, 2 for the shield portion neutron transport problem, and 3 for the photon transport problem.

2. Flux solution option, AO2. The forward solution option, AO2 = 0, is selected for all three S/W problems.

3. Anisotropic scattering option, AO3. The neutron transport problems use as input transport corrected neutron cross section data and P_l photon cross section data from APPROPOS. AO3 is input as 0 for the neutron transport problems and as 1 for the photon transport problem.

4. Number of discrete directions in the calculation, AO4. This value is input as 48 for the S_8 angular quadrature used for all three S/W problems. The input data AO5, AO6, AO7 and AO8 on the ninth card of Data Set 2 further define the quadrature input. This quantity differs from ANISN-W input since the user can input asymmetric quadrature sets into DOT-IIW.

5. Geometry parameter, IGE. In all three S/W problems the r, z geometry, IGE = 1, is used.

6. Number of zones, IZM. In Figures 6-1, 6-2 and 6-3 the number of zones in each are noted. The reactor neutron problem has a total of 19 zones, IZM = 19. The shield neutron problem has zones 11, 18, and 19 repeated from the reactor problem because of the overlap to couple the problems and three additional zones for a total of 6 zones, IZM = 6. The photon problem, which considers the entire NSS, has 22 zones, IZM = 22.

7. Number of radial mesh intervals, IM. The neutron transport problems have 40 radial mesh intervals, IM = 40, with the mesh line coordinates defining these intervals listed in Table 6-1. The photon problem has a total of 6 intervals deleted from the neutron problem mesh to allow the NAGS and DOT-IIW problems to fit in the MSFC UNIVAC-1108 computer, and therefore, IM = 34, is input. The radial mesh line coordinates are listed in Table 6-1 with the lines deleted in the photon problem noted by asterisks. Radial mesh line numbers at zone boundaries are noted in Figures 6-1, 6-2 and 6-3.

8. Number of axial mesh intervals, JM. The neutron transport problems have 50 (reactor) and 47 (shield) mesh intervals, JM = 50 or JM = 47. The mesh line coordinates are listed in Tables 6-2 and 6-3. These problems were coupled at mesh interval 10 of the reactor problem, i.e., in the shield plate zone. Therefore, the combined output from these problems has 87 mesh intervals. The photon problem has 58 mesh intervals, JM = 58, with the mesh line coordinates listed in Table 6-4. Radial mesh line numbers at zone boundaries are noted in Figures 6-1, 6-2 and 6-3.

9. Calculation type, IO4. In the S/W problems the use of a fixed distributed neutron source, fixed boundary source, and fixed distributed photon source in DOT-IIW is demonstrated. The reactor neutron problem uses a fixed distributed source derived from the ANISN-W radial and axial S/W problems described in Section 4.0 and IO4 is input as 0. The shield neutron problem uses the angular dependent source from the reactor neutron problem as a top boundary source and IO4 is input as 5. The photon problem uses as input the fixed distributed source from the NAGS code and IO4 is input as 0.

10. Eigenvalue guess, EV. For the S/W problems, the input value of EV is 0.0. This input EV, is only required in search calculations (I04 = 2, 3 or 4) to provide an initial starting point for search calculations. See Section 2.3.4 of the user's manual for details.

11. Eigenvalue guess modifier, EVM. The input value of EVM is 0.0 for the S/W problems. A non-zero value of EVM is necessary only for search calculations (I04 = 2, 3 or 4). See Section 2.3.4 of the user's manual for details.

12. Convergence criteria for overall problem, EPS. For the S/W problems the input value of EPS is 0.001. Since the S/W problems are fixed source problems and pointwise flux convergence is specified in later input, this value is not used by the DOT-IIW code. Guidelines for selecting a value of EPS are stated in the DOT-IIW user's manual.

13. Left boundary condition, B01. The left boundary of all three S/W problems is the centerline of the NSS and the reflective, B01 = 1, condition for mirror reflection of flux is specified.

14. Right boundary condition, B02. The right boundary condition of all three S/W problems is the cylindrical outer surface of the NSS and the vacuum, B02 = 0, condition for zero return of flux is specified.

15. Top boundary condition, B03. In the reactor neutron problem the top boundary condition is the aft end of the NSS (CHESH zone) and a vacuum boundary condition, B03 = 0, is specified. For the shield neutron problem the top boundary is the shield plate zone of the r, z geometry. The

angular dependent boundary source option, B03 = 5 is used at this boundary to couple the reactor and shield neutron problems. The photon problem has as its top boundary the aft of the NSS (CHESH zone) and a vacuum condition, B03 = 0, is specified.

16. Bottom boundary condition, B04. All three S/W problems have the bottom boundary specified as a vacuum boundary, B04 = 0. In the reactor problem this condition is used since a portion of the BATH shield zone is included in the geometry. This zone overlaps the shield problem geometry and is included to provide the proper angular dependent source entering the BATH shield. This overlap is usually chosen as 2 or more mean free paths of material beyond the coupling plane, i.e., the shield plate zone.

17. Input flux guess option, M07. In all three S/W problems, the option to enter a single set of values of flux, M07 = 0, is used. A flux guess of 0.0 is entered for all three cases since the problems are all fixed source problems.

18. Flux solution option, MODE. In all three S/W problems the mixed mode solution option, MODE = 1, is used. This option specifies a linear diamond difference solution with a step function difference technique used only if a negative angular flux is calculated. This option is recommended for most problems. In certain types of problems involving only attenuation, i.e., no fissions, the weighted difference method may provide improved results for problems with large mesh intervals.

19. Total number of material cross section sets, MT. In the S/W problems, macroscopic cross sections from APPROPOS are entered on punched cards. The reactor problem has an input value of MT equal to 20 for the 19 cross section sets of the 19 zones and a 20th cross section set for an activity calculation. The shield problem has an input value of MT equal to 7 for the 6 cross section sets of the 6 zones and a 7th set for an activity calculation. In the photon problem the input value of MT is 44 for the P_0 and P_1 cross section sets for 22 zones. The P_0 and P_1 sets for each material are entered in sequence. No activity calculation was used in the photon problem.

20. Cross section mixing table length, M01. In the S/W problems, macroscopic cross sections are obtained from the APPROPOS code and no mixing table is specified (M01 = 0).

21. Number of cross section sets from punched cards, MCR. In the S/W problems, the input value of MCR is equal to MT for all problems.

22. Number of material cross section sets from tape, MTP. In the S/W problems all cross sections are entered from punched cards and MTP is entered as 0.

23. Number of radial zones in zone thickness search, IZ. In the S/W problems the zone thickness search option is not used, I04 = 1, and IZ is input as 0.

24. Number of axial zones in zone thickness search, JZ. In the S/W problems the zone thickness search is not used, I04 = 4, and JZ is input as 0.

25. Parametric eigenvalue search type, S02. The S/W problems do not use the search options and S02 is input as 0.

26. Parametric eigenvalue for search, S03. Since the S/W problems are fixed source problems the input value of S03 is 0.0.

27. Number of groups in the solution, IGM. In the neutron problems the number of groups IGM is input as 16. The photon problem is a 13 group solution and IGM is input as 13.

28. Position of the total or transport corrected gross section in the input cross section data, IHT. The value of IHT for the APPROPOS output is 3.

29. Position of the within-group scatter cross section in the input cross section data, IHS. In the S/W problems the input value of IHS is 4 since no up-scatter cross sections are entered.

30. Total number of positions in the input cross section data, ITL. The neutron problems have as input 16 group data with a maximum of 9 downscatter cross sections. This results in 9 plus 4 (the position of within-group scatter, IHS) or 13 as the input value of ITL. In the photon problem cross sections, a total of 12 downscatter positions are entered and ITL is input as 16 (12 plus 4).

31. Problem normalization factor, S01. The three S/W problems are all fixed source problems. The reactor neutron problem is used to normalize the three problems to a full power reactor. The value of S01 is input as the total number of source neutrons in the reactor. This input value is 1.2×10^{20} neutrons per second. This is calculated as follows:

$$S01 = 1.575 \times 10^{9} \text{ watts (thermal)} * 3.1 \times 10^{10} \frac{\text{fissions}}{\text{watt-second}} * 2.45 \frac{\text{neutrons}}{\text{fission}}$$

$$= 1.2 \times 10^{20} \text{ neutrons/second}$$

The DOT-IIW code normalizes the input fixed source to a volume integral source rate equal to S01. In the shield neutron problem and photon problem, S01 is input as 0.0 since the fixed boundary source from the reactor problem is already normalized and the neutron fluxes used in NAGS to calculate the photon source is normalized.

32. Activity calculation option, M05. The S/W neutron problems have as input in the cross section input a set of data to provide four activities and M05 is input equal to 4. The S/W photon problem does not use the activity option and M05 is input as 0.

33. Input fixed distributed source option, M06. The DOT-IIW code has many options of entering a fixed distributed source. The fixed distributed source in the reactor neutron problem is calculated from a radial, axial, and energy distribution. This input value of M06 for this problem is 3. The shield neutron problem does not use a fixed distributed source and M05 is input as 0. The photon problem uses the NAGS photon source tape as input on tape 8 and the input value of M06 is 5.

34. Initial maximum number of inner iterations per group, S04. In all three S/W problems S04 is input as 10. This value was selected to limit computer time at MSFC.

35. Outer iteration maximum, D05. The reactor neutron problem is a single outer iteration problem since neither fissions nor upscatter are present. Since the reactor neutron problem output includes an angular flux tape the input value of D05 is input as 0. This allows a single outer iteration with angular flux output (the input value of IAFT is non-zero as described later). The shield neutron and photon problems are both fixed source problems requiring a single outer iteration for the solution. The input value of D05 for these problems is 1 since no angular flux output is obtained.

36. Maximum number of inner iterations per group, G07. For all three S/W problems this value is input as 10. This value was selected to limit computer time use at MSFC.

37. Dummy input, G05. The quantity G05 is not required input and is assigned a value of 0.0.

38. Pointwise flux convergence criteria, G06. In the S/W problems, the value of G06 is 0.001. This value is equal to EPS and should generally be equal to or smaller than EPS.

39. Search calculation convergence criteria, LAL. Since none of the S/W problem do use the search calculation option, LAL is input as 0.0.

40. Search calculation parameter, LAH. This quantity is input as 0.0 for all three S/W problems.

41. Search calculation parameter oscillation damper, POD. This quantity is input as 0.0 for all three S/W problems.

42. Convergence criteria on new parameters of search calculations, EPSA. This quantity is input as 0.0 for all three S/W problems.

43. Angular flux output trigger, IAFT. In the reactor neutron problem, the angular flux output tape is required for use as the boundary source tape in the shield problem. The input value of IAFT is 1 to produce the tape with no printed output. For the shield neutron and NSS photon problems the input value of IAFT is 0.

44. Number of quadrature angles in the positive η direction, A05. The quadrature data used for all three S/W problems is S_8 data with 48 discrete directions. The S_8 data used are symmetric data with 24 upward ($+\eta$) angles and 24 downward ($-\eta$) angles. The input value of A05 is 24. A description of the input of A04, A05, A06, A07 and A08 is in Section 2.2.4 of the DOT-IIW user's manual.

45. Number of quadrature angles in the negative η direction, A06. The input value of A06 is 24 for all S/W problems. See description of A05 above for details.

46. Number of initialization directions in the positive η direction, A07. The input value of A07 is 4 for all S/W problems.

47. Number of initialization directions in the negative η direction, A08. The input value of A08 is 4 for all three S/W problems.

48. Inner iteration convergence acceleration option, A09. In the DOT-IIW code, there exist four techniques of accelerating the convergence of the group flux solutions. The method selected for the S/W problems is successive over-relaxation (A09 = 1). This method requires only an extra IM*JM core memory locations. The most efficient method is the space point scaling method (A09 = 2); however, this method requires 5*IM*JM extra core memory locations and this requirement limits the use of space point scaling on the UNIVAC-1108 computer with a 65K core memory size. The Chebyshev acceleration method (A09 = 3) is not recommended since the DOT-IIW method is a space independent technique.

49. Zones of convergence option, A10. In the S/W problems the zones of convergence option is not used and A10 is input as 0. In certain problems the use of zones of convergence is necessary to eliminate pointwise flux convergence tests is zones which do not affect the desired answer. In these cases the user specifies the number of zones to be tested as the input value of A10.

50. Axial interval of angular flux output, A11. In the DOT-IIW code the output of angular flux on magnetic tape is optional. In the S/W reactor problem the output tape is required for a boundary source in the shield problem and A11 is input as 10. This is axial interval at which the coupling of the reactor and shield problem is to occur. The DOT-IIW code places data for intervals 9, 10 and 11 on the output tape. In the shield and photon problems the output of angular flux is not requested and A11 is input as 0.

51. Number of neutron groups, A12. This input value is not currently used in DOT-IIW and the S/W problem input is a value of 0.

52. Cross section printed output option, A13. In the S/W problems the cross section data is printed and A13 in input as 0.

53. Upscatter convergence criteria, A14. In the S/W problems the upscatter cross sections in the neutron problems have been removed by spectral weighting and the input value of A14 is not used. A value of 0.001 is input.

54. Dummy input value, A15. This is input as 0 for all three problems.

Data Set 3 - Cross Section Data

Cross section input data to the DOT-IIW code consists of two types of data, i.e., punched card or magnetic tape. The input data MCR and MTP described previously defines the type of input. If the input value of MTP is greater than 0, the tape identification numbers are input in the 13$ array. If the input value of MCR is greater than 0 then punched card input is input in the 14* or 14U array. In the S/W problems all cross sections are input on punched cards. Therefore, MTP is input as 0 for all three problems. MCR is input as 20 for the reactor neutron problem, 7 for the shield neutron problem, and 44 for the photon problem. The cross sections input to the neutron problems were obtained from the APPROPOS code and are transport corrected data with 13 types of cross sections for each of 16 groups or 208 cross sections in each set or 35 cards in each set. These data are listed in Table 6-5 and 6-6. The 20th and 7th cross section sets in the neutron problems are the activity cross sections to provide the neutron flux with energy greater than 1.0 Mev, neutron flux with energy less than 1.0 Mev and greater than 0.3 eV, neutron flux with energy less than 0.3 eV, total neutron flux, and neutron dose rate in Rem/hour. These activities are entered as the first through fifth table positions in each group and when multiplied by group fluxes and summed over groups the desired activities are obtained.

The cross sections input to the photon problem are obtained from the APPROPOS code. These data are P_1 data and consist of a P_0 cross section set followed by a P_1 cross section set for each of 22 materials. This results in a total of 44 cross section sets. The photon cross section data consists of 16 types of cross sections for each of 13 groups or 208 cross sections for each set. The P_0 and P_1 data both have 208 values with 35 cards for each set. No activity cross sections are input to the photon problem.

As shown in the listings in Tables 6-5 through 6-7 the cross section data are followed by a single terminate (T) card.

Data Set 4 - Input Flux Guess Data

In the S/W problems the option to specify the flux distribution guess is used. As shown in Tables 6-5 through 6-7 the 3* array is filled with a uniform guess of 0.0. This input is used since the S/W problems are all fixed source problems with no fissions or up-scatter allowed.

The 3* array is followed by a single terminate (T) card.

Data Set 5 - Fixed Distributed Source Data

Fixed distributed source data for the DOT-IIW code is entered as punched cards or as magnetic tape data as specified by the M06 parameter. In the reactor neutron problem the punched card input is used with M06 input as 3 to require 3 arrays of input. The first 17* array is the χg array to specify the fraction of fission neutrons emitted in each of the 16 groups. These data are listed in Table 6-5. The second and third 17* arrays in Table 6-5 is the radial and axial fission distributions, f(r) and f(z) obtained from the 52 group ANISN-W problems described in Section 4.0. The input option M06 = 3 performs the calculation of the fixed distributed source as:

$$Q\ (r,\ z,\ g) = \chi g * f\ (r) * f\ (z)$$

The integral of the Q (r, z, g) over the entire reactor is then normalized to the input value of S01 which for the reactor neutron problem was input as 1.2×10^{20} neutrons per second.

In the reactor neutron problem each 17* array is followed by a single terminate (T) card.

The shield neutron and photon DOT-IIW problems do not involve the input of a fixed distributed source from punched cards and a 17* array or terminate (T) card is not required. The shield neutron problem uses the top boundary source from tape and the photon problem uses the fixed distributed source from NAGS as input on Tape 8.

Data Set 6 - Fixed Boundary Source Data

Fixed boundary source input data to the DOT-IIW is from magnetic tape or punched cards. The magnetic tape input is allowed only for top boundary sources and this option is described on the first data card of the DOT-IIW input. Punched data card input is allowed for top or right boundary sources and consists of data for each angular flux incident upon the boundary. A description of the card input is in Section 2.3.3 of the DOT-IIW user's manual.

In the S/W problems the reactor neutron and photon problems are a fixed distributed source input and no 18* array or terminate (T) card is entered. In the shield neutron problem the top boundary source is from tape 9 and no 18* array or terminate (T) card is entered.

Data Set 7 - Angular Quadrature Direction Cosine Data

The DOT-IIW code requires as input the direction cosine data defining the discrete direction in the solution. The 7* or 7U array consists of the direction cosines μ and η. In the S/W problems an S_8 angular quadrature is used. This 7U array requires a total of 48 values of μ and 48 values of η. This input is listed in Tables 6-5, 6-6 and 6-7 and is followed by a single terminate (T) card in each problem. The quadrature data requirements of DOT-IIW are described in Section 2.2.4 of the DOT-IIW user's manual. The data used in all three S/W problems is listed in Table 2-1 of the DOT-IIW user's manual.

Data Set 8 - Angular Quadrature Direction Weight Data

The DOT-IIW code requires as input the direction weight data corresponding to the direction cosine data defined in the 7* or 7U array described above.The 6* or 6U array consists of the direction weights, w. In the S/W problems an S_8 angular quadrature is used and there are 48 values of w required. This input is listed in Tables 6-5 through 6-7 and each set of data is followed by a terminate (T) card. The quadrature data requirements of DOT-IIW are described in Section 2.2.4 of the user's manual.

Data Set 9 - Geometry, Mesh Description, and Miscellaneous Data

The remainder of the DOT-IIW input data are entered as a group with each set of data preceeded by an array number. Only a single terminate (T) card is entered following the last array of input. Each input array is described in the following paragraphs and the listings in Table 6-5, 6-6, and 6-7 contain the input arrays required for the S/W problems.

1* Array

The 1* array is the fission spectrum, χg, data. This data is the fraction of neutrons born in each group and the sum of χg's over all groups should be equal to 1.0. The S/W problems are all fixed source problems. Since the neutron cross section input contains the fission cross sections, Σ_g^f, for each fissionable material, the entry of χg's as 0.0 in the neutron problems is used to suppress the calculation of a fission neutron source. In the photon problems the χg's are not used in the calculation and are entered as 0.0's. The sixteen group χg's are used in the first 17* array entered in Data Set 5 to define the fixed sources.

4* Array

The 4* array are the radial mesh line coordinates defining the radial mesh intervals. The radial mesh line coordinates are listed in Table 6-1 for the neutron problems and the mesh lines deleted for the photon problem are noted by asterisks in Table 6-1. There are 41 values required in the 4* array of the neutron problems and 35 values required in the 4* array of the photon problem.

2* Array

The 2* array are the axial mesh line coordinates defining the axial mesh intervals. The radial mesh line coordinates are listed in Tables 6-2, 6-3 and 6-4 for the reactor neutron, shield neutron, and photon problems. The mesh lines deleted from the neutron problem mesh for the photon problem are noted in Tables 6-2 and 6-3. As can be seen from the listing, the coupling of the neutron problems occurs at mesh line 11 or at z of -164.67. These are 51 values entered in the 2* array of the reactor neutron problem, 48 values in the 2* array of the shield neutron problem, and 59 values in the 2* array of the photon problem.

8$ Array

The 8$ input array of the DOT-IIW code defines the zone number of each mesh cell in the mesh description of the model. The zone numbers are entered starting at the bottom boundary - left boundary corner of the model. A total of IM*JM input values are required with IM entered for each row. The input values of the 8$ array must be in the range 1 to IZM, the total number of zones, and each zone must be assigned to a mesh cell. In the S/W problems there are 2000 entries required in the 8$ array of the reactor neutron problem, 1880 entries in the shield problem, and 1972 values in the photon problem.

9$ Array

Input in the 9$ array defines the material number (cross section set) assigned to each zone. In the reactor neutron problem a total of 19 values are entered in the 9$ array. These values correspond to the 19 zones defined in the 8$ array and the cross section set order input in the 14U array. This correspondence is shown in Figure 6-1.

The shield neutron problem has a total of 6 values entered in the 9$ array corresponding to the six zones. The values of the 9$ array correspond to the order of cross section input in the 14U array and is shown in Figure 6-2. The photon problem differs from the neutron problem since P_1 cross section data is entered. The DOT-IIW code uses the sign of the 9$ array values to define a P_l cross section set. In DOT-IIW all cross section sets that are P_l must have l + 1 sets of data input for the material. The user defines the material cross section set in the zone by the P_0 set and the P_1 set must be the next set. In the S/W problems there are 22 zones and 44 cross section sets. The 9$ array data are the odd integers, 1, 3, 5, etc., with a negative sign to declare all sets as P_1 sets.

5* Array

The representative group velocities are entered in the 5* array. For all DOT-IIW problems, except time absorption (I04 = 2) calculations, the 5* array should be entered as 1.0's since the 5* array values are divided into the fluxes during the calculation. In each of the S/W problems the 5* array is entered as 1.0's.

10$, 11$, 12* Arrays

The cross section mixing table in DOT-IIW is specified in the 10$, 11$, and 12* arrays. The S/W problems do not use a mixing table since the APPROPOS code provided macroscopic neutron and photon cross sections. The SATURN code input described in Section 3.0 includes a mixing table similar to a DOT-IIW mixing table and a detailed description of the use of a mixing table is contained in Section 2.3.7 of the DOT-IIW user's manual. In concentration search problems, a specific type of mixing table is required. The user must specify the mixtures to be altered to achieve the desired eigenvalue, S03.

19$ and 20$ Arrays

The 19$ and 20$ arrays define the activity calculations to be performed by the DOT-IIW code. The reactor and shield neutron problems use the activity calculation option to calculate the neutron flux with energy greater than 1.0 Mev, neutron flux with energy less than 1.0 Mev and greater than 0.3 eV, neutron flux with energy less than 0.3 eV, total neutron flux, and neutron dose rate. In the neutron problems the activity cross sections are input as the 20th and 7th cross section sets. The 19$ array input is the material cross section set to be used in the activity calculation and the 20$ array is the cross section table position. In the reactor neutron problem a total of 5 activities are desired and the 19$ is entered as five values of -20 and the 20$ array is entered as positions 1, 2, 3, 4 and 5. In the shield neutron problem the 19$ is entered as -7's and the the 20$ array is entered as 1, 2, 3, 4 and 5.

The negative sign on the 19$ array results in all activities being calculated for all mesh cells. If the 19$ array has a positive sign, then activities only for that zone in which the material number appears is calculated.

21$, 22*, 23$, 24* Arrays

Since the S/W problems do not use the zone thickness search option, these arrays are not input to the problems. A description of this input is described in Section 2.3.4 of the DOT-IIW user's manual.

25*, 26*, 27* Arrays

The DOT-IIW code has the capability to specify the right, top, or bottom boundaries as albedo surfaces. The S/W problems do not use this option and these arrays are not entered.

28$ Array

The zones of convergence option in DOT-IIW allows the user to specify the zones in which convergence of group fluxes are made. Either a pointwise or zone average flux can be used and the user supplies the zones in which this test is to be made in the 28$ array. In the S/W problems this option is not used and the 28$ array is not entered.

The above data arrays 1* through 28* are entered as a group of input and are followed by a single terminate (T) card.

6.2.2 Problem Size Determination

Section 2.2.3 of the DOT-IIW user's manual describes how to determine the core memory locations required for a DOT-IIW problem. If the problem requires more storage than the ISIZE allocation specified on the first input card then the user must reduce the size of the problem by deleting mesh, reducing quadrature order, or deleting calculation options. If the ISIZE allocation is not adequate to read cross sections then the SATURN code can be used to load a group independent cross section tape.

6.2.3 Quadrature Sets

In the S/W problems, the S_8 quadrature data was obtained from Table 2-1 of the DOT-IIW user's manual. A detailed description of quadrature data is contained in Section 2.2.4 of the DOT-IIW user's manual. The DOQ and ADOQ codes can also be employed to calculate quadrature sets for the DOT-IIW code.

6.2.4 Mesh Spacing Requirements

Mesh spacing requirements in the DOT-IIW code are strongly dependent upon the dimensions of the problem being analyzed and the energy range of the multigroup cross sections. The techniques of determining mesh interval sizes are described in Section 2.2.5 of the DOT-IIW manual. These techniques cannot always be used; a considerable amount of user judgement and experience in defining mesh is usually necessary. In the S/W problems the limitations of core memory size and computer time were primary considerations in selecting mesh intervals. However, in the areas of the largest gradients in flux (e.g., at the surface of the BATH shield) the mesh size was minimized to assure reasonable flux solutions.

6.2.5 Boundary Conditions

In the DOT-IIW code a variety of boundary conditions can be specified at each of the external surfaces. These conditions are vacuum, reflective, periodic, white albedo, and fixed source. A description of each condition is given in Section 2.3.6 of the DOT-IIW user's manual. In the S/W problems the vacuum, reflective, and fixed source conditions are used. The vacuum condition is applied to all surfaces on which a zero return of flux is desired. In the case of the reactor neutron problem the vacuum condition is applied at the bottom surface (internal to the BATH shield) since the affect of any flux return on the coupling plane prior to the BATH shield would be small.

The shield neutron problem uses the angular flux from the reactor neutron problem as a fixed boundary source at the top surface. This source is angular dependent data as a function of mesh interval and energy group. The reflective boundary condition is specified for the reactor centerline in all problems. This condition results in the angular flux leaving the boundary re-entering the boundary in the mirror reflected angle.

6.2.6 Convergence Options

Inner iterations in the DOT-IIW code involve the solution of group fluxes. This portion of the calculation is the most time consuming portion of the DOT-IIW calculation. The DOT-IIW code has four techniques of accelerating the rate of convergence of the group flux solution. These techniques are described in Section 2.3.7 of the DOT-IIW user's manual. The choice of these techniques is usually dependent upon the core memory size available for the problem. The normal (Gaussian) convergence acceleration technique is applied on all inner iterations independent of the use of any other technique.

In the S/W problems the successive overrelaxation technique (A09 = 1) is used since this technique only requires an additional IM*JM core memory locations beyond the normal problem requirement. Space point scaling which is usually the best technique is not used since a total of 5*IM*JM locations are required and this would severely limit the problem size.

6.2.7 Problem Setup Information

Section 2.4 of the DOT-IIW user's manual describes the tape assignments, running time estimates and recommended problem debug procedure for the DOT-IIW code. The S/W problems utilize magnetic tape input where possible to reduce punched card preparation and handling. In the reactor neutron problem the punched card input of cross sections and fixed source is used since the APPROPOS and ANISN-W problems were run at WANL. This problem required save tapes on tapes 11 and 4 for the scalar flux output and angular flux output. The scalar flux output on tape 11 is used in CHEAPER and ultimately in NAGS. The tape 4 output of angular flux is used for a fixed boundary source on tape 9 of the shield neutron DOT-IIW problem.

The shield neutron problem uses as input on tape 9 the output tape 4 containing angular fluxes from the reactor neutron problem. A save tape is mounted on tape 11 to save the scalar flux output for use in CHEAPER. The photon DOT-IIW problem uses as input on tape 8 the output photon source tape from the NAGS problem and a save tape is usually mounted on tape 11 to save the scalar flux output.

In addition to the above problem setup requirements, the MSFC user may be required to designate the amount of FASTRAN to save for use in a DOT-IIW problem. The tapes which may be assigned to FASTRAN and the amount of data on each are as follows:

Tapes 1, 2 and 3:

Depending upon the type of calculation these tape will contain the scalar flux, flux moments and boundary angular fluxes or the cross section and fixed source data. The flux data consists of IM*JM*ISCT + MM*JM + MM*IM words. ISCT is the number of flux moments, (A03 + 3) * A03 /2. The cross section data consists of IGM records of a maximum size MT*(ITL + 1) + IM*JM.

The remainder of tape units used in DOT-IIW problems do not normally require FASTRAN since a tape would be mounted for input or output data.

6.3 Output Data Description

Output from a DOT-IIW problem consists of printed and magnetic tape output. The following sections briefly describe the type of output from the S/W problems. In addition, Section 2.5 of the DOT-IIW user's manual describes the output of the DOT-IIW code. The description which follows applies to all three S/W problems except where noted in the discussion.

6.3.1 Printed Output

The first printed output of the DOT-IIW code is an organized printout of the Data Sets 1 and 2 problem input. The order by row of the printout is the same as the card input except that Data Set 1 is printed last. The final line of printout in this section is the amount of core memory storage used for the problem after cross sections are placed on tape. The next section of output is the input punched card edit of the input routine FIDO. The array numbers read by FIDO and the number of entries input in each array are printed. If the wrong number of input values are read for any array, the array is printed and the edit continued.

The next section of printed output is the zone number by mesh cell. This is a printout of the 8$ array. The 8$ array is punched out with the first line of printout the JMth row of zone numbers for IM mesh intervals. The last or lower line is the first row for IM mesh intervals. Following the zone (region) mesh cell description the material number by mesh cell is printed in the same fashion as the zone numbers. The absolute value of the 9$ array values are printed in the mesh cell array.

The next section of printed output is obtained only for the shield neutron problem. The fixed boundary source input from tape is printed. This data is printed for the 24 angles entering the top boundary and for the 40 radial mesh intervals.

The next section of printed output is the discrete ordinate angular quadrature data. This includes the input values of μ, η, and w (7*, 6* arrays) and the computed values necessary for the DOT-IIW calculations including the angle mates for reflective boundary conditions. Following the quadrature data the photon problem printed output has the Legendre polynomial coefficients for evaluation of the anisotropic scattering source.

Cross section input is the next printed section. This data is printed for all materials and positions for each group. This data is printed in the same format as the data is used from scratch tape, i.e., (a single group of data in each record). Following the cross section printout in the reactor neutron and photon problem, is the fixed distributed source by mesh cell for each group. Following the cross section or fixed distributed source data is the mixture table, radii, height, and the material cross section set by zone.

The next section of output is the iteration monitor printout. In the S/W problems a single outer iteration is run. The monitor line contains the scratch tape containing the iteration fluxes (FLUX), the outer iteration count (LC), the total inner iteration (II), the system balance (NB), the upscatter scale factor for the outer iteration (USF), the quantity (EQ) used in search calculations, the eigenvalue (EV), and the eigenvalue convergence λ. On the last outer iteration the group flux convergence for each group and the number of inner iterations is printed. Following the monitor printout is the system balance table as described in 2.5 of the user's manual.

Following the balance table, the radial and axial mesh line coordinates, fission edit, scalar flux, flux moments, and activities are printed. The final output page of a DOT-IIW problem is the tape numbers assigned to the final iterations of the calculation.

6.3.2 Tape Output

The magnetic tape output from the DOT-IIW code is the scalar flux output for use in CHEAPER, NAGS, or MAP and the angular flux tape for use as a boundary source input to another DOT-IIW problem. A description of the tape contents is described in Sections 2.5.2 and 2.5.3 of the DOT-IIW user's manual. In the reactor neutron problem a special angular flux tape is obtained for use in the shield neutron problem. This tape contains only 3 intervals of angular flux data instead of JM intervals of data.

6.4 Description of the DOQ Code

The ANISN-W and DOT-IIW codes use as input the angular quadrature data which defines the discrete directions and direction weight of the angular flux solution. In the ANISN-W and DOT-IIW user's manuals a listing of these data is supplied for use in the codes. In the S/W problems the angular quadrature data was obtained from these tables.

In order to assist the user of these codes, the computer code DOQ which calculates angular quadrature data is supplied in the MSFC computer code package. A detailed description of the DOQ code is in Appendix A of Volume 5, WANL-PR(LL)-034.

The following discussion demonstrates the use of the DOQ code to calculate angular quadrature data.

6.4.1 Input Data Description

The listing of the DOQ code input data for the S/W problem is given in Table 6-8. The S/W DOQ problem demonstrates the use of the code to produce S_8 quadrature data for no summetry, half symmetry, and full symmetry conditions. These three calculations produce S_8 quadrature data for use in the DOT-IIW code.

On the first card of input the maximum core memory locations required for this problem, LIM1, is entered. This value is 10,000 and is entered in columns 1-12. The second card of input contains six input values entered in the FORTRAN format (6I12). These values are:

1. The order of angular quadrature, NQD. In the DOQ S/W problem an S_8 quadrature is to be calculated for all three cases and NQD is input as 8. NQD must be entered as an even integer and values exceeding 16 have not been successfully generated.
2. Quadrature summetry condition, ISYM. This value is input as 1, 2, and 3 for the three cases and demonstrate the no, half, and full symmetry conditions imposed in the selection of the moment equations and point diagrams.
3. Moment equation option, LMRD. In the S/W problems the selection of moment equations is calculated by DOQ and IMRD is input as 0.
4. Direction cosine, η, calculation option, IET. In the S/W problems the code is used to calculate η's based on the input value of the direction cosines, μ. In this case IET is input as 0.

5. Direction cosine, μ, calculation option, NMU. In the S/W problem a single value of μ, is input and NMU is input as a 1. The DOQ code calculates the remaining values of μ based on the input value.

6. Dimensionality of output data, IDEM. The DOQ provides one or two dimensional quadrature data. IDEM is input as the dimensionality of the desired output. In the S/W problem, DOT-IIW output is desired and IDEM is input as 2.

The next set of input cards to DOQ are the direction cosines μ. Since the input value of NMU is 1, only a single value, μ_1, is input. The value of 0.2182179 in the input listing is the μ_1 of the S_8 quadrature sets listed in Table 2-1 of the DOT-IIW user's manual.

This completes the DOQ input since the η input is not required and the moment equations are to be supplied by the code.

6.4.2 Problem Setup Description

The DOQ problem setup is described in Section A-3 of the DOT-IIW user's manual. The DOQ code does not provide any magnetic tape output and the tape 12 required as a scratch tape can be assigned to FASTRAN on the MSFC computer system.

6.4.3 Output Data Description

The printed output from the DOQ code is described in detail in Section A-4 of the DOT-IIW user's manual. The printed data consists of the input data, a tabulation of the moment equations and point diagram used in the calculation, the matrix solution error, the order of quadrature calculated, initial directions in the quadratureset, the point weights, the results of the gamma function calculation, and finally the calculated angular quadrature data.

The punched card output is in a (6E12.5) FORTRAN format and consists of the angular quadrature data as printed in the final section of the output.

6.5 Description of the ADOQ Code

The calculation of radiation transport through voids or near voids and the calculation of radiation streaming through shields using the discrete ordinate transport techniques of DOT-IIW with low order quadrature have been demonstrated to produce anomolous results. This behavior has necessitated the development of asymmetric quadrature techniques in DOT-IIW. Asymmetric quadratures are specialized quadrature data tailored to produce discrete directions in the perferred direction of solution. In order to accurately calculate these asymmetric quadrature data the ADOQ code was developed. The ADOQ code is intended for calculating quadrature in the specific application of a DOT-IIW calculation of radiation transport along the z axis of an r-z two dimensional solution. The asymmetric quadrature for ADOQ is used in the DOT-IIW or MAP codes of the MSFC code package.

The detailed description of the ADOQ code is in Appendix B of Volume 5, WANL-PR(LL)-034. The following discussion demonstrates the use of the ADOQ code to calculate a specific set of asymmetric angular quadrature data for use in DOT-IIW.

6.5.1 Input Data Description

The listing of the ADOQ code input data for the S/W problem is given in Table 6-9. This S/W ADOQ problem demonstrates the use of the code to produce a quadrature set with 80 angles based on an S_{10} and S_6 quadrature set.

The first input card of an ADOQ problem contains three pieces of data. This data is entered in a (6I12) FORTRAN format. The S/W problem input is:

1. The number of direction cosine μ angles in the asymmetric portion, NAZ. This value is input as an even integer and results in NAZ/2 discrete directions in each η level of each octant of the quadrature. In the S/W problem, NAZ is input as 2 for one discrete direction in each octant, i.e., one forward direction and one backward direction.

2. Number of η levels in the angular quadrature of the asymmetric portion, NPL. This value in the S/W problems is 11 for the first 11 quadrature points of an S_{96} Gauss quadrature. An S_{96} and S_{10} Gauss quadrature have an almost common boundary for the first level of the S_{10} and the first 11 levels of the S_{96}.

3. The direction of the asymmetric quadrature, NDR. This is entered as 0 since ADOQ provides data for both directions (up and down).

The second input card is the symmetric quadrature order of the quadrant to be made asymmetric, NQ1. This data is entered in columns 1-12 of the card.

The next set of data are the direction cosine data μ, direction cosine data η, and the direction weights of the symmetric quadrature of order NQ1. The S/W problem input is S_{10} data based on half symmetry conditions and is S_{10} Gauss mechanical quadrature data. These data are three sets of 70 values each.

Following the asymmetric quadrant data is the symmetric quadrant data. The first card of this input is the quadrature order NQ2. In the S/W problem an S_6 or NQZ = 6 is entered in columns 11-12. This card is followed by the direction cosine μ, direction cosine η, and direction weight data for an S_6 quadrature. These data are from Table 2-1 of the DOT-IIW user's manual.

The next set of ADOQ input is the quadrature points and weights to be used in subdividing the upper-most η level of the S_{10} quadrature data. In the S/W problem, the S_{96} Guass mechanical quadrature data is input. Only the first 12 values are input.

The final set of ADOQ input is the angles and angular widths (in degrees) of the azimuthal subdivision of the asymmetric quadrature. Since NAZ is input as 2, two values are input. The first card of input in the S/W problem contains these data in the order of inward to outward direction. Values of 131.0 and 49.0 degrees agree with the same data in the top η level of the S_{10} data. The second card of this set is input as the angular width in degrees. This data is used to determine the direction weights in the asymmetric quadrature portion.

This completes the input to a single ADOQ problem.

6.5.2 Problem Setup Information

The problem setup of an ADOQ problem is described in Section B-3 of the DOT-IIW user's manual. No special tapes are required and very little computer time. The code has fixed dimensions of certain variables which if desired could be expanded for larger problems.

6.5.3 Output Data Description

Printout from the ADOQ code consists of the following:

1. The asymmetric quadrature data including the input quadrature point, its weight, and the lower limit of the angular band in degrees and radians.

2. The quadrature data checks performed on the symmetric and asymmetric data.

3. The asymmetric quadrature data for the downward directed asymmetric followed by the upward directed asymmetric data.

The punched output from the ADOQ code consists of the asymmetric quadrature data described in 3 above. This data is proceeded by the 7U or 6U cards necessary for DOT-IIW input.

6.6 The CHEAPER Code

The CHEAPER code provides a rapid, economical method for reducing the DOT-IIW scalar flux output to a readily useable form. The code can perform several useful operations such as linking to flux tapes, modifying the flux tapes for use as a flux guess in problems of differing geometry, adding two tapes together, and calculating flux-response data.

The CHEAPER code user's manual is published in Volume 1 of this report.

6.6.1 Input Data Description

The listing of the CHEAPER code input data for the MSFC Seminar/ Workshop problem is given in Table 6-10. The function of this CHEAPER problem is to combine the neutron scalar flux output tapes from the two DOT-IIW neutron problems into one tape for input to the NAGS code (see Section 7.0 of this report).

On the first data card, the maximum number of core locations available for the input data is input. This value is 30,500.

The second card is used to provide a descriptive title for the problem.

The third card identifies to the program which of the available types of CHEAPER calculations is to be performed. The first data word in this card is input as a zero, i.e., IND = 0. From the CHEAPER user's manual, one notes that this selects the option to link two DOT-IIW scalar flux tapes axially. All other data (eleven pieces of data) on the third card must therefore be input as zeros.

The fourth card contains the following five pieces of data:

1. The number of radial mesh intervals in the input DOT-IIW scalar flux tape. This quantity is 40 for the neutron problem as shown in Table 6-1.

2. The number of radial mesh intervals desired in the output tape. This quantity must also be input as 40 for this CHEAPER code option.

3. The number of axial mesh intervals in the input DOT-IIW scalar flux. Since IND was input as zero on the third data card, this quantity is actually the number of axial mesh intervals in the final linked output tape. This quantity is input as 87 and was determined as follows: All the mesh intervals, i.e., 47, from the DOT-IIW shield geometry problem were selected, plus, 40 mesh intervals from the DOT-IIW reactor geometry problem (mesh intervals 10 through 50).

4. The number of axial mesh intervals in the desired output scalar flux tape. This quantity is input as 87 as described in Item 3 above.

5. The number of energy groups in the problem. This quantity is 16, which is the same as the DOT-IIW neutron group structure.

The fifth input data card contains three pieces of data as follows:

1. The flux normalization factor. This is simply 1.0 for the Seminar problem.

2. The reference plane distance, in inches, from the DOT-IIW geometry origin. This is input as 0.0 since the option selected in CHEAPER is simply to combine two flux tapes axially.

3. The plot frame size. This quantity is not used in the CHEAPER option selected for the Seminar problem and was simply input as 11.0.

Since IND was input as zero, card six is required as input. This card contains the following six pieces of data:

1. The number of axial mesh for tape 10 input. Tape 10 in this problem contains the DOT-IIW output tape for the shield geometry problem. Thus, all 47 axial mesh intervals are read in from this tape.

2. The number of axial mesh for tape 11 input. Tape 11 in this problem is the DOT-IIW output tape from the reactor geometry problem. Thus, all 50 axial mesh intervals are read in from this tape.

3. The first axial mesh cell to be used from tape 10 in combining the tapes. This is input as axial mesh cell one, i.e., the top of the geometry.

4. The last axial mesh cell to be used from tape 10 in combining the tapes. This is the last axial mesh cell on the tape at the bottom of the geometry, i.e., mesh cell 47.

5. The first axial mesh cell to be used from tape 11. This is input as axial mesh cell 10 from the reactor geometry tape.

6. The last axial mesh cell to be used from tape 11. This is the last mesh cell, i.e., 50 at the bottom of the reactor geometry.

The next set of input data required, as shown in Table 6-1, contains the radial mesh coordinates for the input DOT-IIW scalar flux tape. Forty-one entries are required. These data can be obtained from Table 6-1.

The last set of input data required for the Seminar problem contains the axial mesh coordinates. A total of 88 entries are required. These entries begin at the top of the geometry and end at the bottom of the geometry. The first 48 entries can be obtained from Table 6-2. The last 40 entries can be obtained from Table 6-3 beginning with mesh line 12.

6.6.2 Problem Setup Description

In order to execute the CHEAPER problem, the two DOT-IIW output scalar flux tapes must be input on Tape Units 10 and 11. The CHEAPER output tape is then placed on Tape Unit 12.

6.6.3 Output Data Description

Initially, the CHEAPER code prints out the title card input, all the input data parameters, and the number of data storage locations used in the problem. This is followed by the input and output radial and axial mesh coordinates.

The next section of printout for the Seminar problem contains the <u>output</u> scalar flux by group and by mesh cell.

TABLE 6-1

RADIAL MESH LINE COORDINATES FOR THE DOT-IIW PROBLEM

Neutron Mesh Line No.	Radius (cm)	Photon Mesh Line No.
1	0.0	1
2	3.0	2
3	6.0	3
4	9.0	4
5	12.0	5
6	15.0	6
7	18.0	7
8	21.0	8
9	25.0	9
10	27.0	10
11	29.184	11
12	30.0*	-
13	32.0	12
14	34.0	13
15	36.094	14
16	38.0	15
17	40.0*	-
18	40.971	16
19	42.0	17
20	43.0*	-
21	44.0	18
22	44.654	19
23	45.0	20
24	46.0	21
25	46.99	22
26	49.0	23
27	51.0	24
28	53.34	25
29	54.0*	-
30	55.88	26
31	57.5	27
32	60.0	28
33	61.92	29
34	62.05*	-
35	62.174	30
36	63.0	31
37	65.0	32
38	67.0	33
39	68.58	34
40	70.5*	-
41	71.12	35

*Deleted for the photon problem.

TABLE 6-2

AXIAL MESH LINE COORDINATES FOR THE NEUTRON REACTOR GEOMETRY DOT-IIW PROBLEM

Mesh Line No.	Z (cm)	Mesh Line No.	Z (cm)
1	-175.0*	27	-136.0
2	-174.0	28	-134.0
3	-173.0*	29	-130.0
4	-172.0	30	-122.0
5	-171.0*	31	-114.0
6	-170.0	32	-104.0
7	-169.0*	33	-94.0
8	-168.0	34	-84.0
9	-166.83	35	-74.0
10	-166.0*	36	-64.0
11	-164.67	37	-58.0*
12	-163.0*	38	-53.0
13	-162.0	39	-48.0*
14	-161.29	40	-43.0
15	-159.0	41	-38.0*
16	-157.0*	42	-33.0
17	-155.0	43	-28.0*
18	-153.0*	44	-23.0
19	-151.0	45	-18.0*
20	-149.0*	46	-13.0
21	-147.0	47	-8.0
22	-146.05	48	-6.0*
23	-144.0	49	-5.08
24	-142.0*	50	-2.0
25	-140.0	51	0.0
26	-137.16		

*Deleted for the photon problem.

C.4

TABLE 6-3

AXIAL MESH LINE COORDINATES FOR THE NEUTRON SHIELD GEOMETRY DOT-IIW PROBLEM

Mesh Line No.	Z (cm)	Mesh Line No.	Z (cm)
1	-230.48	25	-188.0
2	-229.21	26	-187.0*
3	-227.94	27	-186.0
4	-224.94	28	-185.0*
5	-221.94	29	-184.0
6	-218.94*	30	-183.0*
7	-215.94	31	-182.0
8	-212.94	32	-181.0*
9	-209.94	33	-180.0
10	-206.94	34	-179.0*
11	-203.94	35	-178.0
12	-200.94	36	-177.0*
13	-197.94	37	-176.0
14	-197.625	38	-175.0*
15	-197.31	39	-174.0
16	-197.0*	40	-173.0*
17	-196.0	41	-172.0
18	-195.0*	42	-171.0*
19	-194.0	43	-170.0
20	-193.0*	44	-169.0*
21	-192.0	45	-168.0
22	-191.0*	46	-166.83
23	-190.0	47	-166.0
24	-189.0*	48	-164.67

*Deleted for the photon problem.

TABLE 6-4

AXIAL MESH LINE COORDINATES FOR THE PHOTON DOT-IIW PROBLEM FOR THE NSS GEOMETRY

Mesh Line No.	Z (cm)	Mesh Line No.	Z (cm)
1	-230.48	31	-164.67
2	-229.21	32	-161.29
3	-227.94	33	-159.0
4	-224.94	34	-155.0
5	-221.94	35	-151.0
6	-215.94	36	-147.0
7	-212.94	37	-146.05
8	-209.94	38	-144.0
9	-206.94	39	-140.0
10	-203.94	40	-137.16
11	-200.94	41	-136.0
12	-197.94	42	-134.0
13	-197.625	43	-130.0
14	-197.31	44	-122.0
15	-196.0	45	-114.0
16	-194.0	46	-104.0
17	-192.0	47	-94.0
18	-190.0	48	-84.0
19	-188.0	49	-74.0
20	-186.0	50	-64.0
21	-184.0	51	-53.0
22	-182.0	52	-43.0
23	-180.0	53	-33.0
24	-178.0	54	-23.0
25	-176.0	55	-13.0
26	-174.0	56	-8.0
27	-172.0	57	-5.08
28	-170.0	58	-2.0
29	-168.0	59	0.0
30	-166.83		

TABLE 6-5. LISTING OF THE DOT-IIW INPUT DATA FOR THE REACTOR GEOMETRY NEUTRON SEMINAR/WORKSHOP PROBLEM

```
   40000     5    6    1    2    8    3    4    0    0    0    0    0    0    0
MSFC SEMINAR-WORKSHOP DOT PROBLEM, NEUTRON TRANSPORT IN REACTOR
           1           0           0          48           1          19
          40          50           0         0.0         0.0       0.001
           1           0           0           0           0           1
          20           0          20           0           0           0
           0         0.0          16           3           4          13
     1.2+20            5           3          10           0          10
         0.0       0.001         0.0         0.0         0.0         0.0
           1          24          24           4           4           1
           0          10           0           0       0.001           0
14U
 1.17421E-03 3.15633E-03 9.63798E-02 5.42859E-02 0.          0.
 0.          0.          0.          0.          0.          0.
 0.          1.14303E-03 2.78186E-03 1.06189E-01 7.61298E-02 3.15204E-02
 0.          0.          0.          0.          0.          0.
 0.          0.          1.11893E-03 2.49557E-03 1.38376E-01 9.58963E-02
 2.38819E-02 3.95783E-03 0.          0.          0.          0.
 0.          0.          0.          1.16294E-03 2.35639E-03 1.82210E-01
 1.46199E-01 3.95797E-02 3.31697E-03 3.57681E-03 0.          0.
 0.          0.          0.          0.          1.46884E-03 2.73228E-03
 2.31968E-01 2.05368E-01 3.42911E-02 1.51460E-03 1.49255E-03 1.64593E-03
 0.          0.          0.          0.          0.          2.59348E-03
 4.33138E-03 2.74078E-01 2.53807E-01 2.48673E-02 4.88287E-04 2.40735E-04
 2.11198E-04 2.10577E-04 0.          0.          0.          0.
 5.21259E-03 8.12024E-03 2.80813E-01 2.38450E-01 1.67836E-02 1.67586E-04
 4.37739E-05 1.67900E-05 9.01181E-06 5.34337E-06 0.          0.
 0.          9.15318E-03 1.30265E-02 2.77795E-01 2.54745E-01 3.67014E-02
 7.99978E-04 8.56250E-05 2.27441E-05 8.51715E-06 3.58379E-06 1.68354E-06
 0.          0.          2.32937E-02 3.29696E-02 2.91988E-01 2.55605E-01
 1.35612E-02 3.88972E-04 8.14637E-05 8.57459E-06 1.95738E-06 7.37634E-07
```

TABLE 6-5 (CONT)

7.07488E-07	1.10036E-06	0.	4.67099E-02	6.84976E-02	3.13045E-01
2.58492E-01	1.27443E-02	2.89991E-04	5.26401E-05	1.10245E-05	1.15619E-06
2.48675E-07	1.19953E-07	4.44050E-08	3.15113E-08	4.45730E-02	5.49473E-02
3.10198E-01	2.46817E-01	7.47032E-03	2.84962E-04	3.75013E-05	6.80734E-06
1.42646E-06	1.49361E-07	3.36792E-08	1.21102E-08	6.01417E-09	4.78169E-02
9.64203E-02	3.08164E-01	2.54164E-01	1.83279E-02	3.12070E-04	5.02672E-05
6.61541E-06	1.20154E-06	2.52045E-07	2.66518E-08	5.88270E-09	2.54705E-09
1.80046E-01	3.55623E-01	4.45433E-01	2.49373E-01	5.21715E-03	2.94740E-04
3.60080E-05	5.80006E-06	7.63316E-07	1.38639E-07	2.90821E-08	3.07520E-09
8.76075E-10	2.49741E-01	5.12171E-01	5.23734E-01	2.64357E-01	1.18586E-02
5.72947E-04	9.78060E-05	1.20027E-05	1.93335E-06	2.54439E-07	4.62130E-08
9.69404E-09	1.64375E-09	4.13739E-01	8.49464E-01	7.01933E-01	2.86214E-01
8.00193E-03	3.44320E-03	3.00049E-04	6.25261E-05	8.00179E-06	1.28890E-06
1.69626E-07	3.08087E-08	9.02088E-09	8.85407E-01	1.81909E+00	1.18610E+00
3.00691E-01	1.97969E-03	1.63347E-03	7.12284E-04	9.30326E-05	2.51170E-05
4.00089E-06	6.44451E-07	8.45826E-08	1.45325E-08		
1.44392E-03	3.94192E-03	9.76978E-02	5.47011E-02	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.41749E-03	3.47559E-03	1.07612E-01	7.69224E-02	3.17876E-02
0.	0.	0.	0.	0.	0.
0.	0.	1.38300E-03	3.11711E-03	1.39919E-01	9.67851E-02
2.39539E-02	4.07076E-03	0.	0.	0.	0.
0.	0.	0.	1.43121E-03	2.94326E-03	1.84052E-01
1.47450E-01	3.98531E-02	3.48478E-03	3.72732E-03	0.	0.
0.	0.	0.	0.	1.80910E-03	3.41277E-03
2.34575E-01	2.07487E-01	3.45764E-02	1.60596E-03	1.59426E-03	1.73536E-03
0.	0.	0.	0.	0.	3.18524E-03
5.40030E-03	2.77813E-01	2.57026E-01	2.50128E-02	5.22543E-04	2.64648E-04
2.25183E-04	2.23172E-04	0.	0.	0.	0.

TABLE 6-5 (CONT)

6.31754E-03	1.01426E-02	2.85400E-01	2.41789E-01	1.67117E-02	1.69298E-04
4.60473E-05	1.76610E-05	9.31365E-06	5.60759E-06	0.	0.
0.	1.11010E-02	1.62373E-02	2.83439E-01	2.58505E-01	3.68436E-02
7.96365E-04	8.61140E-05	2.39181E-05	8.93561E-06	3.64115E-06	1.73651E-06
0.	0.	2.84228E-02	4.11780E-02	3.00842E-01	2.59300E-01
1.34998E-02	3.88972E-04	8.10878E-05	8.58755E-06	1.98749E-06	7.48733E-07
7.41800E-07	1.19302E-06	0.	5.76429E-02	8.49564E-02	3.27949E-01
2.62575E-01	1.27740E-02	2.88732E-04	5.26401E-05	1.09735E-05	1.15688E-06
2.48675E-07	1.22257E-07	4.48411E-08	3.31994E-08	5.06532E-02	6.28657E-02
3.20089E-01	2.45059E-01	7.36298E-03	2.84857E-04	3.73385E-05	6.80734E-06
1.42007E-06	1.49379E-07	3.36792E-08	1.21102E-08	6.00334E-09	5.95026E-02
1.20420E-01	3.23487E-01	2.57797E-01	2.38521E-02	3.08677E-04	5.02487E-05
6.58670E-06	1.20154E-06	2.50880E-07	2.66518E-08	5.88270E-09	2.54705E-09
2.24475E-01	4.43988E-01	4.93469E-01	2.52852E-01	5.21993E-03	3.22622E-04
3.56166E-05	5.79793E-06	7.60003E-07	1.38639E-07	2.89476E-08	3.07520E-09
8.76075E-10	3.09915E-01	6.36540E-01	5.87320E-01	2.67405E-01	1.19701E-02
5.73548E-04	1.06995E-04	1.18722E-05	1.93264E-06	2.53334E-07	4.62130E-08
9.64922E-09	1.64375E-09	5.14189E-01	1.05713E+00	8.05849E-01	2.89532E-01
8.34297E-03	3.45784E-03	3.00858E-04	6.80172E-05	7.91480E-06	1.28843E-06
1.68890E-07	3.08087E-08	8.97664E-09	1.09285E+00	2.24808E+00	1.39773E+00
3.04887E-01	2.12738E-03	1.65676E-03	7.14001E-04	9.33256E-05	2.64049E-05
3.95740E-06	6.44214E-07	8.42127E-08	1.45325E-08		
1.54047E-03	4.23149E-03	9.79435E-02	5.47132E-02	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.51770E-03	3.73228E-03	1.07873E-01	7.71115E-02	3.18167E-02
0.	0.	0.	0.	0.	0.
0.	0.	1.48014E-03	3.34649E-03	1.40205E-01	9.69354E-02
2.38326E-02	4.10000E-03	0.	0.	0.	0.
0.	0.	0.	1.52980E-03	3.15976E-03	1.84199E-01
1.47553E-01	3.98553E-02	3.53752E-03	3.77311E-03	0.	0.
0.	0.	0.	0.	1.93405E-03	3.66347E-03
2.34688E-01	2.07533E-01	3.45082E-02	1.63429E-03	1.63044E-03	1.76410E-03
0.	0.	0.	0.	0.	3.40917E-03
5.80520E-03	2.78309E-01	2.57153E-01	2.49547E-02	5.34971E-04	2.72391E-04
2.29631E-04	2.27215E-04	0.	0.	0.	0.
6.71379E-03	1.08635E-02	2.86179E-01	2.41664E-01	1.68552E-02	1.69762E-04
4.68783E-05	1.79618E-05	9.37631E-06	5.67636E-06	0.	0.
0.	1.19007E-02	1.75467E-02	2.84482E-01	2.58011E-01	3.73499E-02
7.97870E-04	8.62109E-05	2.43471E-05	9.08645E-06	3.64228E-06	1.74289E-06
0.	0.	3.11097E-02	4.53380E-02	3.03720E-01	2.58369E-01
1.42324E-02	3.90293E-04	8.12382E-05	8.58365E-06	1.99771E-06	7.52753E-07
7.26172E-07	1.16195E-06	0.	6.49362E-02	9.48968E-02	3.35628E-01
2.61831E-01	1.38849E-02	2.92699E-04	5.28189E-05	1.09938E-05	1.15594E-06
2.48535E-07	1.21309E-07	4.46014E-08	3.26437E-08	5.29981E-02	6.50610E-02

TABLE 6-5 (CONT)

3.22785E-01	2.42455E-01	8.47879E-03	2.94291E-04	3.78515E-05	6.83046E-06
1.42276E-06	1.49219E-07	3.36581E-08	1.21102E-08	5.99271E-09	6.75137E-02
1.37158E-01	3.31896E-01	2.56756E-01	2.67793E-02	3.20609E-04	5.19129E-05
6.67719E-06	1.20562E-06	2.51343E-07	2.66245E-08	5.87939E-09	2.54705E-09
2.41230E-01	4.79477E-01	5.10797E-01	2.52279E-01	6.55973E-03	3.40789E-04
3.69933E-05	5.98995E-06	7.70445E-07	1.39110E-07	2.90011E-08	3.07205E-09
8.75581E-10	3.33426E-01	6.85310E-01	6.11355E-01	2.67206E-01	1.27538E-02
6.44591E-04	1.12985E-04	1.23311E-05	1.99665E-06	2.56815E-07	4.63699E-08
9.66705E-09	1.64207E-09	5.38872E-01	1.10853E+00	8.29644E-01	2.87957E-01
8.98970E-03	3.75210E-03	3.22814E-04	7.16114E-05	8.22073E-06	1.33110E-06
1.71210E-07	3.09133E-08	8.99321E-09	1.15492E+00	2.37712E+00	1.44744E+00
2.92521E-01	2.81496E-03	1.73396E-03	7.81956E-04	9.90147E-05	2.72862E-05
4.11037E-06	6.65549E-07	8.53728E-08	1.45819E-08		
1.49475E-03	4.07557E-03	9.83396E-02	5.49596E-02	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.46658E-03	3.59595E-03	1.08207E-01	7.74416E-02	3.20367E-02
0.	0.	0.	0.	0.	0.
0.	0.	1.42877E-03	3.22395E-03	1.40590E-01	9.72246E-02
2.39098E-02	4.09638E-03	0.	0.	0.	0.
0.	0.	0.	1.47751E-03	3.04405E-03	1.84694E-01
1.47990E-01	4.00094E-02	3.52933E-03	3.76114E-03	0.	0.
0.	0.	0.	0.	1.86750E-03	3.52932E-03
2.35296E-01	2.08116E-01	3.46253E-02	1.62881E-03	1.61676E-03	1.75591E-03
0.	0.	0.	0.	0.	3.29884E-03
5.60105E-03	2.79555E-01	2.58292E-01	2.50476E-02	5.28223E-04	2.70433E-04
2.28924E-04	2.26272E-04	0.	0.	0.	0.
6.49920E-03	1.04657E-02	2.87465E-01	2.42970E-01	1.70686E-02	1.69429E-04
4.64296E-05	1.78425E-05	9.42230E-06	5.70381E-06	0.	0.
0.	1.15639E-02	1.69834E-02	2.85716E-01	2.59256E-01	3.75446E-02
8.00917E-04	8.61153E-05	2.41154E-05	9.01307E-06	3.67077E-06	1.76691E-06
0.	0.	3.02214E-02	4.38790E-02	3.04711E-01	2.59253E-01
1.45548E-02	3.90293E-04	8.15501E-05	8.58112E-06	1.99177E-06	7.50753E-07
7.86438E-07	1.31796E-06	0.	6.47651E-02	9.31607E-02	3.37058E-01
2.60827E-01	1.48726E-02	2.95577E-04	5.28189E-05	1.10360E-05	1.15581E-06
2.48535E-07	1.25336E-07	4.54379E-08	3.54867E-08	5.20210E-02	6.32459E-02
3.23431E-01	2.45772E-01	1.10485E-02	3.00975E-04	3.82238E-05	6.83046E-06
1.42818E-06	1.49250E-07	3.36581E-08	1.21102E-08	5.98858E-09	7.06060E-02
1.43813E-01	3.36877E-01	2.56784E-01	2.50960E-02	3.50255E-04	5.30918E-05
6.74285E-06	1.20562E-06	2.52308E-07	2.66245E-08	5.87939E-09	2.54705E-09
2.33177E-01	4.64633E-01	5.04638E-01	2.54010E-01	8.28217E-03	3.33797E-04
4.04140E-05	6.12598E-06	7.78021E-07	1.39110E-07	2.91124E-08	3.07205E-09
8.75581E-10	3.27872E-01	6.73285E-01	6.08356E-01	2.70581E-01	1.26999E-02
7.40890E-04	1.10683E-04	1.34713E-05	2.04199E-06	2.59340E-07	4.63699E-08
9.70414E-09	1.64207E-09	5.29172E-01	1.08770E+00	8.22216E-01	2.89919E-01

TABLE 6-5 (CONT)

8.12736E-03	3.91896E-03	3.56057E-04	7.02501E-05	8.98090E-06	1.36133E-06
1.72893E-07	3.09133E-08	9.02981E-09	1.06886E+00	2.19826E+00	1.36393E+00
2.95064E-01	3.12514E-03	1.77534E-03	8.32255E-04	1.07973E-04	2.70034E-05
4.49045E-06	6.80665E-07	8.62186E-08	1.45819E-08		
1.17257E-03	3.07285E-03	9.85253E-02	5.54130E-02	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.12490E-03	2.71095E-03	1.08317E-01	7.78601E-02	3.24000E-02
0.	0.	0.	0.	0.	0.
0.	0.	1.09394E-03	2.43084E-03	1.40786E-01	9.75599E-02
2.42081E-02	4.01871E-03	0.	0.	0.	0.
0.	0.	0.	1.13708E-03	2.29520E-03	1.85057E-01
1.48564E-01	4.03086E-02	3.38695E-03	3.62689E-03	0.	0.
0.	0.	0.	0.	1.43508E-03	2.66109E-03
2.35511E-01	2.08571E-01	3.48024E-02	1.54967E-03	1.50544E-03	1.67041E-03
0.	0.	0.	0.	0.	2.54868E-03
4.23473E-03	2.80805E-01	2.59824E-01	2.52414E-02	4.84535E-04	2.47881E-04
2.17006E-04	2.14648E-04	0.	0.	0.	0.
5.10165E-03	7.89107E-03	2.88273E-01	2.44675E-01	1.75313E-02	1.67256E-04
4.35260E-05	1.68825E-05	9.35470E-06	5.59026E-06	0.	0.
0.	9.08874E-03	1.28844E-02	2.85633E-01	2.61127E-01	3.80450E-02
8.06369E-04	8.54931E-05	2.26160E-05	8.50541E-06	3.71843E-06	1.79781E-06
0.	0.	2.35598E-02	3.32477E-02	3.01329E-01	2.61341E-01
1.50709E-02	3.90293E-04	8.21156E-05	8.56467E-06	1.95332E-06	7.37131E-07
9.37818E-07	1.69540E-06	0.	5.08949E-02	7.18136E-02	3.25357E-01
2.60420E-01	1.60557E-02	2.99382E-04	5.28189E-05	1.11127E-05	1.15494E-06
2.48535E-07	1.35129E-07	4.75897E-08	4.23396E-08	4.19814E-02	5.04032E-02
3.15784E-01	2.50720E-01	1.35912E-02	3.08156E-04	3.87158E-05	6.83046E-06
1.43784E-06	1.49327E-07	3.36581E-08	1.21102E-08	5.99504E-09	5.93985E-02
1.20438E-01	3.28391E-01	2.56862E-01	2.25642E-02	3.77825E-04	5.43585E-05
6.82963E-06	1.20562E-06	2.54060E-07	2.66245E-08	5.87939E-09	2.54705E-09
1.77032E-01	3.51706E-01	4.51128E-01	2.57070E-01	1.07323E-02	3.19187E-04
4.35951E-05	6.27214E-06	7.88035E-07	1.39110E-07	2.93146E-08	3.07205E-09
8.75581E-10	2.52530E-01	5.16081E-01	5.36441E-01	2.75838E-01	1.22762E-02
8.77754E-04	1.05808E-04	1.45317E-05	2.09071E-06	2.62678E-07	4.63699E-08
9.77152E-09	1.64207E-09	4.11914E-01	8.43057E-01	7.09364E-01	2.95208E-01
6.45839E-03	3.90438E-03	4.01126E-04	6.73710E-05	9.68781E-06	1.39381E-06
1.75119E-07	3.09133E-08	9.09631E-09	8.09472E-01	1.65812E+00	1.10726E+00
2.97788E-01	2.24237E-03	1.61466E-03	8.46073E-04	1.19876E-04	2.63245E-05
4.84391E-06	6.96904E-07	8.73366E-08	1.45819E-08		
6.96841E-05	0.	8.77282E-02	5.42867E-02	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	9.57563E-02	6.87563E-02	3.21553E-02
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.27097E-01	7.99249E-02

TABLE 6-5 (CONT)

2.69612E-02	7.18279E-04	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.62659E-01
1.22978E-01	4.71272E-02	2.04623E-05	3.83247E-04	0.	0.
0.	0.	0.	0.	0.	0.
2.08260E-01	1.79417E-01	3.96471E-02	3.18170E-05	1.30705E-05	1.05883E-04
0.	0.	0.	0.	0.	2.06791E-08
0.	2.41578E-01	2.21245E-01	2.88211E-02	2.93765E-05	1.10471E-05
4.53818E-06	8.60820E-06	0.	0.	0.	0.
4.88620E-07	0.	2.46124E-01	2.04262E-01	2.02555E-02	1.35891E-05
2.90646E-06	1.09298E-06	4.48999E-07	2.06462E-07	0.	0.
0.	8.14130E-07	0.	2.47785E-01	2.30918E-01	4.18238E-02
6.90540E-05	7.07496E-06	1.51321E-06	5.69044E-07	2.33765E-07	2.70539E-07
0.	0.	2.38712E-06	0.	2.48318E-01	2.30364E-01
1.68366E-02	3.28245E-05	7.03468E-06	7.20742E-07	1.54154E-07	5.79698E-08
2.38142E-08	6.93533E-09	0.	6.28743E-06	0.	2.48328E-01
2.32192E-01	1.79196E-02	2.57629E-05	4.44231E-06	9.52040E-07	9.75419E-08
2.08625E-08	7.84536E-09	3.22290E-09	1.08550E-09	1.65990E-05	0.
2.48339E-01	2.27314E-01	1.60895E-02	2.67281E-05	3.33164E-06	5.74476E-07
1.23117E-07	1.26140E-08	2.69791E-09	1.01455E-09	5.04441E-10	3.69986E-05
0.	2.44411E-01	2.29910E-01	2.09660E-02	3.35110E-05	4.71482E-06
5.87715E-07	1.01399E-07	2.17656E-08	2.25393E-09	4.93881E-10	2.13384E-10
7.33215E-05	0.	2.50122E-01	2.33799E-01	1.37954E-02	2.56149E-05
3.86665E-06	5.44018E-07	6.78132E-08	1.16999E-08	2.51141E-09	2.60069E-10
7.35507E-11	1.09060E-04	0.	2.62412E-01	2.57050E-01	1.25762E-02
5.35849E-04	8.49796E-06	1.28888E-06	1.81339E-07	2.26044E-08	3.89996E-09
8.37138E-10	1.39011E-10	1.63532E-04	0.	2.79096E-01	2.78244E-01
4.48227E-03	3.15996E-03	1.11156E-04	5.42022E-06	8.59257E-07	1.20893E-07
1.50696E-08	2.59997E-09	7.80120E-10	3.11660E-04	0.	2.71423E-01
2.71112E-01	6.88955E-04	7.70783E-04	5.14293E-04	2.12974E-05	2.14762E-06
4.29628E-07	6.04464E-08	7.51674E-09	1.22641E-09		
1.25644E-03	0.	9.25396E-02	4.47565E-02	0.	0.
0.	0.	0.	0.	0.	0.
0.	6.85917E-05	0.	1.26849E-01	9.98407E-02	2.63803E-02
0.	0.	0.	0.	0.	0.
0.	0.	3.84751E-05	0.	1.41982E-01	1.07419E-01
2.00006E-02	8.54383E-03	0.	0.	0.	0.
0.	0.	0.	4.23501E-05	0.	1.98334E-01
1.73413E-01	2.83404E-02	6.03220E-03	8.74118E-03	0.	0.
0.	0.	0.	0.	1.27248E-04	0.
2.64586E-01	2.47014E-01	2.45215E-02	6.00820E-03	8.10047E-04	2.81339E-03
0.	0.	0.	0.	0.	3.04767E-04
0.	2.96094E-01	2.90728E-01	1.72193E-02	3.08287E-04	1.57084E-04
8.53459E-05	4.17474E-05	0.	0.	0.	0.
4.01251E-04	0.	1.05023E-01	9.09116E-02	4.23347E-03	1.42566E-04

TABLE 6-5 (CONT)

3.04923E-05	1.22377E-05	6.66424E-06	2.51977E-06	0.	0.
0.	1.71325E-04	0.	1.05500E-01	1.00229E-01	1.33121E-02
7.40972E-04	7.42250E-05	1.58754E-05	6.10094E-06	3.18750E-06	1.17454E-06
0.	0.	2.52502E-04	0.	1.05766E-01	9.99540E-02
4.78333E-03	3.44370E-04	7.54845E-05	7.56147E-06	1.61726E-06	6.10477E-07
1.29349E-06	2.39654E-06	0.	6.10123E-04	0.	1.06754E-01
1.00887E-01	5.21507E-03	2.73686E-04	4.66053E-05	1.02157E-05	1.02333E-06
2.18873E-07	1.07929E-07	4.75905E-08	5.30289E-08	1.53409E-03	0.
1.07716E-01	1.00088E-01	4.82676E-03	2.84312E-04	3.53928E-05	6.02695E-06
1.32109E-06	1.32336E-07	2.83044E-08	1.06439E-08	5.34836E-09	3.72191E-03
0.	1.08828E-01	1.02548E-01	5.65859E-03	3.60687E-04	5.01526E-05
6.24342E-06	1.06380E-06	2.33543E-07	2.36465E-08	5.18142E-09	2.23866E-09
7.37907E-03	0.	1.13024E-01	1.02545E-01	1.58950E-03	2.67786E-04
4.16177E-05	5.78683E-06	7.20395E-07	1.22746E-07	2.69472E-08	2.72844E-09
7.71637E-10	1.08971E-02	0.	1.17232E-01	1.04496E-01	1.59210E-03
5.32590E-04	8.88428E-05	1.38726E-05	1.92894E-06	2.40132E-07	4.09153E-08
8.98241E-09	1.45840E-09	1.60553E-02	0.	1.23647E-01	1.07029E-01
1.27075E-03	1.13145E-03	3.29559E-04	5.66814E-05	9.24838E-06	1.28596E-06
1.60088E-07	2.72769E-08	8.38156E-09	3.04924E-02	0.	1.42159E-01
1.11666E-01	5.62642E-04	5.68167E-04	3.76518E-04	1.06220E-04	2.24948E-05
4.62419E-06	6.42981E-07	7.98591E-08	1.28666E-08		
-3.17786E-02	0.	1.27786E-01	4.82227E-02	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.44538E-03	0.	1.40729E-01	8.26668E-02	5.84039E-02
0.	0.	0.	0.	0.	0.
0.	0.	1.64786E-04	0.	2.13903E-01	1.10369E-01
4.98506E-02	1.35758E-02	0.	0.	0.	0.
0.	0.	0.	1.01234E-05	0.	3.03860E-01
2.17344E-01	1.00394E-01	3.59472E-03	3.09534E-02	0.	0.
0.	0.	0.	0.	1.72265E-05	0.
3.59553E-01	2.85805E-01	8.47059E-02	2.27450E-03	2.11899E-03	6.62282E-03
0.	0.	0.	0.	0.	4.56101E-05
0.	4.59167E-01	3.98069E-01	7.25920E-02	1.55649E-03	6.07550E-04
9.77741E-04	1.62106E-03	0.	0.	0.	0.
7.35257E-05	0.	4.57608E-01	3.41018E-01	5.68678E-02	7.19982E-04
1.53991E-04	5.83251E-05	5.98556E-05	1.59522E-04	0.	0.
0.	5.25462E-05	0.	4.58163E-01	4.05033E-01	1.14505E-01
3.74303E-03	3.74849E-04	8.01734E-05	3.02201E-05	1.31629E-05	3.73097E-06
0.	0.	8.27438E-05	0.	4.58553E-01	4.01254E-01
5.14503E-02	1.73912E-03	3.81311E-04	3.81867E-05	8.16745E-06	3.07263E-06
1.87935E-06	1.53666E-06	0.	1.85879E-04	0.	4.58992E-01
4.04103E-01	5.54596E-02	1.40744E-03	2.35365E-04	5.16048E-05	5.16801E-06
1.10534E-06	4.29509E-07	1.83086E-07	7.68926E-08	4.60217E-04	0.
4.59287E-01	3.96622E-01	5.24893E-02	1.45100E-03	1.82009E-04	3.04371E-05

TABLE 6-5 (CONT)

6.67348E-06	6.68321E-07	1.42942E-07	5.37536E-08	2.75466E-08	1.12000E-03
0.	4.83625E-01	4.27415E-01	5.99950E-02	1.85671E-03	2.55956E-04
3.21070E-05	5.37236E-06	1.17974E-06	1.19419E-07	2.61670E-08	1.13056E-08
2.19302E-03	0.	4.89553E-01	4.14653E-01	4.94474E-02	1.35845E-03
2.14235E-04	2.95334E-05	3.70465E-06	6.19888E-07	1.36124E-07	1.37791E-08
3.89690E-09	3.26238E-03	0.	4.97307E-01	4.59475E-01	5.71489E-02
3.37692E-03	4.50677E-04	7.14118E-05	9.84445E-06	1.23488E-06	2.06629E-07
4.53748E-08	7.36516E-09	4.83005E-03	0.	5.51723E-01	5.42699E-01
2.78639E-02	1.30934E-02	1.72095E-03	2.87459E-04	4.76079E-05	6.56297E-06
8.23256E-07	1.37753E-07	4.23402E-08	9.18050E-03	0.	5.82697E-01
5.73517E-01	4.19389E-03	6.70619E-03	2.46415E-03	5.44808E-04	1.13910E-04
2.38039E-05	3.28148E-06	4.10730E-07	6.49784E-08		
2.56008E-03	0.	2.56008E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	3.81309E-03	0.	3.81309E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	4.91300E-03	0.	4.91300E-03	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	6.56000E-03	0.	6.56000E-03
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.03100E-02	0.
1.03100E-02	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	2.13739E-02
0.	2.13739E-02	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
3.87600E-02	0.	3.87600E-02	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	7.56096E-02	0.	7.56096E-02	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	1.54573E-01	0.	1.54573E-01	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	2.50467E-01	0.	2.50467E-01
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	3.43212E-01	0.
3.43212E-01	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	4.17001E-01
0.	4.17001E-01	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
4.77242E-01	0.	4.77242E-01	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	5.20400E-01	0.	5.20400E-01	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	5.78420E-01	0.	5.78420E-01	0.
0.	0.	0.	0.	0.	0.

TABLE 6-5 (CONT)

0.	0.	0.	6.81800E-01	0.	6.81800E-01
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
-3.28221E-02	0.	1.32905E-01	5.29655E-02	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.80425E-03	0.	1.45995E-01	8.29965E-02	5.82379E-02
0.	0.	0.	0.	0.	0.
0.	0.	1.83081E-04	0.	2.22767E-01	1.16866E-01
5.45713E-02	1.44057E-02	0.	0.	0.	0.
0.	0.	0.	2.63665E-05	0.	3.15681E-01
2.27487E-01	1.02411E-01	3.84656E-03	3.16463E-02	0.	0.
0.	0.	0.	0.	3.35314E-05	0.
3.74597E-01	2.99552E-01	8.63675E-02	2.55952E-03	2.01740E-03	6.66078E-03
0.	0.	0.	0.	0.	9.51290E-05
0.	4.89980E-01	4.27633E-01	7.38723E-02	1.55659E-03	6.53910E-04
8.83296E-04	1.64329E-03	0.	0.	0.	0.
1.72264E-04	0.	4.88985E-01	3.69652E-01	5.80824E-02	7.19982E-04
1.53991E-04	5.91930E-05	5.82509E-05	1.59977E-04	0.	0.
0.	1.42087E-04	0.	4.90222E-01	4.34550E-01	1.17149E-01
3.73067E-03	3.74849E-04	8.01734E-05	3.03675E-05	1.43638E-05	4.04340E-06
0.	0.	2.00240E-04	0.	4.91404E-01	4.31459E-01
5.38758E-02	1.73912E-03	3.80051E-04	3.81667E-05	8.16745E-06	3.07522E-06
3.18256E-06	3.57081E-06	0.	4.26903E-04	0.	4.92657E-01
4.34036E-01	5.79703E-02	1.43079E-03	2.35365E-04	5.14344E-05	5.16801E-06
1.10534E-06	4.58342E-07	2.01593E-07	1.11883E-07	1.03772E-03	0.
4.93329E-01	4.27539E-01	5.59389E-02	1.46621E-03	1.85029E-04	3.04371E-05
6.65144E-06	6.68321E-07	1.42942E-07	5.37536E-08	2.82296E-08	2.53699E-03
0.	5.18033E-01	4.59346E-01	6.25235E-02	1.89118E-03	2.58640E-04
3.26397E-05	5.37236E-06	1.17585E-06	1.19419E-07	2.61670E-08	1.13056E-08
4.98757E-03	0.	5.25386E-01	4.47327E-01	5.04724E-02	1.37046E-03
2.18214E-04	2.98430E-05	3.76612E-06	6.19888E-07	1.35675E-07	1.37791E-08
3.89690E-09	7.37747E-03	0.	5.34484E-01	4.92973E-01	5.74454E-02
3.40346E-03	4.54637E-04	7.27378E-05	9.94767E-06	1.25537E-06	2.06629E-07
4.52252E-08	7.36516E-09	1.08893E-02	0.	5.91351E-01	5.76240E-01
2.74370E-02	1.31545E-02	1.72774E-03	2.89831E-04	4.84919E-05	6.63178E-06
8.36915E-07	1.37753E-07	4.21926E-08	2.07042E-02	0.	6.26240E-01
6.05536E-01	4.22195E-03	6.69662E-03	2.47137E-03	5.46734E-04	1.14481E-04
2.42459E-05	3.31589E-06	4.17592E-07	6.49784E-08		
1.16636E-03	0.	7.47825E-02	3.55250E-02	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.92101E-05	0.	1.06012E-01	7.89462E-02	2.05596E-02
0.	0.	0.	0.	0.	0.
0.	0.	2.09169E-05	0.	1.19854E-01	8.63846E-02
1.96640E-02	7.50267E-03	0.	0.	0.	0.

TABLE 6-5 (CONT)

0.	0.	0.	2.41052E-05	0.	1.67910E-01
1.41309E-01	2.62956E-02	6.06656E-03	7.49850E-03	0.	0.
0.	0.	0.	0.	9.73601E-05	0.
2.24800E-01	2.02542E-01	2.46932E-02	6.44463E-03	1.00584E-03	2.45312E-03
0.	0.	0.	0.	0.	2.24057E-04
0.	2.43680E-01	2.29918E-01	2.09686E-02	1.62859E-03	6.12435E-04
2.68514E-04	6.67964E-05	0.	0.	0.	0.
2.70706E-04	0.	8.01832E-02	5.23255E-02	9.20359E-03	7.53358E-04
1.61130E-04	6.05931E-05	2.65662E-05	6.60871E-06	0.	0.
0.	8.06839E-05	0.	7.99571E-02	6.47547E-02	2.54824E-02
3.87713E-03	3.92226E-04	8.38900E-05	3.15470E-05	1.38313E-05	3.44073E-06
0.	0.	1.35136E-04	0.	7.99641E-02	6.35956E-02
1.33815E-02	1.81975E-03	3.94972E-04	3.99569E-05	8.54607E-06	3.21376E-06
1.40903E-06	3.50515E-07	0.	3.68034E-04	0.	8.01969E-02
6.37240E-02	1.43668E-02	1.50465E-03	2.46276E-04	5.34536E-05	5.40758E-06
1.15659E-06	4.34936E-07	1.90691E-07	5.48618E-08	9.31214E-04	0.
8.07604E-02	6.23150E-02	1.37227E-02	1.54220E-03	1.94579E-04	3.18481E-05
6.91256E-06	6.99303E-07	1.49568E-07	5.62455E-08	2.98466E-08	2.23718E-03
0.	8.28305E-02	6.69022E-02	1.51670E-02	1.99796E-03	2.72043E-04
3.43244E-05	5.62141E-06	1.22203E-06	1.24955E-07	2.73801E-08	1.18297E-08
4.40876E-03	0.	8.78679E-02	6.73572E-02	8.50526E-03	1.44314E-03
2.30534E-04	3.13896E-05	3.96051E-06	6.48624E-07	1.41004E-07	1.44179E-08
4.07755E-09	6.52439E-03	0.	9.36296E-02	7.82072E-02	8.23223E-03
2.85212E-03	4.78730E-04	7.68445E-05	1.04632E-05	1.32017E-06	2.16208E-07
4.70012E-08	7.70659E-09	9.59915E-03	0.	1.03323E-01	9.17152E-02
6.21808E-03	5.90779E-03	1.76488E-03	3.05071E-04	5.12297E-05	6.97547E-06
8.80114E-07	1.44139E-07	4.38323E-08	1.86536E-02	0.	1.35203E-01
1.16549E-01	2.00837E-03	2.67994E-03	1.96195E-03	5.68836E-04	1.20216E-04
2.56148E-05	3.48773E-06	4.39161E-07	6.79907E-08		
3.87561E-04	0.	4.98447E-02	1.82478E-02	0.	0.
0.	0.	0.	0.	0.	0.
0.	6.39194E-04	0.	5.85238E-02	3.25309E-02	1.13707E-02
0.	0.	0.	0.	0.	0.
0.	0.	7.73704E-04	0.	6.32812E-02	4.17932E-02
1.04057E-02	6.54729E-03	0.	0.	0.	0.
0.	0.	0.	1.03626E-03	0.	7.89280E-02
6.20684E-02	1.45224E-02	8.56471E-03	7.97485E-03	0.	0.
0.	0.	0.	0.	1.53022E-03	0.
1.07851E-01	9.42614E-02	1.43372E-02	5.01566E-03	5.38930E-03	4.58209E-03
0.	0.	0.	0.	0.	2.68615E-03
0.	1.65693E-01	1.52026E-01	1.12959E-02	1.32268E-03	1.09638E-03
9.44908E-04	6.97379E-04	0.	0.	0.	0.
6.21570E-03	0.	1.86148E-01	1.60006E-01	8.44322E-03	4.95407E-04
1.05052E-04	5.34583E-05	3.33412E-05	2.43603E-05	0.	0.

TABLE 6-5 (CONT)

0.	1.47813E-02	0.	2.56267E-01	2.31692E-01	1.86707E-02
2.27471E-03	2.39927E-04	5.20528E-05	2.25685E-05	1.18789E-05	6.54384E-06
0.	0.	3.82293E-02	0.	5.47571E-01	4.98687E-01
8.85256E-03	1.08613E-03	2.27430E-04	2.39955E-05	5.19710E-06	2.29794E-06
3.66035E-06	6.04129E-06	0.	2.93903E-02	0.	6.86554E-01
6.48485E-01	9.64076E-03	8.13775E-04	1.46991E-04	3.06876E-05	3.33856E-06
9.54723E-07	1.24567E-06	1.63363E-07	1.40128E-07	5.25271E-02	0.
2.20539E-01	1.56408E-01	7.56095E-03	8.38098E-04	1.05237E-04	1.90087E-05
4.31472E-06	5.12785E-07	8.97345E-08	2.05570E-07	1.68480E-08	3.30133E-02
0.	1.58391E-01	1.18504E-01	1.02971E-02	9.37134E-04	1.47840E-04
1.85642E-05	3.35517E-06	6.98891E-07	7.44223E-08	1.64268E-08	7.11237E-09
6.20156E-02	0.	1.91501E-01	1.17670E-01	4.51051E-03	8.03365E-04
1.08131E-04	1.70585E-05	2.14202E-06	3.87135E-07	8.06413E-08	8.58719E-09
2.44635E-09	9.29367E-02	0.	2.26050E-01	1.24407E-01	6.76688E-03
1.30699E-03	2.66495E-04	3.60436E-05	5.68616E-06	7.14008E-07	1.29045E-07
2.68804E-08	4.59000E-09	1.38511E-01	0.	2.77663E-01	1.37260E-01
6.44052E-03	3.85666E-03	7.99429E-04	1.69807E-04	2.40291E-05	3.79077E-06
4.76005E-07	8.60300E-08	2.50032E-08	2.74129E-01	0.	4.28841E-01
1.54713E-01	1.89165E-03	2.26593E-03	1.19143E-03	2.57029E-04	6.68716E-05
1.20145E-05	1.89539E-06	2.37365E-07	4.05806E-08		
6.46502E-04	0.	4.68771E-02	1.69402E-02	0.	0.
0.	0.	0.	0.	0.	0.
0.	6.42140E-05	0.	6.39362E-02	3.63268E-02	1.58362E-02
0.	0.	0.	0.	0.	0.
0.	0.	3.33987E-05	0.	7.08078E-02	3.71818E-02
1.53574E-02	5.64968E-03	0.	0.	0.	0.
0.	0.	0.	3.72299E-05	0.	9.80212E-02
6.44820E-02	2.15289E-02	7.78987E-03	5.27466E-03	0.	0.
0.	0.	0.	0.	7.18295E-05	0.
1.31457E-01	9.30709E-02	2.65044E-02	9.32659E-03	3.19444E-03	2.16957E-03
0.	0.	0.	0.	0.	2.12047E-04
0.	1.81807E-01	1.35832E-01	3.38855E-02	6.05066E-03	2.37784E-03
1.04329E-03	3.12461E-04	0.	0.	0.	0.
3.50864E-04	0.	1.20119E-01	4.04962E-02	2.95510E-02	2.79948E-03
5.98628E-04	2.27247E-04	1.00402E-04	2.75458E-05	0.	0.
0.	7.26074E-04	0.	1.20112E-01	7.00932E-02	7.14527E-02
1.45027E-02	1.45731E-03	3.11667E-04	1.17647E-04	5.18688E-05	1.40517E-05
0.	0.	1.79955E-03	0.	1.67801E-01	1.13193E-01
4.28603E-02	6.76070E-03	1.47742E-03	1.48452E-04	3.17503E-05	1.19578E-05
7.10113E-06	5.96844E-06	0.	7.53016E-04	0.	1.17830E-01
6.48363E-02	4.59101E-02	5.56209E-03	9.14961E-04	1.99947E-04	2.00907E-05
4.29693E-06	2.24541E-06	7.28274E-07	2.95050E-07	1.82376E-03	0.
1.18732E-01	6.00549E-02	4.34748E-02	5.69978E-03	7.19284E-04	1.18322E-04
2.58569E-05	2.60292E-06	5.55675E-07	2.08963E-07	1.09740E-07	4.36417E-03

TABLE 6-5 (CONT)

0.	1.24153E-01	6.86473E-02	4.81866E-02	7.35182E-03	1.00544E-03
1.26884E-04	2.08846E-05	4.57104E-06	4.64231E-07	1.01722E-07	4.39495E-08
8.55176E-03	0.	1.39024E-01	7.05516E-02	3.17699E-02	5.32754E-03
8.48287E-04	1.16012E-04	1.46405E-05	2.40976E-06	5.27427E-07	5.35651E-08
1.51489E-08	1.27255E-02	0.	1.56757E-01	1.11035E-01	3.06622E-02
1.06540E-02	1.76736E-03	2.82762E-04	3.86708E-05	4.88016E-06	8.03254E-07
1.75809E-07	2.86314E-08	1.87996E-02	0.	1.87623E-01	1.59761E-01
2.28016E-02	2.19454E-02	6.59264E-03	1.12669E-03	1.88508E-04	2.57805E-05
3.25344E-06	5.35503E-07	1.64020E-07	3.56493E-02	0.	2.84927E-01
2.49278E-01	9.06263E-03	1.01959E-02	7.31345E-03	2.12487E-03	4.45037E-04
9.42541E-05	1.28903E-05	1.62335E-06	2.52598E-07		
4.61271E-04	0.	4.52550E-02	1.72749E-02	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.82334E-04	0.	5.24580E-02	3.20417E-02	1.54168E-02
0.	0.	0.	0.	0.	0.
0.	0.	1.01316E-04	0.	4.72533E-02	2.94400E-02
1.01770E-02	5.16415E-03	0.	0.	0.	0.
0.	0.	0.	1.33074E-04	0.	5.68966E-02
4.01276E-02	9.79335E-03	6.80424E-03	4.43788E-03	0.	0.
0.	0.	0.	0.	1.82862E-04	0.
8.04240E-02	6.06728E-02	1.27480E-02	6.02900E-03	2.44022E-03	2.06136E-03
0.	0.	0.	0.	0.	6.46065E-04
0.	2.76494E-01	2.43577E-01	1.71800E-02	3.36195E-03	1.67507E-03
7.10712E-04	3.80900E-04	0.	0.	0.	0.
1.19916E-03	0.	3.03587E-01	2.51998E-01	2.40551E-02	1.50981E-03
3.32549E-04	1.35857E-04	6.13476E-05	2.47911E-05	0.	0.
0.	1.83136E-03	0.	1.96668E-01	1.66513E-01	4.59474E-02
7.35042E-03	7.85917E-04	1.73137E-04	6.83508E-05	3.07686E-05	1.17934E-05
0.	0.	4.10011E-03	0.	2.27714E-01	1.92799E-01
2.48155E-02	3.84105E-03	7.48803E-04	8.00577E-05	1.76379E-05	6.86652E-06
9.20907E-06	2.07721E-05	0.	7.98510E-03	0.	1.96843E-01
1.59205E-01	2.70046E-02	3.03367E-03	5.19829E-04	1.01339E-04	1.08346E-05
2.38703E-06	3.34685E-06	4.82907E-07	4.69532E-07	1.98935E-02	0.
2.08760E-01	1.55692E-01	2.49213E-02	3.14747E-03	3.92311E-04	6.72238E-05
1.31051E-05	1.40459E-06	3.08688E-07	1.18021E-07	5.97386E-08	4.71927E-02
0.	2.31374E-01	1.58608E-01	2.83817E-02	3.96801E-03	5.55213E-04
6.92052E-05	1.18655E-05	2.31713E-06	2.50349E-07	5.65086E-08	2.48225E-08
9.70624E-02	0.	2.87288E-01	1.55070E-01	1.59142E-02	2.94356E-03
4.57847E-04	6.40630E-05	7.98521E-06	1.36909E-06	2.67361E-07	2.88864E-08
8.41548E-09	1.45430E-01	0.	3.43425E-01	1.73483E-01	1.83546E-02
5.31230E-03	9.76687E-04	1.52616E-04	2.13543E-05	2.66174E-06	4.56364E-07
8.91203E-08	1.54403E-08	2.17541E-01	0.	4.29489E-01	2.02522E-01
1.70293E-02	1.26362E-02	3.28700E-03	6.23781E-04	1.01744E-04	1.42362E-05
1.77449E-06	3.04243E-07	8.26926E-08	4.05585E-01	0.	6.60290E-01

TABLE 6-5 (CONT)

2.54704E-01	9.42593E-03	7.48265E-03	4.16546E-03	1.05941E-03	2.49135E-04
5.08719E-05	7.11811E-06	8.85146E-07	1.43512E-07		
7.90992E-04	0.	7.25459E-02	2.82189E-02	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.01629E-04	0.	9.45280E-02	6.12180E-02	2.41954E-02
0.	0.	0.	0.	0.	0.
0.	0.	6.11112E-05	0.	1.02012E-01	6.26618E-02
1.91961E-02	8.08255E-03	0.	0.	0.	0.
0.	0.	0.	6.98490E-05	0.	1.40242E-01
1.04088E-01	2.61448E-02	9.38472E-03	7.66281E-03	0.	0.
0.	0.	0.	0.	1.27522E-04	0.
1.85302E-01	1.47406E-01	2.95545E-02	1.04246E-02	3.44348E-03	3.13061E-03
0.	0.	0.	0.	0.	3.79887E-04
0.	2.56334E-01	2.15330E-01	3.37547E-02	5.64606E-03	2.37278E-03
1.02941E-03	4.03705E-04	0.	0.	0.	0.
7.24524E-04	0.	2.09784E-01	1.29953E-01	2.64623E-02	2.53789E-03
5.58563E-04	2.18619E-04	9.53066E-05	3.17881E-05	0.	0.
0.	2.69068E-03	0.	2.03461E-01	1.52772E-01	7.16451E-02
1.26690E-02	1.32044E-03	2.90808E-04	1.12435E-04	4.88986E-05	1.58429E-05
0.	0.	7.22758E-03	0.	3.95302E-01	3.36307E-01
4.19108E-02	6.45158E-03	1.29062E-03	1.34483E-04	2.96253E-05	1.13978E-05
9.59540E-06	1.29310E-05	0.	1.74489E-03	0.	1.70712E-01
1.17921E-01	4.51646E-02	5.26379E-03	8.73126E-04	1.74666E-04	1.81998E-05
4.00935E-06	4.24107E-06	7.10352E-07	4.31879E-07	4.14985E-03	0.
1.72231E-01	1.12430E-01	4.26742E-02	5.45533E-03	6.80709E-04	1.12912E-04
2.25876E-05	2.37494E-06	5.18485E-07	1.98233E-07	1.01568E-07	9.58417E-03
0.	1.77057E-01	1.21065E-01	4.73645E-02	7.02150E-03	9.62318E-04
1.20079E-04	1.99297E-05	3.99355E-06	4.20497E-07	9.49141E-08	4.16929E-08
1.91181E-02	0.	1.97038E-01	1.21093E-01	2.88441E-02	5.09404E-03
8.10173E-04	1.11037E-04	1.38553E-05	2.29958E-06	4.60794E-07	4.85189E-08
1.41350E-08	2.85257E-02	0.	2.19643E-01	1.63345E-01	2.94335E-02
9.66003E-03	1.68990E-03	2.70058E-04	3.70122E-05	4.61844E-06	7.66527E-07
1.53598E-07	2.59342E-08	4.23892E-02	0.	2.57872E-01	2.10665E-01
1.96746E-02	2.06181E-02	5.97737E-03	1.07728E-03	1.80038E-04	2.46748E-05
3.07896E-06	5.11018E-07	1.42745E-07	8.00182E-02	0.	3.72862E-01
2.92844E-01	4.81744E-03	8.09779E-03	6.77515E-03	1.92653E-03	4.25444E-04
9.00192E-05	1.23374E-05	1.53619E-06	2.41049E-07		
2.43080E-04	0.	2.55101E-02	6.12631E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	9.98842E-05	0.	2.92828E-02	1.08982E-02	1.01970E-02
0.	0.	0.	0.	0.	0.
0.	0.	5.16539E-05	0.	2.84262E-02	8.17608E-03
8.26043E-03	3.60838E-03	0.	0.	0.	0.
0.	0.	0.	5.71621E-05	0.	3.82714E-02

TABLE 6-5 (CONT)

1.61109E-02	1.07861E-02	6.14337E-03	3.14205E-03	0.	0.
0.	0.	0.	0.	6.29071E-05	0.
5.06723E-02	2.32442E-02	1.62718E-02	6.93747E-03	2.81388E-03	1.74019E-03
0.	0.	0.	0.	0.	2.15132E-04
0.	1.00118E-01	6.32312E-02	2.37831E-02	5.04239E-03	2.16734E-03
9.28479E-04	3.91097E-04	0.	0.	0.	0.
4.92109E-04	0.	1.31386E-01	6.37066E-02	2.36894E-02	2.26440E-03
4.98824E-04	1.95279E-04	8.61844E-05	3.03013E-05	0.	0.
0.	7.11967E-04	0.	1.28041E-01	8.53868E-02	6.05237E-02
1.16136E-02	1.17882E-03	2.59706E-04	1.00090E-04	4.41268E-05	1.50276E-05
0.	0.	1.35542E-03	0.	1.65949E-01	1.18797E-01
3.64716E-02	5.76157E-03	1.18310E-03	1.20084E-04	2.64568E-05	1.01320E-05
7.52644E-06	1.61634E-05	0.	1.06682E-03	0.	1.40013E-01
9.38820E-02	3.98418E-02	4.73000E-03	7.79744E-04	1.60116E-04	1.62516E-05
3.58054E-06	1.76543E-06	6.61301E-07	4.73017E-07	2.54029E-03	0.
1.41417E-01	9.00319E-02	3.75343E-02	4.92014E-03	6.11679E-04	1.00836E-04
2.07060E-05	2.10440E-06	4.63032E-07	1.77032E-07	9.13171E-08	5.91437E-03
0.	1.43601E-01	9.61089E-02	4.14297E-02	6.31517E-03	8.67911E-04
1.07902E-04	1.77982E-05	3.66070E-06	3.75524E-07	8.47628E-08	3.72338E-08
1.17865E-02	0.	1.58553E-01	9.60272E-02	2.58410E-02	4.55850E-03
7.28674E-04	1.00144E-04	1.24503E-05	2.05364E-06	4.22388E-07	4.33297E-08
1.26232E-08	1.75950E-02	0.	1.76055E-01	1.33156E-01	2.62416E-02
8.65514E-03	1.51222E-03	2.42891E-04	3.33812E-05	4.15009E-06	6.84546E-07
1.40796E-07	2.31605E-08	2.61431E-02	0.	2.06257E-01	1.74923E-01
1.77746E-02	1.84245E-02	5.35558E-03	9.63891E-04	1.61928E-04	2.22541E-05
2.48256E-01	5.19123E-03	7.52948E-03	6.07310E-03	1.72613E-03	3.80382E-04
8.09638E-05	1.11271E-05	1.38046E-06	2.15268E-07		
2.14521E-04	0.	1.70858E-02	2.32646E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	5.07866E-05	0.	2.25729E-02	4.42340E-03	7.74772E-03
0.	0.	0.	0.	0.	0.
0.	0.	2.24841E-05	0.	2.46663E-02	2.24834E-03
8.13740E-03	2.79537E-03	0.	0.	0.	0.
0.	0.	0.	2.43689E-05	0.	3.37385E-02
8.22291E-03	1.24812E-02	5.72902E-03	2.41142E-03	0.	0.
0.	0.	0.	0.	3.10507E-05	0.
4.72513E-02	1.54555E-02	1.87523E-02	7.25170E-03	3.04456E-03	1.24351E-03
0.	0.	0.	0.	0.	1.00804E-04
0.	8.05701E-02	3.68261E-02	2.76252E-02	5.82691E-03	2.31169E-03
1.02946E-03	3.00656E-04	0.	0.	0.	0.
1.98787E-04	0.	8.23409E-02	6.96930E-03	2.79231E-02	2.61675E-03
5.76485E-04	2.22047E-04	9.93560E-05	2.68556E-05	0.	0.
0.	3.39974E-04	0.	8.24280E-02	3.44109E-02	6.74720E-02
1.40632E-02	1.36231E-03	3.00139E-04	1.15056E-04	5.13657E-05	1.37339E-05

TABLE 6-5 (CONT)

0.	0.	7.39600E-04	0.	1.01513E-01	4.97297E-02
4.13271E-02	6.65859E-03	1.43264E-03	1.38779E-04	3.05758E-05	1.16985E-05
6.68720E-06	5.24500E-06	0.	4.82737E-04	0.	8.47259E-02
3.36752E-02	4.42481E-02	5.49062E-03	9.01141E-04	1.93887E-04	1.87816E-05
4.13799E-06	1.81971E-06	7.20641E-07	2.79093E-07	1.16955E-03	0.
8.53736E-02	2.91993E-02	4.19217E-02	5.61503E-03	7.10041E-04	1.16535E-04
2.50733E-05	2.43050E-06	5.35121E-07	2.04594E-07	1.08860E-07	2.79521E-03
0.	8.99839E-02	3.73849E-02	4.64563E-02	7.25163E-03	9.90489E-04
1.25254E-04	2.05692E-05	4.43246E-06	4.33989E-07	9.79594E-08	4.30307E-08
5.46072E-03	0.	1.03141E-01	3.91559E-02	3.09324E-02	5.25494E-03
8.36726E-04	1.14287E-04	1.44524E-05	2.37337E-06	5.11438E-07	5.00756E-08
1.45885E-08	8.15849E-03	0.	1.19168E-01	7.87931E-02	2.98879E-02
1.03789E-02	1.74328E-03	2.78909E-04	3.80957E-05	4.81745E-06	7.91122E-07
1.70479E-07	2.67663E-08	1.20657E-02	0.	1.47594E-01	1.26586E-01
2.22208E-02	2.14756E-02	6.42246E-03	1.11134E-03	1.85939E-04	2.53972E-05
3.21163E-06	5.27415E-07	1.59105E-07	2.28954E-02	0.	2.37399E-01
2.14503E-01	8.94232E-03	9.99562E-03	7.16093E-03	2.07002E-03	4.38972E-04
9.29696E-05	1.26986E-05	1.60250E-06	2.48783E-07		
9.29997E-04	0.	7.72662E-02	3.69117E-02	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.95482E-05	0.	1.06094E-01	8.22122E-02	2.28470E-02
0.	0.	0.	0.	0.	0.
0.	0.	2.10945E-05	0.	1.19050E-01	8.90874E-02
1.77896E-02	6.99338E-03	0.	0.	0.	0.
0.	0.	0.	2.41423E-05	0.	1.65970E-01
1.44886E-01	2.40661E-02	5.23708E-03	7.25086E-03	0.	0.
0.	0.	0.	0.	9.31641E-05	0.
2.18241E-01	2.03183E-01	2.02955E-02	5.58355E-03	7.11008E-04	2.29752E-03
0.	0.	0.	0.	0.	2.22243E-04
0.	2.53482E-01	2.47005E-01	1.44955E-02	6.61168E-04	2.52785E-04
1.07780E-04	3.08825E-05	0.	0.	0.	0.
2.72820E-04	0.	7.47162E-02	5.85138E-02	4.54464E-03	2.96903E-04
6.54146E-05	2.50101E-05	1.06636E-05	3.05545E-06	0.	0.
0.	8.11158E-05	0.	7.44088E-02	6.67819E-02	1.50558E-02
1.53041E-03	1.54578E-04	3.40572E-05	1.30212E-05	5.55186E-06	1.59078E-06
0.	0.	1.33565E-04	0.	7.43430E-02	6.59541E-02
6.82945E-03	7.55560E-04	1.55906E-04	1.57472E-05	3.46949E-06	1.32649E-06
5.65580E-07	1.62056E-07	0.	3.60322E-04	0.	7.45696E-02
6.62389E-02	7.47378E-03	6.19418E-04	1.02254E-04	2.10996E-05	2.13116E-06
4.69544E-07	1.79522E-07	7.65429E-08	2.53647E-08	9.09822E-04	0.
7.51194E-02	6.55237E-02	6.99124E-03	6.45716E-04	8.01025E-05	1.32234E-05
2.72858E-06	2.75599E-07	6.07210E-08	2.32156E-08	1.19803E-08	2.13870E-03
0.	7.63401E-02	6.88174E-02	7.72118E-03	8.21269E-04	1.13904E-04
1.41304E-05	2.33401E-06	4.82393E-07	4.92453E-08	1.11156E-08	4.88276E-09

TABLE 6-5 (CONT)

4.29483E-03	0.	7.96825E-02	6.86845E-02	3.34685E-03	5.92911E-04
9.47618E-05	1.31428E-05	1.63043E-06	2.69309E-07	5.56608E-08	5.68215E-09
1.65538E-09	6.39437E-03	0.	8.33132E-02	7.33030E-02	3.46442E-03
1.12042E-03	1.96700E-04	3.15873E-05	4.38092E-06	5.43475E-07	8.97698E-08
1.85536E-08	3.03721E-09	9.48222E-03	0.	8.92190E-02	7.86982E-02
2.49419E-03	2.43224E-03	6.93286E-04	1.25441E-04	2.10582E-05	2.92062E-06
3.62317E-07	5.98465E-08	1.72744E-08	1.77297E-02	0.	1.06132E-01
8.84024E-02	1.03852E-03	1.12155E-03	8.06539E-04	2.23451E-04	4.96571E-05
1.05291E-05	1.46031E-06	1.80777E-07	2.82298E-08		
1.12697E-03	0.	9.56622E-02	2.76903E-02	0.	0.
0.	0.	0.	0.	0.	0.
0.	4.59537E-04	0.	1.33601E-01	6.47468E-02	3.87626E-02
0.	0.	0.	0.	0.	0.
0.	0.	3.90112E-04	0.	1.47518E-01	6.00046E-02
3.66472E-02	1.18838E-02	0.	0.	0.	0.
0.	0.	0.	7.36495E-04	0.	1.93406E-01
9.91266E-02	5.42847E-02	1.89953E-02	1.07440E-02	0.	0.
0.	0.	0.	0.	1.69375E-03	0.
2.75671E-01	1.65521E-01	7.23604E-02	2.45960E-02	9.27885E-03	4.43716E-03
0.	0.	0.	0.	0.	4.23441E-03
0.	5.70141E-01	4.25979E-01	9.54453E-02	1.83155E-02	7.13682E-03
3.00306E-03	8.82050E-04	0.	0.	0.	0.
8.02890E-03	0.	4.45775E-01	1.93400E-01	9.44358E-02	8.22470E-03
1.81209E-03	6.97442E-04	2.96001E-04	8.40395E-05	0.	0.
0.	1.68249E-02	0.	2.85173E-01	1.16040E-01	2.20139E-01
4.06968E-02	4.28208E-03	9.43442E-04	3.62530E-04	1.54026E-04	4.35142E-05
0.	0.	4.50971E-02	0.	2.88551E-01	8.15892E-02
1.32319E-01	2.09303E-02	4.14587E-03	4.36225E-04	9.61106E-05	3.69089E-05
1.81136E-05	6.94630E-06	0.	1.28576E-01	0.	3.70977E-01
9.11180E-02	1.40602E-01	1.72847E-02	2.83260E-03	5.61083E-04	5.90367E-05
1.30072E-05	8.06366E-06	2.11593E-06	6.88645E-07	3.14790E-01	0.
5.57268E-01	8.28658E-02	1.25670E-01	1.75679E-02	2.23524E-03	3.66309E-04
7.25587E-05	7.63456E-06	1.68207E-06	6.43110E-07	3.31180E-07	7.46634E-01
0.	9.99404E-01	1.21861E-01	1.34934E-01	2.14819E-02	3.09897E-03
3.94304E-04	6.46561E-05	1.28288E-05	1.36418E-06	3.07921E-07	1.35260E-07
1.57348E+00	0.	1.85918E+00	9.41500E-02	8.16051E-02	1.51244E-02
2.47868E-03	3.57573E-04	4.54966E-05	7.46032E-06	1.48024E-06	1.57405E-07
4.58568E-08	2.37454E+00	0.	2.70313E+00	1.87104E-01	1.00606E-01
2.71195E-02	5.02037E-03	8.26225E-04	1.19191E-04	1.51655E-05	2.48677E-06
4.93415E-07	8.41358E-08	3.55517E+00	0.	3.95910E+00	3.42911E-01
9.82195E-02	6.84378E-02	1.67767E-02	3.21875E-03	5.50817E-04	7.94607E-05
1.01104E-05	1.65785E-06	4.58277E-07	6.56351E+00	0.	7.19183E+00
6.28328E-01	6.10158E-02	4.32638E-02	2.25090E-02	5.40696E-03	1.31524E-03
2.75408E-04	3.97304E-05	5.04478E-06	7.82012E-07		

TABLE 6-5 (CONT)

1.0	0.0	0.0	1.0	120.0	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
1.0	0.0	0.0	1.0	105.0	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.6	0.4	0.0	1.0	88.0	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.0	1.0	0.0	1.0	63.5	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.0	1.0	0.0	1.0	32.5	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.0	1.0	0.0	1.0	10.3	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.0	1.0	0.0	1.0	1.15	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.0	1.0	0.0	1.0	.173	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.0	1.0	0.0	1.0	.021	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.0	1.0	0.0	1.0	.009	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.0	1.0	0.0	1.0	.019	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.0	1.0	0.0	1.0	.0562	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.0	0.0	1.00	1.0	.1	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.0	0.0	1.00	1.0	.1	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.0	0.0	1.00	1.0	.1	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0

TABLE 6-5 (CONT)

```
 0.0
 0.0          0.0          1.00         1.0          .1         -06 0.0
 0.0          0.0          0.0          0.0          0.0            0.0
 0.0
  T
 3*           F      0.0   T
17*
   0.227588    0.345503     0.180477     0.152189     0.078617     0.015365
   0.000261    F0.0
  T
17*
        1.63         1.63         1.61         1.59         1.55         1.51
        1.46         1.39         1.33         1.27         1.54         1.49
        1.43         1.38         1.45         1.44         1.45         1.42
        1.47         1.56         1.68         1.36         1.51         1.95
  F      0.0
  T
17*
25R      0.0         5.31         4.91         4.83         5.43         6.56
        7.85         9.01         9.81        10.19        10.16         9.86
        9.48         9.03         8.49         7.83         7.10         6.29
        5.41         4.47         3.48         2.46         1.73         1.42
  F      0.0
  T
 7U
-.308606714 -.218217900  .218217900 -.617213403 -.577350269 -.218217900
 .218217900  .577350269 -.816496581 -.786795790 -.577350269 -.218217900
 .218217900  .577350269  .786795790 -.975900071 -.951189727 -.786795790
-.577350269 -.218217900  .218217900  .577350269  .786795790  .951189727
-.308606714 -.218217900  .218217900 -.617213403 -.577350269 -.218217900
 .218217900  .577350269 -.816496581 -.786795790 -.577350269 -.218217900
 .218217900  .577350269  .786795790 -.975900071 -.951189727 -.786795790
-.577350269 -.218217900  .218217900  .577350269  .786795790  .951189727
-.951189727 -.951189727 -.951189727 -.786795790 -.786795790 -.786795790
-.786795790 -.786795790 -.577350269 -.577350269 -.577350269 -.577350269
-.577350269 -.577350269 -.577350269 -.218217900 -.218217900 -.218217900
-.218217900 -.218217900 -.218217900 -.218217900 -.218217900 -.218217900
 .951189727  .951189727  .951189727  .786795790  .786795790  .786795790
 .786795790  .786795790  .577350269  .577350269  .577350269  .577350269
 .577350269  .577350269  .577350269  .218217900  .218217900  .218217900
 .218217900  .218217900  .218217900  .218217900  .218217900  .218217900
 T
 6U
0.00         .030246915  .030246915 0.00          .022685185  .022685185
```

TABLE 6-5 (CONT)

```
 .022685185  .022685185 0.00        .022685185  .023148144  .022685185
 .022685185  .023148144  .022685185 0.00        .030246915  .022685185
 .022685185  .030246915  .030246915  .022685185  .022685185  .030246915
0.00         .030246915  .030246915 0.00        .022685185  .022685185
 .022685185  .022685185 0.00        .022685185  .023148144  .022685185
 .022685185  .023148144  .022685185 0.00        .030246915  .022685185
 .022685185  .030246915  .030246915  .022685185  .022685185  .030246915
 T
4*
  0.0         3.0         6.0         9.0         12.0        15.0
  18.0        21.0        25.0        27.0        29.184      30.0
  32.0        34.0        36.094      38.0        40.0        40.971
  42.0        43.0        44.0        44.654      45.0        46.0
  46.99       49.0        51.0        53.34       54.0        55.88
  57.5        60.0        61.92       62.05       62.174      63.0
  65.0        67.0        68.58       70.5        71.12
2*
  -175.0      -174.0      -173.0      -172.0      -171.0       -170.0
  -169.0      -168.0      -166.83     -166.0      -164.67     -163.0
  -162.0      -161.29     -159.0      -157.0      -155.0      -153.0
  -151.0      -149.0      -147.0      -146.05     -144.0      -142.0
  -140.0      -137.16     -136.0      -134.0      -130.0      -122.0
  -114.0      -104.0      -94.0       -84.0       -74.0       -64.0
  -58.0       -53.0       -48.0       -43.0       -38.0       -33.0
  -28.0       -23.0       -18.0       -13.0       -8.0        -6.0
  -5.08       -2.0          0.0
8$
38R        19 2R       11  Q       40  Q       80  Q      160
38R        18 2R       11  Q       40
29R        16 9R       17 2R       11  Q       40  Q       40
29R        15 9R       17 2R       11  Q       40  Q       80  Q      160
29R        14 9R       17 2R       11  Q       40  Q       80
10R         1 4R        2 3R        3 4R        4 3R        5 3R        6
 2R         7 3R        8 2R        9 4R       10 2R       11  Q       40
  Q        80  Q      160  Q      320  Q      280
24R        1214R       13 2R       11  Q       40
9$
            1           2           3           4           5           6
            7           8           9          10          11          12
           13          14          15          16          17          18
           19
 1*            F       0.0
 5*            F       1.0
19$            F       -20
```

TABLE 6-5 (CONT)

20$ T	1	2	3	4	5

TABLE 6-6. LISTING OF THE DOT-IIW INPUT DATA FOR THE SHIELD GEOMETRY NEUTRON SEMINAR/WORKSHOP PROBLEM

```
    40000     5    6    1    2    8    3    4    1   40    3    2    1    1   40
MSFC SEMINAR-WORKSHOP DOT PROBLEM, NEUTRON TRANSPORT IN SHIELD
           2           0           0          48           1           6
          40          47           5         0.0         0.0       0.001
           1           0           4           0           0           1
           7           0           7           0           0           0
           0         0.0          16           3           4          13
         0.0           5           0          10           1          10
         0.0       0.001         0.0         0.0         0.0         0.0
           0          24          24           4           4           1
           0           0           0           0       0.001           0
14U
 1.16636E-03 0.          7.47825E-02 3.55250E-02 0.          0.
 0.          0.          0.          0.          0.          0.
 0.          1.92101E-05 0.          1.06012E-01 7.89462E-02 2.05596E-02
 0.          0.          0.          0.          0.          0.
 0.          0.          2.09169E-05 0.          1.19854E-01 8.63846E-02
 1.96640E-02 7.50267E-03 0.          0.          0.          0.
 0.          0.          0.          2.41052E-05 0.          1.67910E-01
 1.41309E-01 2.62956E-02 6.06656E-03 7.49850E-03 0.          0.
 0.          0.          0.          0.          9.73601E-05 0.
 2.24800E-01 2.02542E-01 2.46932E-02 6.44463E-03 1.00584E-03 2.45312E-03
 0.          0.          0.          0.          0.          2.24057E-04
 0.          2.43680E-01 2.29918E-01 2.09686E-02 1.62859E-03 6.12435E-04
 2.68514E-04 6.67964E-05 0.          0.          0.          0.
 2.70706E-04 0.          8.01832E-02 5.23255E-02 9.20359E-03 7.53358E-04
 1.61130E-04 6.05931E-05 2.65662E-05 6.60871E-06 0.          0.
 0.          8.06839E-05 0.          7.99571E-02 6.47547E-02 2.54824E-02
 3.87713E-03 3.92226E-04 8.38900E-05 3.15470E-05 1.38313E-05 3.44073E-06
 0.          0.          1.35136E-04 0.          7.99641E-02 6.35956E-02
 1.33815E-02 1.81975E-03 3.94972E-04 3.99569E-05 8.54607E-06 3.21376E-06
 1.40903E-06 3.50515E-07 0.          3.68034E-04 0.          8.01969E-02
 6.37240E-02 1.43668E-02 1.50465E-03 2.46276E-04 5.34536E-05 5.40758E-06
 1.15659E-06 4.34936E-07 1.90691E-07 5.48618E-08 9.31214E-04 0.
 8.07604E-02 6.23150E-02 1.37227E-02 1.54220E-03 1.94579E-04 3.18481E-05
 6.91256E-06 6.99303E-07 1.49568E-07 5.62455E-08 2.98466E-08 2.23718E-03
 0.          8.28305E-02 6.69022E-02 1.51670E-02 1.99796E-03 2.72043E-04
 3.43244E-05 5.62141E-06 1.22203E-06 1.24955E-07 2.73801E-08 1.18297E-08
 4.40876E-03 0.          8.78679E-02 6.73572E-02 8.50526E-03 1.44314E-03
 2.30534E-04 3.13896E-05 3.96051E-06 6.48624E-07 1.41004E-07 1.44179E-08
```

TABLE 6-6 (CONT)

4.07755E-09	6.52439E-03	0.	9.36296E-02	7.82072E-02	8.23223E-03
2.85212E-03	4.78730E-04	7.68445E-05	1.04632E-05	1.32017E-06	2.16208E-07
4.70012E-08	7.70659E-09	9.59915E-03	0.	1.03323E-01	9.17152E-02
6.21808E-03	5.90779E-03	1.76488E-03	3.05071E-04	5.12297E-05	6.97547E-06
8.80114E-07	1.44139E-07	4.38323E-08	1.86536E-02	0.	1.35203E-01
1.16549E-01	2.00837E-03	2.67994E-03	1.96195E-03	5.68836E-04	1.20216E-04
2.56148E-05	3.48773E-06	4.39161E-07	6.79907E-08		
9.29997E-04	0.	7.72662E-02	3.69117E-02	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.95482E-05	0.	1.06094E-01	8.22122E-02	2.28470E-02
0.	0.	0.	0.	0.	0.
0.	0.	2.10945E-05	0.	1.19050E-01	8.90874E-02
1.77896E-02	6.99338E-03	0.	0.	0.	0.
0.	0.	0.	2.41423E-05	0.	1.65970E-01
1.44886E-01	2.40661E-02	5.23708E-03	7.25086E-03	0.	0.
0.	0.	0.	0.	9.31641E-05	0.
2.18241E-01	2.03183E-01	2.02955E-02	5.58355E-03	7.11008E-04	2.29752E-03
0.	0.	0.	0.	0.	2.22243E-04
0.	2.53482E-01	2.47005E-01	1.44955E-02	6.61168E-04	2.52785E-04
1.07780E-04	3.08825E-05	0.	0.	0.	0.
2.72820E-04	0.	7.47162E-02	5.85138E-02	4.54464E-03	2.96903E-04
6.54146E-05	2.50101E-05	1.06636E-05	3.05545E-06	0.	0.
0.	8.11158E-05	0.	7.44088E-02	6.67819E-02	1.50558E-02
1.53041E-03	1.54578E-04	3.40572E-05	1.30212E-05	5.55186E-06	1.59078E-06
0.	0.	1.33565E-04	0.	7.43430E-02	6.59541E-02
6.82945E-03	7.55560E-04	1.55906E-04	1.57472E-05	3.46949E-06	1.32649E-06
5.65580E-07	1.62056E-07	0.	3.60322E-04	0.	7.45696E-02
6.62389E-02	7.47378E-03	6.19418E-04	1.02254E-04	2.10996E-05	2.13116E-06
4.69544E-07	1.79522E-07	7.65429E-08	2.53647E-08	9.09822E-04	0.
7.51194E-02	6.55237E-02	6.99124E-03	6.45716E-04	8.01025E-05	1.32234E-05
2.72858E-06	2.75599E-07	6.07210E-08	2.32156E-08	1.19803E-08	2.13870E-03
0.	7.63401E-02	6.88174E-02	7.72118E-03	8.21269E-04	1.13904E-04
1.41304E-05	2.33401E-06	4.82393E-07	4.92453E-08	1.11156E-08	4.88276E-09
4.29483E-03	0.	7.96825E-02	6.86845E-02	3.34685E-03	5.92911E-04
9.47618E-05	1.31428E-05	1.63043E-06	2.69309E-07	5.56608E-08	5.68215E-09
1.65538E-09	6.39437E-03	0.	8.33132E-02	7.33030E-02	3.46442E-03
1.12042E-03	1.96700E-04	3.15873E-05	4.38092E-06	5.43475E-07	8.97698E-08
1.85536E-08	3.03721E-09	9.48222E-03	0.	8.92190E-02	7.86982E-02
2.49419E-03	2.43224E-03	6.93286E-04	1.25441E-04	2.10582E-05	2.92062E-06
3.62317E-07	5.98465E-08	1.72744E-08	1.77297E-02	0.	1.06132E-01
8.84024E-02	1.03852E-03	1.12155E-03	8.06539E-04	2.23451E-04	4.96571E-05
1.05291E-05	1.46031E-06	1.80777E-07	2.82298E-08		
1.12697E-03	0.	9.56622E-02	2.76903E-02	0.	0.
0.	0.	0.	0.	0.	0.

TABLE 6-6 (CONT)

0.	4.59537E-04	0.	1.33601E-01	6.47468E-02	3.87626E-02
0.	0.	0.	0.	0.	0.
0.	0.	3.90112E-04	0.	1.47518E-01	6.00046E-02
3.66472E-02	1.18838E-02	0.	0.	0.	0.
0.	0.	0.	7.36495E-04	0.	1.93406E-01
9.91266E-02	5.42847E-02	1.89953E-02	1.07440E-02	0.	0.
0.	0.	0.	0.	1.69375E-03	0.
2.75671E-01	1.65521E-01	7.23604E-02	2.45960E-02	9.27885E-03	4.43716E-03
0.	0.	0.	0.	0.	4.23441E-03
0.	5.70141E-01	4.25979E-01	9.54453E-02	1.83155E-02	7.13682E-03
3.00306E-03	8.82050E-04	0.	0.	0.	0.
8.02890E-03	0.	4.45775E-01	1.93400E-01	9.44358E-02	8.22470E-03
1.81209E-03	6.97442E-04	2.96001E-04	8.40395E-05	0.	0.
0.	1.68249E-02	0.	2.85173E-01	1.16040E-01	2.20139E-01
4.06968E-02	4.28208E-03	9.43442E-04	3.62530E-04	1.54026E-04	4.35142E-05
0.	0.	4.50971E-02	0.	2.88551E-01	8.15892E-02
1.32319E-01	2.09303E-02	4.14587E-03	4.36225E-04	9.61106E-05	3.69089E-05
1.81136E-05	6.94630E-06	0.	1.28576E-01	0.	3.70977E-01
9.11180E-02	1.40602E-01	1.72847E-02	2.83260E-03	5.61083E-04	5.90367E-05
1.30072E-05	8.06366E-06	2.11593E-06	6.88645E-07	3.14790E-01	0.
5.57268E-01	8.28658E-02	1.25670E-01	1.75679E-02	2.23524E-03	3.66309E-04
7.25587E-05	7.63456E-06	1.68207E-06	6.43110E-07	3.31180E-07	7.46634E-01
0.	9.99404E-01	1.21861E-01	1.34934E-01	2.14819E-02	3.09897E-03
3.94304E-04	6.46561E-05	1.28288E-05	1.36418E-06	3.07921E-07	1.35260E-07
1.57348E+00	0.	1.85918E+00	9.41500E-02	8.16051E-02	1.51244E-02
2.47868E-03	3.57573E-04	4.54966E-05	7.46032E-06	1.48024E-06	1.57405E-07
4.58568E-08	2.37454E+00	0.	2.70313E+00	1.87104E-01	1.00606E-01
2.71195E-02	5.02037E-03	8.26225E-04	1.19191E-04	1.51655E-05	2.48677E-06
4.93415E-07	8.41358E-08	3.55517E+00	0.	3.95910E+00	3.42911E-01
9.82195E-02	6.84378E-02	1.67767E-02	3.21875E-03	5.50817E-04	7.94607E-05
1.01104E-05	1.65785E-06	4.58277E-07	6.56351E+00	0.	7.19183E+00
6.28328E-01	6.10158E-02	4.32638E-02	2.25090E-02	5.40696E-03	1.31524E-03
2.75408E-04	3.97304E-05	5.04478E-06	7.82012E-07		
0.	0.	1.08482E-01	5.60325E-02	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	1.03396E-01	9.03813E-02	2.02358E-02
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.20332E-01	1.12280E-01
6.78755E-03	1.34119E-02	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.26995E-01
1.22639E-01	6.54466E-03	4.58148E-03	1.24301E-02	0.	0.
0.	0.	0.	0.	0.	0.
1.97501E-01	1.92436E-01	3.59202E-03	1.21500E-03	1.42940E-03	5.78900E-03
0.	0.	0.	0.	0.	0.

TABLE 6-6 (CONT)

0.	2.52423E-01	2.46941E-01	4.59569E-03	6.61168E-04	2.52785E-04
1.99782E-04	5.78319E-04	0.	0.	0.	0.
0.	0.	3.01712E-01	2.90478E-01	3.87344E-03	2.96903E-04
6.54146E-05	2.50101E-05	1.05327E-05	2.79376E-06	0.	0.
0.	6.94279E-07	0.	3.11038E-01	3.04313E-01	1.03597E-02
1.43879E-03	1.54578E-04	3.40572E-05	1.30212E-05	5.48370E-06	1.45453E-06
0.	0.	2.36941E-06	0.	3.11502E-01	3.04431E-01
5.99500E-03	7.55560E-04	1.46572E-04	1.57472E-05	3.46949E-06	1.32649E-06
5.58636E-07	1.48177E-07	0.	1.30984E-04	0.	3.11630E-01
3.04767E-01	6.29753E-03	6.30780E-04	1.02254E-04	1.98364E-05	2.13116E-06
4.69544E-07	1.79522E-07	7.56032E-08	2.31923E-08	3.97142E-04	0.
3.11897E-01	3.05476E-01	5.77761E-03	6.37075E-04	8.15719E-05	1.32234E-05
2.56523E-06	2.75599E-07	6.07210E-08	2.32156E-08	1.18332E-08	1.25166E-03
0.	3.07759E-01	3.00980E-01	5.07099E-03	8.00457E-04	1.12380E-04
1.43895E-05	2.33401E-06	4.53564E-07	4.92453E-08	1.11156E-08	4.88276E-09
2.22156E-03	0.	2.99178E-01	2.93078E-01	3.43324E-03	5.85053E-04
9.23605E-05	1.29669E-05	1.66033E-06	2.69309E-07	5.23343E-08	5.68215E-09
1.65538E-09	3.02408E-03	0.	2.97918E-01	2.93311E-01	1.76727E-03
1.15127E-03	1.94110E-04	3.07868E-05	4.32230E-06	5.53444E-07	8.97698E-08
1.74448E-08	3.03721E-09	4.21858E-03	0.	2.65915E-01	2.60861E-01
9.16621E-04	1.51531E-03	7.12516E-04	1.23889E-04	2.05245E-05	2.88153E-06
3.68963E-07	5.98465E-08	1.61816E-08	7.37866E-03	0.	1.72222E-01
1.64843E-01	8.35583E-04	6.66331E-04	5.95599E-04	2.29694E-04	4.92824E-05
1.02623E-05	1.44077E-06	1.84115E-07	2.82298E-08		
0.	0.	4.61947E-03	-5.22044E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	7.85474E-03	-9.76120E-03	5.19186E-03
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.08122E-02	-1.47024E-02
6.93133E-03	1.82886E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.51260E-02
-1.63970E-02	1.34624E-02	5.63756E-03	1.48750E-03	0.	0.
0.	0.	0.	0.	0.	0.
2.46903E-02	-1.63017E-02	2.24915E-02	8.59923E-03	3.60105E-03	9.50152E-04
0.	0.	0.	0.	0.	0.
0.	4.13371E-02	-1.14982E-02	3.54444E-02	7.80923E-03	2.98571E-03
1.25031E-03	3.29899E-04	0.	0.	0.	0.
0.	0.	5.15262E-02	-4.63957E-02	3.33982E-02	3.50679E-03
7.72629E-04	2.95400E-04	1.23703E-04	3.26396E-05	0.	0.
0.	8.15062E-06	0.	5.24771E-02	-1.07917E-02	8.76010E-02
1.73884E-02	1.82577E-03	4.02259E-04	1.53796E-04	6.44044E-05	1.69934E-05
0.	0.	2.81831E-05	0.	5.30548E-02	-1.51422E-02
5.46993E-02	8.92412E-03	1.77139E-03	1.85995E-04	4.09790E-05	1.56676E-05
6.56102E-06	1.73115E-06	0.	7.63664E-05	0.	5.31029E-02

TABLE 6-6 (CONT)

-1.45414E-02	5.89432E-02	7.40275E-03	1.20775E-03	2.39732E-04	2.51717E-05
5.54591E-06	2.12038E-06	8.87937E-07	2.70956E-07	2.08465E-04	0.
5.32351E-02	-2.05244E-02	5.58264E-02	7.62247E-03	9.57316E-04	1.56185E-04
3.10019E-05	3.25517E-06	7.17191E-07	2.74205E-07	1.38978E-07	4.84124E-04
0.	5.97800E-02	-7.99640E-03	6.19329E-02	9.84775E-03	1.34460E-03
1.68874E-04	2.75677E-05	5.48128E-06	5.81650E-07	1.31289E-07	5.76715E-08
8.67911E-04	0.	7.63421E-02	4.16719E-02	4.17785E-02	7.14532E-03
1.13628E-03	1.55146E-04	1.94854E-05	3.18088E-06	6.32456E-07	6.71134E-08
1.95521E-08	1.44228E-03	0.	9.37544E-02	8.52655E-02	1.60363E-02
1.40312E-02	2.37017E-03	3.78760E-04	5.17154E-05	6.49514E-06	1.06029E-06
2.10819E-07	3.58733E-08	2.16276E-03	0.	1.27994E-01	1.24136E-01
4.44967E-03	1.31368E-02	8.68356E-03	1.50961E-03	2.52506E-04	3.44769E-05
4.33010E-06	7.06863E-07	1.95830E-07	4.07214E-03	0.	2.34927E-01
2.30855E-01	1.69546E-03	2.59696E-03	4.62919E-03	2.79897E-03	5.93010E-04
1.26253E-04	1.72385E-05	2.16066E-06	3.33429E-07		
1.54424E-03	0.	8.95133E-02	4.31237E-02	0.	0.
0.	0.	0.	0.	0.	0.
0.	2.35988E-05	0.	1.26833E-01	1.00767E-01	2.40955E-02
0.	0.	0.	0.	0.	0.
0.	0.	2.53800E-05	0.	1.42135E-01	1.08684E-01
1.98779E-02	8.80253E-03	0.	0.	0.	0.
0.	0.	0.	2.90470E-05	0.	1.98147E-01
1.75990E-01	2.75839E-02	5.58996E-03	9.13569E-03	0.	0.
0.	0.	0.	0.	1.12091E-04	0.
2.60063E-01	2.46121E-01	2.21276E-02	5.84192E-03	5.74764E-04	2.81169E-03
0.	0.	0.	0.	0.	2.61629E-04
0.	3.00639E-01	2.98606E-01	1.38297E-02	0.	0.
0.	0.	0.	0.	0.	0.
3.28245E-04	0.	8.46465E-02	7.51273E-02	1.77084E-03	0.
0.	0.	0.	0.	0.	0.
0.	9.68568E-05	0.	8.41816E-02	8.13811E-02	9.19095E-03
0.	0.	0.	0.	0.	0.
0.	0.	1.57729E-04	0.	8.40417E-02	8.09094E-02
2.70365E-03	0.	0.	0.	0.	0.
0.	0.	0.	4.30995E-04	0.	8.43148E-02
8.08633E-02	2.97456E-03	0.	0.	0.	0.
0.	0.	0.	0.	1.08943E-03	0.
8.49736E-02	8.04668E-02	3.02045E-03	0.	0.	0.
0.	0.	0.	0.	0.	2.60251E-03
0.	8.58741E-02	8.32716E-02	3.41535E-03	0.	0.
0.	0.	0.	0.	0.	0.
5.45221E-03	0.	8.87238E-02	8.32716E-02	0.	0.
0.	0.	0.	0.	0.	0.
0.	7.70057E-03	0.	9.09722E-02	8.32716E-02	0.

TABLE 6-6 (CONT)

0.	0.	0.	0.	0.		0.
0.	0.	1.12747E-02	0.	9.45463E-02		8.32716E-02
0.	0.	0.	0.	0.		0.
0.	0.	0.	2.07732E-02	0.		1.04045E-01
8.32716E-02	0.	0.	0.	0.		0.
0.	0.	0.	0.			
1.0	0.0	0.0	1.0	120.0	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
1.0	0.0	0.0	1.0	105.0	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.6	0.4	0.0	1.0	88.0	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.0	1.0	0.0	1.0	63.5	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.0	1.0	0.0	1.0	32.5	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.0	1.0	0.0	1.0	10.3	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.0	1.0	0.0	1.0	1.15	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.0	1.0	0.0	1.0	.173	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.0	1.0	0.0	1.0	.021	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.0	1.0	0.0	1.0	.009	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.0	1.0	0.0	1.0	.019	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.0	1.0	0.0	1.0	.0562	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0
0.0						
0.0	0.0	1.00	1.0	.1	-06	0.0
0.0	0.0	0.0	0.0	0.0		0.0

TABLE 6-6 (CONT)

```
0.0
0.0          0.0          1.00         1.0          .1          -06 0.0
0.0          0.0          0.0          0.0          0.0             0.0
0.0
0.0          0.0          1.00         1.0          .1          -06 0.0
0.0          0.0          0.0          0.0          0.0             0.0
0.0
0.0          0.0          1.00         1.0          .1          -06 0.0
0.0          0.0          0.0          0.0          0.0             0.0
0.0
 T
3*           F       0.0   T
7U
-.308606714 -.218217900  .218217900 -.617213403 -.577350269 -.218217900
 .218217900  .577350269 -.816496581 -.786795790 -.577350269 -.218217900
 .218217900  .577350269  .786795790 -.975900071 -.951189727 -.786795790
-.577350269 -.218217900  .218217900  .577350269  .786795790  .951189727
-.308606714 -.218217900  .218217900 -.617213403 -.577350269 -.218217900
 .218217900  .577350269 -.816496581 -.786795790 -.577350269 -.218217900
 .218217900  .577350269  .786795790 -.975900071 -.951189727 -.786795790
-.577350269 -.218217900  .218217900  .577350269  .786795790  .951189727
-.951189727 -.951189727 -.951189727 -.786795790 -.786795790 -.786795790
-.786795790 -.786795790 -.577350269 -.577350269 -.577350269 -.577350269
-.577350269 -.577350269 -.577350269 -.218217900 -.218217900 -.218217900
-.218217900 -.218217900 -.218217900 -.218217900 -.218217900 -.218217900
 .951189727  .951189727  .951189727  .786795790  .786795790  .786795790
 .786795790  .786795790  .577350269  .577350269  .577350269  .577350269
 .577350269  .577350269  .577350269  .218217900  .218217900  .218217900
 .218217900  .218217900  .218217900  .218217900  .218217900  .218217900
 T
6U
0.00         .030246915  .030246915 0.00         .022685185  .022685185
 .022685185  .022685185 0.00         .022685185  .023148144  .022685185
 .022685185  .023148144  .022685185 0.00         .030246915  .022685185
 .022685185  .030246915  .030246915  .022685185  .022685185  .030246915
0.00         .030246915  .030246915 0.00         .022685185  .022685185
 .022685185  .022685185 0.00         .022685185  .023148144  .022685185
 .022685185  .023148144  .022685185 0.00         .030246915  .022685185
 .022685185  .030246915  .030246915  .022685185  .022685185  .030246915
 T
4*
  0.0          3.0          6.0          9.0          12.0         15.0
  18.0         21.0         25.0         27.0         29.184       30.0
  32.0         34.0         36.094       38.0         40.0         40.971
```

TABLE 6-6 (CONT)

```
   42.0         43.0         44.0         44.654       45.0         46.0
   46.99        49.0         51.0         53.34        54.0         55.88
   57.5         60.0         61.92        62.05        62.174       63.0
   65.0         67.0         68.58        70.5         71.12
 2*
  -230.48      -229.21      -227.94      -224.94      -221.94      -218.94
  -215.94      -212.94      -209.94      -206.94      -203.94      -200.94
  -197.94      -197.625     -197.31      -197.0       -196.0       -195.0
  -194.0       -193.0       -192.0       -191.0       -190.0       -189.0
  -188.0       -187.0       -186.0       -185.0       -184.0       -183.0
  -182.0       -181.0       -180.0       -179.0       -178.0       -177.0
  -176.0       -175.0       -174.0       -173.0       -172.0       -171.0
  -170.0       -169.0       -168.0       -166.83      -166.0       -165.355
 8$
38R        6  2R       1400Q
38R        5  2R       1400Q        800Q          Q      16080Q
38R        4  2R       1400Q
38R        3  2R       1400Q        800Q          Q      160   Q      320
  Q      600
38R        2  2R       1400Q
 9$
           1            2            3            4            5            6
 1*           F       0.0
 5*           F       1.0
19$           F        -6
20$                     1            2            3            4            5
  T
```

TABLE 6-7. LISTING OF THE DOT-IIW INPUT DATA FOR THE PHOTON SEMINAR/WORKSHOP PROBLEM

```
   43000     5    6    1    2    8    3    4    0    0    0    0    0    0    0
MSFC SEMINAR-WORKSHOP DOT PROBLEM, PHOTON TRANSPORT IN NUCLEAR SUBSYSTEM
            3           0           1          48           1          22
           34          58           0         0.0         0.0       0.001
            1           0           0           0           0           1
           44           0          44           0           0           0
            0         0.0          13           3           4          16
          0.0          22           5          10           1          10
          0.0       0.001         0.0         0.0         0.0         0.0
            0          24          24           4           4           1
            0          10           0           0       0.001           0
14U
6.19751E-02 0.          7.53968E-02 8.99257E-04 0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          6.11176E-02 0.
7.56002E-02 7.52090E-04 1.26704E-03 0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          6.02035E-02 0.          7.64496E-02 1.52818E-03
2.88798E-03 2.28771E-03 0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
5.92175E-02 0.          7.80717E-02 2.34391E-03 3.56093E-03 2.48815E-03
1.99680E-03 0.          0.          0.          0.          0.
0.          0.          0.          0.          5.81030E-02 0.
8.10839E-02 3.04270E-03 4.73417E-03 3.00182E-03 2.15054E-03 1.75124E-03
0.          0.          0.          0.          0.          0.
0.          0.          5.73138E-02 0.          8.59831E-02 5.28118E-03
7.08418E-03 3.86213E-03 2.54642E-03 1.87580E-03 1.55152E-03 0.
0.          0.          0.          0.          0.          0.
5.71913E-02 0.          9.15306E-02 3.72628E-03 4.77181E-03 2.35252E-03
1.34556E-03 9.14675E-04 6.87743E-04 5.75168E-04 0.          0.
0.          0.          0.          0.          5.76566E-02 0.
9.68745E-02 5.00043E-03 7.42191E-03 4.13948E-03 2.12445E-03 1.25141E-03
```

TABLE 6-7 (CONT)

8.65743E-04	6.58349E-04	5.53862E-04	0.	0.	0.
0.	0.	5.91406E-02	0.	1.04792E-01	7.21001E-03
9.81395E-03	6.20531E-03	3.59456E-03	1.92878E-03	1.17102E-03	8.24135E-04
6.33452E-04	5.35863E-04	0.	0.	0.	0.
6.17623E-02	0.	1.17771E-01	1.17420E-02	1.48714E-02	8.76233E-03
5.77497E-03	3.50684E-03	1.97890E-03	1.23976E-03	8.87359E-04	6.89036E-04
5.85891E-04	0.	0.	0.	6.92163E-02	0.
1.41662E-01	2.26745E-02	2.23998E-02	1.09045E-02	6.90013E-03	4.80032E-03
3.07993E-03	1.83141E-03	1.18177E-03	8.58561E-04	6.72478E-04	5.74253E-04
0.	0.	1.05183E-01	0.	2.09543E-01	6.00932E-02
3.83763E-02	1.62107E-02	9.31397E-03	6.43358E-03	4.73270E-03	3.18816E-03
1.97231E-03	1.29708E-03	9.50232E-04	7.47501E-04	6.39526E-04	0.
2.90556E-01	0.	4.03595E-01	1.13039E-01	4.42663E-02	1.13949E-02
5.65646E-03	3.35194E-03	2.30744E-03	1.67785E-03	1.10731E-03	6.65690E-04
4.27369E-04	3.08010E-04	2.39471E-04	2.03481E-04		
0.	0.	0.	2.69141E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	2.25278E-03	3.78162E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	4.56809E-03
8.59481E-03	6.77189E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	6.99643E-03	1.05479E-02	7.29783E-03
5.82477E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	9.06434E-03	1.39306E-02	8.70463E-03	6.17360E-03	4.99920E-03
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.56502E-02
2.06501E-02	1.09849E-02	7.13337E-03	5.20014E-03	4.27610E-03	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	1.10885E-02	1.38829E-02	6.59926E-03
3.68022E-03	2.46281E-03	1.83197E-03	1.52286E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.48378E-02	2.16325E-02	1.16627E-02	5.76453E-03	3.30790E-03
2.25162E-03	1.69328E-03	1.41563E-03	0.	0.	0.
0.	0.	0.	0.	0.	2.12890E-02
2.82757E-02	1.72905E-02	9.66420E-03	4.98533E-03	2.94466E-03	2.03730E-03
1.54769E-03	1.30062E-03	0.	0.	0.	0.
0.	0.	0.	3.42626E-02	4.17288E-02	2.34203E-02
1.48851E-02	8.69182E-03	4.69883E-03	2.85657E-03	2.00669E-03	1.53832E-03
1.29857E-03	0.	0.	0.	0.	0.
0.	6.43855E-02	5.94097E-02	2.62872E-02	1.57024E-02	1.04602E-02
6.40117E-03	3.61484E-03	2.24907E-03	1.59716E-03	1.23155E-03	1.04235E-03

TABLE 6-7 (CONT)

0.	0.	0.	0.	0.	1.50628E-01
7.95088E-02	2.55731E-02	1.22526E-02	7.54107E-03	5.07052E-03	3.08482E-03
1.70067E-03	1.02702E-03	7.12058E-04	5.38628E-04	4.50790E-04	0.
0.	0.	0.	2.31423E-01	3.00477E-02	-1.02002E-02
-6.55073E-03	-4.34650E-03	-3.17064E-03	-2.39843E-03	-1.64705E-03	-1.03020E-03
-6.78872E-04	-4.96947E-04	-3.90403E-04	-3.33654E-04		
6.57055E-02	0.	7.95662E-02	9.28681E-04	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	6.47422E-02	0.
7.96986E-02	7.76698E-04	1.30850E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	6.36946E-02	0.	8.04723E-02	1.57819E-03
2.98247E-03	2.36256E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
6.25517E-02	0.	8.20228E-02	2.42060E-03	3.67744E-03	2.56956E-03
2.06214E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	6.12424E-02	0.
8.49753E-02	3.14226E-03	4.88907E-03	3.10004E-03	2.22090E-03	1.80854E-03
0.	0.	0.	0.	0.	0.
0.	0.	6.02671E-02	0.	8.98744E-02	5.45398E-03
7.31597E-03	3.98850E-03	2.62973E-03	1.93717E-03	1.60228E-03	0.
0.	0.	0.	0.	0.	0.
6.00206E-02	0.	9.54835E-02	3.84820E-03	4.92794E-03	2.42950E-03
1.38958E-03	9.44603E-04	7.10245E-04	5.93987E-04	0.	0.
0.	0.	0.	0.	6.04365E-02	0.
1.00938E-01	5.16405E-03	7.66475E-03	4.27492E-03	2.19396E-03	1.29235E-03
8.94069E-04	6.79890E-04	5.71985E-04	0.	0.	0.
0.	0.	6.19541E-02	0.	1.09100E-01	7.44592E-03
1.01351E-02	6.40835E-03	3.71218E-03	1.99189E-03	1.20933E-03	8.51101E-04
6.54178E-04	5.53396E-04	0.	0.	0.	0.
6.47246E-02	0.	1.22566E-01	1.21262E-02	1.53580E-02	9.04903E-03
5.96392E-03	3.62158E-03	2.04365E-03	1.28033E-03	9.16394E-04	7.11581E-04
6.05062E-04	0.	0.	0.	7.30280E-02	0.
1.47844E-01	2.34164E-02	2.31327E-02	1.12613E-02	7.12590E-03	4.95738E-03
3.18070E-03	1.89133E-03	1.22044E-03	8.86653E-04	6.94482E-04	5.93043E-04
0.	0.	1.14437E-01	0.	2.22211E-01	6.20594E-02
3.96319E-02	1.67411E-02	9.61872E-03	6.64409E-03	4.88755E-03	3.29248E-03
2.03685E-03	1.33952E-03	9.81323E-04	7.71959E-04	6.60451E-04	0.
3.28034E-01	0.	4.44772E-01	1.16738E-01	4.57147E-02	1.17677E-02
5.84153E-03	3.46162E-03	2.38294E-03	1.73275E-03	1.14354E-03	6.87471E-04
4.41352E-04	3.18088E-04	2.47306E-04	2.10138E-04		
0.	0.	0.	2.77947E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.

TABLE 6-7 (CONT)

0.	2.32649E-03	3.90535E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	4.71756E-03
8.87602E-03	6.99347E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	7.22536E-03	1.08930E-02	7.53662E-03
6.01536E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	9.36093E-03	1.43864E-02	8.98944E-03	6.37560E-03	5.16277E-03
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.61623E-02
2.13258E-02	1.13443E-02	7.36677E-03	5.37029E-03	4.41601E-03	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	1.14513E-02	1.43371E-02	6.81518E-03
3.80063E-03	2.54339E-03	1.89191E-03	1.57269E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.53233E-02	2.23403E-02	1.20443E-02	5.95314E-03	3.41614E-03
2.32530E-03	1.74868E-03	1.46195E-03	0.	0.	0.
0.	0.	0.	0.	0.	2.19856E-02
2.92009E-02	1.78563E-02	9.98041E-03	5.14845E-03	3.04101E-03	2.10396E-03
1.59833E-03	1.34318E-03	0.	0.	0.	0.
0.	0.	0.	3.53837E-02	4.30941E-02	2.41866E-02
1.53721E-02	8.97621E-03	4.85257E-03	2.95003E-03	2.07235E-03	1.58865E-03
1.34106E-03	0.	0.	0.	0.	0.
0.	6.64922E-02	6.13536E-02	2.71473E-02	1.62162E-02	1.08024E-02
6.61062E-03	3.73312E-03	2.32266E-03	1.64942E-03	1.27185E-03	1.07646E-03
0.	0.	0.	0.	0.	1.55557E-01
8.21103E-02	2.64099E-02	1.26535E-02	7.78781E-03	5.23642E-03	3.18575E-03
1.75631E-03	1.06063E-03	7.35356E-04	5.56459E-04	4.65540E-04	0.
0.	0.	0.	2.38995E-01	3.10309E-02	-1.05340E-02
-6.76506E-03	-4.48871E-03	-3.27438E-03	-2.47691E-03	-1.70094E-03	-1.06391E-03
-7.01085E-04	-5.13207E-04	-4.03177E-04	-3.44571E-04		
6.69602E-02	0.	8.09473E-02	9.37143E-04	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	6.59581E-02	0.
8.10509E-02	7.83775E-04	1.32042E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	6.48609E-02	0.	8.17914E-02	1.59257E-03
3.00965E-03	2.38409E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
6.36591E-02	0.	8.33076E-02	2.44266E-03	3.71095E-03	2.59297E-03
2.08093E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	6.22757E-02	0.
8.62249E-02	3.17089E-03	4.93362E-03	3.12829E-03	2.24114E-03	1.82502E-03

TABLE 6-7 (CONT)

0.	0.	0.	0.	0.	0.
0.	0.	6.12281E-02	0.	9.11052E-02	5.50367E-03
7.38264E-03	4.02484E-03	2.65370E-03	1.95482E-03	1.61688E-03	0.
0.	0.	0.	0.	0.	0.
6.09320E-02	0.	9.67180E-02	3.88326E-03	4.97285E-03	2.45164E-03
1.40225E-03	9.53210E-04	7.16717E-04	5.99400E-04	0.	0.
0.	0.	0.	0.	6.13258E-02	0.
1.02196E-01	5.21110E-03	7.73459E-03	4.31387E-03	2.21396E-03	1.30413E-03
9.02216E-04	6.86085E-04	5.77197E-04	0.	0.	0.
0.	0.	6.28503E-02	0.	1.10425E-01	7.51377E-03
1.02274E-02	6.46674E-03	3.74600E-03	2.01004E-03	1.22035E-03	8.58856E-04
6.60139E-04	5.58439E-04	0.	0.	0.	0.
6.56683E-02	0.	1.24037E-01	1.22367E-02	1.54980E-02	9.13148E-03
6.01827E-03	3.65458E-03	2.06227E-03	1.29199E-03	9.24744E-04	7.18065E-04
6.10575E-04	0.	0.	0.	7.42743E-02	0.
1.49772E-01	2.36298E-02	2.33435E-02	1.13639E-02	7.19083E-03	5.00256E-03
3.20969E-03	1.90856E-03	1.23156E-03	8.94733E-04	7.00810E-04	5.98446E-04
0.	0.	1.17664E-01	0.	2.26420E-01	6.26249E-02
3.99931E-02	1.68936E-02	9.70636E-03	6.70463E-03	4.93209E-03	3.32248E-03
2.05541E-03	1.35172E-03	9.90265E-04	7.78993E-04	6.66470E-04	0.
3.41550E-01	0.	4.59352E-01	1.17801E-01	4.61313E-02	1.18750E-02
5.89476E-03	3.49316E-03	2.40465E-03	1.74854E-03	1.15396E-03	6.93736E-04
4.45374E-04	3.20987E-04	2.49560E-04	2.12053E-04		
0.	0.	0.	2.80480E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	2.34768E-03	3.94094E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	4.76054E-03
8.95690E-03	7.05719E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	7.29119E-03	1.09922E-02	7.60529E-03
6.07017E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	9.44622E-03	1.45175E-02	9.07135E-03	6.43369E-03	5.20981E-03
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.63095E-02
2.15201E-02	1.14477E-02	7.43390E-03	5.41923E-03	4.45625E-03	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	1.15556E-02	1.44678E-02	6.87728E-03
3.83527E-03	2.56657E-03	1.90915E-03	1.58702E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.54629E-02	2.25439E-02	1.21540E-02	6.00739E-03	3.44727E-03
2.34648E-03	1.76462E-03	1.47527E-03	0.	0.	0.

TABLE 6-7 (CONT)

0.	0.	0.	0.	0.	2.21859E-02
2.94670E-02	1.80190E-02	1.00714E-02	5.19537E-03	3.06872E-03	2.12313E-03
1.61289E-03	1.35542E-03	0.	0.	0.	0.
0.	0.	0.	3.57061E-02	4.34868E-02	2.44070E-02
1.55122E-02	9.05800E-03	4.89679E-03	2.97692E-03	2.09123E-03	1.60313E-03
1.35328E-03	0.	0.	0.	0.	0.
0.	6.70981E-02	6.19127E-02	2.73947E-02	1.63639E-02	1.09009E-02
6.67085E-03	3.76713E-03	2.34382E-03	1.66445E-03	1.28344E-03	1.08627E-03
0.	0.	0.	0.	0.	1.56974E-01
8.28585E-02	2.66505E-02	1.27688E-02	7.85877E-03	5.28414E-03	3.21478E-03
1.77231E-03	1.07029E-03	7.42057E-04	5.61529E-04	4.69782E-04	0.
0.	0.	0.	2.41173E-01	3.13136E-02	-1.06299E-02
-6.82671E-03	-4.52961E-03	-3.30421E-03	-2.49948E-03	-1.71644E-03	-1.07360E-03
-7.07473E-04	-5.17884E-04	-4.06851E-04	-3.47711E-04		
6.64649E-02	0.	8.04403E-02	9.36364E-04	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	6.54840E-02	0.
8.05642E-02	7.83124E-04	1.31933E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	6.44151E-02	0.	8.13315E-02	1.59124E-03
3.00715E-03	2.38211E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
6.32478E-02	0.	8.28799E-02	2.44063E-03	3.70786E-03	2.59082E-03
2.07920E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	6.19095E-02	0.
8.58387E-02	3.16825E-03	4.92952E-03	3.12569E-03	2.23928E-03	1.82350E-03
0.	0.	0.	0.	0.	0.
0.	0.	6.09088E-02	0.	9.07610E-02	5.49910E-03
7.37650E-03	4.02150E-03	2.65149E-03	1.95320E-03	1.61554E-03	0.
0.	0.	0.	0.	0.	0.
6.06473E-02	0.	9.64036E-02	3.88004E-03	4.96871E-03	2.44960E-03
1.40108E-03	9.52418E-04	7.16121E-04	5.98902E-04	0.	0.
0.	0.	0.	0.	6.10599E-02	0.
1.01896E-01	5.20677E-03	7.72816E-03	4.31029E-03	2.21212E-03	1.30305E-03
9.01466E-04	6.85515E-04	5.76717E-04	0.	0.	0.
0.	0.	6.25901E-02	0.	1.10126E-01	7.50752E-03
1.02189E-02	6.46137E-03	3.74289E-03	2.00837E-03	1.21934E-03	8.58142E-04
6.59590E-04	5.57975E-04	0.	0.	0.	0.
6.53953E-02	0.	1.23715E-01	1.22266E-02	1.54851E-02	9.12390E-03
6.01326E-03	3.65155E-03	2.06056E-03	1.29092E-03	9.23975E-04	7.17468E-04
6.10067E-04	0.	0.	0.	7.38558E-02	0.
1.49291E-01	2.36102E-02	2.33241E-02	1.13545E-02	7.18485E-03	4.99840E-03
3.20702E-03	1.90698E-03	1.23053E-03	8.93989E-04	7.00227E-04	5.97949E-04
0.	0.	1.16220E-01	0.	2.24886E-01	6.25728E-02

TABLE 6-7 (CONT)

3.99598E-02	1.68796E-02	9.69830E-03	6.69906E-03	4.92799E-03	3.31972E-03
2.05370E-03	1.35060E-03	9.89442E-04	7.78346E-04	6.65916E-04	0.
3.34749E-01	0.	4.52452E-01	1.17703E-01	4.60929E-02	1.18651E-02
5.88986E-03	3.49026E-03	2.40265E-03	1.74708E-03	1.15301E-03	6.93159E-04
4.45004E-04	3.20720E-04	2.49352E-04	2.11877E-04		
0.	0.	0.	2.80247E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	2.34573E-03	3.93766E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	4.75659E-03
8.94946E-03	7.05133E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	7.28513E-03	1.09831E-02	7.59897E-03
6.06513E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	9.43837E-03	1.45054E-02	9.06381E-03	6.42835E-03	5.20548E-03
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.62960E-02
2.15022E-02	1.14382E-02	7.42772E-03	5.41472E-03	4.45255E-03	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	1.15460E-02	1.44557E-02	6.87157E-03
3.83208E-03	2.56443E-03	1.90757E-03	1.58570E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.54501E-02	2.25251E-02	1.21439E-02	6.00240E-03	3.44440E-03
2.34453E-03	1.76315E-03	1.47405E-03	0.	0.	0.
0.	0.	0.	0.	0.	2.21675E-02
2.94425E-02	1.80040E-02	1.00630E-02	5.19105E-03	3.06617E-03	2.12137E-03
1.61155E-03	1.35429E-03	0.	0.	0.	0.
0.	0.	0.	3.56764E-02	4.34507E-02	2.43867E-02
1.54993E-02	9.05048E-03	4.89272E-03	2.97444E-03	2.08950E-03	1.60180E-03
1.35215E-03	0.	0.	0.	0.	0.
0.	6.70423E-02	6.18612E-02	2.73719E-02	1.63503E-02	1.08918E-02
6.66531E-03	3.76400E-03	2.34188E-03	1.66307E-03	1.28237E-03	1.08536E-03
0.	0.	0.	0.	0.	1.56844E-01
8.27897E-02	2.66284E-02	1.27582E-02	7.85224E-03	5.27975E-03	3.21211E-03
1.77084E-03	1.06940E-03	7.41440E-04	5.61062E-04	4.69392E-04	0.
0.	0.	0.	2.40973E-01	3.12876E-02	-1.06211E-02
-6.82103E-03	-4.52585E-03	-3.30147E-03	-2.49740E-03	-1.71502E-03	-1.07271E-03
-7.06885E-04	-5.17453E-04	-4.06513E-04	-3.47422E-04		
6.24728E-02	0.	7.61215E-02	9.14474E-04	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	6.16270E-02	0.
7.63547E-02	7.64816E-04	1.28848E-03	0.	0.	0.

TABLE 6-7 (CONT)

0.	0.	0.	0.	0.	0.
0.	0.	6.07332E-02	0.	7.72541E-02	1.55404E-03
2.93685E-03	2.32642E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
5.97751E-02	0.	7.89483E-02	2.38357E-03	3.62118E-03	2.53025E-03
2.03059E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	5.87037E-02	0.
8.20735E-02	3.09419E-03	4.81428E-03	3.05261E-03	2.18693E-03	1.78087E-03
0.	0.	0.	0.	0.	0.
0.	0.	5.79689E-02	0.	8.71232E-02	5.37054E-03
7.20405E-03	3.92748E-03	2.58950E-03	1.90754E-03	1.57777E-03	0.
0.	0.	0.	0.	0.	0.
5.78952E-02	0.	9.28155E-02	3.78933E-03	4.85256E-03	2.39233E-03
1.36833E-03	9.30152E-04	6.99380E-04	5.84901E-04	0.	0.
0.	0.	0.	0.	5.83975E-02	0.
9.82790E-02	5.08505E-03	7.54749E-03	4.20952E-03	2.16040E-03	1.27258E-03
8.80392E-04	6.69489E-04	5.63234E-04	0.	0.	0.
0.	0.	5.99220E-02	0.	1.06346E-01	7.33201E-03
9.98002E-03	6.31031E-03	3.65539E-03	1.96142E-03	1.19083E-03	8.38080E-04
6.44170E-04	5.44930E-04	0.	0.	0.	0.
6.25878E-02	0.	1.19545E-01	1.19407E-02	1.51231E-02	8.91060E-03
5.87269E-03	3.56618E-03	2.01239E-03	1.26074E-03	9.02375E-04	7.00695E-04
5.95805E-04	0.	0.	0.	7.00341E-02	0.
1.43706E-01	2.30582E-02	2.27788E-02	1.10890E-02	7.01689E-03	4.88154E-03
3.13205E-03	1.86240E-03	1.20177E-03	8.73089E-04	6.83857E-04	5.83970E-04
0.	0.	1.05618E-01	0.	2.11743E-01	6.11100E-02
3.90257E-02	1.64850E-02	9.47157E-03	6.54245E-03	4.81278E-03	3.24211E-03
2.00569E-03	1.31902E-03	9.66311E-04	7.60149E-04	6.50348E-04	0.
2.88850E-01	0.	4.03602E-01	1.14952E-01	4.50154E-02	1.15877E-02
5.75217E-03	3.40866E-03	2.34648E-03	1.70624E-03	1.12605E-03	6.76954E-04
4.34601E-04	3.13222E-04	2.43523E-04	2.06924E-04		
0.	0.	0.	2.73695E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	2.29090E-03	3.84561E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	4.64539E-03
8.74024E-03	6.88648E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	7.11482E-03	1.07263E-02	7.42132E-03
5.92334E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	9.21772E-03	1.41663E-02	8.85192E-03	6.27806E-03	5.08379E-03
0.	0.	0.	0.	0.	0.

TABLE 6-7 (CONT)

0.	0.	0.	0.	0.	1.59150E-02
2.09995E-02	1.11708E-02	7.25407E-03	5.28814E-03	4.34845E-03	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	1.12761E-02	1.41178E-02	6.71092E-03
3.74249E-03	2.50448E-03	1.86297E-03	1.54863E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.50889E-02	2.19985E-02	1.18600E-02	5.86207E-03	3.36388E-03
2.28972E-03	1.72193E-03	1.43959E-03	0.	0.	0.
0.	0.	0.	0.	0.	2.16492E-02
2.87542E-02	1.75831E-02	9.82773E-03	5.06969E-03	2.99448E-03	2.07178E-03
1.57388E-03	1.32263E-03	0.	0.	0.	0.
0.	0.	0.	3.48424E-02	4.24349E-02	2.38166E-02
1.51369E-02	8.83889E-03	4.77834E-03	2.90490E-03	2.04065E-03	1.56435E-03
1.32054E-03	0.	0.	0.	0.	0.
0.	6.54750E-02	6.04150E-02	2.67320E-02	1.59681E-02	1.06372E-02
6.50949E-03	3.67601E-03	2.28713E-03	1.62419E-03	1.25239E-03	1.05999E-03
0.	0.	0.	0.	0.	1.53177E-01
8.08542E-02	2.60059E-02	1.24599E-02	7.66867E-03	5.15632E-03	3.13702E-03
1.72944E-03	1.04440E-03	7.24107E-04	5.47946E-04	4.58418E-04	0.
0.	0.	0.	2.35339E-01	3.05562E-02	-1.03728E-02
-6.66157E-03	-4.42004E-03	-3.22429E-03	-2.43902E-03	-1.67492E-03	-1.04763E-03
-6.90359E-04	-5.05356E-04	-3.97009E-04	-3.39300E-04		
1.72569E-02	0.	2.40423E-02	4.54631E-04	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.76257E-02	0.
2.49475E-02	3.80228E-04	6.40569E-04	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	1.82580E-02	0.	2.64714E-02	7.72593E-04
1.46005E-03	1.15658E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
1.91818E-02	0.	2.87137E-02	1.18499E-03	1.80027E-03	1.25791E-03
1.00951E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	2.05576E-02	0.
3.21759E-02	1.53827E-03	2.39342E-03	1.51761E-03	1.08723E-03	8.85360E-04
0.	0.	0.	0.	0.	0.
0.	0.	2.22621E-02	0.	3.67562E-02	2.66997E-03
3.58149E-03	1.95255E-03	1.28737E-03	9.48332E-04	7.84390E-04	0.
0.	0.	0.	0.	0.	0.
2.37835E-02	0.	4.11442E-02	1.88387E-03	2.41245E-03	1.18935E-03
6.80263E-04	4.62425E-04	3.47697E-04	2.90783E-04	0.	0.
0.	0.	0.	0.	2.49545E-02	0.
4.47815E-02	2.52803E-03	3.75224E-03	2.09276E-03	1.07404E-03	6.32665E-04
4.37687E-04	3.32836E-04	2.80012E-04	0.	0.	0.
0.	0.	2.63662E-02	0.	4.94460E-02	3.64511E-03

TABLE 6-7 (CONT)

4.96157E-03	3.13717E-03	1.81728E-03	9.75119E-04	5.92022E-04	4.16652E-04
3.20249E-04	2.70912E-04	0.	0.	0.	0.
2.82136E-02	0.	5.65296E-02	5.93633E-03	7.51844E-03	4.42990E-03
2.91961E-03	1.77293E-03	1.00046E-03	6.26777E-04	4.48615E-04	3.48351E-04
2.96205E-04	0.	0.	0.	3.04367E-02	0.
6.70625E-02	1.14634E-02	1.13245E-02	5.51290E-03	3.48845E-03	2.42686E-03
1.55710E-03	9.25890E-04	5.97458E-04	4.34056E-04	3.39980E-04	2.90321E-04
0.	0.	3.56743E-02	0.	8.84345E-02	3.03808E-02
1.94016E-02	8.19550E-03	4.70879E-03	3.25258E-03	2.39267E-03	1.61181E-03
9.97128E-04	6.55753E-04	4.80401E-04	3.77908E-04	3.23320E-04	0.
5.93344E-02	0.	1.16483E-01	5.71482E-02	2.23794E-02	5.76083E-03
2.85969E-03	1.69462E-03	1.16655E-03	8.48258E-04	5.59816E-04	3.36548E-04
2.16062E-04	1.55718E-04	1.21068E-04	1.02872E-04		
0.	0.	0.	1.36068E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.13892E-03	1.91184E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	2.30945E-03
4.34521E-03	3.42361E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	3.53713E-03	5.33260E-03	3.68951E-03
2.94479E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	4.58259E-03	7.04277E-03	4.40073E-03	3.12114E-03	2.52741E-03
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	7.91215E-03
1.04399E-02	5.55355E-03	3.60636E-03	2.62900E-03	2.16183E-03	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	5.60592E-03	7.01866E-03	3.33633E-03
1.86058E-03	1.24510E-03	9.26176E-04	7.69903E-04	0.	0.
0.	0.	0.	0.	0.	0.
0.	7.50144E-03	1.09366E-02	5.89620E-03	2.91433E-03	1.67235E-03
1.13834E-03	8.56059E-04	7.15690E-04	0.	0.	0.
0.	0.	0.	0.	0.	1.07629E-02
1.42951E-02	8.74144E-03	4.88586E-03	2.52040E-03	1.48871E-03	1.02998E-03
7.82453E-04	6.57545E-04	0.	0.	0.	0.
0.	0.	0.	1.73219E-02	2.10965E-02	1.18404E-02
7.52533E-03	4.39426E-03	2.37555E-03	1.44417E-03	1.01451E-03	7.77717E-04
6.56508E-04	0.	0.	0.	0.	0.
0.	3.25509E-02	3.00353E-02	1.32898E-02	7.93854E-03	5.28827E-03
3.23619E-03	1.82753E-03	1.13705E-03	8.07466E-04	6.22626E-04	5.26974E-04
0.	0.	0.	0.	0.	7.61520E-02
4.01967E-02	1.29288E-02	6.19446E-03	3.81248E-03	2.56346E-03	1.55957E-03

TABLE 6-7 (CONT)

8.59792E-04	5.19225E-04	3.59990E-04	2.72411E-04	2.27903E-04	0.
0.	0.	0.	1.16999E-01	1.51910E-02	-5.15684E-03
-3.31180E-03	-2.19742E-03	-1.60295E-03	-1.21256E-03	-8.32687E-04	-5.20832E-04
-3.43212E-04	-2.51238E-04	-1.97373E-04	-1.68683E-04		
5.29246E-02	0.	6.94347E-02	1.10619E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	5.30736E-02	0.
7.08888E-02	9.25155E-04	1.55861E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	5.35846E-02	0.	7.35691E-02	1.87984E-03
3.55254E-03	2.81414E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
5.45067E-02	0.	7.76995E-02	2.88328E-03	4.38034E-03	3.06070E-03
2.45629E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	5.60774E-02	0.
8.43466E-02	3.74286E-03	5.82357E-03	3.69258E-03	2.64540E-03	2.15422E-03
0.	0.	0.	0.	0.	0.
0.	0.	5.83136E-02	0.	9.35800E-02	6.49645E-03
8.71434E-03	4.75086E-03	3.13238E-03	2.30744E-03	1.90854E-03	0.
0.	0.	0.	0.	0.	0.
6.05815E-02	0.	1.02823E-01	4.58374E-03	5.86987E-03	2.89387E-03
1.65519E-03	1.12515E-03	8.46001E-04	7.07522E-04	0.	0.
0.	0.	0.	0.	6.25599E-02	0.
1.10802E-01	6.15110E-03	9.12978E-03	5.09202E-03	2.61332E-03	1.53937E-03
1.06496E-03	8.09844E-04	6.81313E-04	0.	0.	0.
0.	0.	6.52764E-02	0.	1.21433E-01	8.86913E-03
1.20723E-02	7.63323E-03	4.42172E-03	2.37262E-03	1.44048E-03	1.01378E-03
7.79217E-04	6.59172E-04	0.	0.	0.	0.
6.89622E-02	0.	1.37860E-01	1.44440E-02	1.82935E-02	1.07787E-02
7.10386E-03	4.31381E-03	2.43427E-03	1.52505E-03	1.09155E-03	8.47592E-04
7.20713E-04	0.	0.	0.	7.41174E-02	0.
1.63234E-01	2.78922E-02	2.75543E-02	1.34138E-02	8.48794E-03	5.90493E-03
3.78866E-03	2.25284E-03	1.45371E-03	1.05613E-03	8.27224E-04	7.06396E-04
0.	0.	8.72483E-02	0.	2.15622E-01	7.39214E-02
4.72072E-02	1.99409E-02	1.14572E-02	7.91403E-03	5.82175E-03	3.92180E-03
2.42617E-03	1.59555E-03	1.16889E-03	9.19510E-04	7.86690E-04	0.
1.47388E-01	0.	2.86439E-01	1.39051E-01	5.44526E-02	1.40170E-02
6.95808E-03	4.12327E-03	2.83841E-03	2.06395E-03	1.36212E-03	8.18874E-04
5.25712E-04	3.78888E-04	2.94576E-04	2.50304E-04		
0.	0.	0.	3.31074E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	2.77117E-03	4.65182E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.

TABLE 6-7 (CONT)

0.	0.	0.	0.	0.	5.61927E-03
1.05726E-02	8.33019E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	8.60640E-03	1.29751E-02	8.97716E-03
7.16513E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.11502E-02	1.71362E-02	1.07077E-02	7.59422E-03	6.14958E-03
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.92515E-02
2.54020E-02	1.35127E-02	8.77485E-03	6.39677E-03	5.26008E-03	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	1.36401E-02	1.70775E-02	8.11783E-03
4.52709E-03	3.02953E-03	2.25353E-03	1.87330E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.82522E-02	2.66104E-02	1.43464E-02	7.09102E-03	4.06910E-03
2.76975E-03	2.08293E-03	1.74139E-03	0.	0.	0.
0.	0.	0.	0.	0.	2.61879E-02
3.47823E-02	2.12693E-02	1.18881E-02	6.13252E-03	3.62226E-03	2.50611E-03
1.90383E-03	1.59991E-03	0.	0.	0.	0.
0.	0.	0.	4.21469E-02	5.13311E-02	2.88097E-02
1.83103E-02	1.06919E-02	5.78009E-03	3.51390E-03	2.46846E-03	1.89231E-03
1.59739E-03	0.	0.	0.	0.	0.
0.	7.92014E-02	7.30807E-02	3.23362E-02	1.93157E-02	1.28672E-02
7.87417E-03	4.44666E-03	2.76661E-03	1.96469E-03	1.51495E-03	1.28221E-03
0.	0.	0.	0.	0.	1.85290E-01
9.78049E-02	3.14578E-02	1.50721E-02	9.27636E-03	6.23731E-03	3.79467E-03
2.09201E-03	1.26336E-03	8.75912E-04	6.62820E-04	5.54523E-04	0.
0.	0.	0.	2.84677E-01	3.69621E-02	-1.25474E-02
-8.05813E-03	-5.34668E-03	-3.90024E-03	-2.95034E-03	-2.02606E-03	-1.26727E-03
-8.35089E-04	-6.11301E-04	-4.80240E-04	-4.10432E-04		
2.20617E-02	0.	3.04701E-02	5.63364E-04	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	2.24823E-02	0.
3.15553E-02	4.71167E-04	7.93773E-04	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	2.32179E-02	0.	3.33957E-02	9.57372E-04
1.80925E-03	1.43319E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
2.42788E-02	0.	3.60905E-02	1.46841E-03	2.23084E-03	1.55877E-03
1.25095E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	2.58656E-02	0.
4.02627E-02	1.90618E-03	2.96585E-03	1.88057E-03	1.34726E-03	1.09711E-03
0.	0.	0.	0.	0.	0.
0.	0.	2.78573E-02	0.	4.58179E-02	3.30854E-03

TABLE 6-7 (CONT)

4.43807E-03	2.41954E-03	1.59527E-03	1.17514E-03	9.71991E-04	0.
0.	0.	0.	0.	0.	0.
2.96541E-02	0.	5.11668E-02	2.33443E-03	2.98943E-03	1.47380E-03
8.42960E-04	5.73023E-04	4.30855E-04	3.60329E-04	0.	0.
0.	0.	0.	0.	3.10529E-02	0.
5.56220E-02	3.13266E-03	4.64965E-03	2.59329E-03	1.33092E-03	7.83978E-04
5.42368E-04	4.12440E-04	3.46982E-04	0.	0.	0.
0.	0.	3.27589E-02	0.	6.13588E-02	4.51690E-03
6.14821E-03	3.88748E-03	2.25191E-03	1.20834E-03	7.33615E-04	5.16301E-04
3.96843E-04	3.35706E-04	0.	0.	0.	0.
3.49988E-02	0.	7.00871E-02	7.35611E-03	9.31661E-03	5.48939E-03
3.61788E-03	2.19695E-03	1.23974E-03	7.76682E-04	5.55910E-04	4.31665E-04
3.67047E-04	0.	0.	0.	3.77486E-02	0.
8.31342E-02	1.42051E-02	1.40330E-02	6.83141E-03	4.32277E-03	3.00729E-03
1.92950E-03	1.14733E-03	7.40351E-04	5.37869E-04	4.21292E-04	3.59756E-04
0.	0.	4.43612E-02	0.	1.09740E-01	3.76470E-02
2.40419E-02	1.01556E-02	5.83498E-03	4.03049E-03	2.96492E-03	1.99731E-03
1.23561E-03	8.12588E-04	5.95298E-04	4.68292E-04	4.00648E-04	0.
7.44756E-02	0.	1.45292E-01	7.08163E-02	2.77318E-02	7.13863E-03
3.54364E-03	2.09991E-03	1.44556E-03	1.05113E-03	6.93706E-04	4.17039E-04
2.67737E-04	1.92961E-04	1.50023E-04	1.27476E-04		
0.	0.	0.	1.68611E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.41131E-03	2.36910E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	2.86180E-03
5.38445E-03	4.24243E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	4.38310E-03	6.60799E-03	4.57192E-03
3.64909E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	5.67860E-03	8.72717E-03	5.45325E-03	3.86762E-03	3.13188E-03
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	9.80449E-03
1.29368E-02	6.88178E-03	4.46889E-03	3.25777E-03	2.67888E-03	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	6.94667E-03	8.69730E-03	4.13428E-03
2.30557E-03	1.54289E-03	1.14769E-03	9.54039E-04	0.	0.
0.	0.	0.	0.	0.	0.
0.	9.29554E-03	1.35522E-02	7.30638E-03	3.61134E-03	2.07232E-03
1.41059E-03	1.06080E-03	8.86860E-04	0.	0.	0.
0.	0.	0.	0.	0.	1.33371E-02
1.77141E-02	1.08321E-02	6.05440E-03	3.12320E-03	1.84476E-03	1.27632E-03

TABLE 6-7 (CONT)

9.69591E-04	8.14809E-04	0.	0.	0.	0.
0.	0.	0.	2.14647E-02	2.61421E-02	1.46723E-02
9.32515E-03	5.44522E-03	2.94371E-03	1.78957E-03	1.25715E-03	9.63722E-04
8.13524E-04	0.	0.	0.	0.	0.
0.	4.03360E-02	3.72188E-02	1.64683E-02	9.83719E-03	6.55306E-03
4.01019E-03	2.26461E-03	1.40899E-03	1.00059E-03	7.71539E-04	6.53009E-04
0.	0.	0.	0.	0.	9.43651E-02
4.98104E-02	1.60210E-02	7.67598E-03	4.72430E-03	3.17656E-03	1.93257E-03
1.06543E-03	6.43407E-04	4.46088E-04	3.37563E-04	2.82410E-04	0.
0.	0.	0.	1.44981E-01	1.88242E-02	-6.39019E-03
-4.10388E-03	-2.72298E-03	-1.98633E-03	-1.50256E-03	-1.03184E-03	-6.45398E-04
-4.25298E-04	-3.11326E-04	-2.44579E-04	-2.09027E-04		
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
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0.	0.	0.	0.	0.	0.
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0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
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0.	0.	0.	0.	0.	0.
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0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.

TABLE 6-7 (CONT)

0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
2.78139E-02	0.	3.76458E-02	6.58744E-04	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	2.81702E-02	0.
3.87793E-02	5.50937E-04	9.28163E-04	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	2.88449E-02	0.	4.07458E-02	1.11946E-03

TABLE 6-7 (CONT)

2.11557E-03	1.67584E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
2.98417E-02	0.	4.36532E-02	1.71701E-03	2.60853E-03	1.82267E-03
1.46274E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	3.13730E-02	0.
4.82076E-02	2.22891E-03	3.46798E-03	2.19896E-03	1.57536E-03	1.28286E-03
0.	0.	0.	0.	0.	0.
0.	0.	3.33536E-02	0.	5.43551E-02	3.86869E-03
5.18946E-03	2.82917E-03	1.86536E-03	1.37410E-03	1.13655E-03	0.
0.	0.	0.	0.	0.	0.
3.51923E-02	0.	6.03473E-02	2.72965E-03	3.49555E-03	1.72332E-03
9.85677E-04	6.70038E-04	5.03800E-04	4.21335E-04	0.	0.
0.	0.	0.	0.	3.66694E-02	0.
6.53981E-02	3.66303E-03	5.43686E-03	3.03234E-03	1.55625E-03	9.16709E-04
6.34193E-04	4.82268E-04	4.05727E-04	0.	0.	0.
0.	0.	3.85351E-02	0.	7.19770E-02	5.28164E-03
7.18913E-03	4.54565E-03	2.63317E-03	1.41291E-03	8.57819E-04	6.03714E-04
4.64030E-04	3.92542E-04	0.	0.	0.	0.
4.10118E-02	0.	8.20407E-02	8.60154E-03	1.08940E-02	6.41877E-03
4.23041E-03	2.56891E-03	1.44963E-03	9.08178E-04	6.50028E-04	5.04748E-04
4.29190E-04	0.	0.	0.	4.42018E-02	0.
9.72714E-02	1.66101E-02	1.64088E-02	7.98800E-03	5.05463E-03	3.51644E-03
2.25618E-03	1.34158E-03	8.65695E-04	6.28932E-04	4.92619E-04	4.20665E-04
0.	0.	5.21349E-02	0.	1.28583E-01	4.40208E-02
2.81122E-02	1.18750E-02	6.82287E-03	4.71287E-03	3.46690E-03	2.33546E-03
1.44480E-03	9.50163E-04	6.96085E-04	5.47576E-04	4.68480E-04	0.
8.86451E-02	0.	1.71451E-01	8.28058E-02	3.24270E-02	8.34723E-03
4.14359E-03	2.45544E-03	1.69029E-03	1.22910E-03	8.11153E-04	4.87646E-04
3.13066E-04	2.25631E-04	1.75423E-04	1.49058E-04		
0.	0.	0.	1.97157E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.65025E-03	2.77019E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	3.34632E-03
6.29606E-03	4.96070E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	5.12518E-03	7.72675E-03	5.34597E-03
4.26689E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	6.64001E-03	1.02047E-02	6.37651E-03	4.52242E-03	3.66212E-03
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.14644E-02
1.51271E-02	8.04690E-03	5.22549E-03	3.80932E-03	3.13242E-03	0.

TABLE 6-7 (CONT)

0.	0.	0.	0.	0.	0.
0.	0.	0.	8.12278E-03	1.01698E-02	4.83423E-03
2.69592E-03	1.80411E-03	1.34200E-03	1.11556E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.08693E-02	1.58467E-02	8.54339E-03	4.22276E-03	2.42318E-03
1.64941E-03	1.24040E-03	1.03701E-03	0.	0.	0.
0.	0.	0.	0.	0.	1.55951E-02
2.07132E-02	1.26660E-02	7.07944E-03	3.65197E-03	2.15709E-03	1.49241E-03
1.13375E-03	9.52760E-04	0.	0.	0.	0.
0.	0.	0.	2.50988E-02	3.05681E-02	1.71564E-02
1.09039E-02	6.36712E-03	3.44209E-03	2.09256E-03	1.46999E-03	1.12688E-03
9.51257E-04	0.	0.	0.	0.	0.
0.	4.71651E-02	4.35201E-02	1.92565E-02	1.15027E-02	7.66252E-03
4.68913E-03	2.64802E-03	1.64754E-03	1.16999E-03	9.02164E-04	7.63567E-04
0.	0.	0.	0.	0.	1.10342E-01
5.82436E-02	1.87354E-02	8.97555E-03	5.52415E-03	3.71437E-03	2.25976E-03
1.24581E-03	7.52339E-04	5.21612E-04	3.94714E-04	3.30223E-04	0.
0.	0.	0.	1.69527E-01	2.20112E-02	-7.47208E-03
-4.79868E-03	-3.18399E-03	-2.32262E-03	-1.75695E-03	-1.20653E-03	-7.54667E-04
-4.97302E-04	-3.64035E-04	-2.85987E-04	-2.44416E-04		
4.15115E-02	0.	5.47735E-02	8.88565E-04	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	4.16966E-02	0.
5.60070E-02	7.43147E-04	1.25198E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	4.21962E-02	0.	5.82491E-02	1.51001E-03
2.85364E-03	2.26050E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
4.30579E-02	0.	6.16879E-02	2.31604E-03	3.51859E-03	2.45856E-03
1.97306E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	4.44804E-02	0.
6.71881E-02	3.00652E-03	4.67788E-03	2.96613E-03	2.12497E-03	1.73042E-03
0.	0.	0.	0.	0.	0.
0.	0.	4.64485E-02	0.	7.47769E-02	5.21838E-03
6.99995E-03	3.81621E-03	2.51614E-03	1.85349E-03	1.53307E-03	0.
0.	0.	0.	0.	0.	0.
4.83998E-02	0.	8.23308E-02	3.68197E-03	4.71507E-03	2.32455E-03
1.32956E-03	9.03799E-04	6.79565E-04	5.68329E-04	0.	0.
0.	0.	0.	0.	5.00670E-02	0.
8.88185E-02	4.94098E-03	7.33366E-03	4.09026E-03	2.09919E-03	1.23653E-03
8.55449E-04	6.50521E-04	5.47277E-04	0.	0.	0.
0.	0.	5.23120E-02	0.	9.74211E-02	7.12428E-03
9.69726E-03	6.13153E-03	3.55182E-03	1.90585E-03	1.15709E-03	8.14336E-04
6.25920E-04	5.29491E-04	0.	0.	0.	0.

TABLE 6-7 (CONT)

5.53414E-02	0.	1.10684E-01	1.16024E-02	1.46946E-02	8.65814E-03
5.70630E-03	3.46514E-03	1.95537E-03	1.22502E-03	8.76809E-04	6.80843E-04
5.78925E-04	0.	0.	0.	5.94878E-02	0.
1.31072E-01	2.24049E-02	2.21335E-02	1.07748E-02	6.81808E-03	4.74324E-03
3.04331E-03	1.80963E-03	1.16772E-03	8.48353E-04	6.64482E-04	5.67425E-04
0.	0.	6.98887E-02	0.	1.73007E-01	5.93786E-02
3.79200E-02	1.60179E-02	9.20322E-03	6.35709E-03	4.67642E-03	3.15025E-03
1.94886E-03	1.28165E-03	9.38933E-04	7.38613E-04	6.31922E-04	0.
1.17253E-01	0.	2.28948E-01	1.11695E-01	4.37400E-02	1.12594E-02
5.58920E-03	3.31209E-03	2.28000E-03	1.65790E-03	1.09415E-03	6.57775E-04
4.22288E-04	3.04348E-04	2.36624E-04	2.01061E-04		
0.	0.	0.	2.65941E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	2.22599E-03	3.73665E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	4.51377E-03
8.49261E-03	6.69137E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	6.91325E-03	1.04224E-02	7.21106E-03
5.75552E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	8.95657E-03	1.37649E-02	8.60113E-03	6.10019E-03	4.93975E-03
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.54641E-02
2.04046E-02	1.08543E-02	7.04855E-03	5.13831E-03	4.22525E-03	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	1.09566E-02	1.37178E-02	6.52079E-03
3.63646E-03	2.43353E-03	1.81019E-03	1.50476E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.46614E-02	2.13753E-02	1.15240E-02	5.69599E-03	3.26857E-03
2.22485E-03	1.67315E-03	1.39680E-03	0.	0.	0.
0.	0.	0.	0.	0.	2.10359E-02
2.79395E-02	1.70849E-02	9.54930E-03	4.92606E-03	2.90965E-03	2.01308E-03
1.52929E-03	1.28516E-03	0.	0.	0.	0.
0.	0.	0.	3.38552E-02	4.12326E-02	2.31419E-02
1.47081E-02	8.58847E-03	4.64296E-03	2.82260E-03	1.98283E-03	1.52003E-03
1.28313E-03	0.	0.	0.	0.	0.
0.	6.36200E-02	5.87033E-02	2.59747E-02	1.55157E-02	1.03358E-02
6.32506E-03	3.57186E-03	2.22233E-03	1.57817E-03	1.21691E-03	1.02996E-03
0.	0.	0.	0.	0.	1.48837E-01
7.85635E-02	2.52691E-02	1.21069E-02	7.45140E-03	5.01023E-03	3.04814E-03
1.68044E-03	1.01481E-03	7.03591E-04	5.32422E-04	4.45430E-04	0.
0.	0.	0.	2.28672E-01	2.96904E-02	-1.00789E-02

TABLE 6-7 (CONT)

-6.47284E-03	-4.29462E-03	-3.13294E-03	-2.36991E-03	-1.62747E-03	-1.01795E-03
-6.70800E-04	-4.91038E-04	-3.85761E-04	-3.29687E-04		
1.04211E-01	0.	1.19308E-01	1.01149E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.01400E-01	0.
1.17690E-01	8.45955E-04	1.42518E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	9.78368E-02	0.	1.16110E-01	1.71891E-03
3.24841E-03	2.57322E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
9.35307E-02	0.	1.14738E-01	2.63644E-03	4.00535E-03	2.79868E-03
2.24601E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	8.78710E-02	0.
1.13720E-01	3.42244E-03	5.32502E-03	3.37646E-03	2.41894E-03	1.96980E-03
0.	0.	0.	0.	0.	0.
0.	0.	8.22703E-02	0.	1.14518E-01	5.94030E-03
7.96832E-03	4.34415E-03	2.86422E-03	2.10991E-03	1.74516E-03	0.
0.	0.	0.	0.	0.	0.
7.85530E-02	0.	1.17178E-01	4.19134E-03	5.36736E-03	2.64613E-03
1.51349E-03	1.02863E-03	7.73576E-04	6.46952E-04	0.	0.
0.	0.	0.	0.	7.69071E-02	0.
1.21020E-01	5.62451E-03	8.34820E-03	4.65610E-03	2.38960E-03	1.40759E-03
9.73792E-04	7.40514E-04	6.22987E-04	0.	0.	0.
0.	0.	7.71503E-02	0.	1.28500E-01	8.10986E-03
1.10388E-02	6.97977E-03	4.04318E-03	2.16950E-03	1.31717E-03	9.26992E-04
7.12510E-04	6.02741E-04	0.	0.	0.	0.
7.93449E-02	0.	1.42344E-01	1.32075E-02	1.67275E-02	9.85591E-03
6.49571E-03	3.94451E-03	2.22588E-03	1.39449E-03	9.98107E-04	7.75031E-04
6.59014E-04	0.	0.	0.	9.31788E-02	0.
1.74666E-01	2.55044E-02	2.51954E-02	1.22654E-02	7.76130E-03	5.39942E-03
3.46432E-03	2.05998E-03	1.32926E-03	9.65714E-04	7.56407E-04	6.45923E-04
0.	0.	1.79446E-01	0.	2.96830E-01	6.75931E-02
4.31659E-02	1.82338E-02	1.04764E-02	7.23653E-03	5.32336E-03	3.58606E-03
2.21847E-03	1.45896E-03	1.06883E-03	8.40793E-04	7.19343E-04	0.
6.55851E-01	0.	7.82998E-01	1.27147E-01	4.97910E-02	1.28170E-02
6.36241E-03	3.77028E-03	2.59542E-03	1.88725E-03	1.24551E-03	7.48772E-04
4.80707E-04	3.46452E-04	2.69358E-04	2.28876E-04		
0.	0.	0.	3.02731E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	2.53393E-03	4.25358E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	5.13821E-03
9.66748E-03	7.61706E-03	0.	0.	0.	0.

TABLE 6-7 (CONT)

0.	0.	0.	0.	0.	0.
0.	0.	0.	7.86963E-03	1.18643E-02	8.20864E-03
6.55174E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.01956E-02	1.56692E-02	9.79101E-03	6.94410E-03	5.62312E-03
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.76034E-02
2.32273E-02	1.23559E-02	8.02365E-03	5.84915E-03	4.80978E-03	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	1.24724E-02	1.56155E-02	7.42288E-03
4.13953E-03	2.77018E-03	2.06061E-03	1.71293E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.66896E-02	2.43323E-02	1.31182E-02	6.48397E-03	3.72075E-03
2.53264E-03	1.90461E-03	1.59231E-03	0.	0.	0.
0.	0.	0.	0.	0.	2.39460E-02
3.18047E-02	1.94485E-02	1.08703E-02	5.60753E-03	3.31217E-03	2.29157E-03
1.74085E-03	1.46295E-03	0.	0.	0.	0.
0.	0.	0.	3.85388E-02	4.69367E-02	2.63433E-02
1.67428E-02	9.77660E-03	5.28527E-03	3.21308E-03	2.25714E-03	1.73031E-03
1.46064E-03	0.	0.	0.	0.	0.
0.	7.24212E-02	6.68244E-02	2.95680E-02	1.76621E-02	1.17657E-02
7.20007E-03	4.06599E-03	2.52977E-03	1.79650E-03	1.38526E-03	1.17244E-03
0.	0.	0.	0.	0.	1.69428E-01
8.94320E-02	2.87648E-02	1.37818E-02	8.48223E-03	5.70335E-03	3.46982E-03
1.91292E-03	1.15520E-03	8.00926E-04	6.06077E-04	5.07051E-04	0.
0.	0.	0.	2.60306E-01	3.37978E-02	-1.14732E-02
-7.36829E-03	-4.88896E-03	-3.56635E-03	-2.69777E-03	-1.85261E-03	-1.15878E-03
-7.63599E-04	-5.58969E-04	-4.39128E-04	-3.75296E-04		
2.87085E-02	0.	3.71288E-02	5.64167E-04	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	2.86741E-02	0.
3.77600E-02	4.71838E-04	7.94904E-04	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	2.87846E-02	0.	3.89768E-02	9.58737E-04
1.81183E-03	1.43524E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
2.90458E-02	0.	4.08743E-02	1.47050E-03	2.23402E-03	1.56099E-03
1.25273E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	2.95679E-02	0.
4.39854E-02	1.90890E-03	2.97008E-03	1.88325E-03	1.34918E-03	1.09867E-03
0.	0.	0.	0.	0.	0.
0.	0.	3.04147E-02	0.	4.84009E-02	3.31325E-03
4.44440E-03	2.42298E-03	1.59754E-03	1.17682E-03	9.73376E-04	0.
0.	0.	0.	0.	0.	0.

TABLE 6-7 (CONT)

3.13504E-02	0.	5.28938E-02	2.33775E-03	2.99369E-03	1.47590E-03
8.44161E-04	5.73839E-04	4.31469E-04	3.60843E-04	0.	0.
0.	0.	0.	0.	3.22260E-02	0.
5.68301E-02	3.13712E-03	4.65628E-03	2.59698E-03	1.33282E-03	7.85096E-04
5.43140E-04	4.13028E-04	3.47476E-04	0.	0.	0.
0.	0.	3.35039E-02	0.	6.21445E-02	4.52334E-03
6.15698E-03	3.89302E-03	2.25512E-03	1.21006E-03	7.34660E-04	5.17037E-04
3.97408E-04	3.36184E-04	0.	0.	0.	0.
3.52667E-02	0.	7.04051E-02	7.36660E-03	9.32988E-03	5.49722E-03
3.62304E-03	2.20008E-03	1.24150E-03	7.77789E-04	5.56702E-04	4.32280E-04
3.67570E-04	0.	0.	0.	3.78892E-02	0.
8.33395E-02	1.42253E-02	1.40530E-02	6.84114E-03	4.32893E-03	3.01157E-03
1.93225E-03	1.14897E-03	7.41406E-04	5.38635E-04	4.21892E-04	3.60269E-04
0.	0.	4.48540E-02	0.	1.10326E-01	3.77006E-02
2.40761E-02	1.01701E-02	5.84330E-03	4.03623E-03	2.96915E-03	2.00015E-03
1.23737E-03	8.13746E-04	5.96146E-04	4.68959E-04	4.01219E-04	0.
7.72479E-02	0.	1.48165E-01	7.09172E-02	2.77714E-02	7.14880E-03
3.54869E-03	2.10291E-03	1.44762E-03	1.05263E-03	6.94695E-04	4.17634E-04
2.68118E-04	1.93236E-04	1.50237E-04	1.27657E-04		
0.	0.	0.	1.68651E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.41332E-03	2.37247E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	2.86588E-03
5.39212E-03	4.24848E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	4.38935E-03	6.61740E-03	4.57844E-03
3.65429E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	5.68669E-03	8.73961E-03	5.46102E-03	3.87313E-03	3.13634E-03
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	9.81846E-03
1.29552E-02	6.89159E-03	4.47526E-03	3.26241E-03	2.68269E-03	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	6.95657E-03	8.70970E-03	4.14017E-03
2.30886E-03	1.54509E-03	1.14932E-03	9.55399E-04	0.	0.
0.	0.	0.	0.	0.	0.
0.	9.30879E-03	1.35716E-02	7.31680E-03	3.61649E-03	2.07528E-03
1.41260E-03	1.06231E-03	8.88124E-04	0.	0.	0.
0.	0.	0.	0.	0.	1.33561E-02
1.77393E-02	1.08475E-02	6.06303E-03	3.12765E-03	1.84739E-03	1.27814E-03
9.70973E-04	8.15970E-04	0.	0.	0.	0.
0.	0.	0.	2.14953E-02	2.61794E-02	1.46932E-02

TABLE 6-7 (CONT)

9.33844E-03	5.45298E-03	2.94790E-03	1.79212E-03	1.25894E-03	9.65096E-04
8.14683E-04	0.	0.	0.	0.	0.
0.	4.03935E-02	3.72719E-02	1.64918E-02	9.85120E-03	6.56240E-03
4.01590E-03	2.26784E-03	1.41100E-03	1.00201E-03	7.72638E-04	6.53940E-04
0.	0.	0.	0.	0.	9.44996E-02
4.98814E-02	1.60438E-02	7.68692E-03	4.73104E-03	3.18109E-03	1.93532E-03
1.06695E-03	6.44324E-04	4.46723E-04	3.38044E-04	2.82812E-04	0.
0.	0.	0.	1.45188E-01	1.88510E-02	-6.39930E-03
-4.10973E-03	-2.72686E-03	-1.98916E-03	-1.50470E-03	-1.03331E-03	-6.46318E-04
-4.25904E-04	-3.11770E-04	-2.44927E-04	-2.09325E-04		
4.06331E-02	0.	5.05548E-02	6.64760E-04	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	4.01513E-02	0.
5.08573E-02	5.55969E-04	9.36639E-04	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	3.96856E-02	0.	5.16952E-02	1.12968E-03
2.13489E-03	1.69115E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
3.91609E-02	0.	5.30985E-02	1.73269E-03	2.63235E-03	1.83932E-03
1.47610E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	3.86806E-02	0.
5.56689E-02	2.24926E-03	3.49965E-03	2.21904E-03	1.58975E-03	1.29457E-03
0.	0.	0.	0.	0.	0.
0.	0.	3.84978E-02	0.	5.96911E-02	3.90402E-03
5.23685E-03	2.85501E-03	1.88239E-03	1.38665E-03	1.14693E-03	0.
0.	0.	0.	0.	0.	0.
3.87115E-02	0.	6.40962E-02	2.75458E-03	3.52748E-03	1.73906E-03
9.94679E-04	6.76157E-04	5.08401E-04	4.25183E-04	0.	0.
0.	0.	0.	0.	3.92157E-02	0.
6.82068E-02	3.69648E-03	5.48651E-03	3.06003E-03	1.57046E-03	9.25081E-04
6.39985E-04	4.86673E-04	4.09433E-04	0.	0.	0.
0.	0.	4.02938E-02	0.	7.40412E-02	5.32987E-03
7.25479E-03	4.58717E-03	2.65722E-03	1.42582E-03	8.65653E-04	6.09227E-04
4.68268E-04	3.96127E-04	0.	0.	0.	0.
4.19014E-02	0.	8.33050E-02	8.68009E-03	1.09934E-02	6.47739E-03
4.26904E-03	2.59237E-03	1.46287E-03	9.16472E-04	6.55965E-04	5.09357E-04
4.33110E-04	0.	0.	0.	4.49401E-02	0.
9.84943E-02	1.67617E-02	1.65587E-02	8.06095E-03	5.10080E-03	3.54855E-03
2.27678E-03	1.35383E-03	8.73601E-04	6.34676E-04	4.97118E-04	4.24506E-04
0.	0.	5.40351E-02	0.	1.31181E-01	4.44228E-02
2.83690E-02	1.19834E-02	6.88518E-03	4.75591E-03	3.49856E-03	2.35679E-03
1.45800E-03	9.58841E-04	7.02442E-04	5.52577E-04	4.72758E-04	0.
9.80319E-02	0.	1.81594E-01	8.35620E-02	3.27231E-02	8.42347E-03
4.18143E-03	2.47786E-03	1.70573E-03	1.24032E-03	8.18561E-04	4.92100E-04

TABLE 6-7 (CONT)

3.15925E-04	2.27691E-04	1.77025E-04	1.50419E-04		
0.	0.	0.	1.98958E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.66532E-03	2.79549E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
6.35356E-03	5.00600E-03	0.	0.	0.	3.37688E-03
0.	0.	0.	0.	0.	0.
0.	0.	0.	5.17199E-03	7.79731E-03	5.39479E-03
4.30586E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	6.70065E-03	1.02979E-02	6.43474E-03	4.56372E-03	3.69557E-03
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.15691E-02
1.52652E-02	8.12039E-03	5.27321E-03	3.84411E-03	3.16103E-03	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	8.19696E-03	1.02627E-02	4.87838E-03
2.72054E-03	1.82059E-03	1.35425E-03	1.12575E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.09686E-02	1.59914E-02	8.62141E-03	4.26133E-03	2.44531E-03
1.66447E-03	1.25173E-03	1.04648E-03	0.	0.	0.
0.	0.	0.	0.	0.	1.57375E-02
2.09023E-02	1.27817E-02	7.14409E-03	3.68532E-03	2.17679E-03	1.50604E-03
1.14410E-03	9.61461E-04	0.	0.	0.	0.
0.	0.	0.	2.53280E-02	3.08472E-02	1.73131E-02
1.10035E-02	6.42527E-03	3.47352E-03	2.11167E-03	1.48341E-03	1.13718E-03
9.59944E-04	0.	0.	0.	0.	0.
0.	4.75958E-02	4.39176E-02	1.94324E-02	1.16077E-02	7.73250E-03
4.73195E-03	2.67221E-03	1.66259E-03	1.18067E-03	9.10403E-04	7.70540E-04
0.	0.	0.	0.	0.	1.11349E-01
5.87755E-02	1.89045E-02	9.05752E-03	5.57460E-03	3.74829E-03	2.28040E-03
1.25719E-03	7.59209E-04	5.26376E-04	3.98319E-04	3.33239E-04	0.
0.	0.	0.	1.71075E-01	2.22122E-02	-7.54032E-03
-4.84251E-03	-3.21307E-03	-2.34384E-03	-1.77300E-03	-1.21755E-03	-7.61559E-04
-5.01844E-04	-3.67359E-04	-2.88599E-04	-2.46648E-04		
4.71410E-02	0.	6.05399E-02	8.97735E-04	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	4.69913E-02	0.
6.14493E-02	7.50817E-04	1.26490E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	4.70378E-02	0.	6.32564E-02	1.52560E-03
2.88309E-03	2.28383E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.

TABLE 6-7 (CONT)

4.72743E-02	0.	6.60965E-02	2.33994E-03	3.55490E-03	2.48393E-03
1.99342E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	4.78671E-02	0.
7.08092E-02	3.03755E-03	4.72616E-03	2.99674E-03	2.14690E-03	1.74827E-03
0.	0.	0.	0.	0.	0.
0.	0.	4.89637E-02	0.	7.75845E-02	5.27224E-03
7.07219E-03	3.85560E-03	2.54211E-03	1.87262E-03	1.54889E-03	0.
0.	0.	0.	0.	0.	0.
5.02638E-02	0.	8.45450E-02	3.71997E-03	4.76373E-03	2.34854E-03
1.34328E-03	9.13127E-04	6.86578E-04	5.74194E-04	0.	0.
0.	0.	0.	0.	5.15441E-02	0.
9.06956E-02	4.99197E-03	7.40934E-03	4.13247E-03	2.12086E-03	1.24929E-03
8.64277E-04	6.57234E-04	5.52925E-04	0.	0.	0.
0.	0.	5.34860E-02	0.	9.90606E-02	7.19780E-03
9.79734E-03	6.19481E-03	3.58848E-03	1.92552E-03	1.16903E-03	8.22740E-04
6.32379E-04	5.34956E-04	0.	0.	0.	0.
5.61911E-02	0.	1.12105E-01	1.17222E-02	1.48463E-02	8.74750E-03
5.76519E-03	3.50090E-03	1.97555E-03	1.23766E-03	8.85857E-04	6.87870E-04
5.84900E-04	0.	0.	0.	6.03526E-02	0.
1.32676E-01	2.26362E-02	2.23619E-02	1.08860E-02	6.88845E-03	4.79219E-03
3.07472E-03	1.82831E-03	1.17977E-03	8.57108E-04	6.71340E-04	5.73281E-04
0.	0.	7.16201E-02	0.	1.75803E-01	5.99914E-02
3.83113E-02	1.61832E-02	9.29820E-03	6.42269E-03	4.72469E-03	3.18276E-03
1.96898E-03	1.29488E-03	9.48623E-04	7.46235E-04	6.38444E-04	0.
1.24374E-01	0.	2.37222E-01	1.12848E-01	4.41914E-02	1.13756E-02
5.64688E-03	3.34627E-03	2.30353E-03	1.67501E-03	1.10544E-03	6.64563E-04
4.26646E-04	3.07489E-04	2.39066E-04	2.03136E-04		
0.	0.	0.	2.68685E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	2.24896E-03	3.77522E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	4.56036E-03
8.58026E-03	6.76043E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	6.98459E-03	1.05300E-02	7.28548E-03
5.81491E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	9.04900E-03	1.39070E-02	8.68989E-03	6.16315E-03	4.99073E-03
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.56237E-02
2.06151E-02	1.09663E-02	7.12129E-03	5.19134E-03	4.26886E-03	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	1.10697E-02	1.38594E-02	6.58808E-03

TABLE 6-7 (CONT)

3.67399E-03	2.45864E-03	1.82887E-03	1.52029E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.48127E-02	2.15959E-02	1.16429E-02	5.75477E-03	3.30230E-03
2.24781E-03	1.69041E-03	1.41324E-03	0.	0.	0.
0.	0.	0.	0.	0.	2.12530E-02
2.82279E-02	1.72613E-02	9.64784E-03	4.97690E-03	2.93967E-03	2.03385E-03
1.54507E-03	1.29842E-03	0.	0.	0.	0.
0.	0.	0.	3.42046E-02	4.16581E-02	2.33807E-02
1.48599E-02	8.67710E-03	4.69087E-03	2.85173E-03	2.00330E-03	1.53572E-03
1.29637E-03	0.	0.	0.	0.	0.
0.	6.42765E-02	5.93092E-02	2.62427E-02	1.56758E-02	1.04425E-02
6.39034E-03	3.60872E-03	2.24526E-03	1.59446E-03	1.22947E-03	1.04059E-03
0.	0.	0.	0.	0.	1.50373E-01
7.93743E-02	2.55298E-02	1.22319E-02	7.52830E-03	5.06194E-03	3.07959E-03
1.69779E-03	1.02529E-03	7.10852E-04	5.37916E-04	4.50027E-04	0.
0.	0.	0.	2.31031E-01	2.99969E-02	-1.01829E-02
-6.53964E-03	-4.33914E-03	-3.16527E-03	-2.39437E-03	-1.64426E-03	-1.02846E-03
-6.77723E-04	-4.96106E-04	-3.89742E-04	-3.33089E-04		
2.27885E-02	0.	2.82647E-02	3.66904E-04	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	2.24983E-02	0.
2.84073E-02	3.06858E-04	5.16963E-04	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	2.22057E-02	0.	2.88342E-02	6.23511E-04
1.17832E-03	9.33401E-04	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
2.18745E-02	0.	2.95671E-02	9.56333E-04	1.45288E-03	1.01518E-03
8.14710E-04	0.	0.	0.	0.	0.
0.	0.	0.	0.	2.15445E-02	0.
3.09209E-02	1.24144E-03	1.93158E-03	1.22476E-03	8.77435E-04	7.14518E-04
0.	0.	0.	0.	0.	0.
0.	0.	2.13896E-02	0.	3.30868E-02	2.15476E-03
2.89040E-03	1.57578E-03	1.03896E-03	7.65338E-04	6.33031E-04	0.
0.	0.	0.	0.	0.	0.
2.14677E-02	0.	3.54784E-02	1.52035E-03	1.94693E-03	9.59847E-04
5.48997E-04	3.73194E-04	2.80604E-04	2.34673E-04	0.	0.
0.	0.	0.	0.	2.17175E-02	0.
3.77187E-02	2.04021E-03	3.02819E-03	1.68894E-03	8.66792E-04	5.10584E-04
3.53229E-04	2.68611E-04	2.25980E-04	0.	0.	0.
0.	0.	2.22902E-02	0.	4.09165E-02	2.94174E-03
4.00416E-03	2.53181E-03	1.46661E-03	7.86957E-04	4.77783E-04	3.36253E-04
2.58453E-04	2.18636E-04	0.	0.	0.	0.
2.31549E-02	0.	4.60070E-02	4.79084E-03	6.06765E-03	3.57509E-03
2.35623E-03	1.43082E-03	8.07406E-04	5.05832E-04	3.62049E-04	2.81132E-04

TABLE 6-7 (CONT)

2.39048E-04	0.	0.	0.	2.48379E-02	0.
5.43962E-02	9.25138E-03	9.13929E-03	4.44911E-03	2.81530E-03	1.95856E-03
1.25663E-03	7.47227E-04	4.82170E-04	3.50299E-04	2.74376E-04	2.34299E-04
0.	0.	2.99645E-02	0.	7.25439E-02	2.45184E-02
1.56578E-02	6.61407E-03	3.80017E-03	2.62495E-03	1.93098E-03	1.30079E-03
8.04719E-04	5.29217E-04	3.87701E-04	3.04986E-04	2.60931E-04	0.
5.48790E-02	0.	1.01000E-01	4.61207E-02	1.80610E-02	4.64920E-03
2.30788E-03	1.36762E-03	9.41451E-04	6.84575E-04	4.51792E-04	2.71606E-04
1.74370E-04	1.25671E-04	9.77059E-05	8.30215E-05		
0.	0.	0.	1.09811E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	9.19149E-04	1.54293E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.86381E-03
3.50674E-03	2.76298E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	2.85460E-03	4.30360E-03	2.97757E-03
2.37655E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	3.69832E-03	5.68377E-03	3.55155E-03	2.51887E-03	2.03971E-03
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	6.38540E-03
8.42539E-03	4.48192E-03	2.91047E-03	2.12170E-03	1.74468E-03	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	4.52418E-03	5.66432E-03	2.69254E-03
1.50156E-03	1.00484E-03	7.47458E-04	6.21340E-04	0.	0.
0.	0.	0.	0.	0.	0.
0.	6.05393E-03	8.82621E-03	4.75845E-03	2.35197E-03	1.34965E-03
9.18679E-04	6.90871E-04	5.77588E-04	0.	0.	0.
0.	0.	0.	0.	0.	8.68607E-03
1.15367E-02	7.05466E-03	3.94307E-03	2.03405E-03	1.20144E-03	8.31234E-04
6.31468E-04	5.30663E-04	0.	0.	0.	0.
0.	0.	0.	1.39794E-02	1.70256E-02	9.55567E-03
6.07321E-03	3.54632E-03	1.91716E-03	1.16550E-03	8.18745E-04	6.27646E-04
5.29826E-04	0.	0.	0.	0.	0.
0.	2.62698E-02	2.42396E-02	1.07254E-02	6.40669E-03	4.26783E-03
2.61173E-03	1.47488E-03	9.17637E-04	6.51654E-04	5.02482E-04	4.25287E-04
0.	0.	0.	0.	0.	6.14575E-02
3.24402E-02	1.04340E-02	4.99915E-03	3.07681E-03	2.06881E-03	1.25863E-03
6.93884E-04	4.19034E-04	2.90525E-04	2.19846E-04	1.83926E-04	0.
0.	0.	0.	9.44224E-02	1.22597E-02	-4.16176E-03
-2.67274E-03	-1.77340E-03	-1.29364E-03	-9.78577E-04	-6.72009E-04	-4.20330E-04
-2.76985E-04	-2.02758E-04	-1.59287E-04	-1.36133E-04		

TABLE 6-7 (CONT)

1.15971E-02	0.	1.46583E-02	2.05105E-04	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.15095E-02	0.
1.48127E-02	1.71538E-04	2.88990E-04	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	1.14475E-02	0.	1.51529E-02	3.48552E-04
6.58697E-04	5.21785E-04	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
1.14019E-02	0.	1.57022E-02	5.34605E-04	8.12185E-04	5.67502E-04
4.55435E-04	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.14040E-02	0.
1.66455E-02	6.93986E-04	1.07978E-03	6.84662E-04	4.90500E-04	3.99427E-04
0.	0.	0.	0.	0.	0.
0.	0.	1.15130E-02	0.	1.80519E-02	1.20454E-03
1.61578E-03	8.80885E-04	5.80793E-04	4.27836E-04	3.53874E-04	0.
0.	0.	0.	0.	0.	0.
1.17035E-02	0.	1.95357E-02	8.49898E-04	1.08837E-03	5.36569E-04
3.06898E-04	2.08621E-04	1.56862E-04	1.31186E-04	0.	0.
0.	0.	0.	0.	1.19319E-02	0.
2.08768E-02	1.14051E-03	1.69281E-03	9.44142E-04	4.84550E-04	2.85424E-04
1.97461E-04	1.50158E-04	1.26326E-04	0.	0.	0.
0.	0.	1.23239E-02	0.	2.27362E-02	1.64448E-03
2.23839E-03	1.41532E-03	8.19857E-04	4.39921E-04	2.67088E-04	1.87971E-04
1.44479E-04	1.22221E-04	0.	0.	0.	0.
1.28857E-02	0.	2.56604E-02	2.67815E-03	3.39191E-03	1.99853E-03
1.31717E-03	7.99849E-04	4.51353E-04	2.82768E-04	2.02391E-04	1.57157E-04
1.33632E-04	0.	0.	0.	1.38345E-02	0.
3.03580E-02	5.17166E-03	5.10901E-03	2.48712E-03	1.57380E-03	1.09487E-03
7.02478E-04	4.17712E-04	2.69541E-04	1.95823E-04	1.53380E-04	1.30977E-04
0.	0.	1.65467E-02	0.	4.03493E-02	1.37062E-02
8.75296E-03	3.69737E-03	2.12435E-03	1.46739E-03	1.07945E-03	7.27163E-04
4.49850E-04	2.95840E-04	2.16731E-04	1.70492E-04	1.45865E-04	0.
2.94836E-02	0.	5.52658E-02	2.57822E-02	1.00964E-02	2.59897E-03
1.29014E-03	7.64519E-04	5.26286E-04	3.82688E-04	2.52559E-04	1.51832E-04
9.74754E-05	7.02518E-05	5.46191E-05	4.64103E-05		
0.	0.	0.	6.13863E-04	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	5.13819E-04	8.62521E-04	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.04190E-03
1.96032E-03	1.54455E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	1.59576E-03	2.40578E-03	1.66451E-03

TABLE 6-7 (CONT)

1.32853E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	2.06742E-03	3.17732E-03	1.98537E-03	1.40809E-03	1.14023E-03
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	3.56954E-03
4.70993E-03	2.50546E-03	1.62700E-03	1.18606E-03	9.75303E-04	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	2.52909E-03	3.16644E-03	1.50517E-03
8.39393E-04	5.61724E-04	4.17840E-04	3.47339E-04	0.	0.
0.	0.	0.	0.	0.	0.
0.	3.38424E-03	4.93399E-03	2.66005E-03	1.31479E-03	7.54475E-04
5.13556E-04	3.86207E-04	3.22881E-04	0.	0.	0.
0.	0.	0.	0.	0.	4.85565E-03
6.44920E-03	3.94366E-03	2.20424E-03	1.13707E-03	6.71625E-04	4.64673E-04
3.53001E-04	2.96649E-04	0.	0.	0.	0.
0.	0.	0.	7.81470E-03	9.51760E-03	5.34177E-03
3.39502E-03	1.98245E-03	1.07172E-03	6.51533E-04	4.57691E-04	3.50864E-04
2.96181E-04	0.	0.	0.	0.	0.
0.	1.46852E-02	1.35503E-02	5.99565E-03	3.58144E-03	2.38578E-03
1.45999E-03	8.24481E-04	5.12974E-04	3.64285E-04	2.80895E-04	2.37742E-04
0.	0.	0.	0.	0.	3.43557E-02
1.81346E-02	5.83278E-03	2.79461E-03	1.71998E-03	1.15650E-03	7.03592E-04
3.87892E-04	2.34246E-04	1.62408E-04	1.22897E-04	1.02817E-04	0.
0.	0.	0.	5.27836E-02	6.85336E-03	-2.32649E-03
-1.49411E-03	-9.91359E-04	-7.23166E-04	-5.47040E-04	-3.75664E-04	-2.34971E-04
-1.54839E-04	-1.13345E-04	-8.90441E-05	-7.61007E-05		
4.18847E-02	0.	5.52598E-02	8.96140E-04	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	4.20700E-02	0.
5.65024E-02	7.49483E-04	1.26265E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	4.25720E-02	0.	5.87617E-02	1.52289E-03
2.87797E-03	2.27978E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
4.34386E-02	0.	6.22274E-02	2.33579E-03	3.54858E-03	2.47952E-03
1.98988E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	4.48702E-02	0.
6.77715E-02	3.03215E-03	4.71776E-03	2.99141E-03	2.14308E-03	1.74517E-03
0.	0.	0.	0.	0.	0.
0.	0.	4.68517E-02	0.	7.54216E-02	5.26287E-03
7.05962E-03	3.84875E-03	2.53759E-03	1.86929E-03	1.54614E-03	0.
0.	0.	0.	0.	0.	0.
4.88171E-02	0.	8.30374E-02	3.71336E-03	4.75527E-03	2.34437E-03
1.34089E-03	9.11505E-04	6.85359E-04	5.73174E-04	0.	0.

TABLE 6-7 (CONT)

0.	0.	0.	0.	5.04970E-02	0.
8.95789E-02	4.98310E-03	7.39618E-03	4.12513E-03	2.11709E-03	1.24707E-03
8.62742E-04	6.56067E-04	5.51942E-04	0.	0.	0.
0.	0.	5.27599E-02	0.	9.82535E-02	7.18502E-03
9.77993E-03	6.18380E-03	3.58210E-03	1.92210E-03	1.16696E-03	8.21278E-04
6.31256E-04	5.34005E-04	0.	0.	0.	0.
5.58137E-02	0.	1.11628E-01	1.17013E-02	1.48199E-02	8.73196E-03
5.75495E-03	3.49468E-03	1.97204E-03	1.23546E-03	8.84284E-04	6.86648E-04
5.83860E-04	0.	0.	0.	5.99949E-02	0.
1.32190E-01	2.25959E-02	2.23222E-02	1.08667E-02	6.87621E-03	4.78368E-03
3.06925E-03	1.82506E-03	1.17767E-03	8.55585E-04	6.70147E-04	5.72263E-04
0.	0.	7.04847E-02	0.	1.74482E-01	5.98849E-02
3.82433E-02	1.61545E-02	9.28168E-03	6.41128E-03	4.71629E-03	3.17711E-03
1.96548E-03	1.29258E-03	9.46938E-04	7.44910E-04	6.37310E-04	0.
1.18254E-01	0.	2.30902E-01	1.12647E-01	4.41129E-02	1.13554E-02
5.63685E-03	3.34032E-03	2.29944E-03	1.67203E-03	1.10347E-03	6.63383E-04
4.25888E-04	3.06943E-04	2.38641E-04	2.02775E-04		
0.	0.	0.	2.68208E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	2.24497E-03	3.76851E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	4.55226E-03
8.56501E-03	6.74842E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	6.97218E-03	1.05113E-02	7.27254E-03
5.80458E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	9.03292E-03	1.38823E-02	8.67445E-03	6.15220E-03	4.98187E-03
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.55960E-02
2.05785E-02	1.09468E-02	7.10864E-03	5.18212E-03	4.26128E-03	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	1.10500E-02	1.38348E-02	6.57638E-03
3.66746E-03	2.45427E-03	1.82562E-03	1.51759E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.47864E-02	2.15575E-02	1.16222E-02	5.74455E-03	3.29644E-03
2.24382E-03	1.68741E-03	1.41072E-03	0.	0.	0.
0.	0.	0.	0.	0.	2.12152E-02
2.81777E-02	1.72306E-02	9.63070E-03	4.96805E-03	2.93445E-03	2.03024E-03
1.54232E-03	1.29611E-03	0.	0.	0.	0.
0.	0.	0.	3.41439E-02	4.15841E-02	2.33391E-02
1.48335E-02	8.66169E-03	4.68254E-03	2.84667E-03	1.99974E-03	1.53299E-03
1.29407E-03	0.	0.	0.	0.	0.

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TABLE 6-7 (CONT)

0.	6.41623E-02	5.92038E-02	2.61961E-02	1.56480E-02	1.04239E-02
6.37898E-03	3.60231E-03	2.24128E-03	1.59163E-03	1.22728E-03	1.03874E-03
0.	0.	0.	0.	0.	1.50106E-01
7.92332E-02	2.54845E-02	1.22101E-02	7.51493E-03	5.05294E-03	3.07412E-03
1.69477E-03	1.02346E-03	7.09590E-04	5.36961E-04	4.49228E-04	0.
0.	0.	0.	2.30621E-01	2.99436E-02	-1.01648E-02
-6.52802E-03	-4.33143E-03	-3.15965E-03	-2.39012E-03	-1.64134E-03	-1.02663E-03
-6.76519E-04	-4.95225E-04	-3.89050E-04	-3.32498E-04		
5.02569E-02	0.	6.55235E-02	1.02287E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	5.03169E-02	0.
6.67903E-02	8.55475E-04	1.44122E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	5.06919E-02	0.	6.91712E-02	1.73825E-03
3.28497E-03	2.60218E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
5.13752E-02	0.	7.28211E-02	2.66611E-03	4.05043E-03	2.83018E-03
2.27129E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	5.26253E-02	0.
7.87653E-02	3.46096E-03	5.38495E-03	3.41446E-03	2.44616E-03	1.99197E-03
0.	0.	0.	0.	0.	0.
0.	0.	5.44469E-02	0.	8.70572E-02	6.00715E-03
8.05800E-03	4.39304E-03	2.89646E-03	2.13365E-03	1.76480E-03	0.
0.	0.	0.	0.	0.	0.
5.63581E-02	0.	9.54178E-02	4.23850E-03	5.42776E-03	2.67591E-03
1.53052E-03	1.04041E-03	7.82282E-04	6.54233E-04	0.	0.
0.	0.	0.	0.	5.80892E-02	0.
1.02698E-01	5.68781E-03	8.44215E-03	4.70850E-03	2.41649E-03	1.42343E-03
9.84751E-04	7.48848E-04	6.29998E-04	0.	0.	0.
0.	0.	6.05206E-02	0.	1.12448E-01	8.20112E-03
1.11630E-02	7.05832E-03	4.08868E-03	2.19392E-03	1.33199E-03	9.37424E-04
7.20528E-04	6.09525E-04	0.	0.	0.	0.
6.38376E-02	0.	1.27546E-01	1.33561E-02	1.69157E-02	9.96683E-03
6.56882E-03	3.98890E-03	2.25093E-03	1.41018E-03	1.00934E-03	7.83753E-04
6.66430E-04	0.	0.	0.	6.85929E-02	0.
1.50997E-01	2.57915E-02	2.54790E-02	1.24035E-02	7.84865E-03	5.46019E-03
3.50331E-03	2.08316E-03	1.34422E-03	9.76582E-04	7.64920E-04	6.53192E-04
0.	0.	8.08839E-02	0.	1.99589E-01	6.83538E-02
4.36516E-02	1.84390E-02	1.05943E-02	7.31797E-03	5.38327E-03	3.62642E-03
2.24344E-03	1.47538E-03	1.08085E-03	8.50255E-04	7.27438E-04	0.
1.37618E-01	0.	2.66196E-01	1.28578E-01	5.03514E-02	1.29613E-02
6.43401E-03	3.81271E-03	2.62463E-03	1.90849E-03	1.25953E-03	7.57198E-04
4.86117E-04	3.50351E-04	2.72390E-04	2.31452E-04		
0.	0.	0.	3.06138E-03	0.	0.

TABLE 6-7 (CONT)

0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	2.56245E-03	4.30145E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	5.19604E-03
9.77628E-03	7.70278E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	7.95819E-03	1.19978E-02	8.30102E-03
6.62547E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.03104E-02	1.58455E-02	9.90120E-03	7.02224E-03	5.68640E-03
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.78015E-02
2.34887E-02	1.24949E-02	8.11395E-03	5.91498E-03	4.86391E-03	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	1.26127E-02	1.57913E-02	7.50641E-03
4.18612E-03	2.80136E-03	2.08380E-03	1.73220E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.68775E-02	2.46062E-02	1.32658E-02	6.55694E-03	3.76262E-03
2.56114E-03	1.92604E-03	1.61023E-03	0.	0.	0.
0.	0.	0.	0.	0.	2.42155E-02
3.21626E-02	1.96673E-02	1.09927E-02	5.67064E-03	3.34944E-03	2.31736E-03
1.76044E-03	1.47941E-03	0.	0.	0.	0.
0.	0.	0.	3.89725E-02	4.74650E-02	2.66398E-02
1.69312E-02	9.88663E-03	5.34475E-03	3.24924E-03	2.28254E-03	1.74978E-03
1.47708E-03	0.	0.	0.	0.	0.
0.	7.32362E-02	6.75764E-02	2.99008E-02	1.78609E-02	1.18981E-02
7.28110E-03	4.11175E-03	2.55824E-03	1.81672E-03	1.40085E-03	1.18564E-03
0.	0.	0.	0.	0.	1.71334E-01
9.04384E-02	2.90885E-02	1.39369E-02	8.57769E-03	5.76753E-03	3.50887E-03
1.93445E-03	1.16820E-03	8.09940E-04	6.12898E-04	5.12757E-04	0.
0.	0.	0.	2.63236E-01	3.41782E-02	-1.16024E-02
-7.45121E-03	-4.94398E-03	-3.60648E-03	-2.72813E-03	-1.87346E-03	-1.17182E-03
-7.72192E-04	-5.65259E-04	-4.44070E-04	-3.79520E-04		
3.83637E-01	0.	4.29366E-01	3.06383E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	3.72493E-01	0.
4.21836E-01	2.56242E-03	4.31690E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	3.58319E-01	0.	4.13670E-01	5.20663E-03
9.83955E-03	7.79437E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
3.40794E-01	0.	4.05032E-01	7.98587E-03	1.21323E-02	8.47729E-03
6.80324E-03	0.	0.	0.	0.	0.

TABLE 6-7 (CONT)

0.	0.	0.	0.	3.17320E-01	0.
3.95618E-01	1.03667E-02	1.61297E-02	1.02274E-02	7.32703E-03	5.96659E-03
0.	0.	0.	0.	0.	0.
0.	0.	2.93973E-01	0.	3.91651E-01	1.79933E-02
2.41363E-02	1.31586E-02	8.67582E-03	6.39097E-03	5.28613E-03	0.
0.	0.	0.	0.	0.	0.
2.77999E-01	0.	3.94996E-01	1.26957E-02	1.62579E-02	8.01521E-03
4.58441E-03	3.11636E-03	2.34319E-03	1.95964E-03	0.	0.
0.	0.	0.	0.	2.70485E-01	0.
4.04103E-01	1.70368E-02	2.52870E-02	1.41035E-02	7.23816E-03	4.26364E-03
2.94965E-03	2.24304E-03	1.88705E-03	0.	0.	0.
0.	0.	2.70933E-01	0.	4.26472E-01	2.45650E-02
3.34368E-02	2.11419E-02	1.22469E-02	6.57149E-03	3.98974E-03	2.80789E-03
2.15821E-03	1.82572E-03	0.	0.	0.	0.
2.80710E-01	0.	4.71537E-01	4.00059E-02	5.06680E-02	2.98539E-02
1.96757E-02	1.19481E-02	6.74225E-03	4.22395E-03	3.02330E-03	2.34759E-03
1.99617E-03	0.	0.	0.	3.48885E-01	0.
5.95713E-01	7.72537E-02	7.63177E-02	3.71524E-02	2.35092E-02	1.63550E-02
1.04935E-02	6.23973E-03	4.02637E-03	2.92518E-03	2.29118E-03	1.95652E-03
0.	0.	7.91614E-01	0.	1.14717E+00	2.04742E-01
1.30751E-01	5.52308E-02	3.17333E-02	2.19197E-02	1.61246E-02	1.08623E-02
6.71981E-03	4.41923E-03	3.23751E-03	2.54679E-03	2.17891E-03	0.
3.17957E+00	0.	3.56470E+00	3.85132E-01	1.50819E-01	3.88232E-02
1.92719E-02	1.14203E-02	7.86160E-03	5.71655E-03	3.77269E-03	2.26805E-03
1.45608E-03	1.04941E-03	8.15894E-04	6.93272E-04		
0.	0.	0.	9.16982E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	7.67536E-03	1.28842E-02	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.55638E-02
2.92831E-02	2.30723E-02	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	2.38373E-02	3.59373E-02	2.48642E-02
1.98454E-02	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	3.08828E-02	4.74624E-02	2.96573E-02	2.10339E-02	1.70326E-02
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	5.33213E-02
7.03563E-02	3.74263E-02	2.43039E-02	1.77173E-02	1.45690E-02	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	3.77792E-02	4.73000E-02	2.24841E-02
1.25388E-02	8.39096E-03	6.24165E-03	5.18851E-03	0.	0.
0.	0.	0.	0.	0.	0.

TABLE 6-7 (CONT)

0.	5.05535E-02	7.37034E-02	3.97355E-02	1.96402E-02	1.12703E-02
7.67144E-03	5.76912E-03	4.82316E-03	0.	0.	0.
0.	0.	0.	0.	0.	7.25331E-02
9.63374E-02	5.89100E-02	3.29266E-02	1.69854E-02	1.00327E-02	6.94123E-03
5.27309E-03	4.43131E-03	0.	0.	0.	0.
0.	0.	0.	1.16735E-01	1.42173E-01	7.97947E-02
5.07145E-02	2.96136E-02	1.60092E-02	9.73253E-03	6.83694E-03	5.24117E-03
4.42432E-03	0.	0.	0.	0.	0.
0.	2.19366E-01	2.02413E-01	8.95624E-02	5.34992E-02	3.56385E-02
2.18092E-02	1.23160E-02	7.66274E-03	5.44165E-03	4.19598E-03	3.55137E-03
0.	0.	0.	0.	0.	5.13201E-01
2.70892E-01	8.71294E-02	4.17455E-02	2.56929E-02	1.72756E-02	1.05102E-02
5.79429E-03	3.49914E-03	2.42603E-03	1.83583E-03	1.53587E-03	0.
0.	0.	0.	7.88475E-01	1.02375E-01	-3.47528E-02
-2.23188E-02	-1.48088E-02	-1.08026E-02	-8.17162E-03	-5.61162E-03	-3.50997E-03
-2.31296E-03	-1.69313E-03	-1.33013E-03	-1.13678E-03		
3.33182E-04	0.	4.90499E-04	1.05403E-05	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	3.46696E-04	0.
5.16448E-04	8.81535E-06	1.48512E-05	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	3.68190E-04	0.	5.58613E-04	1.79121E-05
3.38504E-05	2.68145E-05	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
3.97969E-04	0.	6.18961E-04	2.74733E-05	4.17381E-05	2.91639E-05
2.34048E-05	0.	0.	0.	0.	0.
0.	0.	0.	0.	4.40512E-04	0.
7.09875E-04	3.56639E-05	5.54899E-05	3.51847E-05	2.52067E-05	2.05265E-05
0.	0.	0.	0.	0.	0.
0.	0.	4.91313E-04	0.	8.27350E-04	6.19014E-05
8.30346E-05	4.52686E-05	2.98469E-05	2.19865E-05	1.81856E-05	0.
0.	0.	0.	0.	0.	0.
5.35233E-04	0.	9.37728E-04	4.36762E-05	5.59310E-05	2.75743E-05
1.57715E-05	1.07210E-05	8.06112E-06	6.74162E-06	0.	0.
0.	0.	0.	0.	5.67755E-04	0.
1.02743E-03	5.86108E-05	8.69932E-05	4.85194E-05	2.49010E-05	1.46679E-05
1.01475E-05	7.71660E-06	6.49190E-06	0.	0.	0.
0.	0.	6.04846E-04	0.	1.13994E-03	8.45095E-05
1.15031E-04	7.27333E-05	4.21324E-05	2.26075E-05	1.37256E-05	9.65980E-06
7.42477E-06	6.28092E-06	0.	0.	0.	0.
6.52466E-04	0.	1.30895E-03	1.37630E-04	1.74310E-04	1.02704E-04
6.76892E-05	4.11042E-05	2.31950E-05	1.45314E-05	1.04009E-05	8.07628E-06
6.86731E-06	0.	0.	0.	7.05655E-04	0.
1.55480E-03	2.65771E-04	2.62551E-04	1.27813E-04	8.08773E-05	5.62652E-05

TABLE 6-7 (CONT)

3.61003E-05	2.14662E-05	1.38517E-05	1.00633E-05	7.88221E-06	6.73090E-06
0.	0.	8.27085E-04	0.	2.05030E-03	7.04360E-04
4.49814E-04	1.90007E-04	1.09170E-04	7.54089E-05	5.54726E-05	3.73689E-05
2.31178E-05	1.52032E-05	1.11378E-05	8.76156E-06	7.49597E-06	0.
1.37563E-03	0.	2.70058E-03	1.32495E-03	5.18852E-04	1.33561E-04
6.63001E-05	3.92886E-05	2.70458E-05	1.96663E-05	1.29790E-05	7.80265E-06
5.00925E-06	3.61023E-06	2.80687E-06	2.38502E-06		
0.	0.	0.	3.15464E-05	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	2.64051E-05	4.43249E-05	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	5.35432E-05
1.00741E-04	7.93743E-05	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	8.20062E-05	1.23633E-04	8.55389E-05
6.82730E-05	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.06244E-04	1.63282E-04	1.02028E-04	7.23616E-05	5.85963E-05
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.83438E-04
2.42043E-04	1.28755E-04	8.36112E-05	6.09516E-05	5.01207E-05	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	1.29970E-04	1.62723E-04	7.73508E-05
4.31363E-05	2.88669E-05	2.14728E-05	1.78497E-05	0.	0.
0.	0.	0.	0.	0.	0.
0.	1.73916E-04	2.53557E-04	1.36700E-04	6.75668E-05	3.87724E-05
2.63916E-05	1.98472E-05	1.65928E-05	0.	0.	0.
0.	0.	0.	0.	0.	2.49531E-04
3.31424E-04	2.02665E-04	1.13275E-04	5.84338E-05	3.45147E-05	2.38795E-05
1.81407E-05	1.52448E-05	0.	0.	0.	0.
0.	0.	0.	4.01597E-04	4.89108E-04	2.74513E-04
1.74470E-04	1.01878E-04	5.50756E-05	3.34822E-05	2.35207E-05	1.80309E-05
1.52207E-05	0.	0.	0.	0.	0.
0.	7.54671E-04	6.96350E-04	3.08116E-04	1.84050E-04	1.22605E-04
7.50290E-05	4.23700E-05	2.63617E-05	1.87206E-05	1.44352E-05	1.22175E-05
0.	0.	0.	0.	0.	1.76553E-03
9.31934E-04	2.99746E-04	1.43615E-04	8.83899E-05	5.94322E-05	3.61576E-05
1.99337E-05	1.20379E-05	8.34613E-06	6.31568E-06	5.28377E-06	0.
0.	0.	0.	2.71254E-03	3.52193E-04	-1.19558E-04
-7.67819E-05	-5.09459E-05	-3.71635E-05	-2.81123E-05	-1.93053E-05	-1.20751E-05
-7.95715E-06	-5.82478E-06	-4.57597E-06	-3.91081E-06		
5.03598E-02	0.	6.64361E-02	1.07712E-03	0.	0.
0.	0.	0.	0.	0.	0.

TABLE 6-7 (CONT)

0.	0.	0.	0.	5.05814E-02	0.
6.79285E-02	9.00847E-04	1.51765E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	5.11832E-02	0.	7.06426E-02	1.83045E-03
3.45920E-03	2.74019E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
5.22228E-02	0.	7.48062E-02	2.80752E-03	4.26525E-03	2.98028E-03
2.39175E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	5.39409E-02	0.
8.14673E-02	3.64452E-03	5.67055E-03	3.59555E-03	2.57590E-03	2.09762E-03
0.	0.	0.	0.	0.	0.
0.	0.	5.63199E-02	0.	9.06597E-02	6.32575E-03
8.48537E-03	4.62603E-03	3.05007E-03	2.24681E-03	1.85840E-03	0.
0.	0.	0.	0.	0.	0.
5.86801E-02	0.	9.98115E-02	4.46330E-03	5.71563E-03	2.81783E-03
1.61170E-03	1.09559E-03	8.23772E-04	6.88931E-04	0.	0.
0.	0.	0.	0.	6.06979E-02	0.
1.07673E-01	5.98948E-03	8.88989E-03	4.95823E-03	2.54465E-03	1.49893E-03
1.03698E-03	7.88565E-04	6.63411E-04	0.	0.	0.
0.	0.	6.34168E-02	0.	1.18098E-01	8.63609E-03
1.17551E-02	7.43267E-03	4.30554E-03	2.31028E-03	1.40263E-03	9.87142E-04
7.58743E-04	6.41852E-04	0.	0.	0.	0.
6.70861E-02	0.	1.34173E-01	1.40645E-02	1.78129E-02	1.04954E-02
6.91721E-03	4.20046E-03	2.37031E-03	1.48498E-03	1.06287E-03	8.25321E-04
7.01776E-04	0.	0.	0.	7.21114E-02	0.
1.58886E-01	2.71594E-02	2.68303E-02	1.30613E-02	8.26491E-03	5.74978E-03
3.68911E-03	2.19364E-03	1.41551E-03	1.02838E-03	8.05489E-04	6.87835E-04
0.	0.	8.47198E-02	0.	2.09721E-01	7.19791E-02
4.59668E-02	1.94170E-02	1.11562E-02	7.70609E-03	5.66878E-03	3.81875E-03
2.36242E-03	1.55363E-03	1.13818E-03	8.95350E-04	7.66019E-04	0.
1.42138E-01	0.	2.77535E-01	1.35397E-01	5.30218E-02	1.36487E-02
6.77526E-03	4.01493E-03	2.76383E-03	2.00971E-03	1.32633E-03	7.97358E-04
5.11899E-04	3.68932E-04	2.86836E-04	2.43727E-04		
0.	0.	0.	3.22375E-03	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	2.69836E-03	4.52959E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	5.47162E-03
1.02948E-02	8.11132E-03	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	8.38027E-03	1.26341E-02	8.74128E-03
6.97686E-03	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.

TABLE 6-7 (CONT)

```
0.          1.08572E-02 1.66859E-02 1.04263E-02 7.39468E-03 5.98799E-03
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          1.87457E-02
2.47345E-02 1.31576E-02 8.54429E-03 6.22869E-03 5.12187E-03 0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          1.32817E-02 1.66288E-02 7.90453E-03
4.40813E-03 2.94993E-03 2.19432E-03 1.82407E-03 0.          0.
0.          0.          0.          0.          0.          0.
0.          1.77726E-02 2.59112E-02 1.39694E-02 6.90470E-03 3.96218E-03
2.69697E-03 2.02820E-03 1.69563E-03 0.          0.          0.
0.          0.          0.          0.          0.          2.54998E-02
3.38684E-02 2.07104E-02 1.15757E-02 5.97139E-03 3.52709E-03 2.44026E-03
1.85381E-03 1.55787E-03 0.          0.          0.          0.
0.          0.          0.          4.10395E-02 4.99823E-02 2.80527E-02
1.78292E-02 1.04110E-02 5.62821E-03 3.42157E-03 2.40360E-03 1.84259E-03
1.55542E-03 0.          0.          0.          0.          0.
0.          7.71204E-02 7.11605E-02 3.14866E-02 1.88082E-02 1.25291E-02
7.66727E-03 4.32982E-03 2.69392E-03 1.91307E-03 1.47514E-03 1.24852E-03
0.          0.          0.          0.          0.          1.80421E-01
9.52350E-02 3.06313E-02 1.46761E-02 9.03262E-03 6.07342E-03 3.69497E-03
2.03704E-03 1.23016E-03 8.52897E-04 6.45404E-04 5.39953E-04 0.
0.          0.          0.          2.77197E-01 3.59909E-02-1.22177E-02
-7.84640E-03-5.20619E-03-3.79776E-03-2.87282E-03-1.97282E-03-1.23397E-03
-8.13147E-04-5.95239E-04-4.67622E-04-3.99648E-04
 T
3*          F      0.0  T
7U
-.308606714 -.218217900  .218217900 -.617213403 -.577350269 -.218217900
 .218217900  .577350269 -.816496581 -.786795790 -.577350269 -.218217900
 .218217900  .577350269  .786795790 -.975900071 -.951189727 -.786795790
-.577350269 -.218217900  .218217900  .577350269  .786795790  .951189727
-.308606714 -.218217900  .218217900 -.617213403 -.577350269 -.218217900
 .218217900  .577350269 -.816496581 -.786795790 -.577350269 -.218217900
 .218217900  .577350269  .786795790 -.975900071 -.951189727 -.786795790
-.577350269 -.218217900  .218217900  .577350269  .786795790  .951189727
-.951189727 -.951189727 -.951189727 -.786795790 -.786795790 -.786795790
-.786795790 -.786795790 -.577350269 -.577350269 -.577350269 -.577350269
-.577350269 -.577350269 -.577350269 -.218217900 -.218217900 -.218217900
-.218217900 -.218217900 -.218217900 -.218217900 -.218217900 -.218217900
 .951189727  .951189727  .951189727  .786795790  .786795790  .786795790
 .786795790  .786795790  .577350269  .577350269  .577350269  .577350269
 .577350269  .577350269  .577350269  .218217900  .218217900  .218217900
 .218217900  .218217900  .218217900  .218217900  .218217900  .218217900
 T
```

TABLE 6-7 (CONT)

```
6U
0.00          .030246915  .030246915 0.00          .022685185  .022685185
 .022685185  .022685185 0.00          .022685185  .023148144  .022685185
 .022685185  .023148144  .022685185 0.00          .030246915  .022685185
 .022685185  .030246915  .030246915  .022685185  .022685185  .030246915
0.00          .030246915  .030246915 0.00          .022685185  .022685185
 .022685185  .022685185 0.00          .022685185  .023148144  .022685185
 .022685185  .023148144  .022685185 0.00          .030246915  .022685185
 .022685185  .030246915  .030246915  .022685185  .022685185  .030246915
 T
4*
   0.0          3.0          6.0          9.0          12.0         15.0
   18.0         21.0         25.0         27.0         29.184       32.0
   34.0         36.094       38.0         40.971       42.0
   44.0         44.654       45.0         46.0         46.99
   49.0         51.0         53.34        55.88        57.5         60.0
   61.92        62.174       63.0         65.0         67.0         68.58
   71.12
2*
  -230.48      -229.21      -227.94      -224.94      -221.94
  -215.94      -212.94      -209.94      -206.94      -203.94      -200.94
  -197.94      -197.625     -197.31      -196.0
  -194.0       -192.0       -190.0       -188.0       -186.0       -184.0
  -182.0       -180.0       -178.0       -176.0       -174.0       -172.0
  -170.0       -168.0       -166.83      -164.67      -161.29      -159.0
  -155.0       -151.0       -147.0       -146.05      -144.0       -140.0
  -137.16      -136.0       -134.0       -130.0       -122.0       -114.0
  -104.0       -94.0        -84.0        -74.0        -64.0        -53.0
  -43.0        -33.0        -23.0        -13.0        -8.0
  -5.08        -2.0          0.0
 8$
33R        22          11  Q       34
33R        21          11  Q       34  Q       68  Q       136  Q       34
33R        20          11  Q       34
33R        19          11  Q       34  Q       68  Q       136  Q       34
 Q        238
33R        18          11
25R        16 8R       17          11
25R        15 8R       17          11  Q       34  Q        68  Q       34
25R        14 8R       17          11  Q       34  Q        34
10R         1 3R        2 2R        3 3R        4 3R        5 3R        6
            7 3R        8           9 4R       10           11  Q       34
 Q         68  Q      136  Q       34  Q      272
21R        1212R       13          11  Q       34
```

TABLE 6-7 (CONT)

9$						
	-1	-3	-5	-7	-9	-11
	-13	-15	-19	-19	-21	-23
	-25	-27	-29	-31	-33	-35
	-37	-39	-41	-43		
1*	F	0.0				
5*	F	1.0				
19$	201	1	22			
20$	F	1				
T						

WRONG

Shown as received by NTIS

TABLE 6-8. INPUT CARD LISTING FOR THE DOQ CODE PROBLEM TO GENERATE S_8 ANGULAR QUADRATURE DATA

```
      10000
          8          1          0          0          1          2
 0.2182179
          8          2          0          0          1          2
 0.2182179
          8          3          0          0          1          2
 0.2182179
```

TABLE 6-9. LISTING FOR THE ADOQ CODE INPUT DATA FOR THE MSFC SEMINAR/WORKSHOP

```
          2           11           0
         10
-2.26949E-01-1.48874E-01 1.48874E-01-5.01663E-01-4.33395E-01-1.48874E-01
 1.48874E-01 4.33395E-01-7.33759E-01-6.79410E-01-4.33395E-01-1.48874E-01
 1.48874E-01 4.33395E-01 6.79410E-01-9.01204E-01-8.65063E-01-6.79410E-01
-4.33395E-01-1.48874E-01 1.48874E-01 4.33395E-01 6.79410E-01 8.65063E-01
-9.88856E-01-9.73907E-01-8.65063E-01-6.79410E-01-4.33395E-01-1.48874E-01
 1.48874E-01 4.33395E-01 6.79410E-01 8.65063E-01 9.73907E-01-2.26949E-01
-1.48874E-01 1.48874E-01-5.01663E-01-4.33395E-01-1.48874E-01 1.48874E-01
 4.33395E-01-7.33759E-01-6.79410E-01-4.33395E-01-1.48874E-01 1.48874E-01
 4.33395E-01 6.79410E-01-9.01204E-01-8.65063E-01-6.79410E-01-4.33395E-01
-1.48874E-01 1.48874E-01 4.33395E-01 6.79410E-01 8.65063E-01-9.88856E-01
-9.73907E-01-8.65063E-01-6.79410E-01-4.33395E-01-1.48874E-01 1.48874E-01
 4.33395E-01 6.79410E-01 8.65063E-01 9.73907E-01
-9.73907E-01-9.73907E-01-9.73907E-01-8.65063E-01-8.65063E-01-8.65063E-01
-8.65063E-01-8.65063E-01-6.79410E-01-6.79410E-01-6.79410E-01-6.79410E-01
-6.79410E-01-6.79410E-01-6.79410E-01-4.33395E-01-4.33395E-01-4.33395E-01
-4.33395E-01-4.33395E-01-4.33395E-01-4.33395E-01-4.33395E-01-4.33395E-01
-1.48874E-01-1.48874E-01-1.48874E-01-1.48874E-01-1.48874E-01-1.48874E-01
-1.48874E-01-1.48874E-01-1.48874E-01-1.48874E-01-1.48874E-01 9.73907E-01
 9.73907E-01 9.73907E-01 8.65063E-01 8.65063E-01 8.65063E-01 8.65063E-01
 8.65063E-01 6.79410E-01 6.79410E-01 6.79410E-01 6.79410E-01 6.79410E-01
 6.79410E-01 6.79410E-01 4.33395E-01 4.33395E-01 4.33395E-01 4.33395E-01
 4.33395E-01 4.33395E-01 4.33395E-01 4.33395E-01 4.33395E-01 1.48874E-01
 1.48874E-01 1.48874E-01 1.48874E-01 1.48874E-01 1.48874E-01 1.48874E-01
 1.48874E-01 1.48874E-01 1.48874E-01 1.48874E-01
 0.          1.66678E-02 1.66678E-02 0.          2.44419E-02 1.29209E-02
 1.29209E-02 2.44419E-02 0.          2.70111E-02 8.54983E-03 1.92106E-02
 1.92106E-02 8.54983E-03 2.70111E-02 0.          2.44419E-02 8.54983E-03
 2.74683E-02 6.85661E-03 6.85661E-03 2.74683E-02 8.54983E-03 2.44419E-02
 0.          1.66678E-02 1.29209E-02 1.92106E-02 6.85661E-03 1.82251E-02
 1.82251E-02 6.85661E-03 1.92106E-02 1.29209E-02 1.66678E-02 0.
 1.66678E-02 1.66678E-02 0.          2.44419E-02 1.29209E-02 1.29209E-02
 2.44419E-02 0.          2.70111E-02 8.54983E-03 1.92106E-02 1.92106E-02
 8.54983E-03 2.70111E-02 0.          2.44419E-02 8.54983E-03 2.74683E-02
 6.85661E-03 6.85661E-03 2.74683E-02 8.54983E-03 2.44419E-02 0.
 1.66678E-02 1.29209E-02 1.92106E-02 6.85661E-03 1.82251E-02 1.82251E-02
 6.85661E-03 1.92106E-02 1.29209E-02 1.66678E-02
          6
-3.61249E-01-2.38619E-01 2.38619E-01-7.50201E-01-6.61209E-01-2.38619E-01
 2.38619E-01 6.61209E-01-9.71113E-01-9.32470E-01-6.61209E-01-2.38619E-01
 2.38619E-01 6.61209E-01 9.32470E-01-3.61249E-01-2.38619E-01 2.38619E-01
-7.50201E-01-6.61209E-01-2.38619E-01 2.38619E-01 6.61209E-01-9.71113E-01
-9.32470E-01-6.61209E-01-2.38619E-01 2.38619E-01 6.61209E-01 9.32470E-01
```

TABLE 6-9 (CONT)

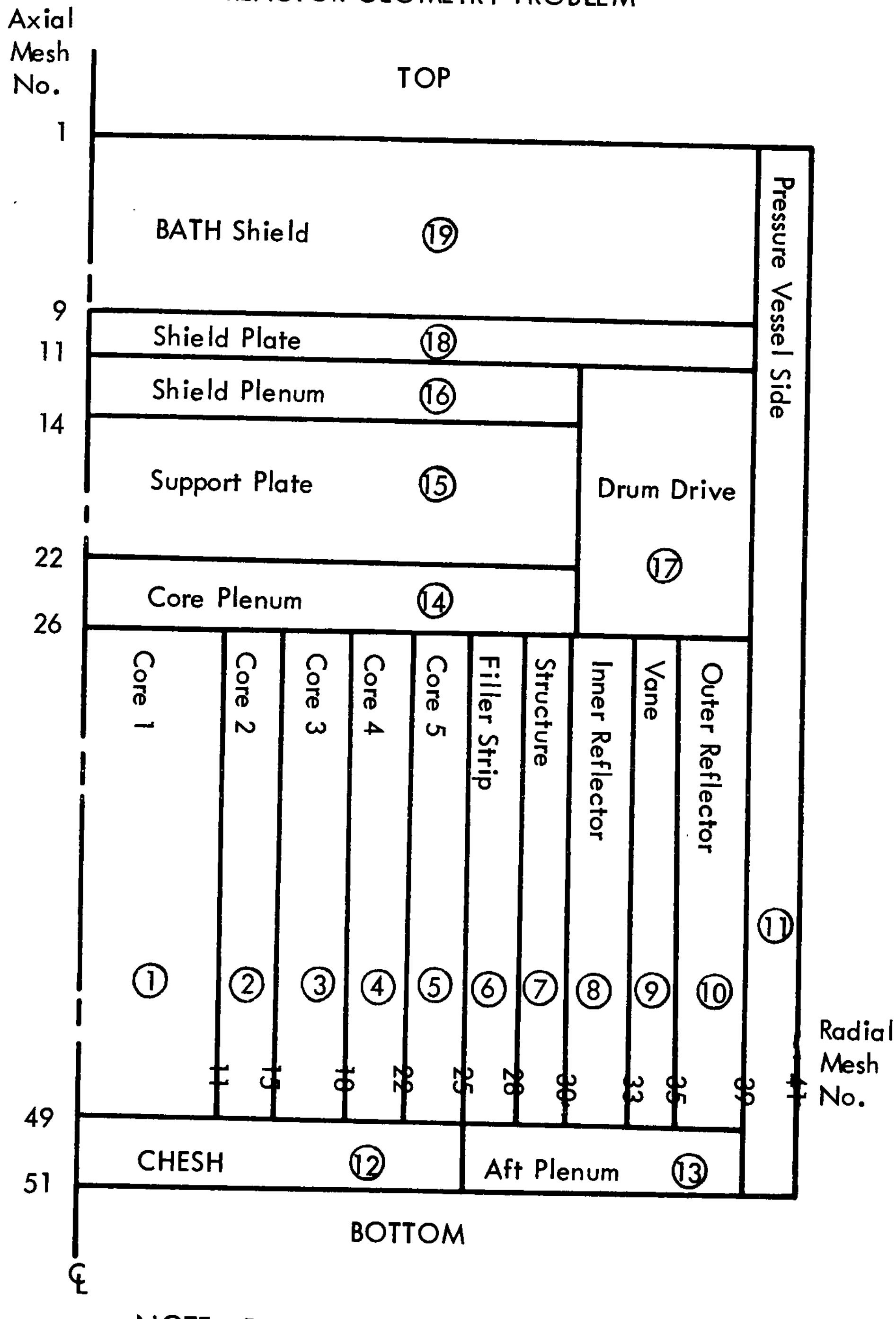
```
-9.32470E-01-9.32470E-01-9.32470E-01-6.61209E-01-6.61209E-01-6.61209E-01
-6.61209E-01-6.61209E-01-2.38619E-01-2.38619E-01-2.38619E-01-2.38619E-01
-2.38619E-01-2.38619E-01-2.38619E-01 9.32470E-01 9.32470E-01 9.32470E-01
 6.61209E-01 6.61209E-01 6.61209E-01 6.61209E-01 6.61209E-01 2.38619E-01
 2.38619E-01 2.38619E-01 2.38619E-01 2.38619E-01 2.38619E-01 2.38619E-01
 0.          4.28311E-02 4.28311E-02 0.          5.52387E-02 3.49517E-02
 3.49517E-02 5.52387E-02 0.          4.28311E-02 3.49517E-02 3.91956E-02
 3.91956E-02 3.49517E-02 4.28311E-02 0.          4.28311E-02 4.28311E-02
 0.          5.52387E-02 3.49517E-02 3.49517E-02 5.52387E-02 0.
 4.28311E-02 3.49517E-02 3.91956E-02 3.91956E-02 3.49517E-02 4.28311E-02
 0.999689504 0.998364376 0.995981843 0.992543900 0.988054126 0.982517263S96-ETA
 0.975939174 0.968326828 0.959688291 0.950032718 0.939370340 0.927712457S96-ETA
 0.000796792 0.001853961 0.002910732 0.003964554 0.005014203 0.006058546S96-WTS
 0.007096471 0.008126877 0.009148671 0.010160770 0.011162102 0.012151605S96-WTS
 131.0       49.0                                                         S-80
 90.0        90.0                                                         S-80
```

TABLE 6-10. LISTING OF THE CHEAPER CODE INPUT DATA FOR THE MSFC SEMINAR/WORKSHOP

```
30500
MSFC SEMINAR/WORKSHOP PROBLEM - NEUTRON DOT LINKAGE WITH CHEAPER
    0      0      0      0      0      0      0      0      0      0      0      0
   40     40     87     87     16
        1.0           0.0          11.0
   47     50      1     46     10     50
  0.0          3.0          6.0          9.0          12.0         15.0
  18.0         21.0         25.0         27.0         29.184       30.0
  32.0         34.0         36.094       38.0         40.0         40.971
  42.0         43.0         44.0         44.654       45.0         46.0
  46.99        49.0         51.0         53.34        54.0         55.88
  57.5         60.0         61.92        62.05        62.174       63.0
  65.0         67.0         68.58        70.5         71.12
  -230.48      -229.21      -227.94      -224.94      -221.94      -218.94
  -215.94      -212.94      -209.94      -206.94      -203.94      -200.94
  -197.94      -197.625     -197.31      -197.0       -196.0       -195.0
  -194.0       -193.0       -192.0       -191.0       -190.0       -189.0
  -188.0       -187.0       -186.0       -185.0       -184.0       -183.0
  -182.0       -181.0       -180.0       -179.0       -178.0       -177.0
  -176.0       -175.0       -174.0       -173.0       -172.0       -171.0
  -170.0       -169.0       -168.0       -166.83      -166.0       -164.67
  -163.0       -162.0       -161.29      -159.0       -157.0       -155.0
  -153.0       -151.0       -149.0       -147.0       -146.05      -144.0
  -142.0       -140.0       -137.16      -136.0       -134.0       -130.0
  -122.0       -114.0       -104.0       -94.0        -84.0        -74.0
  -64.0        -58.0        -53.0        -48.0        -43.0        -38.0
  -33.0        -28.0        -23.0        -18.0        -13.0        -8.0
  -6.0         -5.08        -2.0         -0.0
```

FIGURE 6-1

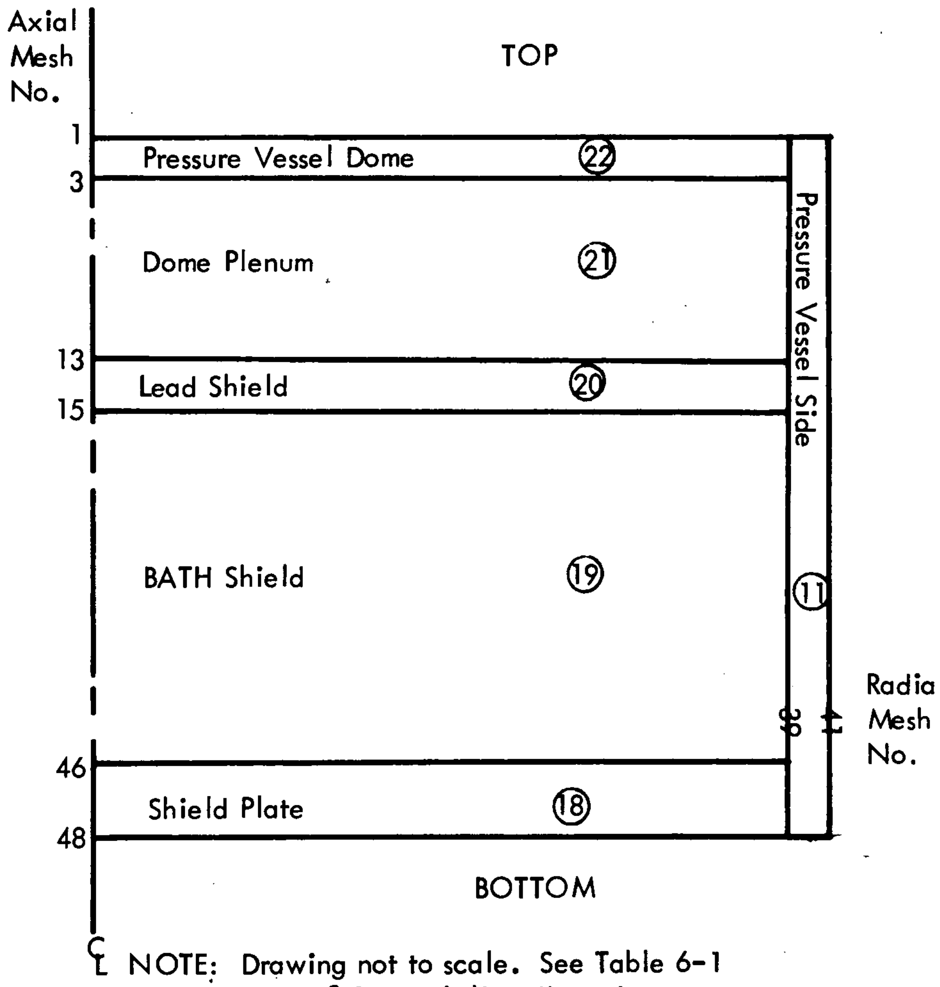
REGION AND MESH MODEL FOR THE DOT-IIW NEUTRON REACTOR GEOMETRY PROBLEM



NOTE: Drawing not to scale. See Tables 6-1 and 6-2 for mesh line dimensions. Circled numbers are DOT-IIW material numbers

FIGURE 6-2

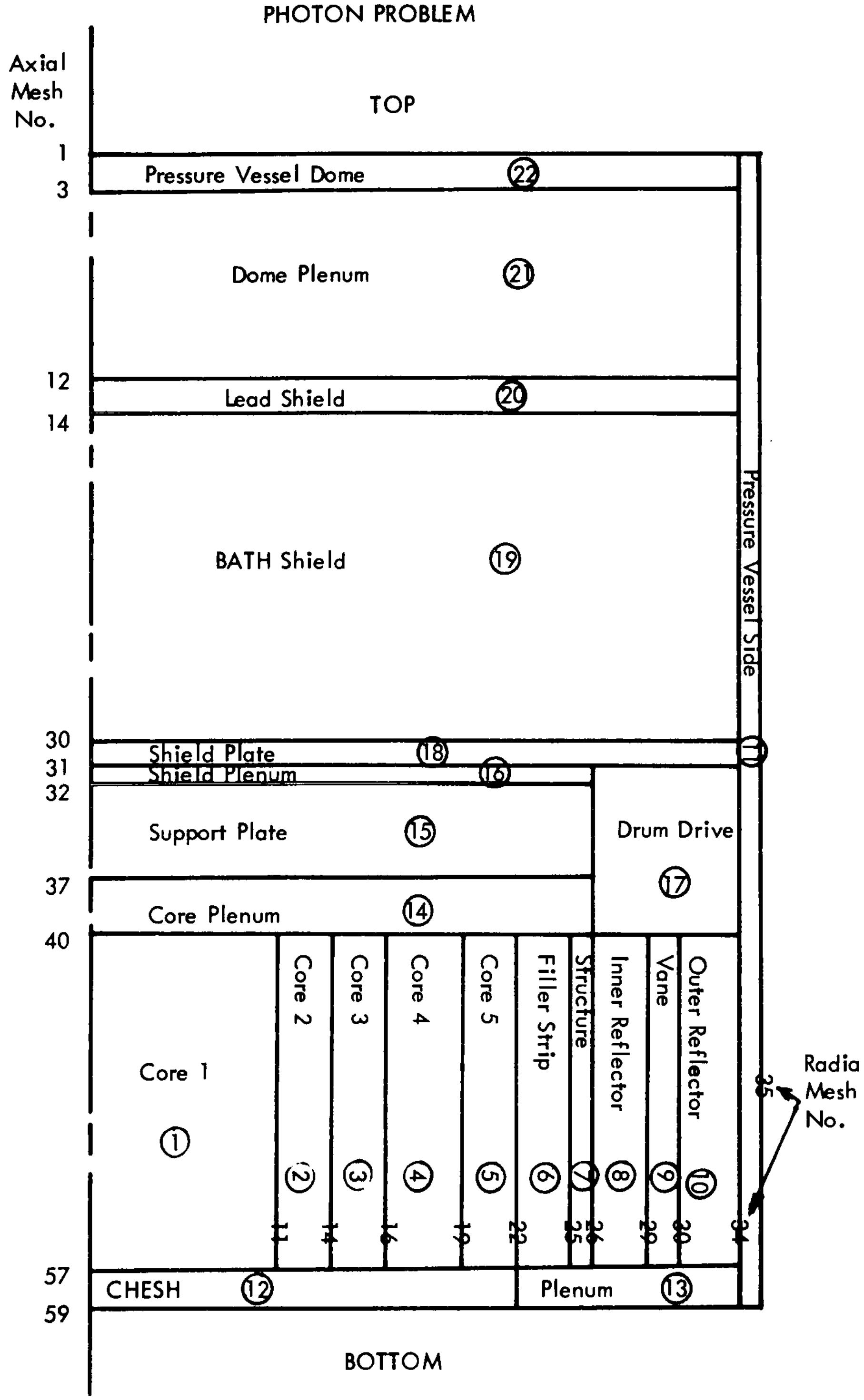
REGION AND MESH MODEL FOR THE DOT-IIW NEUTRON SHIELD GEOMETRY PROBLEM



NOTE: Drawing not to scale. See Table 6-1 and 6-3 for mesh line dimensions. Circled numbers are DOT-IIW material numbers

FIGURE 6-3

REGION AND MESH MODEL OF THE NSS FOR THE DOT-IIW PHOTON PROBLEM



NOTE: Drawing not to scale. See Tables 6-1 and 6-4 for mesh line dimensions. Circled numbers are DOT-IIW material numbers.

7.0 The NAGS Code

When the vast amount of data handling required in a complete, two-dimensional radiation analysis of a nuclear system is considered, the need for an automated, data processing link between discrete ordinates transport techniques and both point kernel and Monte Carlo techniques is evident. The NAGS code provides this needed link. NAGS processes multigroup, neutron and photon flux distributions for one-dimensional, slab or cylinder geometry models, or two-dimensional, r,z or r,θ geometry models. Flux input data to the NAGS code are obtained by magnetic tape or disk from the ANISN-W or DOT-IIW discrete ordinate transport codes. Additional input required by the NAGS code are prepared by the APPROPOS code.

7.1 General Description of the Code

The NAGS code provides: (1) neutron and photon source data for use in point kernel, Monte Carlo, or discrete ordinate transport analyses, (2) neutron and photon dose rates, and (3) nuclear energy deposition data (neutron and photon) for use in subsequent thermal and hydraulic design analyses. Source distribution data are generated, on punched data cards for input into the KAP-VI point kernel code and on magnetic tape for use in the ANISN-W or DOT-IIW discrete ordinate codes.

In the MSFC Seminar/Workshop problem, the NAGS code was used only to provide source data for use in the point kernel code, KAP-VI, and the two-dimensional discrete ordinates code, DOT-IIW. The other options available in NAGS, described above, were not utilized.

7.2 Input Data Description

The input data for a NAGS problem are subdivided into four sets of data as follows:

(1) General problem data - integer data pertaining to data or array dimensions (i.e., number of mesh, number of groups, etc.), problem title information, integer control words, flux normalization parameters, neutron fission parameters, and mesh cell specifications;

(2) Flux data - input flux data required for the NAGS code, including mode of input; (the flux data are supplied from tape or disk);

(3) Library data - neutron and photon multigroup quantities, and for each element: identification, physical constants and group-wise nuclear data;

(4) Region data - region title information, region composition by element or material, and depending upon the library option or type of calculation, region dependent multigroup neutron cross sections.

All card input to the NAGS code is entered in fixed, FORTRAN formats. For convenience, the number columns required per input parameter are either 3, 6, or 12 so that the probability of an input error due to card format is minimized.

Input flux data for the NAGS code are input from binary tape from either the one-dimensional ANISN-W, or two-dimensional DOT-IIW, discrete ordinate transport code. Input flux data is supplied from tape 11, tape 12 or both tape 11 and 12 depending on the values of NYPE and NBIN in Data Set 1. The input flux data are assumed to be group independent such that a logical tape record is ICT x JCT long and there are NGN(NTYPE = 1), NGG(NTYPE = 3), or NGN + NGG(NTYPE = 2) records on the binary tape.

The library data for the NAGS code are a compilation of the nuclear and radiation data for the reactor geometry and for the elements in the reactor. These library data, are obtained as a complete punched decimal data deck from the APPROPOS code or can be input by the user. The data are divided into two sections referred to as general data and element data. The general data include neutron and photon group dependent quantities required for photon energy release from fission, neutron dose tate, neutron kinetic energy heating, and photon dose rate calculations. The element data are required for each element in the problem.

A listing of the input data cards for the NAGS Seminar/Workshop problem is provided in Table 7-1.

The NAGS program user's manual is published as a separate document WANL-PR(LL)-034, Volume 3. It is assumed that the reader will utilize the NAGS user's manual during the description of the input data to follow.

7.2.1 Data Set 1 - General Problem Data

The first card of Data Set 1 contains the maximum number of locations available for NAGS data. For the MSFC UNIVAC-1108, this value is 47000_{10}.

The second card of Data Set 1 contains the following fifteen pieces of data:

(1) Number of radial mesh intervals in the input flux solution. The input flux to the NAGS problem is the DOT-IIW neutron flux. From Table 6-1 of Section 6, it is noted that the number of radial mesh intervals is 40 for the neutron problem.

(2) Number of redefined radial mesh intervals to be used in all calculations. This input value is 34 which is the same as the number of radial intervals in the DOT-IIW photon problem given in Table 6-1 of Section 6.

(3) Number of axial mesh intervals in the input flux solution. The input flux to the NAGS problem is the DOT-IIW neutron flux from both the reactor and shield geometries. All the mesh intervals in the shield problem are employed in NAGS, i.e., 47 intervals. Only 40 intervals (intervals 1 through 10 were not used) from the reactor problem were employed in NAGS. Thus, the total number of axial intervals is 47 + 40 = 87.

(4) Number of redefined axial mesh intervals to be used in all calculations. This input value is 58 which is the same as the number of axial intervals in the DOT-IIW photon problem as given in Table 6-4 of Section 6.

(5) Total number of neutron groups, which is 16 for the MSFC Seminar problem.

(6) Number of fast neutron groups, which is 11 for the MSFC Seminar problem.

(7) Number of fast neutron groups for photon production from inelastic events, which is 6 for the MSFC Seminar problem.

(8) Number of photon energy groups, which is 13 for the MSFC code package.

(9) Number of elements in the library data. This is the total number (16) of elements as shown in Table 3-3 of Section 3.

(10) Program control word for the type of calculation to be performed. This quantity is input as a one since this problem is a photon source calculation.

(11) Program control word for punched output. This quantity is input as a one so that source data for input to the KAP-VI code are obtained as punched output.

(12) Program control word for SC-4020 plotting. Although this quantity is input as a one, the plotting routine is no longer operational on the MSFC UNIVAC-1108 due to the limited core storage capacity.

(13) Program control word for classification of plotted output. This quantity was input as zero (unclassified) but is not operational on the MSFC UNIVAC-1108.

(14) Type of plotted output was input as a nine for "hard" copy only, but this is not operational as cited previously.

(15) The flux print option was input as one so that the input neutron fluxes are obtained as printed output data.

The third card of Data Set 1 contains an overall descriptive problem title.

The fourth card contains the following nine pieces of data:

(1) The first piece of data is input as zero and is not presently used by the program.

(2) The input flux control word is input as a one. This input quantity must be selected from Table 4-1, Page 4-15 of the NAGS user's manual. With NTYPE = 1 and NBIN = 1, a photon source is calculated using neutron fluxes as input on Tape 11.

(3) The library data option is input as zero, i.e., the region dependent neutron cross section data included with region input for each element.

(4) The number of zero entries to the right of the NAGS calculated source in each radial row. This quantity is input as zero, since this NAGS option is not being utilized in the Seminar problem. (Refer to the NAGS user's manual for details.)

(5) The number of zero entries to the right of the NAGS calculated sources in each axial row is also input as zero for the reason previously stated.

(6) The starting radial mesh cell number in the NAGS input to be used in the redefinition of flux data. This is input as a one, indicating that the first mesh cell will be used.

(7) The starting axial mesh cell number in the NAGS input to be used in the redefinition of the flux data. This is input as a one, indicating that the first mesh cell will be used.

(9) The source positioning index in the axial direction for all calculated results. This is input as 58, which is equal to the number of axial mesh in the calculated source solution. This value is used in determining the logical record output as Tape 8.

Card 5 contains the reference plane distance in inches from Z = 0.0. This quantity is input as 0.0 in the Seminar problem. This input quantity can be utilized for changing the reference plane for source and energy deposition printouts.

Card 6 contains six pieces of data as follows:

(1) The average number of neutrons released per fission. This quantity is input as 1.0 since the DOT-IIW fluxes have already been properly normalized.

(2) Fraction of fissions due to neutron fission events. This is always input as 1.0 unless the cross section data represent n, 2n reactors by pseudo-fission.

(3) The multiplication factor. This is input as 1.0 since the DOT-IIW fluxes have already been properly normalized.

(4) The volume of fissionable regions. This quantity is input as 1.0 for all R-Z problems.

(5) Conversion factor for input flux data in units of fission per second. This quantity is input as 1.0 since the DOT-IIW fluxes have already been normalized.

(6) Area factor to account for partial geometrical solutions in transport problem. This quantity is always input as 1.0 for R-Z geometry problems.

Card 7 contains 16 values (one for each neutron group) describing the fraction of a fission neutron born in each group. These data are the same as input to the DOT-IIW problem previously described in Section 6. The sum of these input values should equal 1.0.

Card 8 contains 16 values (one for each neutron group) describing the number of neutrons per fission event by group. These data are the same as input to the DOT-IIW problem previously described in Section 6.

Card 9 contains the mesh coordinate number of the right radial mesh coordinate of each redefined mesh cell. These values can be determined from Table 6-1 of Section 6--simply delete the mesh coordinate number opposite the asterisk in the neutron radial mesh list.

Card 10 lists the mesh coordinate number of the top mesh coordinate of each redefined mesh cell. Values between 2 and 48 can be determined from Table 6-2 of Section 6--simply delete the values between 2 and 48 marked with an asterisk. Values between 51 and 88 must be determined from Table 6-3 of Section 6, the DOT-IIW axial mesh description for the reactor geometry. Mesh line 12 is equivalent to mesh line 49 in the redefined mesh. The redefined mesh should be numbered in that sequence--those marked with an asterisk are not entered in the NAGS problem.

Card 11 lists the radial mesh line coordinates for the input flux data. These values are simply the radial mesh lines in the DOT-IIW neutron problem given in Table 6-1 of Section 6.

Card 12 lists the axial mesh line coordinates for the input flux data. These data are entered from the top to the bottom of the geometry. Beginning with the top of the geometry, these input are listed according to the axial mesh given in Table 6-3, i.e., -230.48, -229.21, etc., up to -164.57. In addition, the mesh given in Table 6-2 of Section 6 for the reactor geometry must be included to complete the mesh description. These values begin with -163.0, -162.0, etc., up to 0.0.

7.2.2 Data Set 2 - Flux Input From Tape

Table 4-1, Page 4-15 of the NAGS user's manual defines the options available in the NAGS code for inspecting the flux from tape for various modes of operation.

7.2.3 Data Set 3 - Library Data

Since NLIB was input as zero on Card 4 of Data Set 1, the "short" library form is input to the Seminar problem in Data Set 3. Thus, only Cards 13 through 24 are entered as input. The entire Data Set 3 is the punched card output from the APPROPOS problem.

Card 13 contains one piece of data which is the number of elements in the library. This value is 16 as previously described in Section 3 on the APPROPOS code.

Card 14 contains 13 values (one for each photon group) for the prompt fission photon spectrum.

Card 15 contains 13 values (one for each photon group) for the fission product decay photon spectrum. These data apply at the end of a 60 minute reactor run.

Card 16 contains 13 values (one for each photon group) for the gamma ray flux to dose into conversion factors. These data were previously described in Section 3 of the APPROPOS code.

Card 17 contains 16 values (one for each output neutron group) for the neutron flux to dose rate conversion factors. These data were previously described in Section 3.

Card 18 contains 16 values of the upper lethargy for each neutron group as previously described in Section 3.

Cards 19 through 24 are entered for each of the 16 elements in the Seminar problem. These cards are clearly marked for U^{235} in Table 7-1, the NAGS input data listing.

Card 19 contains the following four pieces of data:

(1) Element identification number. These numbers are consistent with those given in Table 3-3, Page 3-26 of the APPROPOS user's manual.

(2) The atomic weight of the element. These data are also given in Table 3-3, Page 3-26 of the APPROPOS user's manual.

(3) The energy of the alpha particle is the n, α reaction.

(4) A description title for the element.

Card 20 contains 78 values for the neutron inelastic photon energy spectra. There are 13 values for each photon for each of the 6 possible neutron group reactions.

Card 21 contains 13 values (one for each photon group) describing the neutron radiative capture gamma ray spectra.

Card 22 contains 11 values (one for each fast neutron energy group) for the "effective" energy deposition cross section for calculating neutron energy deposition. The "effective" cross section is defined on Page 3-4 of Volume 2, WANL-PR(LL)-034. These values are all input as 0.0 in the element library. The actual cross sections are input region-wise in the region data and are printed out by element in the NAGS printout.

Card 23 contains 16 values (one for each neutron energy group) for the n, α reaction cross section.

Card 24 contains 13 values (one for each photon group) for the gamma ray mass energy absorption cross section (cm^2/gm) for use in photon energy deposition calculations.

Data cards 25 through 28 are not part of the Seminar problem because NLIB was input as a zero.

7.2.4 Data Set 4 - Region Data

The majority of the region data input cards are punched out by the APPROPOS code. Any exceptions are noted in the discussion which follows.

Cards 29 through 35 are always required if a source calculation is to be performed by the NAGS code. These cards are listed in Table 7-1 for each region in the NAGS Seminar problem. Cards 29 through 35 are clearly marked in Table 7-1 for the element hydrogen in Core Region 1.

Card 29 contains a title descriptive of the region of interest.

The card 30 for each region punched out by the APPROPOS code was not employed as input to NAGS. Recall that, when the APPROPOS input data was prepared, the photon DOT-IIW and NAGS region geometry had not been set-up. Hence, the mesh line input to APPROPOS were input as zeros. Each card 30 input to NAGS for each region was, therefore, set-up and input "by hand" at the time the NAGS problem was run.

Card 30 contains six pieces of data as follows:

(1) The first four pieces of data describe the left and right radial and top and bottom axial collapsed mesh line numbers. To set-up these input quantities one must refer to Figure 6- describing the NSS geometry for the photon DOT-IIW problem. For example, for core region 11, the left and right radial mesh line numbers are 1 and 11, respectively; and the top and bottom axial mesh line numbers are 40 and 57, respectively. The card 30 for each region is set up in a similar manner.

(2) The number of elements in the region. This quantity is the same as previously input into the APPROPOS problem for each region. If this quantity is proceeded by a minus sign, the program assumes that the composition for the region is identical to that for the preceeding region. This option was employed (as noted in Table 7-1) for the vane region and for the second region describing the side of the pressure vessel. If this quantity is input as a negative number, cards 31 through 35 are <u>not</u> entered as region input.

(3) The last piece of data which is a control word similar to that used in the APPROPOS code. This quantity is input as a one for all regions except the last region of the problem. For the last region, this quantity must be input as a four.

Card 31 (punched out by the APPROPOS code) contains two pieces of data for each element in each region as follows:

(1) The element identification number which is identified in Table 3-3, Page 3-26 of the APPROPOS user's manual.

(2) The atom density (x 10^{-24}) of the element. These data are consistent with those given in Table 3-3 of Section 3 of this report.

Card 32 (punched out by the APPROPOS code) contains 16 values (one for each neutron group) for the microscopic neutron fission cross section for each element.

Card 33 (punched out by the APPROPOS code) contains 16 values for the microscopic neutron absorption cross sections (radiative capture) for each element.

Card 34 (punched out by the APPROPOS code) contains 11 values of the microscopic neutron "effective" energy deposition cross section previously described for each element.

Card 35 (punched out by the APPROPOS code) contains 6 values of the microscopic inelastic scatter cross section for each element.

The remaining cards (36 through 42) are required only if an energy deposition calculation is to be performed by the NAGS code.

7.2.5 Flux Normalization

If the neutron fluxes output from the DOT-IIW have not been normalized to full power reactor conditions, the NAGS code has the capability to perform the proper normalization after redefinition of the mesh cell description. In the Seminar problems, the DOT-IIW output neutron fluxes were already properly normalized. This was possible because of prior knowledge of similar NERVA Nuclear Subsystem analysis.

If, however, the user did not have this prior information, six parameters can be entered as input on card 6 of the NAGS problem to calculate the proper normalization factor. This equation is quite simple and is presented on Page 4-25 of the NAGS user's manual.

7.2.6 Problem Size Calculations

Prior to running the NAGS problem, it is necessary to determine whether or not the problem can fit within the core storage allocation available for the NAGS input data. Page 4-31 of the NAGS user's manual presents some straightforward equations that can be evaluated to determine the required storage allocation. If the problem of interest does not "fit" on the computer it is suggested that some additional mesh lines be deleted from the problem.

7.2.7 Problem Setup Instructions

Detailed instructions on how to setup the NAGS problems are given on Page 4-32 of the NAGS user's manual.

7.3 Output Data Description

The NAGS code provides printed output, tape output, and punched card output to interface with subsequent point kernel, discrete ordinates transport, and/or Monte Carlo analyses. Each of the forms of output are briefly described in this section.

7.3.1 Printed Output

The first section of output from a NAGS calculation is a listing of the storage requirements and starting locations of the variables in the flexible dimension allocation. The code then prints a message indicating the total number of storage locations required to execute the problem.

The next page of output lists selected parameters in Data Set 1. These parameters set the variable dimension requirements. Below this listing is a tabulation of the IC, JC, R, and Z arrays. The IC and JC arrays are used to perform mesh deletion operations; the R and Z arrays are the coordinate dimensions of the mesh lines bounding the mesh cells in the problem geometry. The code lists the neutron fission parameters, χ_g and ν_g, as a function of neutron energy group. The zero reference plane is printed below the tables. This parameter provides a convenient method of shifting the z-coordinates for heating calculations.

The problem normalization factors are printed on the next page. The last parameter, the power normalization factor, is the computed scale factor for the flux normalization.

The next section of output lists the neutron and/or photon scaler fluxes by mesh cell and energy group, In the Seminar problem, only neutron fluxes are listed for each of 16 input groups. These fluxes have been normalized by NAGS, and mesh deletion operations have been performed.

The library input data are printed next. The first section lists the prompt and decay gamma ray spectrum of energy released from the fission of ^{235}Uranium. Neutron and gamma ray dose rate conversion factors as well as the upper lethargy of each neutron group are also listed. Library data for each element are printed next. The atomic mass units of the element, the energy of the emitted a particle, the element name, the spectrum of gamma ray energy emitted from thermal neutron capture and inelastic neutron scattering, and the mass energy absorption coefficient are listed, by element.

The next section of printout lists the region title, the parameters, IS, IF, JS, JF, NELE, and IND, as well as the region-dependent or -independent microscopic cross section data by element within the region. These data are repeated for each region in the problem.

The next section lists the results of the calculations within each region. If the calculation is a source calculation as is the Seminar problem, the following information is printed:

(1) The parameters, IS, JS, JF, and JS and their corresponding mesh line coordinate;

(2) The number of elements within the region;

(3) The GAM ID number, the element name, the atom density (in barns/atom x 10^{24}), the physical density (in gms/cm^3), the weight (in grams), the number of fissions (fissions/sec), and the number of inelastic neutron scattering events (neutron inelastic scatters/sec). These quantities are region integrated quantities, where applicable;

(4) The region volume (in cm^3);

(5) The region weight (in grams);

(6) The region integrated photon source (MeV/sec), fissions (fissions/sec) neutron source (neutrons/sec), and the photon source by photon energy group for both region integrated and region average conditions;

(7) The region integrated neutron flux;

(8) The relative photon, fission, and neutron distributions in each of the coordinate directions;

(9) The actual data points that are plotted (if requested); and

(10) The card images of the source distributions punched on cards and provided for the KAP-VI code (if requested).

The next page of output lists the total photon source (MeV/sec), the total fissions (fissions/sec), and the total neutron source (neutrons/sec) over the entire problem geometry.

The next section of output lists the neutron source distribution by mesh cell. These data are followed by a listing of the fission source distribution by mesh cell. These two output data differ by ν_g, the number of neutrons released per fission as a function of neutron group, g.

The photon distributed source by mesh cell and by photon energy group is the final section of printout for a source calculation. These data are the same as input to the DOT-IIW problem.

For a heating calculation, the region output from the region calculation lists the total neutron and photon energy deposition as well as the relative distributions along the coordinate axes.

Following these region data, the neutron and gamma ray dose rate, by mesh cell, are listed.

7.3.2 Tape Output

At the conclusion of a source calculation, the distributed neutron or photon source (depending on NPUN) by mesh cell and energy group is placed on tape 8 in the form acceptable to the ANISN-W and DOT-IIW codes. The neutron source tape contains NGN records, where each record is ICM by JCM words long (if zeros are not added); the photon source tape contains NGG records, where each record is also ICM by JCM in length.

Tape 10 contains the normalized, mesh cell deleted, scalar fluxes. This tape may be used for a subsequent NAGS calculation or as a flux guess for subsequent DOT-IIW calculations.

Both tapes 8 and 10 contains end-of-file marks after the required data.

7.3.3 Punched Output

Punched card output consists of punched output source distributions in the format acceptable to the KAP-VI point kernel code. These cards are listed in the region output data for convenience. The addresses on each card will be discussed in detail in Section 9 of this report, The KAP-VI Code.

7.4 Other Applications of NAGS

The Seminar/Workshop NAGS problem was set-up only to calculate the photon sources in a redefined mesh model for input to the DOT-IIW photon problem and the KAP-VI point kernel problem describing the Nuclear Subsystem geometry.

The NAGS code can also optimally calculate photon and/or neutron heating rate distributions and heating by region throughout the geometry of interest. The code can also calculate (as a separate problem) the delayed gamma ray heating for various reactor operating histories.

The application of the NAGS code to R, θ geometry was not part of the Seminar problem. This application is similar to that for the R, Z geometry. Those parameters which differ from an R, Z problem are described in the NAGS user's manual.

TABLE 7-1. INPUT DATA LISTING FOR THE NAGS PROBLEM

```
47000
 40 34 87 58 16 11  6 13 16  1  1  1  0  9  1
 MSFC SEMINAR/WORKSHOP NAGS PROBLEM, PHOTON SOURCE IN NUCLEAR SUBSYSTEM
  0  1  0  0  0  1  1  2 62
 0.0
 1.0          1.0          1.0          1.0          1.0          1.0
0.227588     0.345503     0.180477     0.152189     0.078617     0.015365             7
0.0002612    0.0          0.0          0.0          0.0          0.0                 7A
0.0          0.0          0.0          0.0                                           7B
3.0025       2.6488       2.5509       2.4974       2.4581       2.4389                8
2.4350       2.4342       2.4340       2.43         2.434        2.43                 8A
2.4300       2.43         2.43         2.43                                          8B
  2  3  4  5  6  7  8  9 10 11 13 14 15 16 18 19 21 22 23 24 25 26 27 28
 30 31 32 33 35 36 37 38 39 41
  2  3  4  5  7  8  9 10 11 12 13 14 15 17 19 21 23 25 27 29 31 33 35 37
 39 41 43 45 46 48 51 52 54 56 58 59 60 62 63 64 65 66 67 68 69 70 71 72
 73 75 77 79 81 83 84 86 87 88
   0.0          3.0          6.0          9.0          12.0         15.0
   18.0         21.0         25.0         27.0         29.184       30.0
   32.0         34.0         36.094       38.0         40.0         40.971
   42.0         43.0         44.0         44.654       45.0         46.0
   46.99        49.0         51.0         53.34        54.0         55.88
   57.5         60.0         61.92        62.05        62.174       63.0
   65.0         67.0         68.58        70.5         71.12
   -230.48      -229.21      -227.94      -224.94      -221.94      -218.94
   -215.94      -212.94      -209.94      -206.94      -203.94      -200.94
   -197.94      -197.625     -197.31      -197.0       -196.0       -195.0
   -194.0       -193.0       -192.0       -191.0       -190.0       -189.0
   -188.0       -187.0       -186.0       -185.0       -184.0       -183.0
   -182.0       -181.0       -180.0       -179.0       -178.0       -177.0
   -176.0       -175.0       -174.0       -173.0       -172.0       -171.0
   -170.0       -169.0       -168.0       -166.83      -166.0       -164.67
   -163.0       -162.0       -161.29      -159.0       -157.0       -155.0
   -153.0       -151.0       -149.0       -147.0       -146.05      -144.0
   -142.0       -140.0       -137.16      -136.0       -134.0       -130.0
   -122.0       -114.0       -104.0       -94.0        -84.0        -74.0
   -64.0        -58.0        -53.0        -48.0        -43.0        -38.0
   -33.0        -28.0        -23.0        -18.0        -13.0        -8.0
   -6.0         -5.08        -2.0         -0.0
----------------------------------------------------------------------------
 16
 3.00000E-03 1.50000E-02 4.00000E-02 1.11000E-01 2.52000E-01 5.59000E-01
 3.63000E-01 5.03000E-01 7.08000E-01 9.47000E-01 1.38900E+00 2.05300E+00
 1.23500E+00
----------------------------------------------------------------------------
 0.          0.          0.          4.27000E-02 2.30200E-01 5.87000E-01
```

TABLE 7-1 (CONT)

```
3.69000E-01 5.00000E-01 5.87000E-01 8.51000E-01 1.00900E+00 1,15200E+00
2.67000E-01
1.06300E-06 1.08300E-06 1.11600E-06 1.16600E-06 1.24000E-06 1.33200E-06
1.41700E-06 1.50400E-06 1.56400E-06 1.67300E-06 1.80300E-06 2.11200E-06
3.51600E-06
1.20000E-04 1.05000E-04 8.80000E-05 6.35000E-05 3.25000E-05 1.03000E-05
1.15000E-06 1.73000E-07 2.10000E-08 9.00000E-09 1.90000E-08 5.62000E-08
1.00000E-07 1.00000E-07 1.00000E-07 1.00000E-07
0.          1.25000E+00 2.00000E+00 2.50000E+00 3.25000E+00 4.50000E+00
6.50000E+00 7.50000E+00 9.75000E+00 1.17500E+01 1.37500E+01 1.55000E+01
1.73000E+01 1.82000E+01 1.89000E+01 2.00000E+01
 1 1.00797E+00 0.                              HYDROG
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.
0.          0.          0.          0.          0.          0.
0.          2.22300E+00 0.          0.          0.          0.
0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
2.56600E-02 2.67000E-02 2.83600E-02 3.06500E-02 3.39300E-02 3.78400E-02
4.12200E-02 4.37300E-02 4.65800E-02 5.02500E-02 5.43500E-02 6.37100E-02
1.06000E-01
 3 9.01220E+00 0.                              BERYLL
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
```

TABLE 7-1 (CONT)

0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	4.28300E+00	1.20000E-01	0.	1.56800E+00
0.	6.26000E-01	0.	0.	0.	2.17000E-01
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	
7.76700E-02	1.00200E-01	4.53100E-03	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.28700E-02	1.32300E-02	1.38300E-02	1.46800E-02	1.59200E-02	1.74400E-02
1.87700E-02	1.97800E-02	2.09700E-02	2.25300E-02	2.43200E-02	2.85000E-02
4.74000E-02					

4 1.08110E+01 2.31100E+00 BORNAT

0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.

TABLE 7-1 (CONT)

0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	4.78000E-01
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	
5.31801E-02	7.70081E-02	6.19582E-02	1.19102E-01	2.76948E-01	6.39794E-01
1.30540E+00	2.85791E+00	8.14680E+00	2.26453E+01	5.54816E+01	1.33639E+02
2.73085E+02	4.12887E+02	6.34215E+02	1.14195E+03		
1.38700E-02	1.42100E-02	1.47800E-02	1.56100E-02	1.68300E-02	1.83300E-02
1.96600E-02	2.06800E-02	2.18800E-02	2.34700E-02	2.53300E-02	2.96700E-02
4.93600E-02					
5 1.20111E+01 0.				CARBON	
0.	0.	0.	0.	4.28400E+00	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	3.37600E+00	1.19300E+00
0.	0.	0.	0.	3.75000E-01	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.55200E-02	1.58500E-02	1.64200E-02	1.72500E-02	1.84800E-02	2.00200E-02
2.13400E-02	2.24300E-02	2.37100E-02	2.53900E-02	2.73900E-02	3.20800E-02
5.33700E-02					
10 2.35044E+02 0.				U-235	

TABLE 7-1 (CONT)

0.	0.	0.	0.	1.48600E-03	1.71000E-02	$\Gamma(N,N';\gamma)$
4.29600E-02	1.16200E-01	2.66400E-01	6.17200E-01	1.02100E+00	1.16900E+00	
2.83800E-01						
0.	0.	0.	0.	0.	0.	
2.38000E-04	3.68100E-03	2.88000E-02	1.66100E-01	4.76200E-01	8.05200E-01	
2.59800E-01						
0.	0.	0.	0.	0.	0.	
0.	0.	0.	1.98700E-02	1.66800E-01	5.00900E-01	
2.16400E-01						
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	2.46100E-02	1.85500E-01	
2.00000E-01						
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	9.48600E-02	
1.68000E-01						
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	9.47400E-02	
1.67800E-01						
4.80000E-04	3.50000E-04	1.89000E-02	7.02000E-02	2.13000E-01	5.06000E-01	$\Gamma(N,\gamma)$
3.25000E-01	4.71000E-01	6.04000E-01	8.57000E-01	1.10800E+00	1.71000E+00	
7.25000E-01						
0.	0.	0.	0.	0.	0.	σ
0.	0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.	σ
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.			
4.27900E-02	4.15600E-02	3.99400E-02	3.80400E-02	3.57000E-02	3.35100E-02	μ/ρ
3.23200E-02	3.19600E-02	3.19200E-02	3.46500E-02	4.39500E-02	1.07800E-01	
4.42700E-01						
12 2.38051E+02 0.				U-238		
0.	0.	6.25500E-03	1.41800E-01	5.94900E-01	3.74600E-01	
1.38200E-01	1.53900E-01	1.70400E-01	2.07900E-01	2.04000E-01	2.53700E-01	
1.97500E-01						
0.	0.	0.	0.	0.	0.	
1.46900E-03	1.31600E-02	4.08400E-02	1.04500E-01	1.70500E-01	2.78700E-01	
2.19300E-01						
0.	0.	0.	0.	0.	0.	
0.	0.	0.	4.67500E-03	5.35300E-02	2.40600E-01	
1.93600E-01						
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	2.44100E-03	1.22000E-01	
2.03200E-01						
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	1.63500E-02	

TABLE 7-1 (CONT)

2.89500E-02					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	1.12000E-01	4.50000E-01
1.04000E-01	2.99000E-01	6.34000E-01	7.16000E-01	6.19000E-01	1.06900E+00
6.26000E-01					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
4.27900E-02	4.15600E-02	3.99400E-02	3.80400E-02	3.57000E-02	3.35100E-02
3.23200E-02	3.19600E-02	3.19200E-02	3.46500E-02	4.39500E-02	1.07800E-01
4.42700E-01					
25 2.69815E+01 0.				ALUMIN	
4.01200E-03	3.24100E-03	2.35100E-02	7.18300E-02	1.66200E-01	2.17900E-01
2.18700E-01	5.26700E-01	4.43500E-01	3.64300E-01	3.21100E-01	6.63700E-02
1.63200E-02					
0.	0.	0.	0.	0.	0.
0.	1.28600E-01	8.50600E-02	2.81400E-01	5.46000E-01	8.79500E-02
2.16400E-02					
0.	0.	0.	0.	0.	0.
0.	0.	0.	1.57600E-01	3.59400E-01	1.92400E-01
4.73400E-02					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
2.60100E+00	2.39000E-01	6.85000E-01	4.47000E-01	1.68600E+00	9.46000E-01
4.25000E-01	2.70000E-01	1.73000E-01	1.12000E-01	5.50000E-02	4.90000E-02
3.90000E-02					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	
1.57200E-02	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.84300E-02	1.85200E-02	1.87400E-02	1.91200E-02	1.97400E-02	2.06200E-02
2.14800E-02	2.22200E-02	2.32100E-02	2.46100E-02	2.64400E-02	3.10200E-02

TABLE 7-1 (CONT)

5.20400E-02					
27 5.19960E+01 0.				CHROMI	
5.41800E-02	1.33900E-02	7.65600E-02	1.15500E-01	3.10000E-01	3.28400E-01
1.10000E-01	8.63900E-02	1.20500E-01	3.23400E-01	4.83300E-01	2.76400E-01
1.16400E-01					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
4.89300E+00	9.77000E-01	8.77000E-01	7.08000E-01	2.16000E-01	3.63000E-01
9.50000E-02	4.56000E-01	1.49000E-01	1.73000E-01	1.10000E-02	3.58000E-01
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
2.28500E-02	2.25800E-02	2.23300E-02	2.20500E-02	2.18200E-02	2.17500E-02
2.19100E-02	2.22200E-02	2.28500E-02	2.38800E-02	2.55800E-02	3.05400E-02
5.48500E-02					
28 5.49380E+01 0.				MANGAN	
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					

TABLE 7-1 (CONT)

0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	2.72400E+00	7.12000E-01	1.66600E+00	7.92000E-01	5.43000E-01
1.22000E-01	2.64000E-01	2.94000E-01	9.40000E-02	7.00000E-03	1.30000E-02
3.80000E-02					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
2.29700E-02	2.26900E-02	2.24200E-02	2.20900E-02	2.17800E-02	2.16500E-02
2.17500E-02	2.20200E-02	2.26100E-02	2.36100E-02	2.52800E-02	3.02900E-02
5.50300E-02					
29 5.58470E+01 0.				IRON	
6.63000E-03	3.48900E-03	1.68300E-02	6.86500E-02	1.02600E-01	5.81500E-01
4.40600E-01	3.77700E-01	4.10200E-01	4.56900E-01	4.08400E-01	3.03000E-01
7.45400E-02					
0.	0.	0.	0.	0.	0.
7.12100E-04	6.10400E-04	3.40200E-02	6.29600E-02	2.52200E-01	2.64800E-01
6.51500E-02					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	2.38700E-01	2.71900E-01
6.68800E-02					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
4.09300E+00	5.21000E-01	9.12000E-01	7.09000E-01	5.18000E-01	4.33000E-01
1.34000E-01	7.90000E-02	5.20000E-02	1.91000E-01	6.60000E-02	8.70000E-02
5.20000E-02					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		

2.39800E-02	2.36600E-02	2.33300E-02	2.29400E-02	2.25400E-02	2.23300E-02
2.23900E-02	2.26300E-02	2.32000E-02	2.41900E-02	2.59100E-02	3.11700E-02
5.72700E-02					
31 5.87100E+01 0.				NICKEL	
2.58000E-03	1.41800E-03	1.69700E-02	5.16100E-02	1.30800E-01	2.28300E-01
1.38400E-01	1.48300E-01	1.38000E-01	1.33200E+00	3.86400E-01	2.28500E-01
7.63900E-02					
0.	0.	0.	0.	0.	0.
0.	1.60300E-03	1.15300E-02	1.24700E+00	2.92700E-01	1.03700E-02
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
6.26400E+00	1.20000E-02	1.14200E+00	4.21000E-01	1.71000E-01	1.28000E-01
7.10000E-02	5.20000E-02	8.90000E-02	1.20000E-02	3.60000E-02	1.07000E-01
2.40000E-02					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
2.54600E-02	2.50700E-02	2.46400E-02	2.41700E-02	2.36800E-02	2.33000E-02
2.32300E-02	2.34000E-02	2.39300E-02	2.48000E-02	2.66700E-02	3.23600E-02
6.10800E-02					
44 9.12200E+01 0.				ZIRCON	
0.	0.	2.34000E-02	1.17700E-01	2.92100E-01	5.19000E-01
2.33000E-01	3.56500E-01	3.44300E-01	3.17800E-01	2.48100E-01	1.59300E-01
3.91900E-02					
0.	0.	0.	0.	0.	0.
0.	1.82900E-01	2.07600E-01	2.71900E-01	3.39800E-01	2.18100E-01
5.36600E-02					
0.	0.	0.	0.	0.	0.
0.	0.	0.	1.43500E-01	3.39800E-01	2.18100E-01
5.36600E-02					
0.	0.	0.	0.	0.	0.

TABLE 7-1 (CONT)

0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
1.39000E-01	5.30000E-02	1.33500E+00	7.91000E-01	1.06200E+00	1.55600E+00
7.05000E-01	6.77000E-01	9.36000E-01	5.14000E-01	4.57000E-01	9.20000E-02
5.60000E-02					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
2.86400E-02	2.80100E-02	2.72400E-02	2.62900E-02	2.50500E-02	2.38300E-02
2.31400E-02	2.29300E-02	2.30800E-02	2.37400E-02	2.56300E-02	3.40200E-02
8.00100E-02					
126 2.07190E+02 0.				LEAD	
0.	6.92200E-03	5.09700E-02	3.92100E-02	2.76800E-01	3.29100E-01
7.35700E-01	2.03200E-01	1.47300E-01	2.17700E-01	2.22100E-01	3.53400E-01
4.03600E-03					
0.	0.	0.	0.	0.	0.
6.55400E-02	1.49200E-02	3.53600E-02	6.55900E-02	2.41200E-01	6.00000E-01
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.38100E-01	4.07000E-01
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	6.93000E+00	3.39000E-01	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.

TABLE 7-1 (CONT)

0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
4.05600E-02	3.94000E-02	3.79000E-02	3.60400E-02	3.35700E-02	3.11700E-02
2.97800E-02	2.92100E-02	2.89600E-02	3.05400E-02	3.75300E-02	8.37300E-02
3.36100E-01					
128 4.79000E+01	0.			TITANI	
1.21400E-02	1.00100E-02	3.86200E-02	1.48000E-01	3.31400E-01	3.78500E-01
1.00400E-01	4.72000E-02	3.70300E-02	3.21000E-01	9.92500E-01	3.75100E-03
3.49100E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	5.76800E-02	1.05100E+00	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.16900E+00	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
1.50000E-02	2.20000E-02	5.64100E+00	1.33000E-01	5.39000E-01	4.31000E-01
7.70000E-02	4.90000E-02	9.40000E-02	1.13100E+00	3.10000E-02	1.30000E-02
9.20000E-02					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
2.17600E-02	2.15700E-02	2.14200E-02	2.12700E-02	2.12000E-02	2.12900E-02
2.15600E-02	2.19400E-02	2.26300E-02	2.37100E-02	2.53900E-02	3.01300E-02
5.31000E-02					
129 1.80948E+02	0.			TANTAL	
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.

TABLE 7-1 (CONT)

0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
2.70000E-02	2.50000E-02	7.40000E-02	3.40000E-01	9.03000E-01	1.41300E+00
8.08000E-01	8.72000E-01	8.29000E-01	4.76000E-01	1.19000E-01	1.39000E-01
4.00000E-02					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
3.83500E-02	3.72200E-02	3.57600E-02	3.39400E-02	3.15600E-02	2.91800E-02
2.77500E-02	2.71200E-02	2.68200E-02	2.79300E-02	3.30200E-02	6.67600E-02
2.58000E-01					
301 1.83850E+02 0.				TUNGST	
0.	0.	0.	3.46400E-02	1.04000E-01	3.21400E-01
1.46700E-01	4.29300E-01	7.69100E-01	1.03700E+00	1.33700E+00	6.22400E-01
4.74300E-02					
0.	0.	0.	0.	0.	0.
0.	2.13500E-02	2.17700E-01	4.18200E-01	8.05300E-01	4.18200E-01
5.84600E-02					
0.	0.	0.	0.	0.	0.
0.	0.	0.	1.14500E-02	1.70100E-01	2.25400E-01
1.07100E-01					
0.	0.	0.	0.	0.	0.
0.	0.	0.	1.07700E-03	1.60100E-02	1.98800E-01
1.32800E-01					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.88600E-01
1.30300E-01					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.					
4.00000E-02	8.90000E-02	6.08000E-01	7.21000E-01	8.58000E-01	1.17800E+00
6.36000E-01	6.90000E-01	5.38000E-01	2.21000E-01	6.00000E-02	8.30000E-02
2.70000E-02					
0.	0.	0.	0.	0.	0.

TABLE 7-1 (CONT)

0.	0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.			
3.86600E-02	3.75200E-02	3.60200E-02	3.42100E-02	3.18100E-02	2.94300E-02	
2.79900E-02	2.73500E-02	2.70400E-02	2.81700E-02	3.34200E-02	6.84400E-02	
2.65600E-01						
CORE REGION 1 - SPECTRUM 1 RADIAL						
1 11 40 57 10 1						
5 4.46100E-02						
0.	0.	0.	0.	0.	0.	σ_f
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.			
0.	0.	0.	0.	0.	3.34102E-07	σ_a
8.69270E-06	1.36509E-05	3.86069E-05	9.58374E-05	2.77695E-04	5.49326E-04	
1.18248E-03	1.79639E-03	2.68969E-03	5.33404E-03			
9.10680E-01	5.04458E-01	3.75930E-01	2.60610E-01	1.26680E-01	3.21446E-02	σ_e
6.29480E-03	1.59345E-03	1.86796E-04	3.04965E-05	3.69531E-06		
4.39040E-02	0.	0.	0.	0.	0.	σ_s
27 1.41800E-04						
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.			
5.80685E-03	2.93434E-03	4.01500E-03	4.00000E-03	4.75340E-03	6.48567E-03	
2.50210E-02	4.17087E-02	3.76824E-02	8.62610E-02	2.35790E-01	4.62945E-01	
9.96060E-01	1.50423E+00	2.21789E+00	4.35177E+00			
1.23034E-01	1.59354E-01	9.22760E-02	5.71190E-02	2.96630E-02	8.67986E-03	
4.02050E-03	9.34016E-04	4.32036E-05	7.08276E-06	8.56145E-07		
1.30254E+00	5.36030E-01	6.60970E-02	1.64960E-03	0.	0.	
29 4.80500E-04						
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.			
5.72568E-03	2.92438E-03	4.01730E-03	5.00760E-03	5.82130E-03	2.53824E-02	
5.57470E-02	3.90504E-02	4.74240E-02	7.37063E-02	1.89213E-01	4.03825E-01	
8.68368E-01	1.31145E+00	1.93458E+00	3.79600E+00			
1.30720E-01	1.01402E-01	6.01560E-02	5.69960E-02	2.41740E-02	9.81144E-03	
2.43660E-03	5.39926E-04	1.05821E-04	1.79734E-05	2.17781E-06		
1.21144E+00	6.87894E-01	2.76910E-01	0.	0.	0.	
28 1.37000E-05						
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.			
1.91169E-03	3.10705E-03	4.38170E-03	6.28350E-03	1.37850E-02	5.53731E-02	

TABLE 7-1 (CONT)

1.14170E-01	1.31059E+00	4.95007E+00	4.12731E-01	1.02876E+00	2.12317E+00
4.53494E+00	6.85128E+00	1.01036E+01	1.96938E+01		
1.14151E-01	9.84842E-02	6.97290E-02	5.25430E-02	2.88920E-02	1.46396E-02
1.17440E-02	2.86765E-03	2.06878E-03	4.99729E-06	4.30667E-07	
1.71911E+00	1.47209E+00	8.10600E-01	5.83480E-01	2.58390E-01	0.
31 2.03900E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.97558E-01	8.00625E-02	1.50000E-02	1.29970E-02	9.91540E-03	1.33097E-02
1.81230E-02	2.41663E-02	5.22581E-02	1.14512E-01	3.16746E-01	7.34803E-01
1.57908E+00	2.38480E+00	3.51788E+00	6.90313E+00		
1.16474E-01	1.23087E-01	1.03100E-01	5.98820E-02	3.93380E-02	2.15495E-02
4.72780E-03	2.03779E-03	1.51190E-04	2.56957E-05	3.13474E-06	
1.33459E+00	8.05041E-01	0.	0.	0.	0.
129 1.00000E-05					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
3.96676E-02	8.77143E-02	1.35740E-01	2.02910E-01	3.76030E-01	1.32435E+00
5.33030E+00	1.56515E+01	2.59298E+01	6.26672E+01	2.37290E+02	5.52745E+00
7.98132E+00	1.12910E+01	1.57790E+01	2.83681E+01		
4.85002E-02	2.70756E-02	2.76300E-02	2.57900E-02	1.41940E-02	3.76582E-03
6.72970E-04	1.56779E-04	1.83267E-05	2.99187E-06	3.62527E-07	
2.71908E+00	2.76495E+00	2.48010E+00	2.14870E+00	1.50390E+00	6.36351E-01
10 7.94200E-04					
1.27804E+00	1.28950E+00	1.23000E+00	1.18800E+00	1.39950E+00	2.23633E+00
4.19870E+00	6.73810E+00	1.70552E+01	3.54345E+01	2.84245E+01	4.98790E+01
1.83967E+02	2.64954E+02	4.39435E+02	9.41033E+02		
2.37854E-02	5.26853E-02	9.21410E-02	1.56520E-01	3.05840E-01	7.61189E-01

TABLE 7-1 (CONT)

```
1.34940E+00 3.09355E+00 8.26189E+00 1.95430E+01 1.92046E+01 9.33920E+00
4.06617E+01 4.63765E+01 7.68857E+01 1.64730E+02
3.51533E-02 3.32920E-02 2.30220E-02 1.62180E-02 1.15930E-02 3.85258E-03
8.33250E-04 2.11761E-04 2.47534E-05 4.88368E-06 5.44378E-07
1.91165E+00 1.75192E+00 1.53610E+00 1.63360E+00 1.32060E+00 8.79194E-02
12 5.76700E-05
6.02663E-01 4.61921E-01 2.50130E-02 0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
1.16842E-02 4.91545E-02 1.24990E-01 1.36790E-01 1.81940E-01 2.91849E-01
3.99400E-01 1.53316E+00 8.25168E+00 4.00636E+01 7.06084E+01 4.33430E-01
9.30866E-01 1.40632E+00 2.07645E+00 4.09077E+00
4.01602E-02 2.98802E-02 2.43610E-02 2.29900E-02 1.44990E-02 5.08055E-03
1.19120E-03 3.72144E-04 2.49072E-05 4.06608E-06 4.79834E-07
2.48115E+00 2.52040E+00 2.12520E+00 1.62840E+00 1.01090E+00 1.31978E-01
44 7.32500E-03
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
2.76041E-03 3.89679E-03 7.26910E-03 1.08480E-02 1.29020E-02 2.26924E-02
9.47380E-02 1.43547E-01 3.19743E-01 3.55914E-03 1.04707E-02 3.05766E-02
6.54667E-02 9.93738E-02 1.48742E-01 2.94910E-01
1.07758E-01 1.03955E-01 9.24700E-02 7.51640E-02 3.51020E-02 8.94279E-03
1.65090E-03 3.59954E-04 3.94341E-05 6.09103E-06 7.41204E-07
1.47181E+00 6.38020E-01 1.02560E-01 0.          0.          0.
 1 3.42000E-04
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          9.38680E-04 3.31999E-03 8.23267E-03 2.60060E-02 5.35939E-02
1.10252E-01 1.75448E-01 2.62701E-01 5.20518E-01
3.80211E+00 2.88622E+00 2.21110E+00 1.66600E+00 1.02850E+00 3.75151E-01
9.47210E-02 2.41181E-02 2.86483E-03 4.67692E-04 5.66707E-05
0.          0.          0.          0.          0.          0.
```

```
  CORE REGION 2 - SPECTRUM 2 RADIAL
11 14 40 57 10  1
 5 4.47400E-02
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
0.          0.          0.          0.          0.          3.31160E-07
8.69270E-06 1.36214E-05 3.85999E-05 9.53171E-05 2.90604E-04 5.50544E-04
1.18225E-03 1.78941E-03 2.68145E-03 5.27859E-03
```

TABLE 7-1 (CONT)

9.11078E-01	5.04886E-01	3.75930E-01	2.60610E-01	1.26680E-01	3.22627E-02
6.29480E-03	1.59978E-03	1.86840E-04	3.08061E-05	3.40551E-06	
4.37198E-02	0.	0.	0.	0.	0.
27 1.54200E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
5.80351E-03	2.93218E-03	4.01500E-03	4.00000E-03	4.75340E-03	6.47664E-03
2.50210E-02	4.17069E-02	3.76767E-02	8.58077E-02	2.46547E-01	4.63989E-01
9.95868E-01	1.49831E+00	2.21156E+00	4.31085E+00		
1.23063E-01	1.59524E-01	9.22760E-02	5.71190E-02	2.96630E-02	8.72520E-03
4.02050E-03	9.39839E-04	4.32137E-05	7.15451E-06	7.88921E-07	
1.30262E+00	5.37628E-01	6.60970E-02	1.64960E-03	0.	0.
29 5.22600E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
5.71621E-03	2.92237E-03	4.01730E-03	5.00760E-03	5.82130E-03	2.52576E-02
5.57470E-02	3.88465E-02	4.74230E-02	7.33458E-02	1.98113E-01	4.04736E-01
8.68203E-01	1.30627E+00	1.92907E+00	3.76030E+00		
1.30734E-01	1.01482E-01	6.01560E-02	5.69960E-02	2.41740E-02	9.82550E-03
2.43660E-03	5.41478E-04	1.05845E-04	1.81558E-05	2.00702E-06	
1.21095E+00	6.88775E-01	2.76910E-01	0.	0.	0.
28 1.49000E-05					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.91261E-03	3.10430E-03	4.38170E-03	6.28350E-03	1.37850E-02	5.52167E-02
1.14170E-01	1.30420E+00	4.95191E+00	4.11347E-01	1.07679E+00	2.12780E+00
4.53416E+00	6.82470E+00	1.00756E+01	1.95087E+01		
1.14166E-01	9.85256E-02	6.97290E-02	5.25430E-02	2.88920E-02	1.46900E-02
1.17440E-02	2.88198E-03	2.06961E-03	5.05988E-06	3.95921E-07	
1.71933E+00	1.47342E+00	8.10600E-01	5.83480E-01	2.58390E-01	0.
31 2.21800E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.97367E-01	8.02151E-02	1.50000E-02	1.29970E-02	9.91540E-03	1.32935E-02
1.81230E-02	2.41565E-02	5.22481E-02	1.13960E-01	3.31604E-01	7.36466E-01
1.57878E+00	2.37538E+00	3.50785E+00	6.83822E+00		
1.16506E-01	1.23059E-01	1.03100E-01	5.98820E-02	3.93380E-02	2.15285E-02
4.72780E-03	2.04911E-03	1.51224E-04	2.59551E-05	2.88904E-06	
1.33483E+00	8.07086E-01	0.	0.	0.	0.
129 1.00000E-05					

TABLE 7-1 (CONT)

0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
3.97051E-02	8.76232E-02	1.35740E-01	2.02910E-01	3.76030E-01	1.31934E+00
5.33030E+00	1.56137E+01	2.59249E+01	6.20996E+01	2.29069E+02	5.52664E+00
7.98002E+00	1.12631E+01	1.57369E+01	2.81552E+01		
4.85050E-02	2.70902E-02	2.76300E-02	2.57900E-02	1.41940E-02	3.77966E-03
6.72970E-04	1.57403E-04	1.83310E-05	3.02224E-06	3.34096E-07	
2.71924E+00	2.76553E+00	2.48010E+00	2.14870E+00	1.50390E+00	6.38662E-01
10 9.92000E-04					
1.27815E+00	1.28965E+00	1.23000E+00	1.18600E+00	1.39950E+00	2.23225E+00
4.19870E+00	6.72421E+00	1.70541E+01	3.51856E+01	2.60363E+01	4.98730E+01
1.83882E+02	2.63633E+02	4.37822E+02	9.31065E+02		
2.38048E-02	5.26249E-02	9.21410E-02	1.56520E-01	3.05840E-01	7.59284E-01
1.34940E+00	3.08640E+00	8.26029E+00	1.93207E+01	1.80086E+01	9.27099E+00
4.06485E+01	4.61453E+01	7.66041E+01	1.62982E+02		
3.51769E-02	3.33220E-02	2.30220E-02	1.62180E-02	1.15930E-02	3.86521E-03
8.33250E-04	2.12603E-04	2.47592E-05	4.91903E-06	5.01701E-07	
1.91185E+00	1.75286E+00	1.53610E+00	1.63360E+00	1.32060E+00	8.85177E-02
12 7.20300E-05					
6.02577E-01	4.62420E-01	2.50130E-02	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.17149E-02	4.90660E-02	1.24990E-01	1.36790E-01	1.81940E-01	2.92090E-01
3.99400E-01	1.52813E+00	8.24846E+00	3.93710E+01	6.02017E+01	4.34398E-01
9.30689E-01	1.40079E+00	2.07053E+00	4.05237E+00		
4.01676E-02	2.99001E-02	2.43610E-02	2.29900E-02	1.44990E-02	5.09708E-03
1.19120E-03	3.73657E-04	2.49131E-05	4.10736E-06	4.38287E-07	
2.48147E+00	2.52077E+00	2.12520E+00	1.62840E+00	1.01090E+00	1.32997E-01
44 7.31100E-03					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
2.75890E-03	3.89172E-03	7.26910E-03	1.08480E-02	1.29020E-02	2.26352E-02
9.47380E-02	1.43648E-01	3.19872E-01	3.53902E-03	1.09542E-02	3.06435E-02
6.54536E-02	9.89865E-02	1.48286E-01	2.91844E-01		
1.07747E-01	1.03982E-01	9.24700E-02	7.51640E-02	3.51020E-02	8.97621E-03
1.65090E-03	3.61527E-04	3.94438E-05	6.15273E-06	6.83168E-07	
1.47132E+00	6.40047E-01	1.02560E-01	0.	0.	0.
1 3.42000E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.

TABLE 7-1 (CONT)

```
0.          9.34710E-04 3.31937E-03 8.18927E-03 2.71710E-02 5.37132E-02
1.10317E-01 1.74770E-01 2.61904E-01 5.15100E-01
3.80113E+00 2.88773E+00 2.21110E+00 1.66600E+00 1.02850E+00 3.76265E-01
9.47210E-02 2.42129E-02 2.86550E-03 4.72440E-04 5.22262E-05
0.          0.          0.          0.          0.          0.
```

```
  CORE REGION 3 - SPECTRUM 3 RADIAL
14 16 40 57 10  1
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
0.          0.          0.          0.          0.          3.34894E-07
8.71030E-06 1.37084E-05 3.92220E-05 9.68772E-05 2.99272E-04 5.64115E-04
1.21341E-03 1.79332E-03 2.62924E-03 5.19385E-03
9.11413E-01 5.05391E-01 3.75980E-01 2.60560E-01 1.26660E-01 3.22777E-02
6.29500E-03 1.59591E-03 1.84816E-04 3.01370E-05 3.19549E-06
4.35679E-02 0.          0.          0.          0.          0.
27 1.49500E-04
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
 5 4.46800E-02
5.80035E-03 2.93008E-03 4.01500E-03 4.00000E-03 4.75180E-03 6.48046E-03
2.51690E-02 4.13831E-02 3.82253E-02 8.72182E-02 2.53755E-01 4.75308E-01
1.02122E+00 1.50155E+00 2.17201E+00 4.25539E+00
1.23064E-01 1.59727E-01 9.22580E-02 5.71480E-02 2.96960E-02 8.72401E-03
4.04400E-03 9.28173E-04 4.27451E-05 6.99909E-06 7.40202E-07
1.30268E+00 5.39173E-01 6.60970E-02 1.65190E-03 0.          0.
29 5.06600E-04
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
5.70789E-03 2.92046E-03 4.01730E-03 5.00720E-03 5.82080E-03 2.52669E-02
5.59020E-02 3.85939E-02 4.76303E-02 7.42710E-02 2.04076E-01 4.14609E-01
8.90372E-01 1.30901E+00 1.89468E+00 3.71201E+00
1.30747E-01 1.01486E-01 6.02070E-02 5.69610E-02 2.41320E-02 9.78777E-03
2.43960E-03 5.41515E-04 1.04924E-04 1.77615E-05 1.88324E-06
1.21062E+00 6.89561E-01 2.76910E-01 0.          0.          0.
28 1.44000E-05
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
1.91331E-03 3.10180E-03 4.38170E-03 6.28140E-03 1.37790E-02 5.52823E-02
1.14740E-01 1.31512E+00 4.83950E+00 4.16019E-01 1.10908E+00 2.17854E+00
4.64914E+00 6.84613E+00 9.90066E+00 1.92513E+01
```

TABLE 7-1 (CONT)

1.14179E-01	9.85335E-02	6.96930E-02	5.24830E-02	2.88620E-02	1.47011E-02
1.18330E-02	2.89806E-03	2.08767E-03	4.93440E-06	3.70409E-07	
1.71950E+00	1.47470E+00	8.10600E-01	5.83550E-01	2.58770E-01	0.
31 2.15000E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.97219E-01	8.03563E-02	1.50000E-02	1.30000E-02	9.91550E-03	1.33035E-02
1.80850E-02	2.42367E-02	5.31623E-02	1.15732E-01	3.41563E-01	7.54389E-01
1.61908E+00	2.38038E+00	3.44510E+00	6.75034E+00		
1.16531E-01	1.23014E-01	1.03080E-01	5.98780E-02	3.94830E-02	2.15872E-02
4.74850E-03	2.02793E-03	1.49773E-04	2.53933E-05	2.71100E-06	
1.33502E+00	8.09099E-01	0.	0.	0.	0.
129 1.00000E-05					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
3.97333E-02	8.75371E-02	1.35740E-01	2.02860E-01	3.75850E-01	1.32106E+00
5.34890E+00	1.57219E+01	2.64453E+01	6.18455E+01	2.25139E+02	5.57510E+00
8.14833E+00	1.12822E+01	1.54726E+01	2.78862E+01		
4.85090E-02	2.70693E-02	2.75820E-02	2.57580E-02	1.41360E-02	3.77511E-03
6.72660E-04	1.57017E-04	1.81324E-05	2.95660E-06	3.13492E-07	
2.71937E+00	2.76607E+00	2.48010E+00	2.14890E+00	1.50440E+00	6.38641E-01
10 1.06500E-03					
1.27821E+00	1.28976E+00	1.23000E+00	1.18800E+00	1.39930E+00	2.23512E+00
4.18890E+00	6.76831E+00	1.74903E+01	3.66085E+01	2.50989E+01	5.29116E+01
1.84968E+02	2.64374E+02	4.27638E+02	9.17023E+02		
2.38193E-02	5.25676E-02	9.21410E-02	1.56460E-01	3.05710E-01	7.60407E-01
1.34660E+00	3.10893E+00	8.54708E+00	2.06685E+01	1.80820E+01	9.69429E+00
3.98884E+01	4.62763E+01	7.48220E+01	1.60521E+02		
3.51957E-02	3.33082E-02	2.30190E-02	1.62190E-02	1.15740E-02	3.86510E-03
8.32620E-04	2.12081E-04	2.44910E-05	4.80626E-06	4.69942E-07	
1.91204E+00	1.75376E+00	1.53610E+00	1.63340E+00	1.32150E+00	8.83955E-02
12 7.73100E-05					
6.02500E-01	4.62983E-01	2.50130E-02	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.17381E-02	4.89730E-02	1.24990E-01	1.36800E-01	1.81870E-01	2.92003E-01
4.06780E-01	1.53844E+00	8.76795E+00	4.14291E+01	5.72139E+01	4.45061E-01
9.54552E-01	1.40367E+00	2.03320E+00	4.00021E+00		
4.01735E-02	2.99197E-02	2.43840E-02	2.29370E-02	1.44550E-02	5.09370E-03
1.19180E-03	3.72301E-04	2.46432E-05	4.01814E-06	4.08405E-07	
2.48175E+00	2.52113E+00	2.12520E+00	1.62850E+00	1.01150E+00	1.32845E-01
44 7.31400E-03					

TABLE 7-1 (CONT)

```
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
2.75753E-03 3.88685E-03 7.26910E-03 1.08460E-02 1.29010E-02 2.26600E-02
9.51000E-02 1.44163E-01 3.17754E-01 3.60067E-03 1.12786E-02 3.13900E-02
6.71734E-02 9.92031E-02 1.45402E-01 2.87159E-01
1.07739E-01 1.04048E-01 9.25850E-02 7.50140E-02 3.49740E-02 8.97751E-03
1.65210E-03 3.60346E-04 3.90038E-05 6.01928E-06 6.41113E-07
1.47094E+00 6.41831E-01 1.02560E-01 0.          0.          0.
 1 3.42000E-04
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          9.46828E-04 3.38027E-03 8.34056E-03 2.79340E-02 5.50353E-02
1.11171E-01 1.75148E-01 2.57015E-01 5.06840E-01
3.80039E+00 2.88864E+00 2.21110E+00 1.66570E+00 1.02820E+00 3.76503E-01
9.47260E-02 2.41562E-02 2.83446E-03 4.62178E-04 4.90054E-05
0.          0.          0.          0.          0.          0.
```

```
  CORE REGION 4 - SPECTRUM 4 RADIAL
16 19 40 57 10  1
 5 4.48800E-02
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
0.          0.          0.          0.          0.          3.37350E-07
8.71030E-06 1.37758E-05 3.96686E-05 1.00882E-04 2.96251E-04 5.84806E-04
1.23749E-03 1.82096E-03 2.66978E-03 4.99027E-03
9.11767E-01 5.05554E-01 3.75980E-01 2.60560E-01 1.26660E-01 3.21803E-02
6.29500E-03 1.58168E-03 1.82010E-04 2.82681E-05 3.24971E-06
4.33721E-02 0.          0.          0.          0.          0.
27 1.71000E-04
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
5.79036E-03 2.92925E-03 4.01500E-03 4.00000E-03 4.75180E-03 6.48794E-03
2.51690E-02 4.13825E-02 3.85841E-02 9.08103E-02 2.51228E-01 4.92688E-01
1.04078E+00 1.52517E+00 2.20326E+00 4.10490E+00
1.23056E-01 1.59792E-01 9.22580E-02 5.71480E-02 2.96960E-02 8.68667E-03
4.04400E-03 9.15216E-04 4.20977E-05 6.56528E-06 7.52776E-07
1.30275E+00 5.39782E-01 6.60970E-02 1.65190E-03 0.          0.
29 5.79100E-04
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
```

TABLE 7-1 (CONT)

0.	0.	0.	0.		
5.69293E-03	2.91970E-03	4.01730E-03	5.00720E-03	5.82080E-03	2.53699E-02
5.59020E-02	3.90477E-02	4.76783E-02	7.67413E-02	2.01986E-01	4.29771E-01
9.07530E-01	1.32964E+00	1.92194E+00	3.58073E+00		
1.30764E-01	1.01517E-01	6.02070E-02	5.69610E-02	2.41320E-02	9.77599E-03
2.43960E-03	5.38036E-04	1.03376E-04	1.66600E-05	1.91520E-06	
1.21030E+00	6.89896E-01	2.76910E-01	0.	0.	0.
28 1.65000E-05					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.91405E-03	3.10075E-03	4.38170E-03	6.28140E-03	1.37790E-02	5.54116E-02
1.14740E-01	1.32935E+00	4.72279E+00	4.27723E-01	1.09785E+00	2.25624E+00
4.73707E+00	6.95427E+00	1.00381E+01	1.85713E+01		
1.14195E-01	9.85493E-02	6.96930E-02	5.24830E-02	2.88620E-02	1.46595E-02
1.18330E-02	2.86527E-03	2.03312E-03	4.57607E-06	3.76609E-07	
1.71969E+00	1.47521E+00	8.10600E-01	5.83550E-01	2.58770E-01	0.
31 2.45800E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.97049E-01	8.04144E-02	1.50000E-02	1.30000E-02	9.91550E-03	1.33170E-02
1.80850E-02	2.42587E-02	5.37986E-02	1.20218E-01	3.38073E-01	7.81900E-01
1.65031E+00	2.41791E+00	3.49469E+00	6.51162E+00		
1.16559E-01	1.23004E-01	1.03080E-01	5.98780E-02	3.94830E-02	2.16050E-02
4.74850E-03	2.00271E-03	1.47549E-04	2.38253E-05	2.75698E-06	
1.33524E+00	8.09877E-01	0.	0.	0.	0.
129 1.00000E-05					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
3.97628E-02	8.75023E-02	1.35740E-01	2.02860E-01	3.75850E-01	1.32521E+00
5.34890E+00	1.58081E+01	2.67641E+01	6.25892E+01	2.29844E+02	5.62985E+00
8.27856E+00	1.13931E+01	1.56876E+01	2.71071E+01		
4.85131E-02	2.70750E-02	2.75820E-02	2.57580E-02	1.41360E-02	3.76373E-03
6.72660E-04	1.55614E-04	1.78571E-05	2.77326E-06	3.18811E-07	
2.71960E+00	2.76629E+00	2.48010E+00	2.14890E+00	1.50440E+00	6.36737E-01
10 1.02600E-03					
1.27818E+00	1.28981E+00	1.23000E+00	1.18800E+00	1.39930E+00	2.23850E+00
4.18890E+00	6.80005E+00	1.75709E+01	3.73049E+01	2.53261E+01	5.75878E+01
1.86054E+02	2.69608E+02	4.35549E+02	8.80256E+02		
2.38337E-02	5.25446E-02	9.21410E-02	1.56460E-01	3.05710E-01	7.61986E-01
1.34660E+00	3.12529E+00	8.65109E+00	2.19420E+01	1.84269E+01	1.03167E+01
3.93272E+01	4.71923E+01	7.62049E+01	1.54072E+02		

TABLE 7-1 (CONT)

```
3.52145E-02 3.33197E-02 2.30190E-02 1.62190E-02 1.15740E-02 3.85469E-03
8.32620E-04 2.10186E-04 2.41191E-05 4.52334E-06 4.77108E-07
1.91247E+00 1.75412E+00 1.53610E+00 1.63340E+00 1.32150E+00 8.79030E-02
12 7.44700E-05
6.02355E-01 4.63173E-01 2.50130E-02 0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
1.17610E-02 4.89393E-02 1.24990E-01 1.36800E-01 1.81870E-01 2.91803E-01
4.06780E-01 1.55000E+00 8.97693E+00 4.32475E+01 5.99859E+01 4.61389E-01
9.73004E-01 1.42573E+00 2.06250E+00 3.85925E+00
4.01794E-02 2.99272E-02 2.43840E-02 2.29370E-02 1.44550E-02 5.08009E-03
1.19180E-03 3.68877E-04 2.42690E-05 3.76898E-06 4.16399E-07
2.48230E+00 2.52127E+00 2.12520E+00 1.62850E+00 1.01150E+00 1.32007E-01
44 7.28300E-03
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
2.75488E-03 3.88492E-03 7.26910E-03 1.08460E-02 1.29010E-02 2.27073E-02
9.51000E-02 1.43952E-01 3.09420E-01 3.75833E-03 1.11652E-02 3.25278E-02
6.85035E-02 1.00730E-01 1.47642E-01 2.75904E-01
1.07730E-01 1.04058E-01 9.25850E-02 7.50140E-02 3.49740E-02 8.94996E-03
1.65210E-03 3.56813E-04 3.83872E-05 5.64663E-06 6.51975E-07
1.47056E+00 6.42603E-01 1.02560E-01 0.          0.          0.
 1 3.42000E-04
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          9.55785E-04 3.41986E-03 8.72194E-03 2.76433E-02 5.70511E-02
1.11640E-01 1.77832E-01 2.60888E-01 4.86935E-01
3.79960E+00 2.88922E+00 2.21110E+00 1.66570E+00 1.02820E+00 3.75584E-01
9.47260E-02 2.39430E-02 2.79142E-03 4.33518E-04 4.98369E-05
0.          0.          0.          0.          0.          0.
```

```
  CORE REGION 5 - SPECTRUM 5 RADIAL
19 22 40 57 10  1
 5 4.54200E-02
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
0.          0.          0.          0.          0.          3.41811E-07
8.71030E-06 1.38649E-05 4.01484E-05 1.04629E-04 2.89498E-04 6.10722E-04
1.24976E-03 1.84456E-03 2.73205E-03 4.99430E-03
9.11631E-01 5.05299E-01 3.75980E-01 2.60560E-01 1.26660E-01 3.20034E-02
6.29500E-03 1.56286E-03 1.78995E-04 2.64830E-05 3.40102E-06
```

TABLE 7-1 (CONT)

4.34053E-02	0.	0.	0.	0.	0.
27 2.23800E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
5.78404E-03	2.93054E-03	4.01500E-03	4.00000E-03	4.75180E-03	6.50153E-03
2.51690E-02	4.13819E-02	3.89696E-02	9.41673E-02	2.45598E-01	5.14435E-01
1.05075E+00	1.54523E+00	2.25094E+00	4.10437E+00		
1.23042E-01	1.59691E-01	9.22580E-02	5.71480E-02	2.96960E-02	8.61881E-03
4.04400E-03	8.98088E-04	4.14020E-05	6.15066E-06	7.87880E-07	
1.30272E+00	5.38829E-01	6.60970E-02	1.65190E-03	0.	0.
29 7.58400E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
5.69040E-03	2.92090E-03	4.01730E-03	5.00720E-03	5.82080E-03	2.55571E-02
5.59020E-02	3.96475E-02	4.77297E-02	7.90826E-02	1.97330E-01	4.48741E-01
9.16258E-01	1.34717E+00	1.96350E+00	3.58027E+00		
1.30761E-01	1.01469E-01	6.02070E-02	5.69610E-02	2.41320E-02	9.75458E-03
2.43960E-03	5.33438E-04	1.01713E-04	1.56079E-05	2.00437E-06	
1.21049E+00	6.89371E-01	2.76910E-01	0.	0.	0.
28 2.16000E-05					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.91376E-03	3.10239E-03	4.38170E-03	6.28140E-03	1.37790E-02	5.56467E-02
1.14740E-01	1.34817E+00	4.59740E+00	4.38639E-01	1.07268E+00	2.35366E+00
4.78164E+00	7.04462E+00	1.02503E+01	1.85677E+01		
1.14191E-01	9.85246E-02	6.96930E-02	5.24830E-02	2.88620E-02	1.45839E-02
1.18330E-02	2.82191E-03	1.97452E-03	4.23206E-06	3.94740E-07	
1.71964E+00	1.47442E+00	8.10600E-01	5.83550E-01	2.58770E-01	0.
31 3.21900E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.97100E-01	8.03235E-02	1.50000E-02	1.30000E-02	9.91550E-03	1.33415E-02
1.80850E-02	2.42878E-02	5.44824E-02	1.24408E-01	3.30297E-01	8.16327E-01
1.66619E+00	2.44982E+00	3.57031E+00	6.51079E+00		
1.16549E-01	1.23020E-01	1.03080E-01	5.98780E-02	3.94830E-02	2.16373E-02
4.74850E-03	1.96939E-03	1.45160E-04	2.23276E-05	2.88527E-06	
1.33518E+00	8.08659E-01	0.	0.	0.	0.
129 1.00000E-05					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.

TABLE 7-1 (CONT)

0.	0.	0.	0.		
3.97505E-02	8.75567E-02	1.35740E-01	2.02860E-01	3.75850E-01	1.33274E+00
5.34890E+00	1.59221E+01	2.71066E+01	6.33539E+01	2.33115E+02	5.70311E+00
8.34520E+00	1.14882E+01	1.60039E+01	2.70879E+01		
4.85116E-02	2.70661E-02	2.75820E-02	2.57580E-02	1.41360E-02	3.74306E-03
6.72660E-04	1.53759E-04	1.75613E-05	2.59812E-06	3.33656E-07	
2.71966E+00	2.76594E+00	2.48010E+00	2.14890E+00	1.50440E+00	6.33279E-01
10 7.73600E-04					
1.27806E+00	1.28973E+00	1.23000E+00	1.18800E+00	1.39930E+00	2.24466E+00
4.18890E+00	6.84199E+00	1.76575E+01	3.81391E+01	2.67685E+01	6.39625E+01
1.86784E+02	2.74083E+02	4.47732E+02	8.80597E+02		
2.38267E-02	5.25806E-02	9.21410E-02	1.56460E-01	3.05710E-01	7.64853E-01
1.34660E+00	3.14690E+00	8.76284E+00	2.32817E+01	1.91666E+01	1.13373E+01
3.90794E+01	4.79752E+01	7.83328E+01	1.54133E+02		
3.52054E-02	3.33017E-02	2.30190E-02	1.62190E-02	1.15740E-02	3.83578E-03
8.32620E-04	2.07682E-04	2.37196E-05	4.26554E-06	4.99371E-07	
1.91260E+00	1.75356E+00	1.53610E+00	1.63340E+00	1.32150E+00	8.70082E-02
12 5.61800E-05					
6.02333E-01	4.62875E-01	2.50130E-02	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.17496E-02	4.89920E-02	1.24990E-01	1.36800E-01	1.81870E-01	2.91440E-01
4.06780E-01	1.56529E+00	9.20147E+00	4.59194E+01	6.54995E+01	4.81822E-01
9.82389E-01	1.44448E+00	2.10713E+00	3.85850E+00		
4.01765E-02	2.99154E-02	2.43840E-02	2.29370E-02	1.44550E-02	5.05538E-03
1.19180E-03	3.64351E-04	2.38670E-05	3.53096E-06	4.38110E-07	
2.48242E+00	2.52106E+00	2.12520E+00	1.62850E+00	1.01150E+00	1.30484E-01
44 7.21700E-03					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
2.75421E-03	3.88794E-03	7.26910E-03	1.08460E-02	1.29010E-02	2.27933E-02
9.51000E-02	1.43674E-01	3.00466E-01	3.90580E-03	1.09121E-02	3.39530E-02
6.91806E-02	1.02035E-01	1.51084E-01	2.76127E-01		
1.07733E-01	1.04042E-01	9.25850E-02	7.50140E-02	3.49740E-02	8.89991E-03
1.65210E-03	3.52143E-04	3.77248E-05	5.29066E-06	6.82278E-07	
1.47073E+00	6.41394E-01	1.02560E-01	0.	0.	0.
1 3.42000E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.
0.	9.67624E-04	3.46239E-03	9.08643E-03	2.70345E-02	5.95753E-02
1.11755E-01	1.80125E-01	2.66901E-01	4.87347E-01		

TABLE 7-1 (CONT)

3.79991E+00	2.88832E+00	2.21110E+00	1.66570E+00	1.02820E+00	3.73915E-01
9.47260E-02	2.36611E-02	2.74518E-03	4.06140E-04	5.21575E-05	
0.	0.	0.	0.	0.	0.

FILLER STRIP - SPECTRUM 6 RADIAL

22 25 40 57 2 1

5 5.57800E-02

0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
0.	0.	0.	0.	0.	3.70724E-07
8.75980E-06	1.40852E-05	4.09855E-05	1.07908E-04	2.84017E-04	6.31806E-04
1.25739E-03	1.86228E-03	2.79235E-03	5.32192E-03		
9.06575E-01	5.04051E-01	3.76730E-01	2.61070E-01	1.26860E-01	3.15789E-02
6.29560E-03	1.53498E-03	1.75271E-04	2.49397E-05	3.52599E-06	
4.61744E-02	0.	0.	0.	0.	0.

1 2.85000E-05

0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.
0.	9.98579E-04	3.54148E-03	9.41402E-03	2.65466E-02	6.16287E-02
1.11692E-01	1.81844E-01	2.72775E-01	5.19354E-01		
3.81163E+00	2.88503E+00	2.21520E+00	1.67040E+00	1.03330E+00	3.70501E-01
9.47400E-02	2.32463E-02	2.68806E-03	3.82472E-04	5.40739E-05	
0.	0.	0.	0.	0.	0.

STRUCTURE - SPECTRUM 7 RADIAL

25 26 40 57 6 1

25 5.84200E-02

0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.71489E-02	3.86399E-04	4.16670E-04	4.80180E-04	1.93940E-03	4.48155E-03
5.39260E-03	1.61478E-03	2.54518E-03	6.85223E-03	1.75302E-02	4.23194E-02
8.39289E-02	1.23877E-01	1.82511E-01	3.46610E-01		
2.31970E-01	2.54458E-01	1.72060E-01	1.36440E-01	6.93300E-02	1.56103E-02
9.21590E-04	2.21966E-04	2.52034E-05	3.53664E-06	5.13677E-07	
6.71409E-01	2.44542E-01	1.07840E-01	0.	0.	0.

27 3.44600E-04

0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
6.07330E-03	2.95481E-03	4.01460E-03	4.00000E-03	4.77830E-03	6.60045E-03
2.55740E-02	4.09468E-02	3.99215E-02	9.83516E-02	2.40638E-01	5.33369E-01
1.05859E+00	1.56294E+00	2.30141E+00	4.37074E+00		

TABLE 7-1 (CONT)

1.23555E-01	1.57915E-01	9.23350E-02	5.73440E-02	2.99660E-02	8.21574E-03
4.10850E-03	8.43494E-04	4.01057E-05	5.65108E-06	8.18714E-07	
1.30055E+00	5.20928E-01	6.55780E-02	1.58430E-03	0.	0.
29 1.17000E-03					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
6.14332E-03	2.94315E-03	4.02460E-03	5.01410E-03	5.82600E-03	2.67545E-02
5.63310E-02	4.06496E-02	4.79614E-02	8.19545E-02	1.93227E-01	4.65259E-01
9.23106E-01	1.36263E+00	2.00747E+00	3.81260E+00		
1.30192E-01	1.00721E-01	6.04840E-02	5.73320E-02	2.42300E-02	9.57233E-03
2.44850E-03	5.23339E-04	9.87810E-05	1.43395E-05	2.08270E-06	
1.22036E+00	6.80126E-01	2.73930E-01	0.	0.	0.
31 5.27800E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
2.02512E-01	7.86692E-02	1.50000E-02	1.29530E-02	9.91590E-03	1.35412E-02
1.79800E-02	2.44641E-02	5.61286E-02	1.29648E-01	3.23446E-01	8.46297E-01
1.67871E+00	2.47796E+00	3.65039E+00	6.93325E+00		
1.15650E-01	1.23554E-01	1.03120E-01	5.98170E-02	3.95120E-02	2.20954E-02
4.76830E-03	1.86492E-03	1.40840E-04	2.05217E-05	2.99795E-06	
1.32812E+00	7.85511E-01	0.	0.	0.	0.
128 5.32200E-05					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
9.94720E-03	6.52900E-04	2.32920E-03	4.06530E-03	4.67510E-03	4.19047E-02
3.77280E-02	3.95428E-02	6.10267E-02	1.64454E-01	4.19751E-01	1.05796E+00
2.09862E+00	3.09795E+00	4.56420E+00	8.66764E+00		
1.64428E-01	1.68200E-01	9.22390E-02	4.66100E-02	3.33940E-02	4.07145E-02
9.31210E-03	7.49333E-04	4.39015E-05	6.01798E-06	8.69339E-07	
1.15811E+00	5.81781E-01	1.00790E-01	0.	0.	0.
1 2.99000E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.
0.		1.01047E-03	3.56780E-03	9.55132E-03	2.65019E-02	6.17824E-02
1.11699E-01	1.82168E-01	2.73293E-01	5.21893E-01		
3.82525E+00	2.87619E+00	2.21520E+00	1.67040E+00	1.03330E+00	3.64902E-01
9.47400E-02	2.29633E-02	2.65910E-03	3.73134E-04	5.41957E-05	
0.	0.	0.	0.	0.	0.

BE INNER REFL.-SPECTRUM 8 RADIAL

TABLE 7-1 (CONT)

26	29	40	57	7	1
25 4.99800E-03					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.77115E-02	3.85078E-04	4.16670E-04	4.30180E-04	1.93940E-03	4.48205E-03
5.39260E-03	1.59641E-03	2.55829E-03	6.92063E-03	1.75714E-02	4.26662E-02
8.41348E-02	1.24068E-01	1.82997E-01	3.47400E-01		
2.30623E-01	2.51710E-01	1.72060E-01	1.36440E-01	6.93300E-02	1.56065E-02
9.21590E-04	2.17868E-04	2.49921E-05	3.47277E-06	5.11170E-07	
6.76315E-01	2.37319E-01	1.07840E-01	0.	0.	0.
3 7.96900E-02					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.
0.	1.29572E-05	1.11534E-04	3.00647E-04	7.58379E-04	1.78426E-03
3.52791E-03	5.22063E-03	7.83960E-03	1.49706E-02		
7.61891E-01	6.03622E-01	5.40290E-01	4.06060E-01	1.81110E-01	4.80008E-02
9.92710E-03	2.33241E-03	2.68717E-04	3.73398E-05	5.49616E-06	
0.	0.	0.	0.	0.	0.
27 1.86200E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
6.20951E-03	2.97909E-03	4.01460E-03	4.00000E-03	4.77830E-03	6.60101E-03
2.55740E-02	4.09362E-02	4.01051E-02	9.92869E-02	2.41196E-01	5.37743E-01
1.06117E+00	1.56535E+00	2.30754E+00	4.38070E+00		
1.20958E-01	1.56013E-01	9.23350E-02	5.73440E-02	2.99660E-02	8.21303E-03
4.10850E-03	8.18626E-04	3.97703E-05	5.54899E-06	8.14713E-07	
1.29978E+00	5.03001E-01	6.55780E-02	1.58430E-03	0.	0.
29 6.32000E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
6.30190E-03	2.96570E-03	4.02460E-03	5.01410E-03	5.82600E-03	2.67621E-02
5.63310E-02	4.15271E-02	4.79818E-02	8.25729E-02	1.93690E-01	4.69074E-01
9.25368E-01	1.36473E+00	2.01282E+00	3.82129E+00		
1.30362E-01	9.98199E-02	6.04840E-02	5.73320E-02	2.42300E-02	9.57143E-03
2.44850E-03	5.16566E-04	9.79763E-05	1.40805E-05	2.07254E-06	
1.22949E+00	6.70275E-01	2.73930E-01	0.	0.	0.
31 2.85100E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.

TABLE 7-1 (CONT)

```
0.           0.           0.           0.
2.04841E-01 7.69609E-02 1.50000E-02 1.29530E-02 9.91590E-03 1.35422E-02
1.79800E-02 2.45060E-02 5.64539E-02 1.30827E-01 3.24219E-01 8.53230E-01
1.68283E+00 2.48179E+00 3.66012E+00 6.94905E+00
1.15386E-01 1.23878E-01 1.03120E-01 5.98170E-02 3.95120E-02 2.20968E-02
4.76830E-03 1.81648E-03 1.39686E-04 2.01528E-05 2.98333E-06
1.32543E+00 7.62569E-01 0.           0.           0.           0.
128 2.87500E-05
0.           0.           0.           0.           0.           0.
0.           0.           0.           0.           0.           0.
0.           0.           0.           0.
1.02615E-02 6.39864E-04 2.32920E-03 4.06530E-03 4.67510E-03 4.19220E-02
3.77280E-02 3.92529E-02 6.13618E-02 1.66090E-01 4.20755E-01 1.06663E+00
2.10377E+00 3.10274E+00 4.57636E+00 8.68736E+00
1.63559E-01 1.65925E-01 9.22390E-02 4.66100E-02 3.33940E-02 4.07200E-02
9.31210E-03 7.28895E-04 4.35306E-05 5.90775E-06 8.65176E-07
1.16262E+00 5.69817E-01 1.00790E-01 0.           0.           0.
 1 1.51000E-03
0.           0.           0.           0.           0.           0.
0.           0.           0.           0.           0.           0.
0.           0.           0.           0.
0.           0.           0.           0.           0.           0.
0.           1.02796E-03 3.58807E-03 9.65765E-03 2.65600E-02 6.22891E-02
1.11720E-01 1.82443E-01 2.74069E-01 5.22864E-01
3.83737E+00 2.85946E+00 2.21520E+00 1.67040E+00 1.03330E+00 3.64836E-01
9.47400E-02 2.25467E-02 2.63680E-03 3.66396E-04 5.39312E-05
0.           0.           0.           0.           0.           0.
```

```
  VANE - SPECTRUM 9           RADIAL
29 30 40 57 -7  1
```

```
  BE OUTER REFL.-SPECTRUM 10 RADIAL
30 34 40 57  7  1
25 5.31200E-03
0.           0.           0.           0.           0.           0.
0.           0.           0.           0.           0.           0.
0.           0.           0.           0.
1.89784E-02 3.83397E-04 4.16670E-04 4.80180E-04 1.93940E-03 4.47590E-03
5.39260E-03 1.57945E-03 2.57143E-03 6.98716E-03 1.76507E-02 4.27423E-02
8.42779E-02 1.24163E-01 1.82976E-01 3.47692E-01
2.28059E-01 2.48212E-01 1.72060E-01 1.36440E-01 6.93300E-02 1.56545E-02
9.21590E-04 2.14082E-04 2.47802E-05 3.41200E-06 5.06710E-07
6.85728E-01 2.28124E-01 1.07840E-01 0.           0.           0.
 3 8.08500E-02
0.           0.           0.           0.           0.           0.
0.           0.           0.           0.           0.           0.
```

TABLE 7-1 (CONT)

0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.
0.	1.33533E-05	1.12126E-04	3.03551E-04	7.61832E-04	1.78747E-03
3.53409E-03	5.22457E-03	7.83858E-03	1.49867E-02		
7.51807E-01	5.77925E-01	5.40290E-01	4.06060E-01	1.81110E-01	4.81315E-02
9.92710E-03	2.29208E-03	2.66439E-04	3.66864E-05	5.44821E-06	
0.	0.	0.	0.	0.	0.
27 5.74000E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
6.56503E-03	3.00999E-03	4.01460E-03	4.00000E-03	4.77830E-03	6.59410E-03
2.55740E-02	4.09264E-02	4.02891E-02	1.00197E-01	2.42269E-01	5.38703E-01
1.06297E+00	1.56655E+00	2.30727E+00	4.38437E+00		
1.16711E-01	1.53592E-01	9.23350E-02	5.73440E-02	2.99660E-02	8.24666E-03
4.10850E-03	7.95654E-04	3.94340E-05	5.45181E-06	8.07596E-07	
1.29819E+00	4.80181E-01	6.55780E-02	1.58430E-03	0.	0.
29 1.94900E-03					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
6.72799E-03	2.99441E-03	4.02460E-03	5.01410E-03	5.82600E-03	2.66687E-02
5.63310E-02	4.23376E-02	4.80023E-02	8.31725E-02	1.94577E-01	4.69912E-01
9.26940E-01	1.36578E+00	2.01258E+00	3.82449E+00		
1.30541E-01	9.86726E-02	6.04840E-02	5.73320E-02	2.42300E-02	9.58255E-03
2.44850E-03	5.10309E-04	9.71695E-05	1.38341E-05	2.05446E-06	
1.24577E+00	6.57736E-01	2.73930E-01	0.	0.	0.
31 8.79100E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
2.09759E-01	7.47862E-02	1.50000E-02	1.29530E-02	9.91590E-03	1.35299E-02
1.79800E-02	2.45446E-02	5.67799E-02	1.31978E-01	3.25700E-01	8.54752E-01
1.68569E+00	2.48370E+00	3.65969E+00	6.95487E+00		
1.14814E-01	1.24290E-01	1.03120E-01	5.98170E-02	3.95120E-02	2.20790E-02
4.76830E-03	1.77174E-03	1.38529E-04	1.98018E-05	2.95732E-06	
1.31954E+00	7.33364E-01	0.	0.	0.	0.
128 8.86400E-05					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.10102E-02	6.23270E-04	2.32920E-03	4.06530E-03	4.67510E-03	4.17071E-02
3.77280E-02	3.89851E-02	6.16977E-02	1.67682E-01	4.22688E-01	1.06853E+00
2.10735E+00	3.10512E+00	4.57583E+00	8.69465E+00		

TABLE 7-1 (CONT)

```
1.61843E-01 1.63029E-01 9.22390E-02 4.66100E-02 3.33940E-02 4.06522E-02
9.31210E-03 7.10015E-04 4.31588E-05 5.80288E-06 8.57756E-07
1.17097E+00 5.54588E-01 1.00790E-01 0.          0.          0.
 1 1.51000E-03
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          1.04412E-03 3.60838E-03 9.76326E-03 2.66742E-02 6.24009E-02
1.11736E-01 1.82580E-01 2.74032E-01 5.23429E-01
3.86152E+00 2.83817E+00 2.21520E+00 1.67040E+00 1.03330E+00 3.65665E-01
9.47400E-02 2.21618E-02 2.61445E-03 3.59984E-04 5.34607E-05
0.          0.          0.          0.          0.          0.
```

```
  PRESS.VESS.SIDE-SPECTRUM 11RADIAL
34 35 40 59  2  1
25 5.02000E-02
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
2.01833E-02 3.82671E-04 4.16670E-04 4.80180E-04 1.93940E-03 4.46329E-03
5.39260E-03 1.57422E-03 2.57804E-03 7.02229E-03 1.77079E-02 4.26073E-02
8.43068E-02 1.24217E-01 1.82614E-01 3.54728E-01
2.25982E-01 2.46702E-01 1.72060E-01 1.36440E-01 6.93300E-02 1.57528E-02
9.21590E-04 2.12916E-04 2.46735E-05 3.38020E-06 5.03575E-07
6.92854E-01 2.24156E-01 1.07840E-01 0.          0.          0.
 1 1.58000E-03
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          1.04910E-03 3.61861E-03 9.81955E-03 2.67572E-02 6.22055E-02
1.11739E-01 1.82658E-01 2.73441E-01 5.35641E-01
3.88120E+00 2.82898E+00 2.21520E+00 1.67040E+00 1.03330E+00 3.67365E-01
9.47400E-02 2.20433E-02 2.60319E-03 3.56630E-04 5.31299E-05
0.          0.          0.          0.          0.          0.
```

```
  PRESS.VESS.SIDE-SPECTRUM 11RADIAL
34 35  1 40 -2  1
```

```
  CHESH- SPECTRUM 12          AXIAL
 1 22 57 59  8  1
 5 6.47000E-03
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
0.          0.          0.          0.          0.          3.29655E-07
```

TABLE 7-1 (CONT)

8.69270E-06	1.36844E-05	3.96247E-05	9.79462E-05	2.72690E-04	5.53079E-04
1.19891E-03	1.81441E-03	2.73684E-03	5.50959E-03		
9.00072E-01	5.03693E-01	3.75930E-01	2.60610E-01	1.26680E-01	3.23231E-02
6.29480E-03	1.58624E-03	1.80441E-04	3.05262E-05	3.93624E-06	
5.09263E-02	0.	0.	0.	0.	0.
27 8.60000E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
6.24398E-03	2.93821E-03	4.01500E-03	4.00000E-03	4.75340E-03	6.47203E-03
2.50210E-02	4.17108E-02	3.85026E-02	8.84242E-02	2.31759E-01	4.66041E-01
1.00941E+00	1.51964E+00	2.25409E+00	4.48223E+00		
1.22443E-01	1.59049E-01	9.22760E-02	5.71190E-02	2.96630E-02	8.74839E-03
4.02050E-03	9.27380E-04	4.17368E-05	7.08500E-06	9.12799E-07	
1.30032E+00	5.33171E-01	6.60970E-02	1.64960E-03	0.	0.
29 2.98000E-03					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
6.31957E-03	2.92798E-03	4.01730E-03	5.00760E-03	5.82130E-03	2.51938E-02
5.57470E-02	3.92827E-02	4.75588E-02	7.49440E-02	1.85977E-01	4.06527E-01
8.80085E-01	1.32491E+00	1.96616E+00	3.90980E+00		
1.30261E-01	1.01257E-01	6.01560E-02	5.69960E-02	2.41740E-02	9.83269E-03
2.43660E-03	5.38158E-04	1.02326E-04	1.79909E-05	2.31981E-06	
1.22332E+00	6.86319E-01	2.76910E-01	0.	0.	0.
28 8.29000E-05					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.88568E-03	3.11198E-03	4.38170E-03	6.28350E-03	1.37850E-02	5.51368E-02
1.14170E-01	1.31788E+00	4.68417E+00	4.20475E-01	1.01019E+00	2.13715E+00
4.59500E+00	6.92177E+00	1.02640E+01	2.02841E+01		
1.13672E-01	9.84102E-02	6.97290E-02	5.25430E-02	2.88920E-02	1.47157E-02
1.17440E-02	2.85132E-03	1.94862E-03	5.04084E-06	4.62971E-07	
1.71214E+00	1.46971E+00	8.10600E-01	5.83480E-01	2.58390E-01	0.
31 1.28000E-03					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
2.03594E-01	7.97898E-02	1.50000E-02	1.29970E-02	9.91540E-03	1.32852E-02
1.81230E-02	2.41776E-02	5.37170E-02	1.17356E-01	3.11145E-01	7.39691E-01
1.60041E+00	2.40928E+00	3.57532E+00	7.11006E+00		
1.15573E-01	1.23137E-01	1.03100E-01	5.98820E-02	3.93380E-02	2.15178E-02
4.72780E-03	2.02489E-03	1.46162E-04	2.57158E-05	3.33888E-06	

TABLE 7-1 (CONT)

1.32678E+00	8.01385E-01	0.	0.	0.	0.
128 1.26000E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.01896E-02	6.59866E-04	2.30230E-03	4.06230E-03	4.66960E-03	3.71343E-02
3.79640E-02	3.99790E-02	5.85243E-02	1.46888E-01	4.03827E-01	9.24705E-01
2.00073E+00	3.01208E+00	4.47032E+00	8.88876E+00		
1.64119E-01	1.69690E-01	9.20890E-02	4.68700E-02	3.34230E-02	3.89438E-02
9.47810E-03	8.05497E-04	4.57279E-05	7.57695E-06	9.65442E-07	
1.15931E+00	5.89726E-01	1.03530E-01	0.	0.	0.
301 7.65000E-03					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
3.05571E-02	5.32167E-02	7.58110E-02	1.02950E-01	1.57660E-01	2.75743E-01
6.26030E-01	1.44797E+00	3.68998E+00	2.54686E+00	4.77782E+00	3.54291E+00
6.51809E+00	9.75904E+00	1.45516E+01	2.87842E+01		
4.39082E-02	3.87382E-02	2.79700E-02	2.27670E-02	1.59750E-02	5.44657E-03
8.24240E-04	2.99538E-04	1.73495E-04	1.28258E-04	6.92628E-07	
2.54609E+00	2.46005E+00	2.11120E+00	1.83940E+00	9.98480E-01	7.03309E-02
1 9.55000E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.
0.	9.43204E-04	3.41038E-03	8.48085E-03	2.53593E-02	5.39589E-02
1.10733E-01	1.77198E-01	2.67254E-01	5.37670E-01		
3.82968E+00	2.88352E+00	2.21110E+00	1.66600E+00	1.02850E+00	3.76835E-01
9.47210E-02	2.40101E-02	2.76735E-03	4.68147E-04	6.03657E-05	
0.	0.	0.	0.	0.	0.

AFT PLENUM- SPECTRUM 10 RADIAL

22 34 57 59 7 1					
25 2.29000E-02					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.89784E-02	3.83492E-04	4.16070E-04	4.76180E-04	1.83760E-03	4.47407E-03
5.38110E-03	1.58045E-03	2.57034E-03	6.98716E-03	1.76507E-02	4.25060E-02
8.40094E-02	1.23930E-01	1.82892E-01	3.47057E-01		
2.28059E-01	2.48436E-01	1.70810E-01	1.35020E-01	6.75400E-02	1.64119E-02
9.20570E-04	2.14082E-04	2.47802E-05	3.41200E-06	5.06710E-07	
6.85728E-01	2.26864E-01	1.10950E-01	0.	0.	0.
27 4.09000E-04					

TABLE 7-1 (CONT)

0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
6.56503E-03	3.01672E-03	4.01520E-03	4.00000E-03	4.69220E-03	6.58350E-03
2.55070E-02	4.09055E-02	4.02745E-02	1.00197E-01	2.42269E-01	5.35722E-01
1.05959E+00	1.56351E+00	2.30629E+00	4.37639E+00		
1.16711E-01	1.53195E-01	9.22190E-02	5.67070E-02	2.90280E-02	8.25279E-03
4.09810E-03	7.96091E-04	3.94336E-05	5.45181E-06	8.07596E-07	
1.29819E+00	4.75193E-01	6.63020E-02	1.75750E-03	0.	0.
29 2.88000E-03					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
6.72799E-03	3.00011E-03	4.01440E-03	4.99430E-03	5.80730E-03	2.63768E-02
5.62620E-02	4.22927E-02	4.80280E-02	8.31725E-02	1.94577E-01	4.67313E-01
9.23985E-01	1.36319E+00	2.01174E+00	3.81748E+00		
1.30541E-01	9.88970E-02	6.01230E-02	5.61710E-02	2.39020E-02	9.58918E-03
2.44730E-03	5.10377E-04	9.71759E-05	1.38341E-05	2.05446E-06	
1.24577E+00	6.56303E-01	2.78080E-01	0.	0.	0.
28 3.63000E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.85498E-03	3.20765E-03	4.37860E-03	6.22380E-03	1.35400E-02	5.64389E-02
1.16190E-01	1.45521E+00	4.20708E+00	4.58526E-01	1.05782E+00	2.44914E+00
4.82057E+00	7.12599E+00	1.04977E+01	1.97952E+01		
1.13581E-01	9.73758E-02	6.96980E-02	5.20570E-02	2.85260E-02	1.39994E-02
1.18440E-02	2.59397E-03	1.66250E-03	3.66034E-06	4.04826E-07	
1.70512E+00	1.42107E+00	8.11870E-01	5.85340E-01	2.71970E-01	0.
31 5.96000E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
2.09759E-01	7.44220E-02	1.50000E-02	1.30920E-02	9.91710E-03	1.34351E-02
1.79960E-02	2.45457E-02	5.67690E-02	1.31978E-01	3.25700E-01	8.50024E-01
1.68030E+00	2.47890E+00	3.65811E+00	6.94213E+00		
1.14814E-01	1.24825E-01	1.03060E-01	6.00800E-02	3.93740E-02	2.19189E-02
4.74110E-03	1.77273E-03	1.38534E-04	1.98018E-05	2.95732E-06	
1.31954E+00	7.26451E-01	0.	0.	0.	0.
128 6.01000E-05					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.10102E-02	6.24366E-04	2.29170E-03	4.05630E-03	4.65580E-03	4.05663E-02

TABLE 7-1 (CONT)

```
3.77620E-02 3.89789E-02 6.16701E-02 1.67682E-01 4.22688E-01 1.06261E+00
2.10062E+00 3.09910E+00 4.57386E+00 8.67883E+00
1.61843E-01 1.63098E-01 9.20790E-02 4.68230E-02 3.31200E-02 3.95886E-02
9.36040E-03 7.10054E-04 4.31588E-05 5.80288E-06 8.57756E-07
1.17097E+00 5.51792E-01 1.04610E-01 0.          0.          0.
 1 5.87000E-03
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          1.04412E-03 3.60838E-03 9.76326E-03 2.66742E-02 6.24009E-02
1.11736E-01 1.82580E-01 2.74032E-01 5.23429E-01
3.86152E+00 2.83817E+00 2.21520E+00 1.67040E+00 1.03330E+00 3.65665E-01
9.47400E-02 2.21618E-02 2.61445E-03 3.59984E-04 5.34607E-05
0.          0.          0.          0.          0.          0.
  CORE PLENUM - SPECTRUM 14   AXIAL
 1 26 37 40  7  1
 4 2.52000E-04
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
5.43169E-02 7.69673E-02 6.19760E-02 1.19490E-01 2.78130E-01 6.50853E-01
1.31260E+00 2.81277E+00 7.70055E+00 2.23384E+01 5.59016E+01 1.33515E+02
2.74850E+02 4.12169E+02 6.19525E+02 1.15647E+03
4.95112E-01 4.80783E-01 3.42760E-01 2.39150E-01 1.15440E-01 3.05401E-02
5.74320E-03 1.38630E-03 1.57745E-04 2.23316E-05 3.23980E-06
1.13206E-01 9.18149E-04 0.          0.          0.          0.
27 2.61000E-03
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
5.97834E-03 2.95423E-03 4.01520E-03 4.00000E-03 4.69220E-03 6.39720E-03
2.55070E-02 4.09329E-02 3.97732E-02 9.76085E-02 2.38767E-01 5.03768E-01
1.03568E+00 1.54667E+00 2.28409E+00 4.24633E+00
1.24212E-01 1.58076E-01 9.22190E-02 5.67070E-02 2.90280E-02 9.19397E-03
4.09810E-03 8.55465E-04 4.03528E-05 5.73636E-06 8.30116E-07
1.30184E+00 5.21344E-01 6.63020E-02 1.75750E-03 0.          0.
29 9.04000E-03
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
5.96181E-03 2.94211E-03 4.01440E-03 4.99430E-03 5.80730E-03 2.38007E-02
5.62620E-02 4.02033E-02 4.79700E-02 8.14497E-02 1.91679E-01 4.39438E-01
9.03035E-01 1.34846E+00 1.99239E+00 3.70403E+00
```

TABLE 7-1 (CONT)

1.30384E-01	1.01163E-01	6.01230E-02	5.61710E-02	2.39020E-02	9.87879E-03
2.44730E-03	5.26531E-04	9.93812E-05	1.45558E-05	2.11167E-06	
1.21224E+00	6.81515E-01	2.78080E-01	0.	0.	0.
28 2.62000E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.90499E-03	3.12859E-03	4.37860E-03	6.22380E-03	1.35400E-02	5.31520E-02
1.16190E-01	1.39007E+00	4.37125E+00	4.49896E-01	1.04221E+00	2.30590E+00
4.71345E+00	7.05000E+00	1.03989E+01	1.92060E+01		
1.13901E-01	9.85178E-02	6.96980E-02	5.20570E-02	2.85260E-02	1.50265E-02
1.18440E-02	2.74810E-03	1.73361E-03	3.89015E-06	4.16528E-07	
1.71699E+00	1.45953E+00	8.11870E-01	5.85340E-01	2.71970E-01	0.
31 1.57000E-03					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.99376E-01	7.88074E-02	1.50000E-02	1.30920E-02	9.91710E-03	1.30881E-02
1.79960E-02	2.44455E-02	5.58794E-02	1.28714E-01	3.20866E-01	7.99390E-01
1.64216E+00	2.45211E+00	3.62289E+00	6.73584E+00		
1.16162E-01	1.23941E-01	1.03060E-01	6.00800E-02	3.93740E-02	2.14737E-02
4.74110E-03	1.88838E-03	1.41697E-04	2.08298E-05	3.03962E-06	
1.33204E+00	7.85575E-01	0.	0.	0.	0.
128 6.21000E-03					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
9.55398E-03	6.57390E-04	2.29170E-03	4.05630E-03	4.65580E-03	3.47372E-02
3.77620E-02	3.96688E-02	6.07549E-02	1.63152E-01	4.16376E-01	9.99326E-01
2.05297E+00	3.06563E+00	4.52985E+00	8.42095E+00		
1.65546E-01	1.68875E-01	9.20790E-02	4.68230E-02	3.31200E-02	3.77064E-02
9.36040E-03	7.58820E-04	4.41751E-05	6.11012E-06	8.81255E-07	
1.15268E+00	5.82531E-01	1.04610E-01	0.	0.	0.
1 3.34000E-03					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.
0.	1.00262E-03	3.55129E-03	9.46592E-03	2.63019E-02	5.83427E-02
1.11331E-01	1.80294E-01	2.71105E-01	5.05535E-01		
3.80939E+00	2.88552E+00	2.20940E+00	1.65660E+00	1.01560E+00	3.86334E-01
9.47370E-02	2.31558E-02	2.67555E-03	3.78763E-04	5.49496E-05	
0.	0.	0.	0.	0.	0.

SUPPORT PLATE - SPECTRUM 15 AXIAL

TABLE 7-1 (CONT)

```
 1 26 32 37  7  1
25 3.14700E-02
0.            0.            0.            0.            0.            0.
0.            0.            0.            0.            0.            0.
0.            0.            0.            0.
1.61736E-02 3.86039E-04 4.16070E-04 4.76180E-04 1.83760E-03 4.31878E-03
5.38110E-03 1.59141E-03 2.57380E-03 6.98458E-03 1.76553E-02 4.16055E-02
8.33672E-02 1.23894E-01 1.84130E-01 3.48375E-01
2.34622E-01 2.53734E-01 1.70810E-01 1.35020E-01 6.75400E-02 1.74561E-02
9.20570E-04 2.16527E-04 2.47242E-05 3.41473E-06 5.06434E-07
6.63151E-01 2.40947E-01 1.10950E-01 0.            0.            0.
27 1.62000E-03
0.            0.            0.            0.            0.            0.
0.            0.            0.            0.            0.            0.
0.            0.            0.            0.
5.92022E-03 2.96918E-03 4.01520E-03 4.00000E-03 4.69220E-03 6.44420E-03
2.55070E-02 4.09123E-02 4.03230E-02 1.00162E-01 2.42331E-01 5.24366E-01
1.05153E+00 1.56306E+00 2.32189E+00 4.39300E+00
1.26058E-01 1.56908E-01 9.22190E-02 5.67070E-02 2.90280E-02 8.95650E-03
4.09810E-03 8.10939E-04 3.93448E-05 5.45617E-06 8.07155E-07
1.30210E+00 5.10305E-01 6.63020E-02 1.75750E-03 0.            0.
29 5.54000E-03
0.            0.            0.            0.            0.            0.
0.            0.            0.            0.            0.            0.
0.            0.            0.            0.
5.91658E-03 2.95598E-03 4.01440E-03 4.99430E-03 5.80730E-03 2.44507E-02
5.62620E-02 4.17701E-02 4.80336E-02 8.31498E-02 1.94628E-01 4.57407E-01
9.16928E-01 1.36280E+00 2.02535E+00 3.83198E+00
1.30194E-01 1.00621E-01 6.01230E-02 5.61710E-02 2.39020E-02 9.80572E-03
2.44730E-03 5.14417E-04 9.69629E-05 1.38452E-05 2.05333E-06
1.20714E+00 6.75484E-01 2.78080E-01 0.            0.            0.
28 1.61000E-03
0.            0.            0.            0.            0.            0.
0.            0.            0.            0.            0.            0.
0.            0.            0.            0.
1.91014E-03 3.14750E-03 4.37860E-03 6.22380E-03 1.35400E-02 5.39813E-02
1.16190E-01 1.43892E+00 4.19123E+00 4.58411E-01 1.05811E+00 2.39818E+00
4.78452E+00 7.12365E+00 1.05671E+01 1.98705E+01
1.13835E-01 9.82446E-02 6.96980E-02 5.20570E-02 2.85260E-02 1.47674E-02
1.18440E-02 2.63251E-03 1.65563E-03 3.66392E-06 4.04593E-07
1.71802E+00 1.45033E+00 8.11870E-01 5.85340E-01 2.71970E-01 0.
31 8.13000E-04
0.            0.            0.            0.            0.            0.
0.            0.            0.            0.            0.            0.
```

TABLE 7-1 (CONT)

```
 0.            0.            0.            0.
 1.98465E-01 7.77584E-02 1.50000E-02 1.30920E-02 9.91710E-03 1.31756E-02
 1.79960E-02 2.45207E-02 5.68549E-02 1.31934E-01 3.25786E-01 8.32016E-01
 1.66745E+00 2.47818E+00 3.68286E+00 6.96849E+00
 1.16233E-01 1.24153E-01 1.03060E-01 6.00800E-02 3.93740E-02 2.15860E-02
 4.74110E-03 1.80165E-03 1.38229E-04 1.98175E-05 2.95570E-06
 1.33297E+00 7.71432E-01 0.            0.            0.            0.
128 1.26000E-05
 0.            0.            0.            0.            0.            0.
 0.            0.            0.            0.            0.            0.
 0.            0.            0.            0.
 9.44622E-03 6.49491E-04 2.29170E-03 4.05630E-03 4.65580E-03 3.62079E-02
 3.77620E-02 3.91514E-02 6.17584E-02 1.67620E-01 4.22799E-01 1.04010E+00
 2.08457E+00 3.09821E+00 4.60480E+00 8.71178E+00
 1.65927E-01 1.67493E-01 9.20790E-02 4.68230E-02 3.31200E-02 3.81813E-02
 9.36040E-03 7.22249E-04 4.30607E-05 5.80760E-06 8.57296E-07
 1.15049E+00 5.75178E-01 1.04610E-01 0.            0.            0.
  1 5.61000E-03
 0.            0.            0.            0.            0.            0.
 0.            0.            0.            0.            0.            0.
 0.            0.            0.            0.
 0.            0.            0.            0.            0.            0.
 0.            1.03396E-03 3.61198E-03 9.75962E-03 2.66811E-02 6.07312E-02
 1.11634E-01 1.82170E-01 2.75865E-01 5.24519E-01
 3.80420E+00 2.87550E+00 2.20940E+00 1.65660E+00 1.01560E+00 3.80561E-01
 9.47370E-02 2.24104E-02 2.60855E-03 3.60273E-04 5.34315E-05
 0.            0.            0.            0.            0.            0.
```

```
   SHIELD PLENUM - SPECTRUM 16 AXIAL
  1 26 31 32  5  1
 27 2.07000E-03
 0.            0.            0.            0.            0.            0.
 0.            0.            0.            0.            0.            0.
 0.            0.            0.            0.
 5.86964E-03 2.97752E-03 4.01520E-03 4.00000E-03 4.69220E-03 6.49303E-03
 2.55070E-02 4.09083E-02 4.04991E-02 1.00520E-01 2.42578E-01 5.25283E-01
 1.05210E+00 1.56322E+00 2.31992E+00 4.38109E+00
 1.27062E-01 1.56257E-01 9.22190E-02 5.67070E-02 2.90280E-02 8.70982E-03
 4.09810E-03 8.02297E-04 3.90220E-05 5.41652E-06 8.05545E-07
 1.30218E+00 5.04147E-01 6.63020E-02 1.75750E-03 0.            0.
 29 7.08000E-03
 0.            0.            0.            0.            0.            0.
 0.            0.            0.            0.            0.            0.
 0.            0.            0.            0.
 5.87327E-03 2.96372E-03 4.01440E-03 4.99430E-03 5.80730E-03 2.51259E-02
```

TABLE 7-1 (CONT)

5.62620E-02	4.20743E-02	4.80540E-02	8.33890E-02	1.94833E-01	4.58207E-01
9.17422E-01	1.36294E+00	2.02363E+00	3.82158E+00		
1.30085E-01	1.00319E-01	6.01230E-02	5.61710E-02	2.39020E-02	9.72981E-03
2.44730E-03	5.12065E-04	9.61883E-05	1.37446E-05	2.04924E-06	
1.20479E+00	6.72120E-01	2.78080E-01	0.	0.	0.
28 2.08000E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.91236E-03	3.15805E-03	4.37860E-03	6.22380E-03	1.35400E-02	5.48428E-02
1.16190E-01	1.44840E+00	4.13356E+00	4.59604E-01	1.05921E+00	2.40229E+00
4.78704E+00	7.12443E+00	1.05583E+01	1.98165E+01		
1.13791E-01	9.80923E-02	6.96980E-02	5.20570E-02	2.85260E-02	1.44982E-02
1.18440E-02	2.61008E-03	1.63066E-03	3.63184E-06	4.03756E-07	
1.71851E+00	1.44520E+00	8.11870E-01	5.85340E-01	2.71970E-01	0.
31 9.34000E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.98040E-01	7.71733E-02	1.50000E-02	1.30920E-02	9.91710E-03	1.32666E-02
1.79960E-02	2.45353E-02	5.71674E-02	1.32385E-01	3.26129E-01	8.33471E-01
1.66835E+00	2.47845E+00	3.67972E+00	6.94959E+00		
1.16248E-01	1.24271E-01	1.03060E-01	6.00800E-02	3.93740E-02	2.17027E-02
4.74110E-03	1.78482E-03	1.37118E-04	1.96743E-05	2.94982E-06	
1.33341E+00	7.63544E-01	0.	0.	0.	0.
1 5.01000E-03					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.
0.	1.04005E-03	3.63142E-03	9.80024E-03	2.67087E-02	6.08372E-02
1.11641E-01	1.82189E-01	2.75615E-01	5.22979E-01		
3.80199E+00	2.86991E+00	2.20940E+00	1.65660E+00	1.01560E+00	3.74564E-01
9.47370E-02	2.22657E-02	2.58708E-03	3.57655E-04	5.33251E-05	
0.	0.	0.	0.	0.	0.

DRUM DRIVE - SPECTRUM 10RADIAL					
26 34 31 40 7 1					
25 3.68000E-03					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.89784E-02	3.63492E-04	4.16070E-04	4.76180E-04	1.83760E-03	4.47407E-03
5.38110E-03	1.58045E-03	2.57034E-03	6.98716E-03	1.76507E-02	4.25060E-02
8.40094E-02	1.23930E-01	1.82892E-01	3.47057E-01		

2.28059E-01	2.48436E-01	1.70810E-01	1.35020E-01	6.75400E-02	1.64119E-02
9.20570E-04	2.14082E-04	2.47802E-05	3.41200E-06	5.06710E-07	
6.85728E-01	2.26864E-01	1.10950E-01	0.	0.	0.
27 6.24000E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
6.56503E-03	3.01672E-03	4.01520E-03	4.00000E-03	4.69220E-03	6.58350E-03
2.55070E-02	4.09055E-02	4.02745E-02	1.00197E-01	2.42269E-01	5.35722E-01
1.05959E+00	1.56351E+00	2.30629E+00	4.37639E+00		
1.16711E-01	1.53195E-01	9.22190E-02	5.67070E-02	2.90280E-02	8.25279E-03
4.09810E-03	7.96091E-04	3.94336E-05	5.45181E-06	8.07596E-07	
1.29819E+00	4.75193E-01	6.63020E-02	1.75750E-03	0.	0.
29 2.44000E-03					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
6.72799E-03	3.00011E-03	4.01440E-03	4.99430E-03	5.80730E-03	2.63768E-02
5.62620E-02	4.22927E-02	4.80280E-02	8.31725E-02	1.94577E-01	4.67313E-01
9.23985E-01	1.36319E+00	2.01174E+00	3.81748E+00		
1.30541E-01	9.88970E-02	6.01230E-02	5.61710E-02	2.39020E-02	9.58918E-03
2.44730E-03	5.10377E-04	9.71759E-05	1.38341E-05	2.05446E-06	
1.24577E+00	6.56303E-01	2.78080E-01	0.	0.	0.
28 1.27000E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.85498E-03	3.20765E-03	4.37860E-03	6.22380E-03	1.35400E-02	5.64389E-02
1.16190E-01	1.45521E+00	4.20708E+00	4.58526E-01	1.05782E+00	2.44914E+00
4.82057E+00	7.12599E+00	1.04977E+01	1.97952E+01		
1.13581E-01	9.73758E-02	6.96980E-02	5.20570E-02	2.85260E-02	1.39994E-02
1.18440E-02	2.59397E-03	1.66250E-03	3.66034E-06	4.04826E-07	
1.70512E+00	1.42107E+00	8.11870E-01	5.85340E-01	2.71970E-01	0.
31 5.34000E-04					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
2.09759E-01	7.44220E-02	1.50000E-02	1.30920E-02	9.91710E-03	1.34351E-02
1.79960E-02	2.45457E-02	5.67690E-02	1.31978E-01	3.25700E-01	8.50024E-01
1.68030E+00	2.47890E+00	3.65811E+00	6.94213E+00		
1.14814E-01	1.24825E-01	1.03060E-01	6.00800E-02	3.93740E-02	2.19189E-02
4.74110E-03	1.77273E-03	1.38534E-04	1.98018E-05	2.95732E-06	
1.31954E+00	7.26451E-01	0.	0.	0.	0.
128 3.77000E-05					

TABLE 7-1 (CONT)

```
0.           0.           0.           0.           0.           0.
0.           0.           0.           0.           0.           0.
0.           0.           0.           0.
1.10102E-02 6.24366E-04 2.29170E-03 4.05630E-03 4.65580E-03 4.05663E-02
3.77620E-02 3.89789E-02 6.16701E-02 1.67682E-01 4.22688E-01 1.06261E+00
2.10062E+00 3.09910E+00 4.57386E+00 8.67683E+00
1.61843E-01 1.63098E-01 9.20790E-02 4.68230E-02 3.31200E-02 3.95886E-02
9.36040E-03 7.10054E-04 4.31588E-05 5.80288E-06 8.57756E-07
1.17097E+00 5.51792E-01 1.04610E-01 0.           0.           0.
 1 5.79000E-03
0.           0.           0.           0.           0.           0.
0.           0.           0.           0.           0.           0.
0.           0.           0.           0.
0.           0.           0.           0.           0.           0.
0.           1.04442E-03 3.60663E-03 9.76326E-03 2.66742E-02 6.20442E-02
1.11769E-01 1.82219E-01 2.73900E-01 5.22345E-01
3.86152E+00 2.84361E+00 2.20940E+00 1.65660E+00 1.01560E+00 3.63453E-01
9.47370E-02 2.21618E-02 2.61445E-03 3.59984E-04 5.34607E-05
0.           0.           0.           0.           0.           0.
  SHIELD PLATE - SPECTRUM 17 AXIAL
 1 34 30 31  2  1
25 5.07000E-02
0.           0.           0.           0.           0.           0.
0.           0.           0.           0.           0.           0.
0.           0.           0.           0.
1.60990E-02 3.85563E-04 4.16070E-04 4.76180E-04 1.83760E-03 4.38351E-03
5.38110E-03 1.58647E-03 2.58737E-03 6.98059E-03 1.76005E-02 4.14003E-02
8.32646E-02 1.23767E-01 1.83463E-01 3.43015E-01
2.34728E-01 2.52744E-01 1.70810E-01 1.35020E-01 6.75400E-02 1.70208E-02
9.20570E-04 2.15425E-04 2.45047E-05 3.41647E-06 5.09400E-07
6.62348E-01 2.38317E-01 1.10950E-01 0.           0.           0.
 1 6.57000E-04
0.           0.           0.           0.           0.           0.
0.           0.           0.           0.           0.           0.
0.           0.           0.           0.
0.           0.           0.           0.           0.           0.
0.           1.03868E-03 3.63295E-03 9.75052E-03 2.66049E-02 6.04307E-02
1.11607E-01 1.81987E-01 2.74805E-01 5.15735E-01
3.80247E+00 2.86954E+00 2.20940E+00 1.65660E+00 1.01560E+00 3.73430E-01
9.47370E-02 2.22984E-02 2.58539E-03 3.60456E-04 5.37445E-05
0.           0.           0.           0.           0.           0.
  BATH SHIELD - SPECTRUM 18  AXIAL
 1 34 14 30  5  1
25 3.69000E-02
```

TABLE 7-1 (CONT)

0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
1.70204E-02	3.85703E-04	4.16070E-04	4.76180E-04	1.83760E-03	4.29857E-03
5.38110E-03	1.57890E-03	2.56445E-03	6.77911E-03	1.68975E-02	3.87293E-02
8.14440E-02	1.22338E-01	1.80173E-01	3.31598E-01		
2.32924E-01	2.53035E-01	1.70810E-01	1.35020E-01	6.75400E-02	1.75919E-02
9.20570E-04	2.13736E-04	2.48755E-05	3.59491E-06	5.47591E-07	
6.68307E-01	2.39089E-01	1.10950E-01	0.	0.	0.
4 5.68000E-03					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
5.42604E-02	7.72701E-02	6.19760E-02	1.19490E-01	2.78130E-01	6.55322E-01
1.31260E+00	2.88050E+00	7.80414E+00	2.22782E+01	5.45227E+01	1.29328E+02
2.72580E+02	4.11339E+02	6.16007E+02	1.13733E+03		
4.96251E-01	4.78031E-01	3.42760E-01	2.39150E-01	1.15440E-01	3.01984E-02
5.74320E-03	1.32389E-03	1.54735E-04	2.23622E-05	3.40632E-06	
1.15654E-01	7.88143E-04	0.	0.	0.	0.
5 1.42000E-03					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
0.	0.	0.	0.	0.	3.17720E-07
8.75210E-06	1.44525E-05	4.16204E-05	1.08203E-04	2.73321E-04	5.79325E-04
1.22103E-03	1.84260E-03	2.75944E-03	5.09465E-03		
8.99614E-01	4.99022E-01	3.75700E-01	2.59610E-01	1.26160E-01	3.30884E-02
6.29550E-03	1.46024E-03	1.71127E-04	2.47317E-05	3.76725E-06	
4.95546E-02	0.	0.	0.	0.	0.
128 9.92000E-03					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
9.93631E-03	6.46176E-04	2.29170E-03	4.05630E-03	4.65580E-03	3.56408E-02
3.77620E-02	3.89545E-02	6.15195E-02	1.62711E-01	4.04324E-01	9.68184E-01
2.03649E+00	3.05936E+00	4.50592E+00	8.29239E+00		
1.64925E-01	1.66913E-01	9.20790E-02	4.68230E-02	3.31200E-02	3.79982E-02
9.36040E-03	7.08330E-04	4.33260E-05	6.11839E-06	9.25834E-07	
1.15486E+00	5.72092E-01	1.04610E-01	0.	0.	0.
1 1.82000E-02					
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		
0.	0.	0.	0.	0.	0.

TABLE 7-1 (CONT)

```
0.          1.04590E-03 3.59752E-03 9.42108E-03 2.56032E-02 5.65152E-02
1.11072E-01 1.79933E-01 2.69586E-01 4.97160E-01
3.81859E+00 2.87129E+00 2.20940E+00 1.65660E+00 1.01560E+00 3.82787E-01
9.47370E-02 2.21267E-02 2.62450E-03 3.79282E-04 5.77739E-05
0.          0.          0.          0.          0.          0.
  LEAD SHIELD - SPECTRUM 19   AXIAL
 1 34 12 14  2  1
126 2.75000E-02
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          4.53364E-03 1.38099E-02 4.40491E-02
7.81121E-02 1.05537E-01 1.46784E-01 2.56034E-01
7.69865E-02 6.00885E-02 4.38540E-02 2.57690E-02 1.53500E-02 4.80168E-03
1.00240E-03 2.35111E-04 2.77326E-05 3.91631E-06 5.77676E-07
1.96141E+00 5.27206E-01 1.25410E-01 0.          0.          0.
 1 6.57000E-04
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          1.05674E-03 3.60641E-03 9.60270E-03 2.64373E-02 6.13561E-02
1.11829E-01 1.85438E-01 2.77050E-01 5.14012E-01
3.87258E+00 2.87979E+00 2.20940E+00 1.65660E+00 1.01560E+00 3.87416E-01
9.47370E-02 2.18688E-02 2.61469E-03 3.69239E-04 5.44648E-05
0.          0.          0.          0.          0.          0.
  DOME PLENUM - SPECTRUM 20   AXIAL
 1 34  3 12  1  1
 1 7.76000E-03
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
0.          1.05034E-03 3.63185E-03 9.84103E-03 2.68640E-02 6.23869E-02
1.11843E-01 1.85859E-01 2.78707E-01 5.24761E-01
3.88102E+00 2.88444E+00 2.20940E+00 1.65660E+00 1.01560E+00 3.82318E-01
9.47370E-02 2.20210E-02 2.58661E-03 3.55456E-04 5.27381E-05
0.          0.          0.          0.          0.          0.
  PRESS.VESS.DOME - SPEC 21   AXIAL
 1 34  1  3  1  4
25 6.10000E-02
0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.
```

TABLE 7-1 (CONT)

0.	0.	0.	0.		
2.16731E-02	3.86864E-04	4.16070E-04	4.76180E-04	1.83760E-03	4.28902E-03
5.38110E-03	1.58783E-03	2.58575E-03	7.06549E-03	1.78595E-02	4.26641E-02
8.93806E-02	1.26243E-01	1.84829E-01	3.40544E-01		
2.24902E-01	2.55448E-01	1.70810E-01	1.35020E-01	6.75400E-02	1.76562E-02
9.20570E-04	2.15728E-04	2.45309E-05	3.34285E-06	4.95592E-07	
6.94827E-01	2.45505E-01	1.10950E-01	0.	0.	0.

8.0 The MAP Code

MAP is a point kernel code designed to calculate the radiation level at detector points located within or outside a complex geometry described by a combination of quadratic surfaces. The unique feature of the MAP code is the use of the discrete ordinate (DOT-IIW) r, z surface leakage data as angular dependent surface source data. In addition, the MAP code provides the means of coupling DOT-IIW calculations in r, z geometry. This coupling is provided by the calculation of an angular dependent boundary source for input to the DOT-IIW code.

The MAP code can be employed as a point kernel code in that the evaluation of material thicknesses intercepted along a line-of-sight from a r, z source surface to a detector point, the calculation of exponential attenuation, and in the case of gammas the calculation of buildup due to multiple scattering is within the capability of the code.

8.1 Description of the MAP Code Capabilities and Limitations

The use of the discrete ordinates transport code output as a surface source in a point kernel code provides a useful tool for performing radiation analysis external to radiation source. In the analyses using the DOT-IIW code, the r, z surface leakage is a normal output. Using this as a surface source in MAP provides a technique which closely approximates the energy and angular distribution of neutron and photon leakage without performing the radiation transport from distributed sources using either a normal point kernel code or a Monte Carlo code.

The primary limitation of this technique lies in the angular representation of the leakage flux. In certain instances the anisotropy of the leakage flux may not be adequately represented by the limited number of discrete directions. In MAP the DOT-IIW discrete direction fluxes are either assurred to be the average flux within the solid angle defined by the quadrature, or are fitted by a polynomial. This limitation most generally results in a propagation of the discrete direction fluxes to the detector surface and an over-prediction of the results along these directions. This results in an under-prediction on the detector surface for points not on the discrete directions.

The limitations of the point kernel technique as described in Section 9.1 for the KAP-VI code applies to the MAP code except that the neutron attenuation model is only an exponential attenuation model.

In the S/W problems the MAP code is employed to calculate the meridian ring neutron and photon fluxes for use in the SCAP and LHAP codes. This use of the code employs only the capability of the code to calculate the inverse square attenuation of radiation from the r, z source of the DOT - IIW NSS model to the meridian ring. The inclusion of a complex geometry such as the propellant tank and command module is almost identical to the SCAP and LHAP codes and the user is referred to Sections 10.0 and 11.0 for a detailed description of this geometry input.

8.2 Input Data Description

Input data for the MAP code consists of four sets of data. These are:

1. Overall problem core memory storage allocation

2. Problem descriptive title, specifications and options

3. Discrete ordinate, detector, source and response data

4. Ray tracing geometry data.

The first two data sets are entered in a fixed FORTRAN format and the third and fourth data sets use the FIDO subroutine to read punched card input. The FIDO subroutine will accept data in one of three FORTRAN formats with the most general capability having input data operations declared by letter code. The use of the FIDO input data operations are demonstrated in the following sections as well as in the description of the SATURN, ANISN-W, DOT-IIW, SCAP, and LHAP code S/W problems.

The MAP code user's manual is published as a separate document (Appendix C of WANL-PR(LL)-034, Volume 5). It is assumed that the reader will utilize this manual during the discussion of the workshop problem input data in the following sections.

The S/W MAP problems demonstrate the use of the MAP code to calculate the neutron and photon flux at a 30 foot meridian ring using as input the three DOT-IIW problems described in Section 6.0.

8.2.1 Input Data Preparation

A listing of the input cards for the three MAP problems is in Tables 8-1, 8-2 and 8-3. The input to all three problems are described simultaneously in the following discussion.

Data Set 1 - Overall Problem Core Memory Allocation

The initial input quantity for the MAP code is the quantity, LIM1, i.e., the maximum number of core memory locations available for data of a MAP problem. On the MSFC UNIVAC-1108 this value is currently 35,000 with the capability increasing this to 50,000 by recompiling with an increased blank COMMON. The S/W problems use an input value of LIM1 of 30,000.

Data Set 2 - Problem Descriptive Title, Specifications and Options

The second data set for the MAP input contains seven cards of input. The first card is the descriptive title of the problem in a (12A6) FORTRAN format. The next five cards contain the problem specifications and options as integer data in the FORTRAN format (6I12). The second card of input contains the source surface specifications and define the DOT-IIW input required by the MAP code. These data are:

1. Number of radial mesh intervals in the surface source, NRI. This value is the same as the DOT-IIW values of 40 for the neutron problems and 34 for the photon problem.

2. Number of radial mesh intervals in the source surface integration, NRK. This input value specifies the number of equal size radial mesh intervals in the integration of the top and bottom source surfaces. If NRK is input as 0 then the input value of NRI and the DOT-IIW mesh is used. In the S/W problems the DOT-IIW mesh is used and the input value of NRK is 0.

3. Number of axial mesh intervals in the surface source, NZI. This value is the same as the DOT-IIW values of 50 for the reactor neutron problem, 47 for the shield problem, and 58 for the photon problem.

4. Number of axial mesh intervals in the source surface integration, NZK. This input value specifies the number of equal size axial mesh intervals in the integration of the side surface. If NZK is input as 0, then the input value of NZI and the DOT-IIW mesh is used. In the S/W problems the DOT-IIW mesh is used and the input value of NZK is 0.

5. Number of azimuthal mesh intervals in the source surface integration on the top or bottom surface, NMU. In the S/W problems the input value of NMU is 18 which subdivides one half of the top or bottom surfaces (180^o) into 18 angular sectors with NRI radial intervals. This results in NMU*NRI source points on one-half of the top or bottom surface.

6. Number of azimuthal mesh intervals in the source surface integration of the side surface, NMUS. In the S/W problems the input value of NMUS is 9. This subdivides the visible side surface (always less than 90^o) into 9 angular sectors with NZI axial intervals. This results in NMUS*NZI source points on one-half of the visible side surface.

The third card of Data Set 2 contains the multigroup angular flux specifications. These are:

1. Number of energy groups, NGN. The neutron S/W problems have 16 energy groups and the photon problem has 13 energy groups.

2. Anisotropic scattering order in the DOT-IIW problem, NPL. The neutron S/W problems use transport corrected data and NPL is input as 0. The photon problem is a P_1 problem and NPL is input as 1.

3. Number of angular quadrature directions on the source surface, NQI. All three S/W problems are S_8 calculations with 48 angles and NQI is input as 48.

4. Number of upward directed angular quadrature directions, at the source surface, NQIU. In the MAP code the angular quadrature is assumed to always be input as downward directed ($-\eta$) data followed by upward directed ($+\eta$) data. In the S/W problems the input value of NQIU is 24 since the S_8 quadrature data is symmetric data.

5. Number of angular quadrature directions at the detector surface, NQJ. In the S/W problems the generation of a boundary source tape at the detector surface is not used. The low order S_2 quadrature data is used. The input value of NQJ is 6.

6. Number of upward directed angular quadrature direction at the detector surface NQJU. This quantity is similar to the quantity NQIU. In the S/W problems the input value is 3 since the S_2 quadrature data is symmetric data.

The fourth card of Data Set 2 contains the MAP code logic and printed, punched, and tape output options. These are:

1. Angular flux interpolation technique option, NIT. The MAP code has the capability to use the DOT-IIW angular flux as discrete point sources or use a polynomial to interpolate the angular flux data. In the S/W problems, the angular flux interpolation scheme is used and NIT is input as 1. This option will use more computer time but provides improved results.

2. Tape and punched card output option, NPNH. The S/W problems are used to supply punched cards for SCAP and LHAP input. No tape output is desired and therefore the input value of NPNH is 1.

3. Printed output option, NPRT. The MAP code has the option to limit the magnitude of printed output. The option selected for the S/W problems include the input data, detector surface scalar flux, and the detector response data. The input value of NPRT is 2 for this option.

The fifth card of Data Set 2 defines the ray trace geometry input. In the S/W problems this option is not used and the six values of input are 0's. This input is similar to SCAP, LHAP, or KAP-VI input and the SCAP or LHAP cards can be used as input. This data is explained in detail in the MAP user's manual and the MAP user can refer to the SCAP or LHAP S/W problems if a geometry is to be input to MAP.

The sixth card of Data Set 2 defines the detector surface geometry option. The required input data are:

1. Detector surface option, NTSUR. In the MAP code, the detector surface is comprised of mesh intervals and the detector points are placed at the midpoint of these intervals. The user may chose a plane normal to the z axis, a spherical detector, a cylindrical surface concentric with the r, z source surface, or a collection of point detectors. The option to specify a collection of points was used and NTSUR was input as 4. This option was used since KAP-VI detector point coordinates were used.

2. Number of detector points or mesh intervals at the detector surface, NRJ. This value is input as 21 for all three problems.

3. Number of tagged surfaces on the top or bottom surface, NAT. The MAP code calculates the flux-response data at the detector points for the entire source surface, and, at option, for selected source surface areas. In the S/W problems the tagged surface option for the top and bottom surface is used and NAT is input as 1. This requires input in later sections.

4. Number of tagged surfaces on the side surface, NAS. The quantity NAS is similar to the quantity NAT except NAS is for the side surface. In the S/W problems this option is used to provide data for the coupling neutron results and NAS is input as 1.

5. Number of response functions, NRP. The S/W neutron problems have as input three response functions (total flux, flux greater than 1.0 Mev, and neutron dose rate). The input value of NRP is 3. In the photon problem two response functions (total flux and gamma dose rate) are input and NRP is input as 2.

The last card of Data Set 2 is the problem normalization and detector surface data. The five input values are:

1. Problem normalization factor, SCALE. This quantity is a constant multiplier of the MAP calculated results. In the S/W problems the normalization was performed in DOT-IIW and therefore SCALE is input as 1.0 for all three problems.

2. Detector surface axial coordinate, ZR. This input value defines the plane detector surface normal to the z axis. In the S/W problem this detector option is not used and ZR is input as 0.0.

3. Detector surface radius, RZ. This input value defines the spherical detector surface radius (meridian ring radius). This detector option is not used but a value of 914.4 (30 feet) was input.

4. Axial coordinate of detector surface, RM. The input value of RM positions the spherical detector surface (meridian ring). In the S/W problems a value of -71.12, the physical center of the reactor core, is input. This value is not used in the MAP calculation since the type of detector surface, NTSUR, is not 2.

5. Cylindrical detector surface radius, RL. This defines the radius of a detector surface concentric with the r, z DOT-IIW geometry. This detector surface option is not used and RL is input as 0.0 for all three S/W problems.

Data Set 3 - Discrete Ordinate, Detector, Source and Response Data

The third set of input data for a MAP problem consists of: (1) the discrete ordinate quadrature and r, z model dimensions which define the source surface, the detector surface coordinates, and the multigroup flux-response data. This data is entered as input under FIDO subroutine control where each type of data is assigned an array number. Each input data array required for a MAP problem is described in the following paragraphs.

1* Array

The radial mesh line coordinates, R1, at the source surface. These are the DOT-IIW input data array 4* and the MAP input data are listed in Table 6-1 for both neutron and photon problems. The photon mesh line coordinates do not include the values in Table 6-1 with asterisks.

2* Array

The axial mesh line coordinates, Z1, at the source surface. These are the DOT-IIW input array 2* and the MAP input data are listed in Table 6-2 for the reactor neutron problem, Table 6-3 for the shield neutron problem, and Table 6-4 for the photon problem.

3* Array

Azimuthal mesh line coordinates, CTQ, at the top or bottom source surface. This input in units of degrees is used to subdivide the range of 0° to 180° into angular sectors. In the S/W problems an equal subdivision is used and the input is 0° to 180° with 17 interpolations.

4* Array

Azimuthal mesh line coordinates, CSQ, at the side source surface. This input in units of degrees is used to subdivide the visible side surface into angular sectors. An equal subdivision is used in the S/W problems and the input is 0° to 90° with 8 interpolants. The MAP code normalizes the input range, 0° to 90°, to the visible angle.

5$ Array

Tagged surface mesh interval numbers for the top or bottom surface, NTGT. For each tagged surface, the MAP code expects two values of NTGT. These are first and last mesh intervals to be included in the tagged source surface. In the S/W neutron problems this data is input as 1 and 40 for the 40 radial mesh intervals of the only tagged surface. The S/W photon problem has as input the values 1 and 34 for the entire top or bottom surface.

6$ Array

Tagged surface mesh interval numbers for the side surface, NTGS. The input is similar to the NTGT array. In the S/W reactor neutron problem the input values 10 and 50 provide results for the portion of the problem not overlapped by the shield neutron problem. In the shield neutron problem the input of 1 and 47 provides the remainder of the NSS side surface. In the photon problem the input of 1 and 58 provides the side surface contribution.

8U Array

Discrete ordinate quadrature data, B1, describing the DOT-IIW angular flux at the source surface. This data is the 7U and 6U of the DOT-IIW and is from Table 2-1 of the DOT-IIW user's manual or Table 3-4 of the MAP user's manual.

10U Array

Discrete ordinate quadrature data, C1, describing the MAP detector surface angular flux. This data is used to define the MAP calculated boundary source at a plane detector. In the S/W problems this output is not desired, but an S_2 angular quadrature from Table 3-4 of the MAP user's manual is used.

11H Array

Response function descriptive title, TITLE. This input is one card for each response function. In the neutron problems three cards are required and the photon problem requires two cards. These are in the listing.

12* Array

Multigroup flux-response data, DOSE. This input is NGN values of input for each flux response. In the S/W neutron problems the first response function data are sixteen 1.0's to provide total flux. The second set of data are two 1.0's, a third value of 0.6, and the remaining 13 values of 0.0's. This results in a flux-response of neutrons with energy greater than 1.0 MeV. The third set of neutron flux-response data are dose rate conversion factors, Rem/hr/n/cm^2-second. In the photon problem the total flux response is obtained by the input of 13 1.0's and the second flux-response is gamma dose rate conversion factors, R/hr/Mev/cm^2-second.

13* and 14* Arrays

In the S/W problems the general detector surface option, NTSUR = 4, is used. The r and z coordinates of the 21 detector points on the 30 foot meridian ring are input. The r coordinates are input in the 13* array and the z coordinates are input in the 14* array.

15* and 16* Arrays

The S/W problems do not require these input arrays. These data are the mesh line coordinates defining mesh intervals on the detector surfaces (plane, spherical, or cylindrical). The midpoint of each interval is considered to be a detector point.

The above data arrays are followed by a single terminate (T) card.

Data Set 4 - Ray Trace Geometry Data

In the S/W problems the ray trace geometry capability is not used and no input is required. This input is similar to the SCAP, LHAP, or KAP-VI input data and the reader is referred to those S/W problems for a description of the input requirements.

8.2.2 Problem Size Determination

Section 3.3 of the MAP user's manual describes how to determine the core memory locations required for a MAP problem. If the problem requires more storage than the ISIZE allocations specified on the first input card, the MAP problem must be reduced in size. Angular flux interpolation, if used, consumes a large portion of the core memory storage requirement and can be deleted if necessary. The S/W neutron problems use approximately 20,000 of the available 30,000 core memory locations.

8.2.3 Problem Setup Information

Section 5.0 of the MAP user's manual describes the tape assignments, running time estimates, and error messages for the MAP code. The S/W problems use magnetic tape input from the DOT-IIW code on tape unit 11. This tape is the only tape required for the S/W problems.

If a boundary source tape was requested, NPNH = 2 or 3, then a save tape would be mounted on tape 9. In problems containing a ray trace geometry the Master Library 5 cross section tape may be required on tape unit 3. The remainder of the tape drives can use FASTRAN. In the S/W problems the tape 10 information was placed on FASTRAN. This information is used in the angular flux interpolation and results in NRJ records of size, NRI*NMU*(4 + NSN), and NRJ records of size, NZI*NMUS*(4 + NSN). The value of NSN is the symmetric angular quadrature order of the DOT-IIW input data. In the S/W reactor neutron problem this results in 21 records with 8640 words and 21 records of 5400 words. A total of 294,840 words are on tape 10. This requires that the MSFC user specify the number of positions on FASTRAN for this data. The other two MAP problems will have a similar amount of data on tape 10.

8.3 Output Data Description

Output data from a MAP problem consists of printed, punched card, and magnetic tape output. The following sections briefly describe the type of output from the S/W problems. In addition, Section 6.0 of the MAP user's manual describes in detail the output of the MAP code. The description which follows applies to all three S/W problems except where noted in the discussion.

8.3.1 Printed Output

In the S/W problems the printed output sections selected by the input option (NPRT) were; (1) the organized print of input data, (2) the calculated angular flux data for each detector point and group, (3) the scalar flux and current for each group and detector point, and (4) the final detector response results.

The S/W angular flux results for each group and detector point are printed in tabular form with each row, the S_2 angular flux at a detector. This data can be related to the S_2 discrete ordinate quadrature data and illustrates the capability of MAP to calculate the angular dependent boundary source. This angular flux is printed for the top or bottom, side, and total surface. Following this data for each group is the scalar flux and vertical current at each detector point. The current data is provided only as a check of the generation of a boundary source technique and the MAP current is the actual result.

Following the group flux data the flux response data is printed. This data consits of the detector point coordinates, flux-response for the total, top or bottom, or side source surface, and the tagged surface data. Of interest in this printout is the reactor neutron tagged surface data for the side. This data is the results from the non-overlapped portion of the NSS side surface. The results of this column are added to the shield neutron data side surface data to provide the total NSS source surface results.

8.3.2 Punched Card Output

Punched card output from the MAP code consists of the multigroup flux at each of the detector points. These data are supplied for the top or bottom, side, and total source surfaces. This punched output is obtained at option, NPNH = 2 or 3, and is punched on cards in a (6E12.5) FORTRAN format. The data is punched for all detectors, NRJ values, for each surface and each group with data for each surface or group starting on a new card. This results in 3*NGN sets of cards each with NRJ values.

In the S/W neutron problems there are 21 detector points which result in 4 cards for each source surface (top or bottom, side, total) and 16 groups or a total of 192 punched cards. The S/W photon problems has 13 group and 156 cards of punched output.

8.3.3 Tape Output

Magnetic tape output from the MAP code consists of the angular flux data at the detector surface. In the MAP to DOT-IIW coupling this tape (tape 9) provides the top boundary source for DOT-IIW. The tape 9 format is described in Section 6.3 of the MAP user's manual and the use of this tape in DOT-IIW is described in the DOT-IIW user's manual.

In the S/W problems the output tape option is not used.

TABLE 8-1. LISTING OF THE MAP CODE INPUT DATA FOR THE SEMINAR/WORKSHOP REACTOR GEOMETRY NEUTRON PROBLEM

```
      30000
MSFC S/W MAP PROBLEM, REACTOR PORTION, NEUTRON, MERIDIAN RING
           40            0           50            0           18            9
           16            0           48           24            6            3
            1            1            2
            0            0            0            0            0            0
            4           21            1            1            3
1.0           0.0         914.4       -71.12        0.0
1*
  0.0          3.0          6.0          9.0          12.0         15.0
  18.0         21.0         25.0         27.0         29.184       30.0
  32.0         34.0         36.094       38.0         40.0         40.971
  42.0         43.0         44.0         44.654       45.0         46.0
  46.99        49.0         51.0         53.34        54.0         55.88
  57.5         60.0         61.92        62.05        62.174       63.0
  65.0         67.0         68.58        70.5         71.12
2*
  -175.0       -174.0       -173.0       -172.0       -171.0       -170.0
  -169.0       -168.0       -166.83      -166.0       -164.67      -163.0
  -162.0       -161.29      -159.0       -157.0       -155.0       -153.0
  -151.0       -149.0       -147.0       -146.05      -144.0       -142.0
  -140.0       -137.16      -136.0       -134.0       -130.0       -122.0
  -114.0       -104.0       -94.0        -84.0        -74.0        -64.0
  -58.0        -53.0        -48.0        -43.0        -38.0        -33.0
  -28.0        -23.0        -18.0        -13.0        -8.0         -6.0
  -5.08        -2.0          0.0
3*
17I 0.0         180.0
4*
8I 0.0          90.0
5$
            1           40
6$
           10           50
8U
-.308606714 -.218217900  .218217900 -.617213403 -.577350269 -.218217900
 .218217900  .577350269 -.816496581 -.786795790 -.577350269 -.218217900
 .218217900  .577350269  .786795790 -.975900071 -.951189727 -.786795790
-.577350269 -.218217900  .218217900  .577350269  .786795790  .951189727
-.308606714 -.218217900  .218217900 -.617213403 -.577350269 -.218217900
 .218217900  .577350269 -.816496581 -.786795790 -.577350269 -.218217900
 .218217900  .577350269  .786795790 -.975900071 -.951189727 -.786795790
-.577350269 -.218217900  .218217900  .577350269  .786795790  .951189727
-.951189727 -.951189727 -.951189727 -.786795790 -.786795790 -.786795790
```

TABLE 8-1 (CONT)

```
-.786795790 -.786795790 -.577350269 -.577350269 -.577350269 -.577350269
-.577350269 -.577350269 -.577350269 -.218217900 -.218217900 -.218217900
-.218217900 -.218217900 -.218217900 -.218217900 -.218217900 -.218217900
 .951189727  .951189727  .951189727  .786795790  .786795790  .786795790
 .786795790  .786795790  .577350269  .577350269  .577350269  .577350269
 .577350269  .577350269  .577350269  .218217900  .218217900  .218217900
 .218217900  .218217900  .218217900  .218217900  .218217900  .218217900
0.00         .030246915  .030246915 0.00         .022685185  .022685185
 .022685185  .022685185 0.00         .022685185  .023148144  .022685185
 .022685185  .023148144  .022685185 0.00         .030246915  .022685185
 .022685185  .030246915  .030246915  .022685185  .022685185  .030246915
0.00         .030246915  .030246915 0.00         .022685185  .022685185
 .022685185  .022685185 0.00         .022685185  .023148144  .022685185
 .022685185  .023148144  .022685185 0.00         .030246915  .022685185
 .022685185  .030246915  .030246915  .022685185  .022685185  .030246915
10U
-0.816500000-0.577350000 0.577350000-0.816500000-0.577350000 0.57735000
-0.577350000-0.577350000-0.577350000 0.577350000 0.577350000 0.577350000
 0.000000000 0.250000000 0.250000000 0.000000000 0.250000000 0.250000000
11H
  TOTAL NEUTRON FLUX
  NEUTRON FLUX, E GREATER THAN 1.0 MEV
  DOSE RATE -REM/HR
12*
16R 1.0
    1.0          1.0          0.60     13R 0.0
    1.2    -4    1.05   -4    8.8    -5    6.35   -5    3.25   -5    1.03   -5
    1.15   -6    1.73   -7    2.1    -8    9.0    -9    1.9    -8    5.62   -8
    1.0    -7    1.0    -7    1.0    -7    1.0    -7
13*
    0.0          31.913       63.789       95.582       127.257      158.786
    174.477      185.687      236.665      312.743      386.444      457.200
    587.767      791.898      900.510      897.602      783.796      690.107
    575.450      297.701      0.0
14*
   -985.52      -984.962     -983.289     -980.509     -976.623     -971.63
   -968.722     -966.464     -954.366     -930.373     -899.850     -863.018
   -771.587     -528.320     -245.597      103.357      399.833      528.781
    639.506      793.463      843.28
  T
```

TABLE 8-2. LISTING OF THE MAP CODE INPUT DATA FOR THE SEMINAR/WORKSHOP SHIELD GEOMETRY NEUTRON PROBLEM

```
      30000
MSFC S/W MAP PROBLEM, SHIELD PORTION, NEUTRON, MERIDIAN RING
         40         0        47         0        18         9
         16         0        48        24         6         3
          1         1         2
          0         0         0         0         0         0
          4        21         1         1         3
1.0          0.0          914.4       -71.12       0.0
1*
  0.0          3.0          6.0          9.0          12.0         15.0
  18.0         21.0         25.0         27.0         29.184       30.0
  32.0         34.0         36.094       38.0         40.0         40.971
  42.0         43.0         44.0         44.654       45.0         46.0
  46.99        49.0         51.0         53.34        54.0         55.88
  57.5         60.0         61.92        62.05        62.174       63.0
  65.0         67.0         68.58        70.5         71.12
2*
  -230.48      -229.21      -227.94      -224.94      -221.94      -218.94
  -215.94      -212.94      -209.94      -206.94      -203.94      -200.94
  -197.94      -197.625     -197.31      -197.0       -196.0       -195.0
  -194.0       -193.0       -192.0       -191.0       -190.0       -189.0
  -188.0       -187.0       -186.0       -185.0       -184.0       -183.0
  -182.0       -181.0       -180.0       -179.0       -178.0       -177.0
  -176.0       -175.0       -174.0       -173.0       -172.0       -171.0
  -170.0       -169.0       -168.0       -166.83      -166.0       -165.355
3*
17I 0.0        180.0
4*
8I 0.0         90.0
5$
          1        40
6$
          1        46
8U
-.308606714 -.218217900  .218217900 -.617213403 -.577350269 -.218217900
 .218217900  .577350269 -.816496581 -.786795790 -.577350269 -.218217900
 .218217900  .577350269  .786795790 -.975900071 -.951189727 -.786795790
-.577350269 -.218217900  .218217900  .577350269  .786795790  .951189727
-.308606714 -.218217900  .218217900 -.617213403 -.577350269 -.218217900
 .218217900  .577350269 -.816496581 -.786795790 -.577350269 -.218217900
 .218217900  .577350269  .786795790 -.975900071 -.951189727 -.786795790
-.577350269 -.218217900  .218217900  .577350269  .786795790  .951189727
-.951189727 -.951189727 -.951189727 -.786795790 -.786795790 -.786795790
-.786795790 -.786795790 -.577350269 -.577350269 -.577350269 -.577350269
```

TABLE 8-2 (CONT)

```
 -.577350269 -.577350269 -.577350269 -.218217900 -.218217900 -.218217900
 -.218217900 -.218217900 -.218217900 -.218217900 -.218217900 -.218217900
  .951189727  .951189727  .951189727  .786795790  .786795790  .786795790
  .786795790  .786795790  .577350269  .577350269  .577350269  .577350269
  .577350269  .577350269  .577350269  .218217900  .218217900  .218217900
  .218217900  .218217900  .218217900  .218217900  .218217900  .218217900
 0.00         .030246915  .030246915 0.00         .022685185  .022685185
  .022685185  .022685185 0.00         .022685185  .023148144  .022685185
  .022685185  .023148144  .022685185 0.00         .030246915  .022685185
  .022685185  .030246915  .030246915  .022685185  .022685185  .030246915
 0.00         .030246915  .030246915 0.00         .022685185  .022685185
  .022685185  .022685185 0.00         .022685185  .023148144  .022685185
  .022685185  .023148144  .022685185 0.00         .030246915  .022685185
  .022685185  .030246915  .030246915  .022685185  .022685185  .030246915
10U
-0.816500000-0.577350000 0.577350000-0.816500000-0.577350000 0.57735000
-0.577350000-0.577350000-0.577350000 0.577350000 0.577350000 0.577350000
 0.000000000 0.250000000 0.250000000 0.000000000 0.250000000 0.250000000
11H
  TOTAL NEUTRON FLUX
  NEUTRON FLUX, E GREATER THAN 1.0 MEV
  DOSE RATE - REM/HR
12*
16R 1.0
    1.0          1.0          0.60    13R 0.0
    1.2    -4    1.05   -4    8.8    -5   6.35   -5    3.25   -5    1.03   -5
    1.15   -6    1.73   -7    2.1    -8   9.0    -9    1.9    -8    5.62   -8
    1.0    -7    1.0    -7    1.0    -7   1.0    -7
13*
    0.0          31.913       63.789      95.582       127.257      158.786
    174.477      185.687      236.665     312.743      386.444      457.200
    587.767      791.898      900.510     897.602      783.796      690.107
    575.450      297.701      0.0
14*
   -985.52      -984.962     -983.289    -980.509     -976.623     -971.63
   -968.722     -966.464     -954.366    -930.373     -899.850     -863.018
   -771.587     -528.320     -245.597     103.357      399.833      528.781
    639.506      793.463      843.28
  T
```

TABLE 8-3. LISTING OF THE MAP CODE INPUT DATA FOR THE SEMINAR/WORKSHOP PHOTON PROBLEM

```
      30000
MSFC S/W MAP PROBLEM, NSS, PHOTON, MERIDIAN RING
         34          0          58          0          18          9
         13          1          48         24           6          3
          1          1           2
          0          0           0          0           0          0
          4         21           1          1           2
1.0         0.0         914.4       -71.12       0.0
1*
    0.0         3.0         6.0         9.0         12.0        15.0
    18.0        21.0        25.0        27.0        29.184      32.0
    34.0        36.094      38.0        40.971      42.0
    44.0        44.654      45.0        46.0        46.99
    49.0        51.0        53.34       55.88       57.5        60.0
    61.92       62.174      63.0        65.0        67.0        68.58
    71.12
2*
   -230.48     -229.21     -227.94     -224.94     -221.94
   -215.94     -212.94     -209.94     -206.94     -203.94     -200.94
   -197.94     -197.625    -197.31     -196.0
   -194.0      -192.0      -190.0      -188.0      -186.0      -184.0
   -182.0      -180.0      -178.0      -176.0      -174.0      -172.0
   -170.0      -168.0      -166.83     -164.67     -161.29     -159.0
   -155.0      -151.0      -147.0      -146.05     -144.0      -140.0
   -137.16     -136.0      -134.0      -130.0      -122.0      -114.0
   -104.0      -94.0       -84.0       -74.0       -64.0       -53.0
   -43.0       -33.0       -23.0       -13.0       -8.0
   -5.08       -2.0         0.0
3*
17I 0.0         180.0
4*
8I 0.0          90.0
5$
          1          34
6$
          1          58
8U
-.308606714 -.218217900  .218217900 -.617213403 -.577350269 -.218217900
 .218217900  .577350269 -.816496581 -.786795790 -.577350269 -.218217900
 .218217900  .577350269  .786795790 -.975900071 -.951189727 -.786795790
-.577350269 -.218217900  .218217900  .577350269  .786795790  .951189727
-.308606714 -.218217900  .218217900 -.617213403 -.577350269 -.218217900
 .218217900  .577350269 -.816496581 -.786795790 -.577350269 -.218217900
 .218217900  .577350269  .786795790 -.975900071 -.951189727 -.786795790
```

TABLE 8-3 (CONT)

```
-.577350269 -.218217900  .218217900  .577350269  .786795790  .951189727
-.951189727 -.951189727 -.951189727 -.786795790 -.786795790 -.786795790
-.786795790 -.786795790 -.577350269 -.577350269 -.577350269 -.577350269
-.577350269 -.577350269 -.577350269 -.218217900 -.218217900 -.218217900
-.218217900 -.218217900 -.218217900 -.218217900 -.218217900 -.218217900
 .951189727  .951189727  .951189727  .786795790  .786795790  .786795790
 .786795790  .786795790  .577350269  .577350269  .577350269  .577350269
 .577350269  .577350269  .577350269  .218217900  .218217900  .218217900
 .218217900  .218217900  .218217900  .218217900  .218217900  .218217900
0.00         .030246915  .030246915 0.00         .022685185  .022685185
 .022685185  .022685185 0.00         .022685185  .023148144  .022685185
 .022685185  .023148144  .022685185 0.00         .030246915  .022685185
 .022685185  .030246915  .030246915  .022685185  .022685185  .030246915
0.00         .030246915  .030246915 0.00         .022685185  .022685185
 .022685185  .022685185 0.00         .022685185  .023148144  .022685185
 .022685185  .023148144  .022685185 0.00         .030246915  .022685185
 .022685185  .030246915  .030246915  .022685185  .022685185  .030246915
10U
-0.816500000-0.577350000 0.577350000-0.816500000-0.577350000 0.57735000
-0.577350000-0.577350000-0.577350000 0.577350000 0.577350000 0.577350000
 0.000000000 0.250000000 0.250000000 0.000000000 0.250000000 0.250000000
11H
  TOTAL GAMMA ENERGY FLUX
  DOSE RATE - R/HR
12*
13R 1.0
    1.063 -6     1.083 -6     1.116 -6     1.166 -6     1.24  -6     1.332 -6
    1.417 -6     1.504 -6     1.564 -6     1.673 -6     1.803 -6     2.112 -6
    3.516 -6
13*
    0.0          31.913       63.789       95.582       127.257      158.786
    174.477      185.687      236.665      312.743      386.444      457.200
    587.767      791.898      900.510      897.602      783.796      690.107
    575.450      297.701      0.0
14*
   -985.52      -984.962     -983.289     -980.509     -976.623     -971.63
   -968.722     -966.464     -954.366     -930.373     -899.850     -863.018
   -771.587     -528.320     -245.597      103.357      399.833      528.781
    639.506      793.463      843.28
  T
```

9.0 The KAP-VI Code

KAP-VI is a point kernel code designed to calculate the radiation level at detector points located within or outside a complex radiation source geometry describable by a combination of quadratic surfaces. The code evaluates the material thicknesses intercepted along the line-of-sight from the source point to the detector point. These material thicknesses (or path lengths) then are employed in attenuation functions to calculate the flux, dose rate, or heating rate at the detector. The attenuation function for gamma rays employs exponential attenuation with a buildup factor. Three optional neutron attenuation functions are included: (1) a modified Albert-Welton function for calculating fast neutron dose rate using removal cross sections; (2) a bivariant polynomial expression for computing neutron spectra using infinite media moments data; and (3) a monovariant polynomial for computing neutron spectra using infinite media moments data.

The code also handles either cylindrical, spherical, disc, line, or point sources. Different source distributions may be employed for neutrons and gamma rays. A variety of options is available for describing the source distributions. The source spatial distributions are assumed separable along the axis and radius of cylindrical-type source regions and independent of the azimuthal source density variation by specifying input data for discrete point sources.

9.1 Description of the KAP-VI Code Capabilities and Limitations

The point kernel technique is a very powerful tool for performing radiation analysis and shield design. However, the technique must be properly applied and the user must recognize its limitations and capabilities.

In regard to gamma ray calculations, the technique provides an exact solution of the uncollided radiation component. The uncollided component is then multiplied by an energy and material dependent buildup factor to account for scattering along the ray between the source point and detector point. In the KAP-VI code the user may select only one material, e.g., water, buildup factor. There have been some point kernel programs written that utilized formulas for combining buildup factors for various media. However, these formulas rarely applied to general situations. Generally, the use of the buildup factor, which implies an infinite material medium, tends to yield an answer which is higher than the "true" answer.

There are situations in which the code cannot be used to accurately predict the correct answer. One example is a reactor surrounded by water, where the reactor geometry includes a shadow shield. The point kernel technique cannot account for radiation leaving the side of the reactor and scattering in the water around the shadow shield to a detector forward of the shield on the centerline.

The modified Albert-Welton function coded in KAP-VI for calculating neutron dose rates assumes: (1) the spectrum is a fission spectrum, and (2) the use of removal theory is valid. The first assumption causes the least trouble. The second assumption implies that there is sufficient water in the geometry of interest so that application of removal cross sections are valid. The user must judge this for himself.

The use of infinite media moments data for calculating neutron spectra for the geometry of interest assumes that the spectrum is representative of the infinite medium used in the problem, e.g., carbon, water, etc. Furthermore, the code cannot handle the low energy component of the spectrum.

The source distribution in point kernel programs is assumed to be separable in the energy and spatial variables. Again, this is an assumption that the user must evaluate. It is important, however, to employ sufficient source points in each source region to adequately describe the spatial distribution of the source. There is a "happy medium", however, because one can employ too many source prints which does not improve the answer but simply wastes computer time.

Care must be used in calculating heating rate internal to a region using the point kernel technique. KAP-VI employs an "exclusion sphere" option which yields reasonable values.

In view of the above limitations, one might conclude that the technique has little use in radiation analysis. Such is not the case, however, since the technique, when properly applied, is an efficient one for shield design and scoping studies. For example, at the surface of the NERVA Nuclear Subsystem on the centerline the DOT-IIW and point kernel calculated gamma ray dose rates agree to within 20%.

9.2 Input Data Description For the Nuclear Subsystem Source Problems

The input data to each KAP-VI problem or "change case" consist of three different sets of data. The sets are:

(1) Alphanumeric data
(2) Integer or fixed point data
(3) Real or floating point data

These three data sets are required for each KAP-VI problem or "change case" and the user must enter the required data in each data set in the above order.

The general card format consists of two data fields. The first field (card columns 1 - 12) is divided into three subfields for all types of data. The second field (card columns 13 - 72) is divided into subfields according to the type of data. The three subfields of the first field are read in a FORTRAN format (I2, I1, I9) and requires the following information in the corresponding subfield which is common to each type of data set input:

(1) The number of pieces or words of data on the card (right adjusted*).

(2) A control word specifying that this is the last card of a particular type of data (i.e., 0 or blank means that more cards of a particular type follow; 1 means that is the last card of particular type of data).

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*Right adjusted means the last significant digit of the number is at the extreme right of the field.

(3) The address or data location of the first piece or word data on the card. All subseqient data in the fields on the card, up to and including the total pieces of data specified in the first subfield, are stored in sequence from the address of the first piece or word data.

The second field is divided according to the type of data to be read.

The ability to assign the specific address of each data word within any data array allows the user to run stacked problems with minor data changes with a minimum card count.

The KAP-VI user's manual is published as a separate document (WANL-PR(LL)-034, Volume 6). It is assumed that the reader will utilize the KAP-VI user's manual during the discussion of the input data to follow.

Four KAP-VI problems were run for the seminar/workshop. The first two problems pertain to the Nuclear Subsystem sources, whereas the second two problems pertain to the Nozzle Sources. The first problem, which describes the Nuclear Subsystem geometry, was employed to calculate the photon radiation levels due to the sources in the NSS on a 30 foot meridian ring for input to the SCAP code. A complete listing of the input data for this problem is given in Table 9-1. The second problem, which describes the NSS, propellant tank and command module geometry, was employed to calculate the direct photon radiation level due to the NSS sources at the tank top and in the crew compartment. A partial listing of the input data for this problem is presented in Table 9-2. Table 9-2 contains only the first case in the KAP-VI deck, i.e., data for Core Region 1. The remainder of the cards input to the second problem were identified to those given in Table 9-1 and are not included in the listing. The third KAP-VI problem, which describes only the NSS geometry, was used to calculate the photon radiation levels due to the nozzle sources on a 30 foot meridian ring for input to the SCAP code. A complete listing of this problem is given in Table 9-11. The fourth problem, which describes the NSS, propellant tank and command module geometry, was employed to calculate the direct photon radiation in the crew compartment due to the nozzle sources. A complete listing of the input data for this problem is given in Table 9-12.

Before discussing in detail the input data requirements for the KAP-VI seminar problem, it is convenient to now introduce the geometry input to the code. Figure 9-1 shows the Nuclear Subsystem geometry employed in the first KAP-VI seminar problem. Figures 9-1, 9-2 and 9-3 combine to form the entire geometry picture--Nuclear Subsystem, propellant tanks, and crew compartment--described in the second KAP-VI seminar problem.

9.2.1 Data Set 1 - Title Data

Various types of title input data are available for use in KAP-VI. In addresses 1 through 45, the overall problem title is input. In Table 9-1, three cards with addresses 1, 16, and 31 are used to describe the overall problem. In address 46, one enters the appropriate title of the source region of interest. In address 106 is entered a title that is printed preceding the output of results for the summation over subtotals. Gamma ray response function titles are entered beginning with address 136-- all five titles for 5 response functions were entered on the same card. Neutron response function titles are entered starting with address 166. The eight titles for the eight responses were input on two separate cards. The title for the Albert-Welton output data is entered in address 196. Beginning with address 226 titles for the detector points are entered, one per card. On the final detector title card, notice that a one is entered in column 3. This one indicates to the code that this is the last title card (the last piece of alphanumeric input data). If this one is missing from the last card, the program will print out an error message and no calculations are performed.

The title cards listed in Table 9-2 for the propellant tank geometry problems are very similar to those described in Table 9-1 and require no further explanation.

9.2.2 Data Set 2 - Integer Data

The KAP-VI input is all addressable data. Hence, it is necessary to include on each input card, the number of pieces of data entered on that card. The user may input as many as 20 pieces of data (or less) on each card.

Referring to Table 9-1, eleven pieces of integer data are entered on the first card beginning with address 1. These data are as follows:

(1) The number of gamma ray energy groups in the problem which is 13 for the same group structure as in the transport code, DOT-IIW.

(2) The number of neutron groups. This input data quantity is arbitrary--in the seminar problem 27 groups were used. Any number of groups between .01 and 10 Mev can be input.

(3) The total number of materials (or elements) in the problem. This value is 16 for the Nuclear Subsystem geometry problem and 19 for the propellant tank geometry. From Table 9-3, the number of elements can be determined. The elements nitrogen, oxygen, and chlorine were used only in the tank-crew compartment problem.

(4) The number of compositions in the problem. The first 22 compositions in Table 9-3 were used in the Nuclear Subsystem problem. All 29 compositions were used in the propellant tank problem.

(5) The total number of detector points for the problem. This quantity is 21 for the nuclear subsystem problem, and 4 for the propellant tank problem.

(6) The total number of boundary surfaces in the problem. From Figure 9-1, one can note that 22 boundaries describe the Nuclear Subsystem geometry. From Figure 9-3, one notes that 66 boundaries describe the geometry for the second seminar problem.

(7) The total number of regions in the problem. From Figure 9-1, one can note that 25 regions describe the Nuclear Subsystem geometry, whereas 76 regions (Figure 9-3) are needed for the second problem.

(8) The total number of response functions to be applied to the calculated gamma ray flux at each detector point. A total of 5 responses are entered and are described in Section 9.2.3.

(9) The total number of response functions to be applied to the calculated neutron flux at each detector point. A total of 8 responses are entered and are described in Section 9.2.3.

(10) The total number of response functions to be applied to the Albert-Welton neutron results at each detector. Only one response is entered and is described in Section 9.2.3.

(11) The total number of elements for which gamma ray coefficients are to be internally calculated by the program. This quantity is the same as entered at address 3.

Addresses 12 through 18 are not currently used by the program.

Beginning with address 19, fifteen pieces of data are entered as follows:

(1) The buildup factor option. This quantity was input as a one. From Table 2-2 of the KAP-VI user's manual, it is observed that water dose buildup factors were selected for the seminar problem.

(2) Control word for the calculation of gamma ray attenuation function. This quantity is input as a one to request the calculation of gamma ray attenuation functions.

(3) Control word for the Albert-Welton neutron dose rate calculations. This quantity is input as a one to request this calculation.

(4) Control word for monovariant polynomial neutron spectra calculation. This quantity is input as a zero indicating that this calculation is not requested.

(5) Control word for bivariant polynomial neutron spectra calculation. This quantity is input as a one to request this calculation.

(6) Control word for the calculation at a detector in the immediate vicinity of source points. This quantity is input as a zero indicating that this calculation is not requested.

(7) The number of the source zones in which path length calculations for this source region are initiated. Since this source region is Core Region 1, this quantity is entered as a one indicating region 1 as shown in Figure 9-1.

(8) Control word for calculation of all source distribution functions. This quantity is input as a one to request the calculation of a new source distribution.

(9) Control word for the calculation of source radial distribution data. This quantity is input as a three to calculate the radial source distribution as a linear variation of the input data, FSI, between mesh points.

(10) Control word for the calculation of source axial distribution. This quantity is also input as three and is utilized in the same manner as the previous quantity.

(11) Control word for source azimuthal distribution calculations. This quantity is input as a three, i.e., the azimuthal source point spacing based on equal azimuthal intervals.

(12) Control word for source distribution interpolation calculation. Input as a one to request interpolation from input data.

(13) Control word for the summation of the contribution of individual source regions to the detector response at each detector. For the first source problem, this quantity is input as a minus one to initialize the subtotal and total values to 0.0. After the first case, this quantity is set equal to a plus one by the program so that each source region is added to the subtotal and total.

(14) Control word for printing the input data. For the first problem this quantity is input as a two so that both card images and organized input data are printed. (This is the long printout option.)

(15) Control word for printing the output data. This quantity is input as zero so that all output data for each source region is printed out.

At addresses 35, 36 and 37 are entered the degree for the energy range for the first, second, and third sets of coefficients for the bivariant polynomial in the neutron spectra subroutine. This describes the independent variable, E_n. These are input as 3, 2, and 3, respectively and are described in more detail in Section 9.2.3.

At addresses 40, 41, and 42 are entered the degree for the energy range for the first, second and third sets of coefficients for the bivariant polynomial in the neutron spectra subroutine. This describes the independent variable, W_R. These are input as 2, 3, and 3, respectively and are described in more detail in Section 9.2.3.

There are seven pieces of data entered on the card beginning with address 50. The first two pieces of data are the number radial and axial mesh intervals in the source region. Five radial and ten axial intervals are employed in the seminar problem. The next five pieces of data are the number of azimuthal mesh intervals in each of the five defined radial intervals. These values are 3, 4, 5, 6 and 7 for the seminar problem.

The two pieces of data entered in the card with address 75 are the data punched out by the NAGS program. These are the number of radial and axial mesh points values for the source region. (Note: When NAGS punched this card, a one is punched in column 3, indicating the last card of a fixed point (integer) data set. For the first

KAP-VI source region, the one in column 3 must be deleted or the program cannot initiate calculations for the first source region since other integer data must follow.) There were 12 radial and 20 axial data values input from NAGS as shown on the "75" card.

Beginning with address 100, the surface type equation number for each surface in sequence is entered. Table 2-3 of the KAP-VI manual lists the available boundary equation numbers. In Table 9-1, there are a total of 22 values entered for the 22 boundaries given in Figure 9-1; twenty are entered on the first card and two on the second card. For the propellant tank geometry problem, there are 66 numbers entered, one for each of the 66 boundaries shown in Figures 9-1, 9-2 and 9-3.

Beginning in address 200, one enters the total number of boundary surfaces for each zone in sequence. For the Nuclear Subsystem problem (Table 9-1) there are 25 values entered, one for each of the twenty-five regions shown in Figure 9-1. Notice that the values for zones 23, 24 and 25 are preceeded by a minus sign, indicating that this is an outside zone or the last zone to be calculated on the ray trace to the detector. In the propellant tank problem, a total of 76 values are required to describe the boundaries for the 76 zones shown in Figures 9-1, 9-2, and 9-3. Notice in the propellant tank problem that regions 23 and 25 are no longer outside zones, while zone 24 is still an outside zone.

Beginning with address 300, the composition number for each zone is entered. For the Nuclear Subsystem problem, 25 values are entered, one for each zone in the geometry. For the propellant tank problem, 76 values are entered, one for each of the 76 zones in the problem. The various compositions are defined in Table 9-3. Composition 22, called "void", is used to describe a zone containing no material, e.g., zone 23.

Beginning with address 500, one enters the surface number for each surface in each zone. No more than 6 values can be entered on each card. Beginning with address 1100, one enters the zone number entered when crossing the boundary previously specified. To avoid errors, it is best to set up these data arrays as shown in the listing in Table 9-1. Always set-up the "1100" card directly behind the "500" card for each zone. One of each card must be supplied for each zone in the geometry. The number of values input for each zone must correspond to the entries in address 200. For example, the first region required 3 boundaries. Hence, 3 values are entered at 500 and 3 at 1100. Notice that the number of entries shown on each card is 6. The program fills in zeros for the remaining values. The addresses of the second cards must begin with 506 and 1106 as shown on Page 2-23 of the KAP-VI manual--the subsequent addresses increase in units of six.

In the Nuclear Subsystem problem, address 1244 is the last card of integer data. Hence, a one must be punched in column 3 of that card.

9.2.3 Floating Point Data

The data input on the first floating point data card are punched out by the NAGS code for each source region. The two values are the gamma ray and neutron source normalization constants. The value input for gamma rays is 1.0 because the actual sources are punched by NAGS in the 1400 address array. The neutron constant is the total number of fissions in the source region. Page 2-178 of the KAP-VI user's manual describes the equations utilizing the source normalization input parameters.

Addresses 3 through 6 are not used in the seminar problem since the cosine and exponential source options were not employed.

Beginning in address 7, the radial dimensions of the source region mesh lines are entered. (The format is 6E12.5 with a maximum of 5 pieces of floating point data per card.) A total of six radial dimensions are input consistent with the 5 intervals input at address 50 of the fixed point data. The inner (0.0) and outer (29.184) radii of the first source zone are included in this array.

Beginning in address 28, the axial dimensions of the source region mesh lines are entered. A total of eleven axial dimensions are input which is consistent with the 10 intervals input at address 51 of the fixed point data. Notice that the axial dimensions are consistent with that for the DOT-IIW problems and all axial dimensions are negative.

At address 49, the azimuthal dimensions of the source region mesh are input. Since ISTC was input as 3, these values are simply 0 and π. (Page 2-179 of the KAP-VI user's manual describes other azimuthal variable input options.)

Address 70 through 932 are not employed in the seminar problem since these source options were not utilized.

Thirteen values (one for each group) of the gamma ray source strengths are input beginning with address 1400. These data are obtained as punched output directly from the NAGS code in units of Mev/sec.

Neutron "source" by energy group are entered for each of the 27 groups in the problem beginning at address 1430. All values are entered as unity. These quantities permit the user to input group dependent integration factors and must not be interpreted as neutron source spectra.

Arrays 1460 through 1960 are not required for the Nuclear Subsystem KAP-VI problem, since only equation numbers 3 and 6 were employed to describe the geometry. However, these data are needed to describe the input parameters used in Equation 2 in the propellant tank geometry problem. Table 9-4 lists the values required as input for each boundary. The only data required as input are those describing the specific boundary of interest. Therefore, the constant A = 1.0 for boundary 36 is entered at address 1495, etc. These data are all listed in Table 9-2.

Beginning with address 2060, the surface equation coefficient D for each surface in the geometry is entered. There are 22 values for the Nuclear Subsystem problem and 66 values for the propellant tank problem. For equation type 6, D is simply the axial dimension of the boundary line. For equation type 3, D is simply the radial dimension of the boundary line. The values of D for equation type 2 are given in Table 9-4.

Starting with address 2160, the cortesian coordinates of a point internal to each zone are input. These are entered as X, Y and Z with the three values input on each card. There must be as many cards entered as regions in the problem; 25 for Nuclear Subsystem geometry and 76 for the propellant tank geometry. For elliptical or conical regions, it is recommended that these values be carefully checked utilizing the equation and input parameters (Table 9-4) to insure that the specified point is truly in the region of interest. These values are used by the KAP-VI code in computing the ambiguity (+ or -) indices of each surface in relation to the zone. The problem may "run" with wrong indices but the answers are not correct.

At address 2460, the element densities from Table 9-3 are input for composition 1. Data for composition 2 begin at address 2480; for composition 3, at address 2500, etc. (Up to 50 compositions each containing as many as 20 materials are permitted.) A dash in Table 9-3 is entered into the program as 0.0. For composition 22 called "void", 0.0 must be entered for each of the materials in the problem. Notice that the units of the element densities are gm/cc.

At address 3460, 27 values of the representative energy of each neutron group for use in the neutron spectra calculation are entered. Twenty-seven values are consistent with the fixed point data input at address 2. The energy values are included in Table 9-8.

The neutron removal cross sections for use with the Albert-Welton kernel are entered at address 3490 in units of cm^2/gm. One value must be entered for each material in the problem. In the Nuclear Subsystem problem 16 values are needed, whereas in the propellant tank problem 19 values are needed. For convenience these data are listed in Table 9-5. Notice that a value of 0.0 is entered for hydrogen. In the Albert-Welton kernel as shown on Page 2-183 of the KAP-VI user's manual, only the non-hydrogeneous portion of the cross section is input for hydrogen-containing materials. The hydrogen calculation is performed by the equations on Page 2-184 of the KAP-VI manual.

The constants (η) for use in the Albert-Welton kernel are input for each material beginning with address 3510. Only a value of η of the element hydrogen is required in the seminar problem since this is the only "hydrogen-containing" material in the problem. The unit of η is cm^3/gm (ρH20/ρhyd) so that when the path length ρ (cm^2/gm) is multiplied by η, the units are in cm. The Albert-Welton coefficients fit a function versus the linear thickness of hydrogen in centimeters; thus, the units in KAP-VI must also be in centimeters when the function is evaluated.

The neutron removal cross sections for each material for use with the neutron spectra function is input beginning with address 3530. Notice, that except for the first element, hydrogen, these values (see Table 9-5) are the same as those used in the Albert-Welton function.

The neutron removal cross section for the material for which the neutron moments data is input is entered at address 3550. For the seminar problem, this is the removal cross section for carbon.

The constants, α, for evaluating the Albert-Welton function are entered at address 3551. A total of seven values are required as listed in Table 9-6. The lead coefficients, α_1 and α_5, are input such that the dose rate units are in rads (ethylene)/hour.

The source strength to be applied to the Albert-Welton kernel is input at address 3558. For the seminar problem, this value is 1.0 since the number of fissions was entered at address 2. The Albert-Welton function fitted a curve assuming a source of one fission per second.

The representative energy (13 values) of each gamma ray source group is input beginning with address 3560. These energies are used to determine the gamma ray buildup factors and gamma ray absorption coefficients.

The total mean free path of source zone material used in determining the exclusion sphere volume for source points adjacent to detector points is input as 0.0 at address 4310 since this option is not used in the seminar problems.

The limit (or maximum range) of mean free paths of gamma ray depth penetration for evaluating buildup factors is input at address 4311 as 20.0. This is an important input quantity. If the total mean free paths along a source-detector ray is calculated to be 35.0, for example, the code will set this equal to 20.0 for evaluating the buildup factor only. Hence, a maximum buildup factor would be reached. The user must decide the validity of these results.

The surface equation - path length calculation error used in determining if a surface is crossed is input at address 4312 as 1×10^{-6}.

The surface equation - path length calculation step quantity used in providing a means for the calculation to cross a boundary is input at address 4313 as 1×10^{-3}.

The neutron energy breakpoints for the application of the bivariant polynomial neutron spectrum data are input beginning with address 4314. These values are 10.0 (Mev), 1.0, 0.1 and 0.01, since the bivariant polynomial was fit over three energy ranges as shown in Table 9-7.

The first set of coefficients for the first energy set are input beginning at address 4620; the second set at 4645, and the third set at 4670. These are entered first on the mass thickness variable and then on energy for each set. Recall that integer data were input at address 35 describing the degree of the equation in energy. These were input as 3, 2, and 3. From Table 9-7, one can note that this is one less than the number of k entries in each table. A similar match-up of the independent variable, i, with integer data entered at address 40, 41 and 42 can be made.

Twenty-seven values (one for each neutron group) are entered beginning with address 4720. These values allow the program to extrapolate the carbon neutron spectra moments data beyond 120 gm/cm^2. These data, along with the energy value, are given in Table 9-8.

The group-dependent gamma ray response functions employed in the seminar problem are tabulated in Table 9-9. Five different sets (13 values per set) are entered starting at addresses 4750, 4780, 4810, 4840, and 4870. The units for the gamma ray data calculated by the code before multiplication by the response functions are Mev/cm^2-sec.

The group-dependent response functions for the neutron spectra data employed in the seminar problem are tabulated in Table 9-10. Eight different sets (27 values per set) are entered starting at addresses 5050, 5080, 5110, 5140, 5170, 5200, 5230, and 5260.

The units for the neutron spectra data calculated by the code before multiplication by the response functions are: $fissions/cm^2$-sec-Mev.

At least one value must be input for the Albert-Welton response at address 5350. This was input as 1.0 so that the units of the function would be rads (ethylene)/hour.

The coordinates for the first detector point are entered in terms of R, Z, and θ beginning with address 5360. Data for the second detector point are entered at 5363; each detector point address is sequenced by three until data for all detector points have been input.

Beginning with address 5513, the atomic number is entered of each element for which gamma ray absorption coefficients are to be calculated by the program.

In Table 9-1 and 9-2 all the data cards from address 5533 to 5806 were punched by the NAGS code and input directly into the KAP-VI deck.

The values of the radial coordinates of the source distribution data are input beginning with address 5533. There are twelve values which agrees with the input at address 75.

The values of the axial coordinates of the source distribution data are input beginning with address 5584. There are 19 values which agrees with the input at address 76.

The radial gamma ray source distribution data and the radial neutron source begin with addresses 5635 and 5737, respectively. Again there are 12 values in each set. The axial gamma ray and neutron source distribution data begin with addresses 5686 and 5788, respectively.

The next case in the KAP-VI problems provides the input data needed for the second source region - Core Region 2. The first card in the second case is the title card punched by the NAGS code. The second card is a "dummy" title with a one in column to indicate the last of the alphanumeric input data. (The second card is not punched by NAGS.) The next piece of data is input at address 25 to indicate the source region number, i.e., 2 for the second core region. The next card has a one input at address 31 so that the code will sum the contribution of this region into the previous subtotal. At address 50, the number of radial, axial, and azimuthal source intervals in the second source region are input. (The cards with addresses 25, 32, and 50 were not punched by NAGS.) The last fixed point data card (address 75) is punched by NAGS, which gives the number of radial and axial points in the source distribution data. Notice the one punched in column three to indicate the end of the fixed point input data.

The radial and axial dimensions of the source region are input by the user at addresses 7 and 28, respectively. The remainder of the input data is punched by the codes and input directly to the KAP-VI deck.

Data for the succeeding core regions is very similar to that for core region 2. The only exception is at address 31 for core region 5. For this case, a two is input, so that an intermediate total (which includes the 5 core regions) is printed out.

A few changes must be made in the first non-core source region, i.e., Region No. 6, the Filler Strip. First of all, no neutron calculation is requested by inputting zeros for addresses 21, 22, and 23. (There is no neutron source in any of the non-core regions.) Second, the summation control at address 31 is set equal to one so that the data for each region is added to the subtotal. For the last input case, this control is set equal to 3, so that the grand total over all source regions is printed out.

9.2.4 Problem Setup Description

Page 2-42 of the KAP-VI user's manual describes in detail the tape assignments for the KAP-VI code. Input, output, and punched card discs were used in the seminar problem.

9.3 Input Data Description for the Nozzle Source Problems

Two separate problems were run to calculate the crew dose contribution from the nozzle sources. The first problem calculates the photon flux on a 30 foot meridian ring centered about the geometric center of the nozzle sources. The output from this KAP-VI problem is input directly into the SCAP code which determines the scattered contribution to the dose rate. The second KAP-VI problem calculates the direct dose at the crew compartment due to the nozzle sources. This second problem is required because of the geometric relationship between the nozzle and Nuclear Subsystem--the meridian ring data would not yield the correct direct dose contribution.

A listing of both KAP-VI problems are given in Tables 9-11 and 9-12. In order to run these problems, the KAP-VI geometry had to be changed so that the nozzle sources were not located in an outside KAP-VI zone. In the Nuclear Subsystem geometry problem used to calculate the meridian ring data, two additional zones and two additional boundaries were needed. As shown in Figure 9-4, zones 26 and 27 were added as outside zones. Zones 23 and 24 are no longer outside zones, but contain no material, i.e., they were assigned composition 22, "void". Boundaries 23 and 24 were added. As shown in Figure 9-5, only one additional zone (zone 77) and one additional boundary (boundary 67) were added for the propellant tank geometry problem for calculating the direct dose contribution. Zone 24 is not an outside zone, but contains composition 22, "void".

The source data for the nozzle was obtained from the March, 1970 Common Radiation Analysis Model (RN-S-0551, published by Aerojet Nuclear Systems Company). The nozzle source was represented in the KAP-VI code by 40 annular source regions. One source point was located between the R and Z coordinates given in Table 9-13. Ten azimuthal source points are located in each source "ring". Table 9-13 gives the lower (Z_l) and upper (Z_u) axial coordinates of each source region. The inner (R_i) and outer (R_o) radial coordinates are also presented with respect to the average ($\bar{R}$) radial location given in the CRAM. These radial coordinates require some explanation as follows. Given the values of $\bar{R}$ from the CRAM, the quantity ΔR was computed:

$$\Delta R = \frac{\text{Volume}}{2 \pi \bar{R} \Delta Z}$$

Then, $R_i = \bar{R} - \frac{1}{2}\Delta R$ and $R_o = \bar{R} + \frac{1}{2}\Delta R$.

The energy distribution of each nozzle source region was obtained directly from Pages 64 through 68 of the CRAM. The data are identical to those given in the KAP-VI listing in Tables 9-11 and 9-12.

9.3.1 Meridian Ring Analysis

Table 9-11 is a listing of the input data to KAP-VI for calculating the photon radiation levels on the meridian ring for input to the SCAP problem.

The title cards with addresses 1, 16, and 46 were changed from the previous problems to provide meaningful title data. Each succeeding case in the deck employed a different title, i.e., Source 2, Source 3, etc., up to, Source 40. All neutron response titles were deleted.

At fixed point address 2, a zero is input indicating that no neutron energies will be employed in the problem. The number of detector points was input at address 5 as nine. The number of boundaries and zones (addresses 6 and 7) was changed to 24 and 27, respectively (see Figure 9-4). Addresses 9 and 10 were input as zero indicating that no neutron response data would be input. Addresses 21 through 23 are all input as zero so that no neutron calculation is performed. The source zone number, 24, is input at address 25. Ones are input at addresses 27 and 28, indicating a flat radial and axial source distribution. A zero is input at address 30 so that no source interpolation is performed.

The fixed point source data is described in addresses 50, 51, and 52, one radial and one axial interval is employed, with 10 azimuthal intervals in the source ring.

The fixed point geometry input data in arrays 100, 200, 300, 500 and 1100 were modified to correspond to the geometry shown in Figure 9-4.

The gamma ray source normalization is input as 1.0 at floating point address 1, because the other source input has been properly normalized. The radial coordinates of the first source zone (see Table 9-13) are input at address 7, and the axial coordinates (Table 9-13) are input at address 28. The source energy distributions from the CRAM are input at address 1400. The point-in-region data are input at addresses 2235 and 2238 for the zones 26 and 27.

The two additional boundary coordinates were added on the card beginning with address 2080.

The detector coordinates are input at addresses 5360 through 5384 for the nine detectors.

For each succeeding case, the title card, radial and axial source coordinates, and the source energy distributions are input. The source coordinates are as shown in Table 9-13 and the energy distribution data are as given in the CRAM. For the last case, the data input at address 31 is changed to a 3 so that the total from all source zones is punched out for input to the SCAP problem.

9.3.2 Crew Dose Analysis

The propellant tank geometry KAP-VI problem listing given in Table 9-2 was modified to calculate the direct dose contribution from the nozzle sources at the tank top and in the crew compartment. The actual input data listing is given in Table 9-12. This listing is very similar to that just described in Section 9.3.1 for the meridian ring analysis. The geometry input description was modified per Figure 9-5. The source description is identical to that given in Table 9-11.

a.6

9.4 Output Data Description

The KAP-VI output data is dependent upon the input control words IOUT(1) and IOUT(2) entered at address 32 and 33, respectively. The control word, IOUT(1), controls the printout of the input data. The control word, IOUT(2) controls the print out of the output data and the control word ISUM controls the frequency of the print out of summary results.

9.4.1 Printed Output

The printout of the input data will be described first. If IOUT(1) is set at zero, no input data will be printed, except the program title. This is followed by the output data described in Section 9.4.2.

If the IOUT(1) is set equal to one, the program title is printed, and is followed by a printout of the image of each input data card as used by the computer. Therefore, only columns 1 to 72 are printed. One exception must be noted: If the floating point data, input at address 2060, include the surface equation constant, D, for equation types 1, 2, or 3, the printed value in the card image is D and the computer squares D, D^2, for subsequent use in geometry calculations.

If IOUT(1) is set equal to two, the input data is printed out as described for IOUT(1) equal to one plus a set of labeled input data. This labeled printout is self explanatory. Included in the labeled printout are the normalized source distribution data. The labeled printout of the input is followed by the output described in Section 9.4.2.

The output printout is dependent upon the types of material attenuation functions that are requested in a particular problem. The output is also dependent upon the input control word ISUM (address 31), and the input control word IOUT(2) (address 33).

If IOUT(2) is set equal to zero, output is printed for each individual source region in the problem. If IOUT(2) is equal to one, the output for each source region is not printed out. Note: If the problem contains only one source region, IOUT(2) must be set equal to zero in order to obtain any answers.

The control word, (ISUM), controls the subtotal output over various source regions, and the total output over all source regions, as described in the input data instructions.

If a gamma ray calculation is performed, the collided fluxes (contain the buildup factor) multiplied by each set of response functions is printed for the first detector point, for each gamma ray group, as well as the total. This is followed by the uncollided gamma ray data.

If an Albert-Welton calculation is performed, the output multiplied by the response functions is then printed.

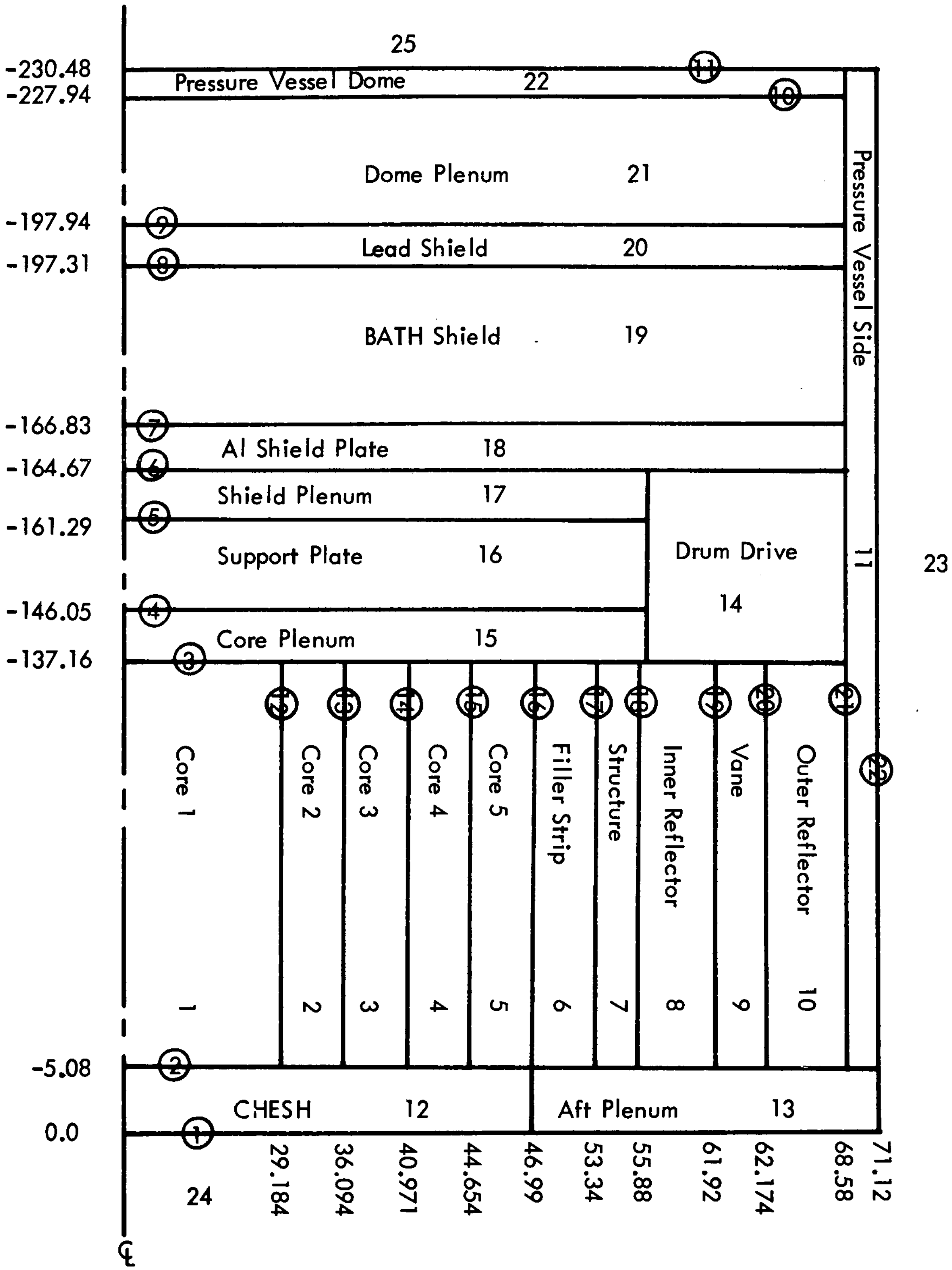
At the end of the output data for each detector point, a comment is printed which tells the program user how many times the value of 20.0 mean free paths, for gamma rays, or 120.0 gm/cm^2, for neutrons, was exceeded for a source region.

9.4.2 Punched Card Output

The punched card output from the KAP-VI code is dependent upon the input control word, ISUM. This punched output is obtained on cards in the FORTRAN format IP6E12.5 when the control word ISUM is set to 3 (i.e., when a total summary printout is obtained). The punched output consists of the gamma ray summary results by group of the first response function in the KAP-VI problem. This optional punched card output is obtained by group and detector point for use in the SCAP code. The first response function should convert the KAP-VI results into units of MeV/cm^2-sec for use in SCAP. The data are obtained as NGG values of group data for the detector 1, NGG values of group data for detector 2, etc., for NDET detectors. The output is then NDET sets of cards with each set containing NGG values.

FIGURE 9-1

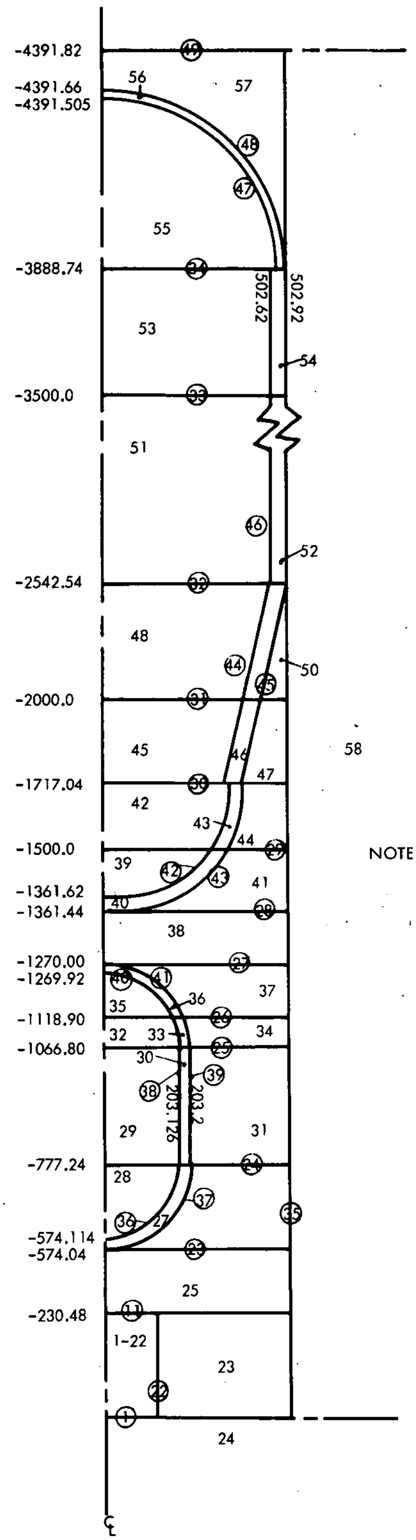
NUCLEAR SUBSYSTEM GEOMETRY MODEL FOR THE KAP-VI POINT KERNEL PROGRAM



NOTE: Drawing not to scale; dimensions in cm. Circled numbers are boundary numbers. Numbers not circled are region numbers.

FIGURE 9-2

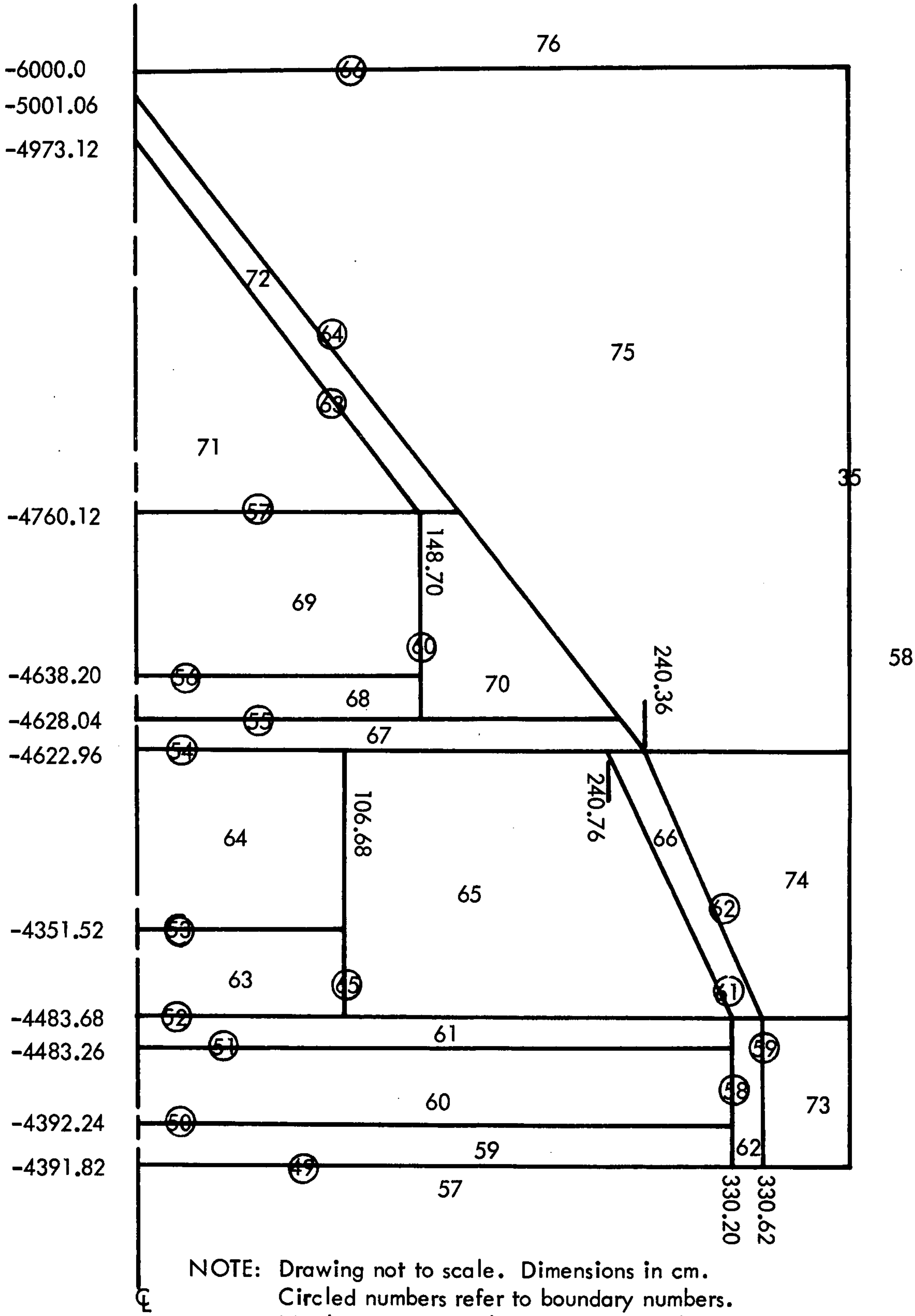
PROPELLANT TANK GEOMETRY MODEL FOR THE KAP-VI PROGRAM



NOTE: Drawing not to scale. Dimensions in cm. Circled numbers are boundary numbers. Numbers not circled are region numbers. See Figure 9-1 for NSS geometry.

FIGURE 9-3

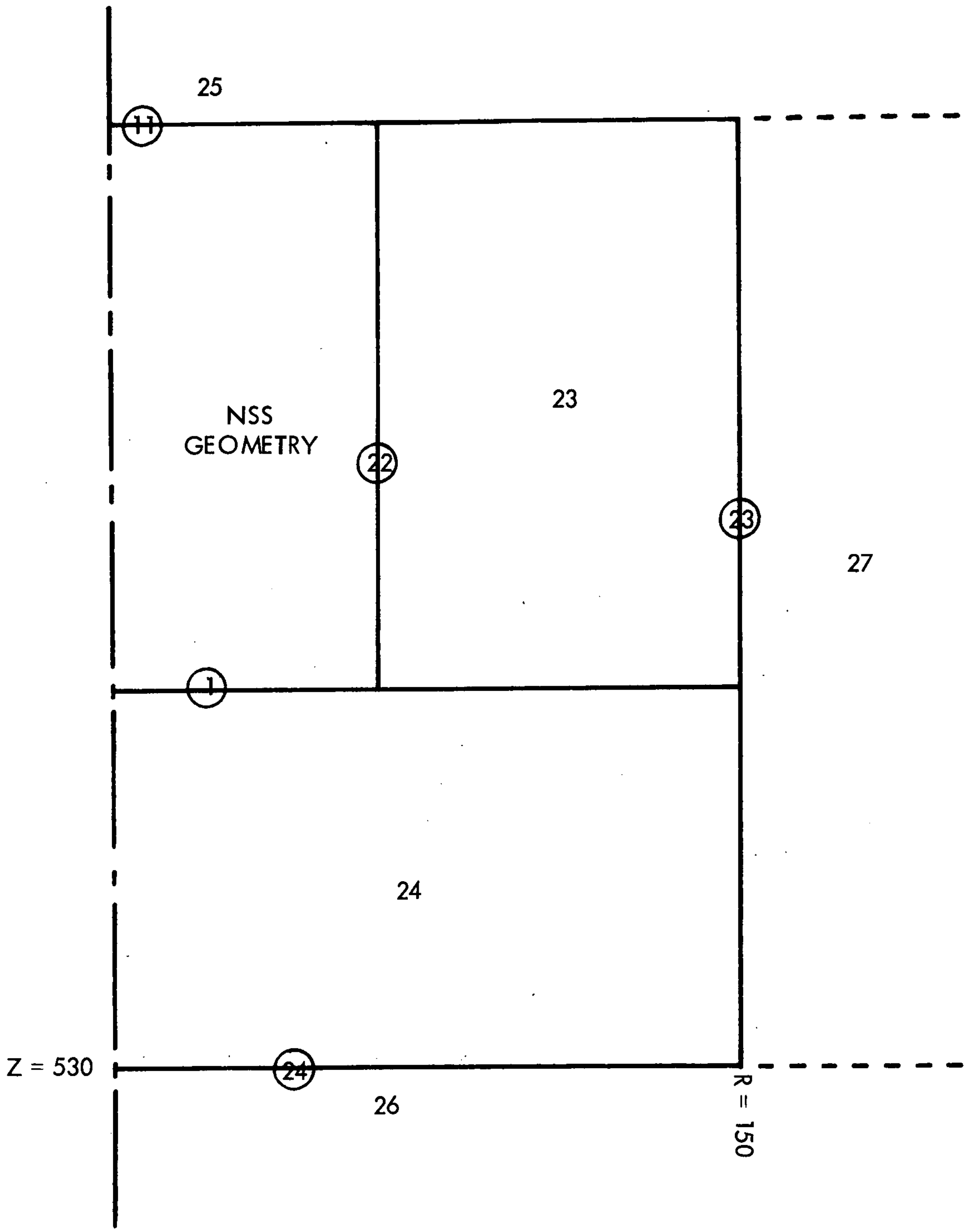
CREW COMPARTMENT GEOMETRY MODEL FOR
THE KAP-VI PROGRAM



NOTE: Drawing not to scale. Dimensions in cm.
Circled numbers refer to boundary numbers.
Numbers not in circles are region numbers.
See Figure 9-2 for propellant tank geometry.

FIGURE 9-4

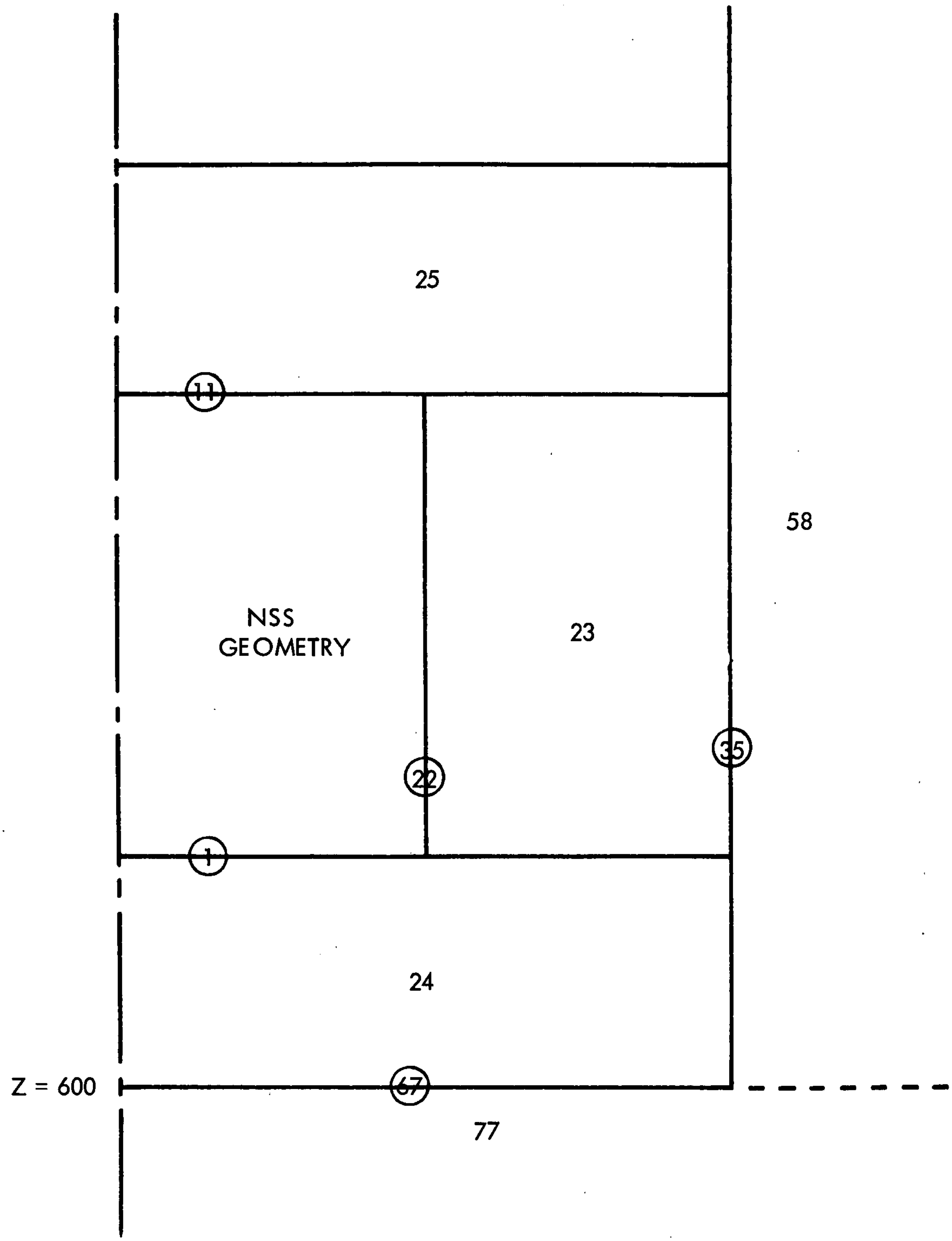
MODIFICATION OF THE KAP-VI NUCLEAR SUBSYSTEM GEOMETRY REQUIRED TO CALCULATE NOZZLE SOURCE CONTRIBUTIONS TO THE MERIDIAN RING



NOTE: DRAWING NOT TO SCALE. CIRCLED NUMBERS ARE BOUNDARY NUMBERS. OTHER NUMBERS ARE ZONE NUMBERS.

FIGURE 9-5

MODIFICATION OF THE KAP-VI PROPELLANT TANK GEOMETRY REQUIRED TO CALCULATE NOZZLE SOURCE CONTRIBUTION OF DIRECT RADIATION TO THE CREW COMPARTMENT



NOTE: DRAWING NOT TO SCALE. CIRCLED NUMBERS ARE BOUNDARY NUMBERS. OTHER NUMBERS ARE ZONE NUMBERS.

TABLE 9-1. INPUT DATA LISTING FOR THE NUCLEAR SUBSYSTEM KAP-VI PROBLEM

```
15     1 KAPVI PROBLEM FOR THE MSFC SEMINAR/WORKSHOP
15    16 SOURCES PUNCHED DIRECTLY FROM NAGS
15    31 MERIDIAN RING ANALYSIS - TASK A
15    46 REGION NO.  1    CORE REGION 1 - SPECTRUM 1 RADIAL
15   106 TOTAL
15   136 MEV/CM2-SEC REM/HR       R/HR          WATT/GM-SST WATT/GM-AL
15   166 DIFF. FLUX  INTG. FLUX 1.0 MEV + E  0.1 MEV + E RAD-ETH/HR
15   181 REM/HR      RAD-TISS/HR MEV/CM2-SEC
15   196 AW RADS/HR
 3   226 30FT 0D
 3   229 30FT 2D
 3   232 30FT 4D
 3   235 30FT 6D
 3   238 30FT 8D
 3   241 30FT 10D
 3   244 30FT 11D
 3   247 30FT 11-43
 3   250 30FT 15D
 3   253 30FT 20D
 3   256 30FT 25D
 3   259 30FT 30D
 3   262 30FT 40D
 3   265 30FT 60D
 3   268 30FT 80D
 3   271 30FT 100D
 3   274 30FT 120D
 3   277 30FT 130D
 3   280 30FT 140D
 3   283 30FT 160D
31   286 30FT 180D
11     1 13 27 16 22 21 22 25  5  8  1 16
15    19  1  1  1  0  1  0  1  1  3  3  3  1 -1  2  0
 3    35  3  2  3
 3    40  2  3  3
 7    50  5 10  3  4  5  6  7
 2    75 12 19
```

TABLE 9-1 (CONT)

20	100	6	6	6	6	6	6	6	6	6	6	6	3	3	3	3	3	3	3	3	3
2	120	3	3																		
20	200	3	4	4	4	4	4	4	4	4	4	4	3	4	4	3	3	3	3	3	3
5	220	3	3	-3	-1	-1															
20	300	1	2	3	4	5	6	7	8	8	9	10	11	12	16	13	14	15	17	18	19
5	320	20	21	22	22	22															
6	500	3	12	2																	
6	1100	15	2	12																	
6	506	3	13	2	12																
6	1106	15	3	12	1																
6	512	3	14	2	13																
6	1112	15	4	12	2																
6	518	3	15	2	14																
6	1118	15	5	12	3																
6	524	3	16	2	15																
6	1124	15	6	12	4																
6	530	3	17	2	16																
6	1130	15	7	13	5																
6	536	3	18	2	17																
6	1136	15	8	13	6																
6	542	3	19	2	18																
6	1142	14	9	13	7																
6	548	3	20	2	19																
6	1148	14	10	13	8																
6	554	3	21	2	20																
6	1154	14	11	13	9																
6	560	11	22	2	21																
6	1160	25	23	13	10																
6	566	2	16	1																	
6	1166	1	13	24																	
6	572	2	22	1	16																
6	1172	6	23	24	12																
6	578	6	21	3	18																
6	1178	18	11	8	15																
6	584	4	18	3																	
6	1184	16	14	1																	
6	590	5	18	4																	
6	1190	17	14	15																	
6	596	6	18	5																	
6	1196	18	14	16																	
6	602	7	21	6																	
6	1202	19	11	17																	
6	608	8	21	7																	
6	1208	20	11	18																	

TABLE 9-1 (CONT)

6	614	9 21 8				
6	1214	21 11 19				
6	620	10 21 9				
6	1220	22 11 20				
6	626	11 21 10				
6	1226	25 11 21				
6	632	11 1 22				
6	1232	25 24 11				
6	638	1				
6	1238	23				
6	644	11				
61	1244	22				
2	1	1.0	1.87907+19			
5	7	0.0	10.0	15.0	20.0	28.0
1	12	29.184				
5	28	-137.16	-135.0	-120.0	-110.0	-90.0
5	33	-80.0	-70.0	-50.0	-30.0	-15.0
1	38	-5.08				
2	49	0.0	3.14159			
50	1400	1.00495+18	5.71576+17	4.31197+18	5.83940+18	1.62077+19
50	1405	3.10225+19	1.87695+19	2.58629+19	3.32099+19	4.40899+19
30	1410	5.74387+19	7.65103+19	3.52042+19		
5	1430	1.0	1.0	1.0	1.0	1.0
5	1435	1.0	1.0	1.0	1.0	1.0
5	1440	1.0	1.0	1.0	1.0	1.0
5	1445	1.0	1.0	1.0	1.0	1.0
5	1450	1.0	1.0	1.0	1.0	1.0
2	1455	1.0	1.0			
5	2060	0.0	-5.08	-137.16	-146.05	-161.29
5	2065	-164.67	-166.83	-197.31	-197.94	-227.94
5	2070	-230.48	29.184	36.094	40.971	44.654
5	2075	46.99	53.34	55.88	61.92	62.174
2	2080	68.58	71.12			
3	2160	1.0	0.0	-100.0		
3	2163	30.0	0.0	-100.0		
3	2166	40.0	0.0	-100.0		
3	2169	43.0	0.0	-100.0		
3	2172	45.0	0.0	-100.0		
3	2175	50.0	0.0	-100.0		
3	2178	54.0	0.0	-100.0		
3	2181	60.0	0.0	-100.0		
3	2184	62.0	0.0	-100.0		
3	2187	65.0	0.0	-100.0		
3	2190	70.0	0.0	-100.0		

TABLE 9-1 (CONT)

3	2193	10.0	0.0	-1.0		
3	2196	50.0	0.0	-1.0		
3	2199	60.0	0.0	-150.0		
3	2202	10.0	0.0	-140.0		
3	2205	10.0	0.0	-150.0		
3	2208	10.0	0.0	-162.0		
3	2211	10.0	0.0	-165.0		
3	2214	10.0	0.0	-180.0		
3	2217	10.0	0.0	-197.5		
3	2220	10.0	0.0	-200.0		
3	2223	10.0	0.0	-229.0		
3	2226	80.0	0.0	-100.0		
3	2229	10.0	0.0	1.0		
3	2232	10.0	0.0	-250.0		
5	2460	.0005729	.889	.00125	.0122	.0199
5	2465	.0446	.003	0.0	1.109	.3099
5	2470	.0228	0.0	0.0	0.0	0.0
1	2475	0.0				
5	2480	.0005729	.892	.00136	.0133	.0216
5	2485	.0485	.003	0.0	1.107	.387
5	2490	.0285	0.0	0.0	0.0	0.0
1	2495	0.0				
5	2500	.0005729	.891	.00131	.0129	.0209
5	2505	.0469	.003	0.0	1.108	.416
5	2510	.0306	0.0	0.0	0.0	0.0
1	2515	0.0				
5	2520	.0005729	.895	.00151	.0148	.0239
5	2525	.0537	.003	0.0	1.103	.40
5	2530	.0294	0.0	0.0	0.0	0.0
1	2535	0.0				
5	2540	.0005729	.906	.00197	.0193	.0314
5	2545	.0703	.003	0.0	1.093	.302
5	2550	.0222	0.0	0.0	0.0	0.0
1	2555	0.0				
5	2560	.0000478	1.112	0.0	0.0	0.0
5	2565	0.0	0.0	0.0	0.0	0.0
5	2570	0.0	0.0	0.0	0.0	0.0
1	2575	0.0				
5	2580	.0005	0.0	0.0	.0297	.0514
5	2585	.1085	0.0	2.617	0.0	0.0
5	2590	0.0	.00423	0.0	0.0	0.0
1	2595	0.0				
5	2600	.00253	0.0	0.0	.0161	.0278
5	2605	.0586	0.0	.224	0.0	0.0

TABLE 9-1 (CONT)

5	2610	0.0	.00229	1.192	0.0	0.0
1	2615	0.0				
5	2620	.00253	0.0	0.0	.0496	.0857
5	2625	.181	0.0	.238	0.0	0.0
5	2630	0.0	.00705	1.209	0.0	0.0
1	2635	0.0				
5	2640	.00265	0.0	0.0	0.0	0.0
5	2645	0.0	0.0	2.249	0.0	0.0
5	2650	0.0	0.0	0.0	0.0	0.0
1	2655	0.0				
5	2660	.0016	.129	.00757	.0743	.1245
5	2665	.276	0.0	0.0	0.0	0.0
5	2670	0.0	.01	0.0	0.0	0.0
1	2675	2.336				
5	2680	.00984	0.0	.0331	.0353	.0581
5	2685	.267	0.0	1.026	0.0	0.0
5	2690	0.0	.00478	0.0	0.0	0.0
1	2695	0.0				
5	2700	.0056	0.0	.0239	.225	.153
5	2705	.839	0.0	0.0	0.0	0.0
5	2710	0.0	.494	0.0	0.0	.00453
1	2715	0.0				
5	2720	.0094	0.0	.0147	.14	.0792
5	2725	.514	0.0	1.41	0.0	0.0
5	2730	0.0	.001	0.0	0.0	0.0
1	2735	0.0				
5	2740	.0084	0.0	.019	.179	.091
5	2745	.657	0.0	0.0	0.0	0.0
5	2750	0.0	0.0	0.0	0.0	0.0
1	2755	0.0				
5	2760	.0097	0.0	.0116	.0539	.052
5	2765	.226	0.0	.165	0.0	0.0
5	2770	0.0	.003	0.0	0.0	0.0
1	2775	0.0				
5	2780	.0011	0.0	0.0	0.0	0.0
5	2785	0.0	0.0	2.27	0.0	0.0
5	2790	0.0	0.0	0.0	0.0	0.0
1	2795	0.0				
5	2800	.0305	.0283	0.0	0.0	0.0
5	2805	0.0	0.0	1.654	0.0	0.0
5	2810	0.0	.789	0.0	0.0	.102
1	2815	0.0				
5	2820	.0011	0.0	0.0	0.0	0.0
5	2825	0.0	0.0	0.0	0.0	0.0

TABLE 9-1 (CONT)

5	2830	0.0		0.0		0.0		9.46		0.0		
1	2835	0.0										
5	2840	.013		0.0		0.0		0.0		0.0		
5	2845	0.0		0.0		0.0		0.0		0.0		
5	2850	0.0		0.0		0.0		0.0		0.0		
1	2855	0.0										
5	2860	0.0		0.0		0.0		0.0		0.0		
5	2865	0.0		0.0		2.735		0.0		0.0		
5	2870	0.0		0.0		0.0		0.0		0.0		
1	2875	0.0										
5	2880	0.0		0.0		0.0		0.0		0.0		
5	2885	0.0		0.0		0.0		0.0		0.0		
5	2890	0.0		0.0		0.0		0.0		0.0		
1	2895	0.0										
5	3460	10.0		9.0		8.0		7.0		6.0		
5	3465	5.0		4.0		3.2		2.5		1.8		
5	3470	1.3		0.95		0.7		0.5		0.4		
5	3475	0.3		0.2		0.1		0.09		0.08		
5	3480	0.07		0.06		0.05		0.04		0.03		
2	3485	0.02		0.01								
5	3490	0.0		.0407		.0197		.0205		.019		
5	3495	.0214		.0111		.0291		.0155		.0091		
5	3500	.0091		.0219		.0717		.0108		.054		
1	3505	.0082										
5	3510	8.937		0.0		0.0		0.0		0.0		
5	3515	0.0		0.0		0.0		0.0		0.0		
5	3520	0.0		0.0		0.0		0.0		0.0		
1	3525	0.0										
5	3530	.559		.0407		.0197		.0205		.019		
5	3535	.0214		.0111		.0291		.0155		.0091		
5	3540	.0091		.0219		.0717		.0108		.054		
1	3545	.0082										
1	3550	.0407										
5	3551	.00016		.29		.778		.58		.000035		
2	3556	10.0		.0956								
1	3558	1.0										
5	3560	8.5		7.25		6.5		5.5		4.5		
5	3565	3.5		2.8		2.5		2.0		1.5		
3	3570	1.0		0.7		0.3						
4	4310	0.0		20.0		1.0	-06	1.0	-03			
4	4314	10.0		1.0		0.1		0.01				
5	4620	0.92058		-2.52297	-2	-1.31193	-4	0.		0.	C	BI
5	4625	-7.35248	-1	3.5555	-3	-2.92013	-5	0.		0.	C	BI
5	4630	-3.33736	-3	-2.40152	-3	1.4441	-5	0.		0.	C	BI

TABLE 9-1 (CONT)

5	4635	-1.4929	-4	1.85572	-4	-9.78989	-7	0.		0.	C BI	
5	4645	2.02125	-1	4.96364	-2	-1.40544	-3	6.0468	-6	0.	C BI	
5	4650	3.27206	-1	-1.29057	-1	2.46613	-3	-1.2386	-5	0.	C BI	
5	4655	-6.57372	-1	8.7204	-2	-1.77728	-3	9.12486	-6	0.	C BI	
5	4670	2.48702		9.47202	-2	-1.65266	-3	6.16259	-6	0.	C BI	
5	4675	-2.80043	+1	-2.76004		1.58054	-2	3.6272	-6	0.	C BI	
5	4680	-1.29332	+2	4.63051	+1	-2.69301	-1	-1.28182	-4	0.	C BI	
5	4685	1.91579	+3	-2.44706	+2	1.589		-3.3677	-4	0.	C BI	
5	4720	.0663		.0663		.0663		.0663		.0663	C BIV	
5	4725	.0663		.0663		.0573		.0508		.049	C BIV	
5	4730	.0517		.0523		.0511		.0520		.0508	C BIV	
5	4735	.051		.050		.0493		.048		.048	C BIV	
5	4740	.0472		.0464		.0417		.0438		.0417	C BIV	
2	4745	.0412		.0464							C BIV	
50	4750	1.		1.		1.		1.		1.	RSPG	11
50	4755	1.		1.		1.		1.		1.	RSPG	12
30	4760	1.		1.		1.					RSPG	13
50	4780	8.5	-07	8.8	-07	9.2	-07	9.5	-07	1.05	-06RSPG	21
50	4785	1.15	-06	1.23	-06	1.27	-06	1.37	-06	1.48	-06RSPG	22
30	4790	1.61	-06	1.67	-06	1.66	-06				RSPG	23
50	4810	1.03	-06	1.05	-06	1.08	-06	1.16	-06	1.21	-06RSPG	31
50	4815	1.31	-06	1.41	-06	1.45	-06	1.56	-06	1.69	-06RSPG	32
30	4820	1.84	-06	1.94	-06	1.89	-06				RSPG	33
50	4840	3.91	-15	3.83	-15	3.77	-15	3.69	-15	3.62	-15RSPG	41
50	4845	3.59	-15	3.62	-15	3.65	-15	3.70	-15	3.88	-15RSPG	42
30	4850	4.22	-15	4.52	-15	5.45	-15				RSPG	43
50	4870	2.94	-15	2.96	-15	2.99	-15	3.05	-15	3.15	-15RSPG	51
50	4875	3.31	-15	3.46	-15	3.58	-15	3.73	-15	3.95	-15RSPG	52
30	4880	4.24	-15	4.54	-15	4.54	-15				RSPG	53
50	5050	2.47		2.47		2.47		2.47		2.47	RSPN	11
50	5055	2.47		2.47		2.47		2.47		2.47	RSPN	12
50	5060	2.47		2.47		2.47		2.47		2.47	RSPN	13
50	5065	2.47		2.47		2.47		2.47		2.47	RSPN	14
50	5070	2.47		2.47		2.47		2.47		2.47	RSPN	15
20	5075	2.47		2.47							RSPN	16
5	5080	1.235		2.47		2.47		2.47		2.47		
5	5085	2.47		2.47		1.482		1.976		1.482		
5	5090	0.9888		0.741		0.494		0.3705		0.247		
5	5095	0.247		0.247		0.13585		0.0247		0.0247		
5	5100	0.0247		0.0247		0.0247		0.0247		0.0247		
2	5105	0.0247		0.01235								
50	5110	1.235		2.47		2.47		2.47		2.47	RSPN	31
50	5115	2.47		2.47		1.482		1.976		1.482	RSPN	32
50	5120	9.88	-01	0.		0.		0.		0.	RSPN	33

TABLE 9-1 (CONT)

50	5125	0.		0.		0.		0.		0.	RSPN	34
50	5130	0.		0.		0.		0.		0.	RSPN	35
20	5135	0.		0.							RSPN	36
50	5140	1.235		2.47		2.47		2.47		2.47	RSPN	41
50	5145	2.47		2.47		1.482		1.976		1.482	RSPN	42
50	5150	9.88	-01	7.41	-01	4.94	-01	2.705	-01	2.47	-01RSPN	43
50	5155	2.47	-01	2.47	-01	1.3565	-01	0.		0.	RSPN	44
50	5160	0.		0.		0.		0.		0.	RSPN	45
20	5165	0.		0.							RSPN	46
50	5170	3.26	-05	6.175	-05	6.546	-05	5.928	-05	5.681	-05RSPN	51
50	5175	5.434	-05	5.434	-05	2.964	-05	3.384	-05	2.238	-05RSPN	52
50	5180	1.284	-05	8.151	-06	4.742	-06	3.088	-06	1.828	-06RSPN	53
50	5185	1.408	-06	1.334	-06	4.495	-07	7.657	-08	6.916	-08RSPN	54
50	5190	6.298	-08	5.558	-08	4.816	-08	4.076	-08	3.211	-08RSPN	55
20	5195	2.297	-08	6.175	-09						RSPN	56
50	5200	1.43	-04	2.72	-04	2.74	-04	2.64	-04	2.64	-04RSPN	61
50	5205	2.62	-04	2.57	-04	1.45	-04	1.785	-04	1.425	-04RSPN	62
50	5210	9.23	-05	6.30	-05	3.44	-05	1.615	-05	1.32	-05RSPN	63
50	5215	9.84	-06	8.6	-06	2.65	-06	4.40	-07	4.13	-07RSPN	64
50	5220	3.39	-07	2.82	-07	2.32	-07	1.78	-07	1.26	-07RSPN	65
20	5225	7.55	-08	1.455	-08						RSPN	66
50	5230	2.20	-05	4.17	-05	4.23	-05	4.00	-05	4.00	-05RSPN	71
50	5235	3.96	-05	3.68	-05	2.04	-05	2.33	-05	1.58	-05RSPN	72
50	5240	9.32	-06	5.72	-06	3.26	-06	2.13	-06	1.26	-06RSPN	73
50	5245	9.70	-07	9.18	-07	3.09	-07	5.27	-08	4.77	-08RSPN	74
50	5250	4.35	-08	3.84	-08	3.32	-08	2.81	-08	2.21	-08RSPN	75
20	5255	1.58	-08	4.25	-09						RSPN	76
5	5260	12.35		22.23		19.76		17.29		14.82		
5	5265	12.35		9.88		4.7424		4.94		2.6676		
5	5270	1.2844		0.70395		0.3458		0.18525		0.0988		
5	5275	0.0741		0.0494		0.013585		0.00223		0.001976		
5	5280	0.001729		0.001482		0.001235		0.000988		0.000741		
2	5285	0.000494		0.0001235								
1	5350	1.0										
3	5360	0.0		-985.52		0.0						
3	5363	31.913		-984.962		0.0						
3	5366	63.789		-983.289		0.0						
3	5369	95.582		-980.509		0.0						
3	5372	127.257		-976.623		0.0						
3	5375	158.786		-971.63		0.0						
3	5378	174.477		-968.722		0.0						
3	5381	185.687		-966.464		0.0						
3	5384	236.665		-954.366		0.0						
3	5387	312.743		-930.373		0.0						

TABLE 9-1 (CONT)

3	5390	386.444	-899.850	0.0		
3	5393	457.200	-863.018	0.0		
3	5396	587.767	-771.587	0.0		
3	5399	791.898	-528.320	0.0		
3	5402	900.510	-245.597	0.0		
3	5405	897.602	103.357	0.0		
3	5408	783.796	399.833	0.0		
3	5411	690.107	528.781	0.0		
3	5414	575.450	639.506	0.0		
3	5417	297.701	793.463	0.0		
3	5420	0.0	843.28	0.0		
5	5513	1.0	6.0	25.0	24.0	28.0
5	5518	26.0	73.0	13.0	40.0	92.0
5	5523	92.0	22.0	4.0	82.0	5.0
1	5528	74.0				
10	5533	0.00000				
50	5534	1.50000+00	4.50000+00	7.50000+00	1.05000+01	1.35000+01
50	5539	1.65000+01	1.95000+01	2.30000+01	2.60000+01	2.80920+01
10	5544	2.91840+01				
10	5584	-1.37160+02				
50	5585	-1.36580+02	-1.35000+02	-1.32000+02	-1.26000+02	-1.18000+02
50	5590	-1.09000+02	-9.90000+01	-8.90000+01	-7.90000+01	-6.90000+01
50	5595	-5.85000+01	-4.80000+01	-3.80000+01	-2.80000+01	-1.80000+01
20	5600	-1.05000+01	-6.54000+00			
10	5602	-5.08000+00				
10	5635	7.08747-01				
50	5636	7.55681-01	1.13116+00	1.11986+00	1.10293+00	1.08034+00
50	5641	1.05209+00	1.01816+00	9.70565-01	9.24908-01	8.87655-01
10	5646	8.65796-01				
10	5686	6.48149-01				
50	5687	6.30804-01	6.03224-01	6.15478-01	7.11905-01	8.76939-01
50	5692	1.05621+00	1.21500+00	1.32230+00	1.37422+00	1.36872+00
50	5697	1.30411+00	1.17644+00	1.00216+00	7.84299-01	5.32611-01
20	5702	3.30922-01	2.22529-01			
10	5704	1.83784-01				
10	5737	7.14134-01				
50	5738	7.60472-01	1.13118+00	1.11989+00	1.10297+00	1.08040+00
50	5743	1.05216+00	1.01823+00	9.70559-01	9.24778-01	8.87238-01
10	5748	8.65171-01				
10	5788	6.61872-01				
50	5789	6.41622-01	6.08913-01	6.17561-01	7.12046-01	8.76652-01
50	5794	1.05595+00	1.21473+00	1.32202+00	1.37391+00	1.36841+00
50	5799	1.30380+00	1.17614+00	1.00190+00	7.84066-01	5.32337-01
20	5804	3.30556-01	2.22241-01			

TABLE 9-1 (CONT)

```
 11    5806  1.83598-01
 15      46 REGION NO.  2   CORE REGION 2 - SPECTRUM 2 RADIAL
151      16
  1      25  2
  1      32  1
  4      50  2 10  8  9
 21      75  5 19
  2       1 1.0          9.97291+18
  3       7 29.184       33.0         36.094
  5      28 -137.16      -135.0       -120.0       -110.0       -90.0
  5      33 -80.0        -70.0        -50.0        -30.0        -15.0
  1      38 -5.08
 50    1400  4.64455+17  2.76816+17  1.91859+18  2.84624+18  8.12460+18
 50    1405  1.58800+19  9.68540+18  1.33893+19  1.72080+19  2.30841+19
 30    1410  3.02001+19  4.04433+19  1.86237+19
 10    5533  2.91840+01
 30    5534  3.05920+01  3.30000+01  3.50470+01
 10    5537  3.60940+01
 10    5584 -1.37160+02
 50    5585 -1.36580+02 -1.35000+02 -1.32000+02 -1.26000+02 -1.18000+02
 50    5590 -1.09000+02 -9.90000+01 -8.90000+01 -7.90000+01 -6.90000+01
 50    5595 -5.85000+01 -4.80000+01 -3.80000+01 -2.80000+01 -1.80000+01
 20    5600 -1.05000+01 -6.54000+00
 10    5602 -5.08000+00
 10    5635  1.07449+00
 30    5636  1.04221+00  9.92587-01  9.57115-01
 10    5639  9.42543-01
 10    5686  6.45886-01
 50    5687  6.25830-01  5.93425-01  6.05849-01  7.06189-01  8.75094-01
 50    5692  1.05564+00  1.21528+00  1.32324+00  1.37561+00  1.37043+00
 50    5697  1.30588+00  1.17834+00  1.00409+00  7.86014-01  5.33705-01
 20    5702  3.31216-01  2.22335-01
 10    5704  1.84480-01
 10    5737  1.07461+00
 30    5738  1.04216+00  9.92524-01  9.57232-01
 10    5741  9.42884-01
 10    5788  6.55703-01
 50    5789  6.33030-01  5.96452-01  6.06516-01  7.05965-01  8.74876-01
 50    5794  1.05553+00  1.21520+00  1.32314+00  1.37551+00  1.37031+00
 50    5799  1.30577+00  1.17822+00  1.00399+00  7.85916-01  5.33543-01
 20    5804  3.30916-01  2.22092-01
 11    5806  1.84437-01
 15      46 REGION NO.  3   CORE REGION 3 - SPECTRUM 3 RADIAL
151      16
```

TABLE 9-1 (CONT)

```
1      25  3
4      50  2 10   9   9
21     75  4 19
2       1 1.0            8.35432+18
3       7 36.094        38.0          40.971
5      28 -137.16      -135.0        -120.0        -110.0        -90.0
5      33 -80.0        -70.0         -50.0         -30.0         -15.0
1      38 -5.08
50   1400  3.49643+17  2.18666+17  1.45728+18  2.28462+18  6.60038+18
50   1405  1.31119+19  8.02828+18  1.11102+19  1.42912+19  1.92484+19
30   1410  2.52159+19  3.38789+19  1.56032+19
10   5533  3.60940+01
20   5534  3.70470+01  3.94855+01
10   5536  4.09710+01
10   5584 -1.37160+02
50   5585 -1.36580+02 -1.35000+02 -1.32000+02 -1.26000+02 -1.18000+02
50   5590 -1.09000+02 -9.90000+01 -8.90000+01 -7.90000+01 -6.90000+01
50   5595 -5.85000+01 -4.80000+01 -3.80000+01 -2.80000+01 -1.80000+01
20   5600 -1.05000+01 -6.54000+00
10   5602 -5.08000+00
10   5635  1.02030+00
20   5636  1.00690+00  9.95844-01
10   5638  1.00909+00
10   5686  6.27262-01
50   5687  6.07252-01  5.76267-01  5.94120-01  7.01874-01  8.74958-01
50   5692  1.05634+00  1.21675+00  1.32501+00  1.37744+00  1.37226+00
50   5697  1.30759+00  1.17985+00  1.00534+00  7.86828-01  5.33894-01
20   5702  3.31413-01  2.24042-01
10   5704  1.87926-01
10   5737  1.01910+00
20   5738  1.00591+00  9.96442-01
10   5740  1.01189+00
10   5788  6.34944-01
50   5789  6.12520-01  5.77905-01  5.94099-01  7.01512-01  8.74799-01
50   5794  1.05631+00  1.21674+00  1.32500+00  1.37743+00  1.37224+00
50   5799  1.30756+00  1.17981+00  1.00530+00  7.86786-01  5.33775-01
20   5804  3.31155-01  2.23967-01
11   5806  1.88363-01
15     46 REGION NO.  4   CORE REGION 4 - SPECTRUM 4 RADIAL
151    16
1      25  4
4      50  2 10   9   9
21     75  5 19
2       1 1.0            7.40528+18
```

TABLE 9-1 (CONT)

3	7	40.971	42.0	44.654		
5	28	-137.16	-135.0	-120.0	-110.0	-90.0
5	33	-80.0	-70.0	-50.0	-30.0	-15.0
1	38	-5.08				
50	1400	3.28608+17	1.95181+17	1.18993+18	1.95829+18	5.65489+18
50	1405	1.14868+19	7.05726+18	9.75743+18	1.25641+19	1.69687+19
30	1410	2.22172+19	2.99337+19	1.37891+19		
10	5533	4.09710+01				
30	5534	4.14855+01	4.30000+01	4.43270+01		
10	5537	4.46540+01				
10	5584	-1.37160+02				
50	5585	-1.36580+02	-1.35000+02	-1.32000+02	-1.26000+02	-1.18000+02
50	5590	-1.09000+02	-9.90000+01	-8.90000+01	-7.90000+01	-6.90000+01
50	5595	-5.85000+01	-4.80000+01	-3.80000+01	-2.80000+01	-1.80000+01
20	5600	-1.05000+01	-6.54000+00			
10	5602	-5.08000+00				
10	5635	9.40173-01				
30	5636	9.44541-01	9.97677-01	1.08856+00		
10	5639	1.12650+00				
10	5686	5.70236-01				
50	5687	5.55266-01	5.39158-01	5.74067-01	6.95943-01	8.75500-01
50	5692	1.05824+00	1.21951+00	1.32823+00	1.38091+00	1.37565+00
50	5697	1.31074+00	1.18258+00	1.00755+00	7.88310-01	5.34377-01
20	5702	3.31359-01	2.26454-01			
10	5704	1.95127-01				
10	5737	9.33539-01				
30	5738	9.38581-01	9.97322-01	1.09838+00		
10	5741	1.14093+00				
10	5788	5.74707-01				
50	5789	5.57668-01	5.38825-01	5.73144-01	6.95381-01	8.75416-01
50	5794	1.05830+00	1.21962+00	1.32835+00	1.38105+00	1.37577+00
50	5799	1.31084+00	1.18265+00	1.00759+00	7.88317-01	5.34294-01
20	5804	3.31157-01	2.26668-01			
11	5806	1.96660-01				
15	46	REGION NO. 5 CORE REGION 5 - SPECTRUM 5 RADIAL				
151	16					
1	25	5				
1	31	2				
4	50	2 10 10 10				
21	75	5 19				
2	1	1.0	5.53878+18			
3	7	44.654	46.0	46.99		
5	28	-137.16	-135.0	-120.0	-110.0	-90.0
5	33	-80.0	-70.0	-50.0	-30.0	-15.0

TABLE 9-1 (CONT)

```
1        38 -5.08
50     1400  3.46459+17  1.61849+17  8.47381+17  1.42607+18  4.04213+18
50     1405  8.40824+18  5.18184+18  7.13819+18  9.19289+18  1.24274+19
30     1410  1.62499+19  2.18953+19  1.00973+19
10     5533  4.46540+01
30     5534  4.48270+01  4.55000+01  4.64950+01
10     5537  4.69900+01
10     5584 -1.37160+02
50     5585 -1.36580+02 -1.35000+02 -1.32000+02 -1.26000+02 -1.18000+02
50     5590 -1.09000+02 -9.90000+01 -8.90000+01 -7.90000+01 -6.90000+01
50     5595 -5.85000+01 -4.80000+01 -3.80000+01 -2.80000+01 -1.80000+01
20     5600 -1.05000+01 -6.54000+00
10     5602 -5.08000+00
10     5635  8.20137-01
30     5636  8.34498-01  9.11644-01  1.14311+00
10     5639  1.28006+00
10     5686  4.62653-01
50     5687  4.62386-01  4.81125-01  5.45255-01  6.88274-01  8.76883-01
50     5692  1.06126+00  1.22363+00  1.33303+00  1.38610+00  1.38066+00
50     5697  1.31550+00  1.18663+00  1.01080+00  7.90769-01  5.35423-01
20     5702  3.31975-01  2.27998-01
10     5704  2.00773-01
10     5737  7.98782-01
30     5738  8.14593-01  9.00123-01  1.16120+00
10     5741  1.31672+00
10     5788  4.58803-01
50     5789  4.57890-01  4.76724-01  5.42427-01  6.87231-01  8.76933-01
50     5794  1.06148+00  1.22401+00  1.33345+00  1.38657+00  1.38110+00
50     5799  1.31591+00  1.18695+00  1.01104+00  7.90921-01  5.35433-01
20     5804  3.32038-01  2.28631-01
11     5806  2.02880-01
15       46 REGION NO.  6   FILLER STRIP - SPECTRUM 6  RADIAL
151      16
3        21  0  0  0
1        25  6
1        31  1
4        50  2 10 10 10
21       75  5 19
2         1 1.0         0.
3         7 46.99       50.0        53.34
5        28 -137.16     -135.0      -120.0      -110.0      -90.0
5        33 -80.0       -70.0       -50.0       -30.0       -15.0
1        38 -5.08
50     1400  0.00000     0.00000     0.00000     0.00000     6.37833+17
```

TABLE 9-1 (CONT)

50	1405	1.59872+16	0.00000	1.42827+15	0.00000	0.00000
30	1410	5.02533+15	0.00000	0.00000		
10	5533	4.69900+01				
30	5534	4.79950+01	5.00000+01	5.21700+01		
10	5537	5.33400+01				
10	5584	-1.37160+02				
50	5585	-1.36580+02	-1.35000+02	-1.32000+02	-1.26000+02	-1.18000+02
50	5590	-1.09000+02	-9.90000+01	-8.90000+01	-7.90000+01	-6.90000+01
50	5595	-5.85000+01	-4.80000+01	-3.80000+01	-2.80000+01	-1.80000+01
20	5600	-1.05000+01	-6.54000+00			
10	5602	-5.08000+00				
10	5635	1.49556+00				
30	5636	1.29539+00	9.86197-01	7.77880-01		
10	5639	6.90661-01				
10	5686	3.53024-01				
50	5687	3.65718-01	4.32454-01	5.41065-01	7.04675-01	8.88976-01
50	5692	1.06488+00	1.22145+00	1.32857+00	1.38070+00	1.37582+00
50	5697	1.31158+00	1.18436+00	1.01034+00	7.93352-01	5.44820-01
20	5702	3.44849-01	2.33857-01			
11	5704	2.04304-01				
15	46	REGION NO. 7	STRUCTURE - SPECTRUM 7		RADIAL	
151	16					
1	25	7				
3	50	1 10 10				
21	75	3 19				
2	7	53.34	55.86			
5	28	-137.16	-135.0	-120.0	-110.0	-90.0
5	33	-80.0	-70.0	-50.0	-30.0	-15.0
1	38	-5.08				
2	1	1.0	0.00000			
50	1400	3.05351+18	2.66863+17	7.94863+17	4.89895+17	1.24925+18
50	1405	8.05938+17	4.11055+17	5.59399+17	4.10268+17	5.69754+17
30	1410	6.93370+17	2.31176+17	7.54673+16		
10	5533	5.33400+01				
10	5534	5.46100+01				
10	5535	5.58800+01				
10	5584	-1.37160+02				
50	5585	-1.36580+02	-1.35000+02	-1.32000+02	-1.26000+02	-1.18000+02
50	5590	-1.09000+02	-9.90000+01	-8.90000+01	-7.90000+01	-6.90000+01
50	5595	-5.85000+01	-4.80000+01	-3.80000+01	-2.80000+01	-1.80000+01
20	5600	-1.05000+01	-6.54000+00			
10	5602	-5.08000+00				
10	5635	1.01741+00				
10	5636	9.99999-01				

TABLE 9-1 (CONT)

```
 10     5637  1.00504+00
 10     5686  3.27586-01
 50     5687  3.47057-01  4.05868-01  5.07379-01  6.81359-01  8.81333-01
 50     5692  1.06587+00  1.22809+00  1.33774+00  1.39050+00  1.38524+00
 50     5697  1.31971+00  1.19052+00  1.01456+00  7.94678-01  5.40614-01
 20     5702  3.35464-01  2.26820-01
 11     5704  1.96080-01
15        46 REGION NO.  8   BE INNER REFL.-SPECTRUM 8  RADIAL
151       16
 1        25  8
 4        50  2 10 10 10
 21       75  5 19
 3         7 55.88        58.0        61.92
 5        28 -137.16     -135.0      -120.0      -110.0      -90.0
 5        33 -80.0       -70.0       -50.0       -30.0       -15.0
 1        38 -5.08
 2         1 1.0          0.00000
 50     1400  2.50124+18  2.06593+17  1.01396+18  3.38795+17  4.12612+17
 50     1405  4.38479+17  1.25787+17  3.24028+17  9.86995+16  1.70746+17
 30     1410  1.23207+17  1.16944+17  2.99220+16
 10     5533  5.58800+01
 30     5534  5.66900+01  5.87500+01  6.09600+01
 10     5537  6.19200+01
 10     5584 -1.37160+02
 50     5585 -1.36580+02 -1.35000+02 -1.32000+02 -1.26000+02 -1.18000+02
 50     5590 -1.09000+02 -9.90000+01 -8.90000+01 -7.90000+01 -6.90000+01
 50     5595 -5.85000+01 -4.80000+01 -3.80000+01 -2.80000+01 -1.80000+01
 20     5600 -1.05000+01 -6.54000+00
 10     5602 -5.08000+00
 10     5635  1.02524+00
 30     5636  1.04921+00  1.06904+00  8.74746-01
 10     5639  7.16310-01
 10     5686  3.41209-01
 50     5687  3.51320-01  4.08286-01  5.05561-01  6.78430-01  8.80227-01
 50     5692  1.06716+00  1.23097+00  1.34112+00  1.39427+00  1.38875+00
 50     5697  1.32293+00  1.19322+00  1.01644+00  7.95083-01  5.36705-01
 20     5702  3.20652-01  1.95763-01
 11     5704  1.61074-01
15        46 REGION NO. 10   BE OUTER REFL.-SPECTRUM 10 RADIAL
151       16
 1        25 10
 4        50  2 10 11 11
 21       75  6 19
 3         7 62.174       67.0        68.58
```

TABLE 9-1 (CONT)

5	28	-137.16	-135.0	-120.0	-110.0	-90.0
5	33	-80.0	-70.0	-50.0	-30.0	-15.0
1	38	-5.08				
2	1	1.0	0.00000			
50	1400	4.52926+18	3.67563+17	1.39489+18	5.72371+17	4.87691+17
50	1405	4.86259+17	1.47956+17	2.86647+17	1.12989+17	2.26127+17
30	1410	1.10859+17	1.63747+17	4.34616+16		
10	5533	6.21740+01				
40	5534	6.25870+01	6.40000+01	6.60000+01	6.77900+01	
10	5538	6.85800+01				
10	5584	-1.37160+02				
50	5585	-1.36580+02	-1.35000+02	-1.32000+02	-1.26000+02	-1.18000+02
50	5590	-1.09000+02	-9.90000+01	-8.90000+01	-7.90000+01	-6.90000+01
50	5595	-5.85000+01	-4.80000+01	-3.80000+01	-2.80000+01	-1.80000+01
20	5600	-1.05000+01	-6.54000+00			
10	5602	-5.08000+00				
10	5635	1.28931+00				
40	5636	1.31637+00	1.25375+00	9.65687-01	5.86340-01	
10	5640	4.81237-01				
10	5686	4.02594-01				
50	5687	4.06468-01	4.39776-01	5.15662-01	6.77571-01	8.78864-01
50	5692	1.06653+00	1.23090+00	1.34106+00	1.39397+00	1.38837+00
50	5697	1.32254+00	1.19296+00	1.01627+00	7.94802-01	5.33777-01
20	5702	3.10096-01	1.81498-01			
11	5704	1.49385-01				
15	46	REGION NO. 11	PRESS.VESS.SIDE-SPECTRUM 11RADIAL			
151	16					
1	25	11				
4	50	2 6 12 12				
21	75	3 21				
3	7	68.58	70.0	71.12		
5	28	-137.16	-125.0	-115.0	-80.0	-50.0
2	33	-20.0	0.0			
2	1	1.0	0.00000			
50	1400	3.26443+17	3.01302+16	8.70204+16	5.94228+16	2.19242+17
50	1405	1.28834+17	6.35199+16	7.92799+16	4.81660+16	5.36583+16
30	1410	6.69498+16	1.95278+16	8.18399+15		
10	5533	6.85800+01				
10	5534	6.98500+01				
10	5535	7.11200+01				
10	5584	-1.37160+02				
50	5585	-1.36580+02	-1.35000+02	-1.32000+02	-1.26000+02	-1.18000+02
50	5590	-1.09000+02	-9.90000+01	-8.90000+01	-7.90000+01	-6.90000+01
50	5595	-5.85000+01	-4.80000+01	-3.80000+01	-2.80000+01	-1.80000+01

TABLE 9-1 (CONT)

```
 40      5600 -1.05000+01 -6.54000+00 -3.54000+00 -1.00000+00
 10      5604  0.00000
 10      5635  1.47425+00
 10      5636  9.99999-01
 10      5637  8.41624-01
 10      5686  5.62283-01
 50      5687  5.46121-01  5.24044-01  5.59880-01  7.05193-01  9.04462-01
 50      5692  1.09522+00  1.26405+00  1.37661+00  1.43047+00  1.42545+00
 50      5697  1.35736+00  1.22481+00  1.04413+00  8.17485-01  5.52441-01
 40      5702  3.30737-01  2.18860-01  1.73167-01  1.48891-01
 11      5706  1.40296-01
15         46 REGION NO. 12   PRESS.VESS.SIDE-SPECTRUM 11RADIAL
151        16
 1         25 11
 4         50  2  6 12 12
 21        75  3 41
 5         28 -230.48      -220.0      -210.0      -190.0      -170.0
 2         33 -150.0       -137.16
 2          1 1.0           0.00000
 50      1400  3.29826+16  3.06092+15  8.92254+15  6.41678+15  2.31010+16
 50      1405  1.42732+16  7.68342+15  1.16405+16  7.84060+15  9.29386+15
 30      1410  1.21870+16  3.29900+15  1.15283+15
 10      5533  6.85800+01
 10      5534  6.98500+01
 10      5535  7.11200+01
 10      5584 -2.30480+02
 50      5585 -2.29845+02 -2.28575+02 -2.26440+02 -2.23440+02 -2.18940+02
 50      5590 -2.14440+02 -2.11440+02 -2.08440+02 -2.05440+02 -2.02440+02
 50      5595 -1.99440+02 -1.97782+02 -1.97467+02 -1.96655+02 -1.95000+02
 50      5600 -1.93000+02 -1.91000+02 -1.89000+02 -1.87000+02 -1.85000+02
 50      5605 -1.83000+02 -1.81000+02 -1.79000+02 -1.77000+02 -1.75000+02
 50      5610 -1.73000+02 -1.71000+02 -1.69000+02 -1.67415+02 -1.65750+02
 50      5615 -1.62980+02 -1.60145+02 -1.57000+02 -1.53000+02 -1.49000+02
 40      5620 -1.46525+02 -1.45025+02 -1.42000+02 -1.38580+02
 10      5624 -1.37160+02
 10      5635  1.22236+00
 10      5636  9.99999-01
 10      5637  9.14912-01
 10      5686  8.35284-03
 50      5687  8.80308-03  9.77769-03  1.09258-02  1.25433-02  1.41023-02
 50      5692  1.50439-02  1.53750-02  1.54336-02  1.50703-02  1.43267-02
 50      5697  1.39785-02  1.42093-02  1.42829-02  1.40821-02  1.54528-02
 50      5702  1.87854-02  2.33863-02  2.88684-02  3.56969-02  4.42007-02
 50      5707  5.50914-02  6.96347-02  9.08381-02  1.22353-01  1.72021-01
```

TABLE 9-1 (CONT)

```
 50    5712  2.50916-01  3.81376-01  6.18969-01  9.57434-01  1.30972+00
 50    5717  1.73188+00  2.16488+00  2.62038+00  3.09062+00  3.52757+00
 40    5722  3.80766+00  3.95670+00  3.94723+00  3.43621+00
 11    5726  3.21030+00
 15      46 REGION NO. 13   CHESH- SPECTRUM 12        AXIAL
151      16
  1      25 12
  6      50  4  2  3  4  5  6
 21      75 23  4
  5       7 0.0          10.0         20.0         30.0         46.99
  3      28 -5.08        -2.0         0.0
  2       1 1.0          0.00000
 50    1400  5.48429+16  3.36988+16  1.79604+17  2.10439+17  2.52443+17
 50    1405  3.51571+17  1.88572+17  2.20079+17  2.23377+17  1.95471+17
 30    1410  2.31378+17  1.88442+17  6.01784+16
 10    5533  0.00000
 50    5534  1.50000+00  4.50000+00  7.50000+00  1.05000+01  1.35000+01
 50    5539  1.65000+01  1.95000+01  2.30000+01  2.60000+01  2.80920+01
 50    5544  3.05920+01  3.30000+01  3.50470+01  3.70470+01  3.94855+01
 50    5549  4.14855+01  4.30000+01  4.43270+01  4.48270+01  4.55000+01
 10    5554  4.64950+01
 10    5555  4.69900+01
 10    5584 -5.08000+00
 20    5585 -3.54000+00 -1.00000+00
 10    5587  0.00000
 10    5635  2.45176-01
 50    5636  3.62128-01  1.29774+00  1.28507+00  1.26615+00  1.24105+00
 50    5641  1.20979+00  1.17231+00  1.12039+00  1.07101+00  1.03218+00
 50    5646  9.83744-01  9.39781-01  9.05318-01  8.75626-01  8.51056-01
 50    5651  8.43688-01  8.56638-01  8.84614-01  9.03309-01  9.40284-01
 10    5656  1.04834+00
 10    5657  1.09916+00
 10    5686  1.52290+00
 20    5687  1.19198+00  7.04344-01
 11    5689  5.72571-01
 15      46 REGION NO. 14   AFT PLENUM- SPECTRUM 10   RADIAL
151      16
  1      25 13
  4      50  3  2  6  7  7
 21      75 14  4
  4       7 46.99        55.0         65.0         71.12
  3      28 -5.08        -2.0         0.0
  2       1 1.0          0.00000
 50    1400  9.74436+16  4.21849+16  3.27742+16  3.52010+16  3.21002+16
```

TABLE 9-1 (CONT)

50	1405	2.39694+16	1.01898+16	2.07997+16	1.28652+16	1.58285+16
30	1410	1.54300+16	7.36223+15	2.68790+15		
10	5533	4.69900+01				
50	5534	4.79950+01	5.00000+01	5.21700+01	5.46100+01	5.66900+01
50	5539	5.87500+01	6.09600+01	6.20470+01	6.25870+01	6.40000+01
20	5544	6.60000+01	6.77900+01			
10	5546	6.85800+01				
10	5584	-5.08000+00				
20	5585	-3.54000+00	-1.00000+00			
10	5587	0.00000				
10	5635	1.17070+00				
50	5636	1.26608+00	1.37603+00	1.41790+00	1.37531+00	1.26826+00
50	5641	1.09226+00	9.07526-01	8.31791-01	7.76557-01	6.56773-01
20	5646	4.99104-01	3.51528-01			
10	5648	3.03417-01				
10	5686	1.43977+00				
20	5687	1.15124+00	7.67097-01			
11	5689	6.53785-01				
15	46	REGION NO. 15 CORE PLENUM - SPECTRUM 14 AXIAL				
151	16					
7	50	5 2 3 4 5 6 7				
1	25	15				
21	75	27 5				
5	7	0.0	10.0	20.0	30.0	45.0
1	12	55.88				
3	28	-146.05	-144.0	-137.16		
2	1	1.0	0.00000			
50	1400	1.24992+18	3.45952+17	1.49523+18	3.48339+17	3.21712+17
50	1405	3.22915+17	1.11139+17	1.26168+17	1.16779+17	4.47296+17
30	1410	3.48619+17	6.36875+17	6.05190+16		
10	5533	0.00000				
50	5534	1.50000+00	4.50000+00	7.50000+00	1.05000+01	1.35000+01
50	5539	1.65000+01	1.95000+01	2.30000+01	2.60000+01	2.80920+01
50	5544	3.05920+01	3.30000+01	3.50470+01	3.70470+01	3.94855+01
50	5549	4.14855+01	4.30000+01	4.43270+01	4.48270+01	4.55000+01
50	5554	4.64950+01	4.79950+01	5.00000+01	5.21700+01	5.46100+01
10	5559	5.58800+01				
10	5584	-1.46050+02				
30	5585	-1.45025+02	-1.42000+02	-1.38580+02		
10	5588	-1.37160+02				
10	5635	7.69868-01				
50	5636	8.43733-01	1.43465+00	1.42011+00	1.39856+00	1.37004+00
50	5641	1.33478+00	1.29314+00	1.23675+00	1.18415+00	1.14399+00
50	5646	1.09351+00	1.04470+00	1.00279+00	9.62195-01	9.14979-01

TABLE 9-1 (CONT)

```
 50    5651  8.79529-01  8.56023-01  8.37709-01  8.31896-01  8.27471-01
 50    5656  8.23740-01  8.16257-01  8.07982-01  8.06478-01  9.04227-01
 10    5661  1.08686+00
 10    5686  1.23716+00
 30    5687  1.09434+00  9.52403-01  9.98938-01
 11    5690  1.05540+00
 15      46 REGION NO. 16   SUPPORT PLATE - SPECTRUM 15  AXIAL
151      16
  1      25 16
  8      50  6  4  3  4  5  6  7  8
 21      75 27  7
  5       7 0.0         10.0        20.0        30.0        40.0
  2      12 50.0        55.88
  5      28 -161.29     -159.0      -155.0      -150.0      -146.05
  2       1 1.0          0.00000
 50    1400  2.24610+18  2.03081+18  9.55944+17  1.43251+18  9.37516+17
 50    1405  6.83590+17  2.25484+17  4.31403+17  3.25954+17  2.80676+17
 30    1410  2.23335+17  1.50715+17  6.45965+16
 10    5533  0.00000
 50    5534  1.50000+00  4.50000+00  7.50000+00  1.05000+01  1.35000+01
 50    5539  1.65000+01  1.95000+01  2.30000+01  2.60000+01  2.80920+01
 50    5544  3.05920+01  3.30000+01  3.50470+01  3.70470+01  3.94855+01
 50    5549  4.14855+01  4.30000+01  4.43270+01  4.48270+01  4.55000+01
 50    5554  4.64950+01  4.79950+01  5.00000+01  5.21700+01  5.46100+01
 10    5559  5.58800+01
 10    5584 -1.61290+02
 50    5585 -1.60145+02 -1.57000+02 -1.53000+02 -1.49000+02 -1.46525+02
 10    5590 -1.46050+02
 10    5635  8.84701-01
 50    5636  9.61794-01  1.57853+00  1.56226+00  1.53828+00  1.50656+00
 50    5641  1.46705+00  1.42020+00  1.35665+00  1.29701+00  1.25119+00
 50    5646  1.19290+00  1.13468+00  1.08307+00  1.03130+00  9.65747-01
 50    5651  9.11024-01  8.68162-01  8.31219-01  8.17517-01  7.99196-01
 50    5656  7.72709-01  7.34131-01  6.84470-01  6.36969-01  6.03883-01
 10    5661  6.06129-01
 10    5686  6.30493-01
 50    5687  7.00195-01  8.88826-01  1.07887+00  1.17066+00  1.14011+00
 11    5692  1.11326+00
 15      46 REGION NO. 17   SHIELD PLENUM - SPECTRUM 16 AXIAL
151      16
  1      25 17
  6      50  4  2  3  4  5  6
 21      75 27  3
  5       7 0.0         10.0        25.0        40.0        55.88
```

TABLE 9-1 (CONT)

3	28	-166.83	-165.0	-161.29		
2	1	1.0	0.00000			
50	1400	2.94497+17	6.08982+16	6.73089+16	5.92107+16	3.43792+16
50	1405	3.20157+16	1.06123+16	2.20604+16	9.96216+15	1.63419+16
30	1410	9.15853+15	1.45350+16	4.03458+15		
10	5533	0.00000				
50	5534	1.50000+00	4.50000+00	7.50000+00	1.05000+01	1.35000+01
50	5539	1.65000+01	1.95000+01	2.30000+01	2.60000+01	2.80920+01
50	5544	3.05920+01	3.30000+01	3.50470+01	3.70470+01	3.94855+01
50	5549	4.14855+01	4.30000+01	4.43270+01	4.48270+01	4.55000+01
50	5554	4.64950+01	4.79950+01	5.00000+01	5.21700+01	5.46100+01
10	5559	5.58800+01				
10	5584	-1.64670+02				
10	5585	-1.62980+02				
10	5586	-1.61290+02				
10	5635	9.80936-01				
50	5636	1.04713+00	1.57673+00	1.56013+00	1.53527+00	1.50262+00
50	5641	1.46266+00	1.41616+00	1.35236+00	1.29238+00	1.24632+00
50	5646	1.18849+00	1.13049+00	1.07885+00	1.02680+00	9.60232-01
50	5651	9.05316-01	8.64451-01	8.29294-01	8.15742-01	7.98185-01
50	5656	7.71696-01	7.34447-01	6.88691-01	6.46540-01	6.21028-01
10	5661	6.20809-01				
10	5686	7.99025-01				
10	5687	9.99998-01				
11	5688	1.20296+00				
15	46	REGION NO. 18 DRUM DRIVE - SPECTRUM 10RADIAL				
151	16					
1	25	14				
5	50	3 4 9 10 11				
21	75	10 11				
4	7	55.88	60.0	66.0	68.58	
5	28	-164.67	-160.0	-155.0	-140.0	-137.16
2	1	1.0	0.00000			
50	1400	5.32413+17	1.20541+17	1.39202+17	1.14994+17	7.90149+16
50	1405	6.53617+16	2.28719+16	7.20838+16	2.27591+16	3.36796+16
30	1410	1.94807+16	2.31873+16	7.35879+15		
10	5533	5.58800+01				
50	5534	5.66900+01	5.87500+01	6.09600+01	6.20470+01	6.25870+01
30	5539	6.40000+01	6.60000+01	6.77900+01		
10	5542	6.85800+01				
10	5584	-1.64670+02				
50	5585	-1.62980+02	-1.60145+02	-1.57000+02	-1.53000+02	-1.49000+02
40	5590	-1.46525+02	-1.45025+02	-1.42000+02	-1.38580+02	
10	5594	-1.37160+02				

TABLE 9-1 (CONT)

10	5635	1.13747+00				
50	5636	1.18070+00	1.20536+00	1.14843+00	1.10062+00	1.06638+00
30	5641	9.66899-01	8.05651-01	6.33482-01		
10	5644	5.57015-01				
10	5686	3.72073-01				
50	5687	4.71165-01	6.32108-01	7.87466-01	9.62849-01	1.10785+00
40	5692	1.18528+00	1.23122+00	1.32670+00	1.43678+00	
11	5696	1.51844+00				
15	46	REGION NO. 19 SHIELD PLATE - SPECTRUM 17 AXIAL				
151	16					
1	25	18				
9	50	7 2 3 4 5 6 7 8 9				
21	75	35 3				
5	7	0.0	10.0	20.0	30.0	40.0
3	12	50.0	60.0	68.58		
3	28	-166.83	-166.0	-164.67		
2	1	1.0	0.00000			
50	1400	3.73588+16	3.46260+15	1.00716+16	7.15789+15	2.59125+16
50	1405	1.58315+16	8.36486+15	1.17391+16	8.31654+15	1.06072+16
30	1410	1.46385+16	4.05219+15	1.38350+15		
10	5533	0.00000				
50	5534	1.50000+00	4.50000+00	7.50000+00	1.05000+01	1.35000+01
50	5539	1.65000+01	1.95000+01	2.30000+01	2.60000+01	2.80920+01
50	5544	3.05920+01	3.30000+01	3.50470+01	3.70470+01	3.94855+01
50	5549	4.14855+01	4.30000+01	4.43270+01	4.48270+01	4.55000+01
50	5554	4.64950+01	4.79950+01	5.00000+01	5.21700+01	5.46100+01
50	5559	5.66900+01	5.87500+01	6.09600+01	6.20470+01	6.25870+01
30	5564	6.40000+01	6.60000+01	6.77900+01		
10	5567	6.85800+01				
10	5584	-1.66830+02				
10	5585	-1.65750+02				
10	5586	-1.64670+02				
10	5635	1.21677+00				
50	5636	1.29432+00	1.91471+00	1.89443+00	1.86228+00	1.82076+00
50	5641	1.77700+00	1.72167+00	1.64379+00	1.56999+00	1.51506+00
50	5646	1.44700+00	1.37739+00	1.31612+00	1.24911+00	1.15682+00
50	5651	1.08698+00	1.03636+00	9.92868-01	9.77693-01	9.56802-01
50	5656	9.25706-01	8.83285-01	8.27015-01	7.73982-01	7.30659-01
50	5661	6.97753-01	6.69039-01	6.38695-01	6.21630-01	6.09790-01
30	5666	5.71531-01	5.03014-01	4.38843-01		
10	5669	4.06395-01				
10	5686	6.70906-01				
10	5687	9.99999-01				
11	5688	1.16390+00				

TABLE 9-1 (CONT)

```
15        46 REGION NO. 20   BATH SHIELD - SPECTRUM 18  AXIAL
151       16
 1        25 19
 9        50  7  6  3  4  5  6  7  8  9
21        75 35 18
 5         7 0.0          10.0          20.0          30.0          40.0
 3        12 50.0         60.0          68.58
 5        28 -197.31      -195.0        -190.0        -185.0        -180.0
 2        33 -170.0       -166.83
 2         1 1.0           0.00000
50      1400  1.95336+16  2.64695+15  1.89701+17  1.11852+16  3.83122+16
50      1405  3.10240+16  1.24190+16  2.82254+16  1.88157+16  6.30843+16
30      1410  6.91942+16  1.04223+18  5.08330+15
10      5533  0.00000
50      5534  1.50000+00  4.50000+00  7.50000+00  1.05000+01  1.35000+01
50      5539  1.65000+01  1.95000+01  2.30000+01  2.60000+01  2.80920+01
50      5544  3.05920+01  3.30000+01  3.50470+01  3.70470+01  3.94855+01
50      5549  4.14855+01  4.30000+01  4.43270+01  4.48270+01  4.55000+01
50      5554  4.64950+01  4.79950+01  5.00000+01  5.21700+01  5.46100+01
50      5559  5.66900+01  5.87500+01  6.09600+01  6.20470+01  6.25870+01
30      5564  6.40000+01  6.60000+01  6.77900+01
10      5567  6.85300+01
10      5584 -1.97310+02
50      5585 -1.96655+02 -1.95000+02 -1.93000+02 -1.91000+02 -1.89000+02
50      5590 -1.87000+02 -1.85000+02 -1.83000+02 -1.81000+02 -1.79000+02
50      5595 -1.77000+02 -1.75000+02 -1.73000+02 -1.71000+02 -1.69000+02
10      5600 -1.67415+02
10      5601 -1.66830+02
10      5635  2.09352+00
50      5636  2.08593+00  2.02518+00  2.00396+00  1.97248+00  1.93116+00
50      5641  1.88008+00  1.81941+00  1.73671+00  1.65901+00  1.59916+00
50      5646  1.52193+00  1.44336+00  1.37131+00  1.29744+00  1.20601+00
50      5651  1.13254+00  1.07708+00  1.02866+00  1.01019+00  9.85745-01
50      5656  9.50216-01  8.98347-01  8.30632-01  7.65302-01  7.01347-01
50      5661  6.46450-01  5.96296-01  5.45374-01  5.19129-01  5.04606-01
30      5666  4.62741-01  3.89977-01  3.21544-01
10      5669  4.43964-01
10      5686  1.98930-01
50      5687  6.86132-02  5.46549-02  7.12716-02  9.49110-02  1.25984-01
50      5692  1.67053-01  2.21837-01  2.95627-01  3.95951-01  5.33739-01
50      5697  7.25177-01  9.95575-01  1.38836+00  2.00416+00  3.40175+00
10      5702  8.06669+00
11      5703  1.45981+01
15        46 REGION NO. 21   LEAD SHIELD - SPECTRUM 19   AXIAL
```

TABLE 9-1 (CONT)

```
151       16
  1       25 20
  9       50  7  1  3  4  5  6  7  8  9
 21       75 35  4
  5        7 0.0          10.0          20.0          30.0          40.0
  3       12 50.0         60.0          68.58
  2       28 -197.94      -197.31
  2        1 1.0           0.00000
 50     1400  0.00000     1.02956+14   1.10270+13   4.63925+12   3.27504+13
 50     1405  3.89385+13  9.11685+13   2.64036+13   1.96521+13   2.98829+13
 30     1410  4.34156+13  8.53479+13   4.77532+11
 10     5533  0.00000
 50     5534  1.50000+00  4.50000+00   7.50000+00   1.05000+01   1.35000+01
 50     5539  1.65000+01  1.95000+01   2.30000+01   2.60000+01   2.80920+01
 50     5544  3.05920+01  3.30000+01   3.50470+01   3.70470+01   3.94855+01
 50     5549  4.14855+01  4.30000+01   4.43270+01   4.48270+01   4.55000+01
 50     5554  4.64950+01  4.79950+01   5.00000+01   5.21700+01   5.46100+01
 50     5559  5.66900+01  5.87500+01   6.09600+01   6.20470+01   6.25870+01
 30     5564  6.40000+01  6.60000+01   6.77900+01
 10     5567  6.85800+01
 10     5584 -1.97940+02
 20     5585 -1.97782+02 -1.97467+02
 10     5587 -1.97310+02
 10     5635  9.35418-01
 50     5636  1.03356+00  1.81873+00   1.83293+00   1.82192+00   1.80082+00
 50     5641  1.78011+00  1.73395+00   1.67702+00   1.62367+00   1.55147+00
 50     5646  1.43317+00  1.32591+00   1.25219+00   1.19054+00   1.12815+00
 50     5651  1.07730+00  1.03553+00   1.00443+00   9.89333-01   9.76305-01
 50     5656  9.66416-01  9.28842-01   8.79507-01   8.35279-01   7.79759-01
 50     5661  7.39470-01  6.87000-01   6.38169-01   5.94490-01   5.69742-01
 30     5666  5.25188-01  4.54018-01   3.96999-01
 10     5669  3.94477-01
 10     5686  9.96957-01
 20     5687  9.95381-01  1.00462+00
 11     5689  9.94744-01
15        46 REGION NO. 22   DOME PLENUM - SPECTRUM 20   AXIAL
151       16
  1       25 21
  9       50  7  4  3  4  5  6  7  8  9
 21       75 35 11
  5        7 0.0          10.0          20.0          30.0          40.0
  3       12 50.0         60.0          68.58
  5       28 -227.94      -225.0        -215.0        -205.0        -197.94
  2        1 1.0           0.00000
```

TABLE 9-1 (CONT)

50	1400	0.00000	0.00000	0.00000	0.00000	0.00000
50	1405	0.00000	0.00000	1.56384+15	0.00000	0.00000
30	1410	0.00000	0.00000	0.00000		
10	5533	0.00000				
50	5534	1.50000+00	4.50000+00	7.50000+00	1.05000+01	1.35000+01
50	5539	1.65000+01	1.95000+01	2.30000+01	2.60000+01	2.80920+01
50	5544	3.05920+01	3.30000+01	3.50470+01	3.70470+01	3.94855+01
50	5549	4.14855+01	4.30000+01	4.43270+01	4.48270+01	4.55000+01
50	5554	4.64950+01	4.79950+01	5.00000+01	5.21700+01	5.46100+01
50	5559	5.66900+01	5.87500+01	6.09600+01	6.20470+01	6.25870+01
30	5564	6.40000+01	6.60000+01	6.77900+01		
10	5567	6.85800+01				
10	5584	-2.27940+02				
50	5585	-2.26440+02	-2.23440+02	-2.18940+02	-2.14440+02	-2.11440+02
40	5590	-2.08440+02	-2.05440+02	-2.02440+02	-1.99440+02	
10	5594	-1.97940+02				
10	5635	1.09815+00				
50	5636	1.18506+00	1.88035+00	1.86362+00	1.83888+00	1.80631+00
50	5641	1.76617+00	1.71875+00	1.65411+00	1.59327+00	1.54645+00
50	5646	1.48668+00	1.42635+00	1.37226+00	1.31744+00	1.24758+00
50	5651	1.18924+00	1.14333+00	1.10280+00	1.08728+00	1.06617+00
50	5656	1.03472+00	9.86500-01	9.20963-01	8.48341-01	7.64611-01
50	5661	6.91882-01	6.17671-01	5.36331-01	4.95652-01	4.75142-01
30	5666	4.20692-01	3.41416-01	2.65352-01		
10	5669	2.32143-01				
10	5686	4.64973-01				
50	5687	5.86357-01	8.12782-01	1.05313+00	1.20432+00	1.23824+00
40	5692	1.21514+00	1.12825+00	9.74121-01	7.34530-01	
11	5696	5.70251-01				
15	46	REGION NO. 23	PRESS.VESS.DOME - SPEC 21		AXIAL	
151	16					
1	25	22				
1	31	3				
9	50	7 2 3 4 5 6 7 8 9				
21	75	35 4				
5	7	0.0	10.0	20.0	30.0	40.0
3	12	50.0	60.0	68.58		
3	28	-230.48	-229.0	-227.94		
2	1	1.0	0.00000			
50	1400	3.33716+14	3.12627+13	9.25645+13	7.21698+13	2.50396+14
50	1405	1.66459+14	9.99469+13	1.60325+14	1.25143+14	1.32886+14
30	1410	1.59275+14	4.02696+13	1.33544+13		
10	5533	0.00000				
50	5534	1.50000+00	4.50000+00	7.50000+00	1.05000+01	1.35000+01

TABLE 9-1 (CONT)

50	5539	1.65000+01	1.95000+01	2.30000+01	2.60000+01	2.80920+01
50	5544	3.05920+01	3.30000+01	3.50470+01	3.70470+01	3.94855+01
50	5549	4.14855+01	4.30000+01	4.43270+01	4.48270+01	4.55000+01
50	5554	4.64950+01	4.79950+01	5.00000+01	5.21700+01	5.46100+01
50	5559	5.66900+01	5.87500+01	6.09600+01	6.20470+01	6.25870+01
30	5564	6.40000+01	6.60000+01	6.77900+01		
10	5567	6.85800+01				
10	5584	-2.30480+02				
20	5585	-2.29845+02	-2.28575+02			
10	5587	-2.27940+02				
10	5635	1.32561+00				
50	5636	1.37838+00	1.80057+00	1.78899+00	1.75882+00	1.72946+00
50	5641	1.69030+00	1.63044+00	1.53689+00	1.45164+00	1.40257+00
50	5646	1.34859+00	1.29626+00	1.25526+00	1.21146+00	1.15672+00
50	5651	1.11264+00	1.07440+00	1.04613+00	1.03648+00	1.02051+00
50	5656	9.96385-01	9.63596-01	9.17397-01	8.64998-01	8.08355-01
50	5661	7.55150-01	7.01035-01	6.42702-01	6.12704-01	5.99496-01
30	5666	5.65495-01	5.11440-01	4.59622-01		
10	5669	4.16244-01				
10	5686	8.20786-01				
20	5687	9.03871-01	1.09613+00			
11	5689	1.17551+00				

TABLE 9-2. INPUT DATA LISTING FOR THE PROPELLANT TANK GEOMETRY KAP-VI PROBLEM WITH NSS SOURCES

```
5          1 KAPVI PROBLEM FOR THE MSFC SEMINAR/WORKSHOP
15        16 SOURCES PUNCHED DIRECTLY FROM NAGS
15        31  TANK TOP AND CREW DOSE - TASK A
15        46 REGION NO.  1    CORE REGION 1 - SPECTRUM 1 RADIAL
15       106 TOTAL
15       136 MEV/CM2-SEC REM/HR          R/HR          WATT/GM-SST WATT/GM-AL
15       166 DIFF. FLUX  INTG. FLUX 1.0 MEV + E  0.1 MEV + E RAD-ETH/HR
15       181 REM/HR      RAD-TISS/HR MEV/CM2-SEC
15       196 AW RADS/HR
 3       226 TANK TOP
 3       229 TANK TOP
 3       232 CREW R=0
 31      235 CREW R=148
11         1 13 27 19 29  4 66 76  5  8  1 19
15        19  1  1  1  0  1  0  1  1  3  3  3  1 -1  2  0
 3        35  3  2  3
 3        40  2  3  3
 7        50  5 10  3  4  5  6  7
 2        75 12 19
20       100  6  6  6  6  6  6  6  6  6  6  6  3  3  3  3  3  3  3  3  3
20       120  3  3  6  6  6  6  6  6  6  6  6  6  6  6  3  2  2  3  3  2
20       140  2  2  2  2  2  3  2  2  6  6  6  6  6  6  6  6  6  3  3  3
```

(Shown as received by NTIS with X across page)

TABLE 9-2 (CONT)

```
15      1 KAPVI PROBLEM FOR THE MSFC SEMINAR/WORKSHOP
15     16 SOURCES PUNCHED DIRECTLY FROM NAGS
15     31  TANK TOP AND CREW DOSE - TASK A
15     46 REGION NO.  1    CORE REGION 1 - SPECTRUM 1 RADIAL
15    106 TOTAL
15    136 MEV/CM2-SEC REM/HR       R/HR          WATT/GM-SST WATT/GM-AL
15    166 DIFF. FLUX  INTG. FLUX 1.0 MEV + E  0.1 MEV + E RAD-ETH/HR
15    181 REM/HR      RAD-TISS/HR MEV/CM2-SEC
15    196 AW RADS/HR
 3    226 TANK TOP
 3    229 TANK TOP
 3    232 CREW R=0
31    235 CREW R=148
11      1 13 27 19 29  4 66 76  5  8  1 19
15     19  1  1  1  0  1  0  1  1  3  3  3  1 -1  2  0
 3     35  3  2  3
 3     40  2  3  3
 7     50  5 10  3  4  5  6  7
 2     75 12 19
20    100  6  6  6  6  6  6  6  6  6  6  6  3  3  3  3  3  3  3  3  3
20    120  3  3  6  6  6  6  6  6  6  6  6  6  6  6  3  2  2  3  3  2
20    140  2  2  2  2  2  3  2  2  6  6  6  6  6  6  6  6  6  3  3  3
 6    160  2  2  2  2  3  6
20    200  3  4  4  4  4  4  4  4  4  4  4  3  4  4  3  3  3  3  3  3
20    220  3  3  4 -1  3  4  3  2  3  4  4  3  4  4  2  3  4  3  2  3
20    240  4  3  4  4  3  4  4  3  4  3  3  4  3  4  2  3  3 -3  3  3
16    260  3  4  3  3  4  4  3  3  3  4  2  3  4  4  4 -1
20    300  1  2  3  4  5  6  7  8  8  9 10 11 12 16 13 14 15 17 18 19
20    320 20 21 22 22 22 22 23 24 24 23 22 24 23 22 25 23 22 22 25 23
```

TABLE 9-2 (CONT)

20	340	22	25	23	22	25	23	22	25	23	22	25	23	25	23	25	23	22	22	23	22
16	360	23	23	22	26	22	23	28	29	27	29	27	29	22	22	22	22				
6	500	3	12	2																	
6	1100	15	2	12																	
6	506	3	13	2	12																
6	1106	15	3	12	1																
6	512	3	14	2	13																
6	1112	15	4	12	2																
6	518	3	15	2	14																
6	1118	15	5	12	3																
6	524	3	16	2	15																
6	1124	15	6	12	4																
6	530	3	17	2	16																
6	1130	15	7	13	5																
6	536	3	18	2	17																
6	1136	15	8	13	6																
6	542	3	19	2	18																
6	1142	14	9	13	7																
6	548	3	20	2	19																
6	1148	14	10	13	8																
6	554	3	21	2	20																
6	1154	14	11	13	9																
6	560	11	22	2	21																
6	1160	25	23	13	10																
6	566	2	16	1																	
6	1166	1	13	24																	
6	572	2	22	1	16																
6	1172	6	23	24	12																
6	578	6	21	3	18																
6	1178	18	11	8	15																
6	584	4	18	3																	
6	1184	16	14	1																	
6	590	5	18	4																	
6	1190	17	14	15																	
6	596	6	18	5																	
6	1196	18	14	16																	
6	602	7	21	6																	
6	1202	19	11	17																	
6	608	8	21	7																	
6	1208	20	11	18																	
6	614	9	21	8																	
6	1214	21	11	19																	
6	620	10	21	9																	
6	1220	22	11	20																	

TABLE 9-2 (CONT)

6	626	11	21	10	
6	1226	25	11	21	
4	632	11	35	1	22
4	1232	25	58	24	11
1	638	1			
1	1238	12			
3	644	23	35	11	
3	1244	26	58	23	
4	650	24	35	23	37
4	1250	31	58	25	27
3	656	24	37	36	
3	1256	30	26	28	
2	662	24	36		
2	1262	29	27		
3	668	25	38	24	
3	1268	32	30	28	
4	674	25	39	24	38
4	1274	33	31	27	29
4	680	25	35	24	39
4	1280	34	58	26	30
3	686	26	40	25	
3	1286	35	33	29	
4	692	26	41	25	40
4	1292	36	34	30	32
4	698	26	35	25	41
4	1298	37	58	31	33
2	704	40	26		
2	1304	36	32		
3	710	41	26	40	
3	1310	37	33	35	
4	716	27	35	26	41
4	1316	38	58	34	36
3	722	28	35	27	
3	1322	41	58	37	
2	728	29	42		
2	1328	42	40		
3	734	29	43	42	
3	1334	43	41	39	
4	740	29	35	28	43
4	1340	44	58	38	40
3	746	30	42	29	
3	1346	45	43	39	
4	752	30	43	29	42
4	1352	46	44	40	42

TABLE 9-2 (CONT)

4	758	30	35	29	43
4	1358	47	58	41	43
3	764	31	44	30	
3	1364	48	46	42	
4	770	31	45	30	44
4	1370	49	47	43	45
4	776	31	35	30	45
4	1376	50	58	44	46
3	782	32	44	31	
3	1382	51	49	45	
4	788	32	45	31	44
4	1388	52	50	46	48
3	794	35	31	45	
3	1394	58	47	49	
3	800	33	46	32	
3	1400	53	52	48	
4	806	33	35	32	46
4	1406	54	58	49	51
3	812	34	46	33	
3	1412	55	54	51	
4	818	34	35	33	46
4	1418	56	58	49	53
2	824	47	34		
2	1424	56	53		
3	830	48	34	47	
3	1430	57	54	55	
3	836	49	35	48	
3	1436	59	58	56	
3	842	66	35	1	
3	1442	76	23	24	
3	848	50	58	49	
3	1448	60	62	57	
3	854	51	58	50	
3	1454	61	62	59	
3	860	52	58	51	
3	1460	63	62	60	
4	866	52	59	49	58
4	1466	66	73	57	60
3	872	53	65	52	
3	1472	64	65	61	
3	878	54	65	53	
3	1478	67	65	63	
4	884	54	61	52	65
4	1484	67	66	61	63

TABLE 9-2 (CONT)

```
4        890 54 62 52 61
4       1490 67 74 62 65
3        896 55 64 54
3       1496 68 75 64
3        902 56 60 55
3       1502 69 70 67
3        908 57 60 56
3       1508 71 70 68
4        914 57 64 55 60
4       1514 72 75 67 68
2        920 63 57
2       1520 72 69
3        926 64 57 63
3       1526 75 70 71
4        932 52 35 49 59
4       1532 74 58 57 62
4        938 54 35 52 62
4       1538 75 58 73 66
4        944 66 35 54 64
4       1544 76 58 74 67
1        950 66
11      1550 75
2          1 1.0            1.87907+19
5          7 0.0           10.0            15.0            20.0            28.0
1         12 29.184
5         28 -137.16       -135.0          -120.0          -110.0          -90.0
5         33 -80.0         -70.0           -50.0           -30.0           -15.0
1         38 -5.08
2         49 0.0           3.14159
50      1400  1.00495+18   5.71576+17   4.31197+18   5.83940+18   1.62077+19
50      1405  3.10225+19   1.87695+19   2.58629+19   3.32099+19   4.40899+19
30      1410  5.74387+19   7.65103+19   3.52042+19
5       1430    1.0           1.0           1.0           1.0           1.0
5       1435    1.0           1.0           1.0           1.0           1.0
5       1440    1.0           1.0           1.0           1.0           1.0
5       1445    1.0           1.0           1.0           1.0           1.0
5       1450    1.0           1.0           1.0           1.0           1.0
2       1455    1.0           1.0
2       1495 1.0           1.0
5       1499 1.0           1.0           1.0           1.0           1.0
1       1504 1.0
2       1506 1.0           1.0
4       1520 1.0           1.0           1.0           1.0
2       1595 1.0           1.0
```

TABLE 9-2 (CONT)

5	1599	1.0	1.0	1.0	1.0	1.0
1	1604	1.0				
2	1606	1.0	1.0			
4	1620	1.0	1.0	1.0	1.0	
2	1695	1.0	1.0			
5	1699	1.0	1.0	1.0	1.0	-.18547
1	1704	-.1850				
2	1706	1.0	1.0			
4	1720	2.6424	2.64676	0.4874	.4887	
2	1795	0.0	0.0			
5	1799	0.0	0.0	0.0	0.0	0.0
1	1804	0.0				
2	1806	0.0	0.0			
4	1820	0.0	0.0	0.0	0.0	
2	1895	0.0	0.0			
5	1899	0.0	0.0	0.0	0.0	0.0
1	1904	0.0				
2	1906	0.0	0.0			
4	1920	0.0	0.0	0.0	0.0	
2	1995	-777.24	-777.24			
5	1999	-1066.80	-1066.80	-1717.04	-1717.04	-1717.04
1	2004	-1717.04				
2	2006	-3888.74	-3888.74			
4	2020	-4483.68	-4483.68	-4760.12	-4760.12	
5	2060	0.0	-5.08	-137.16	-146.05	-161.29
5	2065	-164.67	-166.83	-197.31	-197.94	-227.94
5	2070	-230.48	29.184	36.094	40.971	44.654
5	2075	46.99	53.34	55.88	61.92	62.174
5	2080	68.58	71.12	-574.04	-777.24	-1066.80
5	2085	-1118.90	-1270.0	-1361.44	-1500.0	-1717.04
5	2090	-2000.0	-2542.54	-3500.0	-3888.74	502.92
5	2095	203.126	203.2	203.126	203.2	203.12
5	2100	203.2	355.42	355.60	355.30	355.60
5	2105	502.62	457.045	457.2	-4391.82	-4392.24
5	2110	-4483.26	-4483.68	-4531.52	-4622.96	-4628.04
5	2115	-4638.20	-4760.12	330.20	330.62	148.70
5	2120	330.2	330.62	148.70	168.43	106.68
1	2125	-6000.0				
3	2160	1.0	0.0	-100.0		
3	2163	30.0	0.0	-100.0		
3	2166	40.0	0.0	-100.0		
3	2169	43.0	0.0	-100.0		
3	2172	45.0	0.0	-100.0		
3	2175	50.0	0.0	-100.0		

TABLE 9-2 (CONT)

3	2178	54.0	0.0	-100.0
3	2181	60.0	0.0	-100.0
3	2184	62.0	0.0	-100.0
3	2187	65.0	0.0	-100.0
3	2190	70.0	0.0	-100.0
3	2193	10.0	0.0	-1.0
3	2196	50.0	0.0	-1.0
3	2199	60.0	0.0	-150.0
3	2202	10.0	0.0	-140.0
3	2205	10.0	0.0	-150.0
3	2208	10.0	0.0	-162.0
3	2211	10.0	0.0	-165.0
3	2214	10.0	0.0	-180.0
3	2217	10.0	0.0	-197.5
3	2220	10.0	0.0	-200.0
3	2223	10.0	0.0	-229.0
3	2226	80.0	0.0	-100.0
3	2229	10.0	0.0	1.0
3	2232	100.0	0.0	-300.0
3	2235	300.0	0.0	-700.0
3	2238	0.1	0.0	-574.08
3	2241	1.0	0.0	-600.0
3	2244	1.0	0.0	-800.0
3	2247	203.15	0.0	-800.0
3	2250	300.0	0.0	-800.0
3	2253	0.1	0.0	-1100.0
3	2256	203.15	0.0	-1066.9
3	2259	300.0	0.0	-1100.0
3	2262	0.1	0.0	-1120.0
3	2265	0.1	0.0	-1269.95
3	2268	300.0	0.0	-1200.0
3	2271	0.1	0.0	-1300.0
3	2274	0.1	0.0	-1362.0
3	2277	0.1	0.0	-1361.5
3	2280	360.0	0.0	-1400.0
3	2283	0.1	0.0	-1600.0
3	2286	355.5	0.0	-1717.0
3	2289	360.0	0.0	-1600.0
3	2292	0.1	0.0	-1800.0
3	2295	355.5	0.0	-1717.1
3	2298	500.0	0.0	-1800.0
3	2301	0.1	0.0	-2200.0
3	2304	502.8	0.0	-2542.5
3	2307	502.8	0.0	-2001.0

TABLE 9-2 (CONT)

3	2310	0.1	0.0	-3000.0		
3	2313	502.8	0.0	-3000.0		
3	2316	0.1	0.0	-3800.0		
3	2319	502.8	0.0	-3800.0		
3	2322	0.1	0.0	-4000.0		
3	2325	0.1	0.0	-4391.6		
3	2328	0.1	0.0	-4391.7		
3	2331	510.0	0.0	-2000.0		
3	2334	0.1	0.0	-4392.0		
3	2337	0.1	0.0	-4400.0		
3	2340	0.1	0.0	-4483.5		
3	2343	330.3	0.0	-4400.0		
3	2346	0.1	0.0	-4500.0		
3	2349	0.1	0.0	-4600.0		
3	2352	110.0	0.0	-4500.0		
3	2355	330.3	0.0	-4484.0		
3	2358	0.1	0.0	-4625.0		
3	2361	0.1	0.0	-4630.0		
3	2364	0.1	0.0	-4700.0		
3	2367	149.0	0.0	-4629.0		
3	2370	0.1	0.0	-4800.0		
3	2373	0.1	0.0	-4975.0		
3	2376	331.0	0.0	-4400.0		
3	2379	331.0	0.0	-4500.0		
3	2382	241.0	0.0	-4700.0		
3	2385	1.0	0.0	-6001.0		
5	2460	.0005729	.889	.00125	.0122	.0199
5	2465	.0446	.003	0.0	1.109	.3099
5	2470	.0228	0.0	0.0	0.0	0.0
4	2475	0.0	0.0	0.0	0.0	
5	2480	.0005729	.892	.00136	.0133	.0216
5	2485	.0485	.003	0.0	1.107	.387
5	2490	.0285	0.0	0.0	0.0	0.0
4	2495	0.0	0.0	0.0	0.0	
5	2500	.0005729	.891	.00131	.0129	.0209
5	2505	.0469	.003	0.0	1.108	.416
5	2510	.0306	0.0	0.0	0.0	0.0
4	2515	0.0	0.0	0.0	0.0	
5	2520	.0005729	.895	.00151	.0148	.0239
5	2525	.0537	.003	0.0	1.103	.40
5	2530	.0294	0.0	0.0	0.0	0.0
4	2535	0.0	0.0	0.0	0.0	
5	2540	.0005729	.906	.00197	.0193	.0314
5	2545	.0703	.003	0.0	1.093	.302

TABLE 9-2 (CONT)

5	2550	.0222	0.0	0.0	0.0	0.0
4	2555	0.0	0.0	0.0	0.0	
5	2560	.0000478	1.112	0.0	0.0	0.0
5	2565	0.0	0.0	0.0	0.0	0.0
5	2570	0.0	0.0	0.0	0.0	0.0
4	2575	0.0	0.0	0.0	0.0	
5	2580	.0005	0.0	0.0	.0297	.0514
5	2585	.1085	0.0	2.617	0.0	0.0
5	2590	0.0	.00423	0.0	0.0	0.0
4	2595	0.0	0.0	0.0	0.0	
5	2600	.00253	0.0	0.0	.0161	.0278
5	2605	.0586	0.0	.224	0.0	0.0
5	2610	0.0	.00229	1.192	0.0	0.0
4	2615	0.0	0.0	0.0	0.0	
5	2620	.00253	0.0	0.0	.0496	.0857
5	2625	.181	0.0	.238	0.0	0.0
5	2630	0.0	.00705	1.209	0.0	0.0
4	2635	0.0	0.0	0.0	0.0	
5	2640	.00265	0.0	0.0	0.0	0.0
5	2645	0.0	0.0	2.249	0.0	0.0
5	2650	0.0	0.0	0.0	0.0	0.0
4	2655	0.0	0.0	0.0	0.0	
5	2660	.0016	.129	.00757	.0743	.1245
5	2665	.276	0.0	0.0	0.0	0.0
5	2670	0.0	.01	0.0	0.0	0.0
4	2675	2.336	0.0	0.0	0.0	
5	2680	.00984	0.0	.0331	.0353	.0581
5	2685	.267	0.0	1.026	0.0	0.0
5	2690	0.0	.00478	0.0	0.0	0.0
4	2695	0.0	0.0	0.0	0.0	
5	2700	.0056	0.0	.0239	.225	.153
5	2705	.839	0.0	0.0	0.0	0.0
5	2710	0.0	.494	0.0	0.0	.00453
4	2715	0.0	0.0	0.0	0.0	
5	2720	.0094	0.0	.0147	.14	.0792
5	2725	.514	0.0	1.41	0.0	0.0
5	2730	0.0	.001	0.0	0.0	0.0
4	2735	0.0	0.0	0.0	0.0	
5	2740	.0084	0.0	.019	.179	.091
5	2745	.657	0.0	0.0	0.0	0.0
5	2750	0.0	0.0	0.0	0.0	0.0
4	2755	0.0	0.0	0.0	0.0	
5	2760	.0097	0.0	.0116	.0539	.052
5	2765	.226	0.0	.165	0.0	0.0

TABLE 9-2 (CONT)

5	2770	0.0	.003	0.0	0.0	0.0
4	2775	0.0	0.0	0.0	0.0	
5	2780	.0011	0.0	0.0	0.0	0.0
5	2785	0.0	0.0	2.27	0.0	0.0
5	2790	0.0	0.0	0.0	0.0	0.0
4	2795	0.0	0.0	0.0	0.0	
5	2800	.0305	.0283	0.0	0.0	0.0
5	2805	0.0	0.0	1.654	0.0	0.0
5	2810	0.0	.789	0.0	0.0	.102
4	2815	0.0	0.0	0.0	0.0	
5	2820	.0011	0.0	0.0	0.0	0.0
5	2825	0.0	0.0	0.0	0.0	0.0
5	2830	0.0	0.0	0.0	9.46	0.0
4	2835	0.0	0.0	0.0	0.0	
5	2840	.013	0.0	0.0	0.0	0.0
5	2845	0.0	0.0	0.0	0.0	0.0
5	2850	0.0	0.0	0.0	0.0	0.0
4	2855	0.0	0.0	0.0	0.0	
5	2860	0.0	0.0	0.0	0.0	0.0
5	2865	0.0	0.0	2.735	0.0	0.0
5	2870	0.0	0.0	0.0	0.0	0.0
4	2875	0.0	0.0	0.0	0.0	
5	2880	0.0	0.0	0.0	0.0	0.0
5	2885	0.0	0.0	0.0	0.0	0.0
5	2890	0.0	0.0	0.0	0.0	0.0
4	2895	0.0	0.0	0.0	0.0	
5	2900	0.0	0.0	0.0	0.0	0.0
5	2905	0.0	0.0	2.7	0.0	0.0
5	2910	0.0	0.0	0.0	0.0	0.0
4	2915	0.0	0.0	0.0	0.0	
5	2920	.07	0.0	0.0	0.0	0.0
5	2925	0.0	0.0	0.0	0.0	0.0
5	2930	0.0	0.0	0.0	0.0	0.0
4	2935	0.0	0.0	0.0	0.0	
5	2940	.00088	0.0	0.0	0.0	0.0
5	2945	0.0	0.0	0.0	0.0	0.0
5	2950	0.0	0.0	0.0	0.0	0.0
4	2955	0.0	0.0	0.0	0.0	
5	2960	.0101	.0484	0.0	0.0	0.0
5	2965	0.0	0.0	0.0	0.0	0.0
5	2970	0.0	0.0	0.0	0.0	0.0
4	2975	0.0	.0323	.1425	.0582	
5	2980	.000011	0.0	0.0	0.0	0.0
5	2985	0.0	0.0	0.0	0.0	0.0

TABLE 9-2 (CONT)

5	2990	0.0		0.0		0.0		0.0		0.0		
4	2995	0.0		.00028		.000404		0.0				
5	3000	.0387		.3642		0.0		0.0		0.0		
5	3005	0.0		0.0		0.0		0.0		0.0		
5	3010	0.0		0.0		0.0		0.0		0.0		
4	3015	0.0		.0283		.1294		0.0				
5	3020	0.0		0.0		0.0		0.0		0.0		
5	3025	0.0		0.0		.072		0.0		0.0		
5	3030	0.0		0.0		0.0		0.0		0.0		
4	3035	0.0		0.0		0.0		0.0				
5	3460	10.0		9.0		8.0		7.0		6.0		
5	3465	5.0		4.0		3.2		2.5		1.8		
5	3470	1.3		0.95		0.7		0.5		0.4		
5	3475	0.3		0.2		0.1		0.09		0.08		
5	3480	0.07		0.06		0.05		0.04		0.03		
2	3485	0.02		0.01								
5	3490	0.0		.0407		.0197		.0205		.019		
5	3495	.0214		.0111		.0291		.0155		.0091		
5	3500	.0091		.0219		.0717		.0108		.054		
4	3505	.0082		.0448		.0405		.0252				
5	3510	8.937		0.0		0.0		0.0		0.0		
5	3515	0.0		0.0		0.0		0.0		0.0		
5	3520	0.0		0.0		0.0		0.0		0.0		
1	3525	0.0										
5	3530	.559		.0407		.0197		.0205		.019		
5	3535	.0214		.0111		.0291		.0155		.0091		
5	3540	.0091		.0219		.0717		.0108		.054		
4	3545	.0082		.0448		.0405		.0252				
1	3550	.0407										
5	3551	.00016		.29		.778		.58		.000035		
2	3556	10.0		.0958								
1	3558	1.0										
5	3560	8.5		7.25		6.5		5.5		4.5		
5	3565	3.5		2.8		2.5		2.0		1.5		
3	3570	1.0		0.7		0.3						
4	4310	0.0		20.0		1.0	-06	1.0	-03			
4	4314	10.0		1.0		0.1		0.01				
5	4620	0.92058		-2.52297	-2	-1.31193	-4	0.		0.	C	BI
5	4625	-7.35248	-1	3.5555	-3	-2.92013	-5	0.		0.	C	BI
5	4630	-3.33736	-3	-2.40152	-3	1.4441	-5	0.		0.	C	BI
5	4635	-1.4929	-4	1.85572	-4	-9.78989	-7	0.		0.	C	BI
5	4645	2.02125	-1	4.96364	-2	-1.40544	-3	6.0468	-6	0.	C	BI
5	4650	3.27206	-1	-1.29057	-1	2.46613	-3	-1.2386	-5	0.	C	BI
5	4655	-6.57372	-1	8.7204	-2	-1.77728	-3	9.12486	-6	0.	C	BI

TABLE 9-2 (CONT)

5	4670	2.48702		9.47202	-2	-1.65266	-3	6.16259	-6	0.	C	BI
5	4675	-2.80043	+1	-2.76004		1.58054	-2	3.6272	-6	0.	C	BI
5	4680	-1.29332	+2	4.63051	+1	-2.69301	-1	-1.28182	-4	0.	C	BI
5	4685	1.91579	+3	-2.44706	+2	1.589		-3.3677	-4	0.	C	BI
5	4720	.0663		.0663		.0663		.0663		.0663	C	BIV
5	4725	.0663		.0663		.0573		.0508		.049	C	BIV
5	4730	.0517		.0523		.0511		.0520		.0508	C	BIV
5	4735	.051		.050		.0493		.048		.048	C	BIV
5	4740	.0472		.0464		.0417		.0438		.0417	C	BIV
2	4745	.0412		.0464							C	BIV
50	4750	1.		1.		1.		1.		1.	RSPG	11
50	4755	1.		1.		1.		1.		1.	RSPG	12
30	4760	1.		1.		1.					RSPG	13
50	4780	8.5	-07	8.8	-07	9.2	-07	9.5	-07	1.05	-06RSPG	21
50	4785	1.15	-06	1.23	-06	1.27	-06	1.37	-06	1.48	-06RSPG	22
30	4790	1.61	-06	1.67	-06	1.66	-06				RSPG	23
50	4810	1.03	-06	1.05	-06	1.08	-06	1.16	-06	1.21	-06RSPG	31
50	4815	1.31	-06	1.41	-06	1.45	-06	1.56	-06	1.69	-06RSPG	32
30	4820	1.84	-06	1.94	-06	1.89	-06				RSPG	33
50	4840	3.91	-15	3.83	-15	3.77	-15	3.69	-15	3.62	-15RSPG	41
50	4845	3.59	-15	3.62	-15	3.65	-15	3.70	-15	3.88	-15RSPG	42
30	4850	4.22	-15	4.52	-15	5.45	-15				RSPG	43
50	4870	2.94	-15	2.96	-15	2.99	-15	3.05	-15	3.15	-15RSPG	51
50	4875	3.31	-15	3.46	-15	3.58	-15	3.73	-15	3.95	-15RSPG	52
30	4880	4.24	-15	4.54	-15	4.54	-15				RSPG	53
50	5050	2.47		2.47		2.47		2.47		2.47	RSPN	11
50	5055	2.47		2.47		2.47		2.47		2.47	RSPN	12
50	5060	2.47		2.47		2.47		2.47		2.47	RSPN	13
50	5065	2.47		2.47		2.47		2.47		2.47	RSPN	14
50	5070	2.47		2.47		2.47		2.47		2.47	RSPN	15
20	5075	2.47		2.47							RSPN	16
5	5080	1.235		2.47		2.47		2.47		2.47		
5	5085	2.47		2.47		1.482		1.976		1.482		
5	5090	0.9880		0.741		0.494		0.3705		0.247		
5	5095	0.247		0.247		0.13585		0.0247		0.0247		
5	5100	0.0247		0.0247		0.0247		0.0247		0.0247		
2	5105	0.0247		0.01235								
50	5110	1.235		2.47		2.47		2.47		2.47	RSPN	31
50	5115	2.47		2.47		1.482		1.976		1.482	RSPN	32
50	5120	9.88	-01	0.		0.		0.		0.	RSPN	33
50	5125	0.		0.		0.		0.		0.	RSPN	34
50	5130	0.		0.		0.		0.		0.	RSPN	35
20	5135	0.		0.							RSPN	36
50	5140	1.235		2.47		2.47		2.47		2.47	RSPN	41

TABLE 9-2 (CONT)

50	5145	2.47		2.47		1.482		1.976		1.482	RSPN	42
50	5150	9.88	-01	7.41	-01	4.94	-01	2.705	-01	2.47	-01RSPN	43
50	5155	2.47	-01	2.47	-01	1.3585	-01	0.		0.	RSPN	44
50	5160	0.		0.		0.		0.		0.	RSPN	45
20	5165	0.		0.							RSPN	46
50	5170	3.26	-05	6.175	-05	6.546	-05	5.928	-05	5.681	-05RSPN	51
50	5175	5.434	-05	5.434	-05	2.964	-05	3.384	-05	2.238	-05RSPN	52
50	5180	1.284	-05	8.151	-06	4.742	-06	3.088	-06	1.828	-06RSPN	53
50	5185	1.408	-06	1.334	-06	4.495	-07	7.657	-08	6.916	-08RSPN	54
50	5190	6.298	-08	5.558	-08	4.816	-08	4.076	-08	3.211	-08RSPN	55
20	5195	2.297	-08	6.175	-09						RSPN	56
50	5200	1.43	-04	2.72	-04	2.74	-04	2.64	-04	2.64	-04RSPN	61
50	5205	2.62	-04	2.57	-04	1.45	-04	1.785	-04	1.425	-04RSPN	62
50	5210	9.23	-05	6.30	-05	3.44	-05	1.615	-05	1.32	-05RSPN	63
50	5215	9.84	-06	8.6	-06	2.65	-06	4.40	-07	4.13	-07RSPN	64
50	5220	3.39	-07	2.82	-07	2.32	-07	1.78	-07	1.26	-07RSPN	65
20	5225	7.55	-08	1.455	-08						RSPN	66
50	5230	2.20	-05	4.17	-05	4.23	-05	4.00	-05	4.00	-05RSPN	71
50	5235	3.96	-05	3.68	-05	2.04	-05	2.33	-05	1.58	-05RSPN	72
50	5240	9.32	-06	5.72	-06	3.26	-06	2.13	-06	1.26	-06RSPN	73
50	5245	9.70	-07	9.18	-07	3.09	-07	5.27	-08	4.77	-08RSPN	74
50	5250	4.35	-08	3.84	-08	3.32	-08	2.81	-08	2.21	-08RSPN	75
20	5255	1.58	-08	4.25	-09						RSPN	76
5	5260	12.35		22.23		19.76		17.29		14.82		
5	5265	12.35		9.88		4.7424		4.94		2.6676		
5	5270	1.2844		0.70395		0.3458		0.18525		0.0988		
5	5275	0.0741		0.0494		0.013585		0.00223		0.001976		
5	5280	0.001729		0.001482		0.001235		0.000988		0.000741		
2	5285	0.000494		0.0001235								
1	5350	1.0										
3	5360	0.0		-4391.7		0.0						
3	5363	300.0		-4391.7		0.0						
3	5366	0.0		-4639.0		0.0						
3	5369	148.0		-4639.0		0.0						
5	5513	1.0		6.0		25.0		24.0		28.0		
5	5518	26.0		73.0		13.0		40.0		92.0		
5	5523	92.0		22.0		4.0		82.0		5.0		
4	5528	74.0		7.0		8.0		17.0				
10	5533	0.00000										
50	5534	1.50000+00		4.50000+00		7.50000+00		1.05000+01		1.35000+01		
50	5539	1.65000+01		1.95000+01		2.30000+01		2.60000+01		2.80920+01		
10	5544	2.91840+01										
10	5584	-1.37160+02										
50	5585	-1.36580+02		-1.35000+02		-1.32000+02		-1.26000+02		-1.18000+02		

TABLE 9-2 (CONT)

50	5590	-1.09000+02	-9.90000+01	-8.90000+01	-7.90000+01	-6.90000+01
50	5595	-5.85000+01	-4.80000+01	-3.80000+01	-2.80000+01	-1.80000+01
20	5600	-1.05000+01	-6.54000+00			
10	5602	-5.08000+00				
10	5635	7.08747-01				
50	5636	7.55681-01	1.13116+00	1.11986+00	1.10293+00	1.08034+00
50	5641	1.05209+00	1.01816+00	9.70565-01	9.24908-01	8.87655-01
10	5646	8.65796-01				
10	5686	6.48149-01				
50	5687	6.30804-01	6.03224-01	6.15478-01	7.11905-01	8.76939-01
50	5692	1.05621+00	1.21500+00	1.32230+00	1.37422+00	1.36872+00
50	5697	1.30411+00	1.17644+00	1.00216+00	7.84299-01	5.32611-01
20	5702	3.30922-01	2.22529-01			
10	5704	1.83784-01				
10	5737	7.14134-01				
50	5738	7.60472-01	1.13118+00	1.11989+00	1.10297+00	1.08040+00
50	5743	1.05216+00	1.01823+00	9.70559-01	9.24778-01	8.87238-01
10	5748	8.65171-01				
10	5788	6.61872-01				
50	5789	6.41622-01	6.08913-01	6.17561-01	7.12046-01	8.76652-01
50	5794	1.05595+00	1.21473+00	1.32202+00	1.37391+00	1.36841+00
50	5799	1.30380+00	1.17614+00	1.00190+00	7.84066-01	5.32337-01
20	5804	3.30556-01	2.22241-01			
11	5806	1.83598-01				
15	46	REGION NO. 2 CORE REGION 2 - SPECTRUM 2 RADIAL				
151	16					
1	25	2				
1	32	1				
4	50	2 10 8 9				
21	75	5 19				
2	1	1.0	9.97291+18			
3	7	29.184	33.0	36.094		
5	28	-137.16	-135.0	-120.0	-110.0	-90.0
5	33	-80.0	-70.0	-50.0	-30.0	-15.0
1	38	-5.08				
50	1400	4.64455+17	2.76816+17	1.91859+18	2.84624+18	8.12460+18
50	1405	1.58800+19	9.68540+18	1.33893+19	1.72080+19	2.30841+19
30	1410	3.02001+19	4.04433+19	1.86237+19		
10	5533	2.91840+01				
30	5534	3.05920+01	3.30000+01	3.50470+01		
10	5537	3.60940+01				
10	5584	-1.37160+02				
50	5585	-1.36580+02	-1.35000+02	-1.32000+02	-1.26000+02	-1.18000+02
50	5590	-1.09000+02	-9.90000+01	-8.90000+01	-7.90000+01	-6.90000+01

TABLE 9-3

ELEMENT DENSITIES FOR THE KAP-VI GEOMETRY MODEL (GM/CC)

Composition Description	Composition Number	H	C	Mn	Cr	Ni	Fe	Ta	Al	Zr	U^{235}	U^{238}	Ti	Be	Pb	B	W	N	O	Cl	Total
Core Region 1	1	.0005729	.889	.00125	.0122	.0199	.0446	.003	-	1.109	.3099	.0228	-	-	-	-	-	-	-	-	2.412
Core Region 2	2	.0005729	.892	.00136	.0133	.0216	.0485	.003	-	1.107	.387	.0285	-	-	-	-	-	-	-	-	2.503
Core Region 3	3	.0005729	.891	.00131	.0129	.0209	.0469	.003	-	1.108	.416	.0306	-	-	-	-	-	-	-	-	2.531
Core Region 4	4	.0005729	.895	.00151	.0148	.0239	.0537	.003	-	1.103	.400	.0294	-	-	-	-	-	-	-	-	2.525
Core Region 5	5	.0005729	.906	.00197	.0193	.0314	.0703	.003	-	1.093	.302	.0222	-	-	-	-	-	-	-	-	2.449
Filler Strip	6	.0000478	1.112	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.112
Structure	7	.0005	-	-	.0297	.0514	.1085	-	2.617	-	-	-	.00423	-	-	-	-	-	-	-	2.811
Inner Reflector	8	.00253	-	-	.0161	.0278	.0586	-	.224	-	-	-	.00229	1.192	-	-	-	-	-	-	1.523
Outer Reflector	9	.00253	-	-	.0496	.0857	.181	-	.238	-	-	-	.00705	1.209	-	-	-	-	-	-	1.773
Pressure Vessel Side	10	.00265	-	-	-	-	-	-	2.249	-	-	-	-	-	-	-	-	-	-	-	2.252
CHESH	11	.0016	.129	.00757	.0743	.1245	.276	-	-	-	-	-	.010	-	-	-	2.336	-	-	-	2.959
Aft Plenum	12	.00984	-	.0331	.0353	.0581	.267	-	1.026	-	-	-	.00478	-	-	-	-	-	-	-	1.434
Core Plenum	13	.0056	-	.0239	.225	.153	.839	-	-	-	-	-	.494	-	-	.00453	-	-	-	-	1.745
Support Plate	14	.0094	-	.0147	.140	.0792	.514	-	1.41	-	-	-	.001	-	-	-	-	-	-	-	2.168
Shield Plenum	15	.0084	-	.0190	.179	.091	.657	-	-	-	-	-	-	-	-	-	-	-	-	-	.954
Drum Drive	16	.0097	-	.0116	.0539	.052	.226	-	.165	-	-	-	.003	-	-	-	-	-	-	-	.521
Al Shield Plate	17	.0011	-	-	-	-	-	-	2.27	-	-	-	-	-	-	-	-	-	-	-	2.271
BATH Shield	18	.0305	.0283	-	-	-	-	-	1.654	-	-	-	.789	-	-	.102	-	-	-	-	2.603
Lead Shield	19	.0011	-	-	-	-	-	-	-	-	-	-	-	-	9.46	-	-	-	-	-	9.461
Dome Plenum	20	.013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.013
Pressure Vessel Dome	21	-	-	-	-	-	-	-	2.735	-	-	-	-	-	-	-	-	-	-	-	2.735
"Void"	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tank Wall	23	-	-	-	-	-	-	-	2.7	-	-	-	-	-	-	-	-	-	-	-	2.7
Liquid Hydrogen	24	.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.07
Gaseous Hydrogen	25	.00088	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.00088
Retro Propellant	26	.0101	.0484	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.0323	.1425	.0582	.2915
Air	27	.000011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.00028	.000404	-	.000695
Epoxy	28	.0387	.3642	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.0283	.1294	-	.5606
Capsule Wall	29	-	-	-	-	-	-	-	.072	-	-	-	-	-	-	-	-	-	-	-	.072

TABLE 9-4

PARAMETERS DESCRIBING EQUATION 2 TYPE BOUNDARIES
FOR THE KAP-VI GEOMETRY

Boundary Number	Input Parameters						
	A	B	C	X_o	Y_o	Z_o	D
36	1.0	1.0	1.0	0.0	0.0	-777.24	203.126
37	1.0	1.0	1.0	0.0	0.0	-777.24	203.20
40	1.0	1.0	1.0	0.0	0.0	-1066.80	203.12
41	1.0	1.0	1.0	0.0	0.0	-1066.80	203.20
42	1.0	1.0	1.0	0.0	0.0	-1717.04	355.42
43	1.0	1.0	1.0	0.0	0.0	-1717.04	355.60
44	1.0	1.0	-.18547	0.0	0.0	-1717.04	355.30
45	1.0	1.0	-.1856	0.0	0.0	-1717.04	355.60
47	1.0	1.0	1.0	0.0	0.0	-3934.46	457.045
48	1.0	1.0	1.0	0.0	0.0	-3934.46	457.20
61	1.0	1.0	2.6424	0.0	0.0	-4483.68	330.20
62	1.0	1.0	2.64676	0.0	0.0	-4483.68	330.62
63	1.0	1.0	0.4874	0.0	0.0	-4760.12	148.70
64	1.0	1.0	0.4887	0.0	0.0	-4760.12	168.43

where Equation 2 has the following form:

$$A\,(x - X_o)^2 + B\,(y - Y_o)^2 + C\,(z - Z_o)^2 - D^2 = 0$$

TABLE 9-5

NEUTRON REMOVAL CROSS SECTIONS FOR INPUT TO THE KAP-VI PROBLEM
(cm^2/gm)

Element	For Albert-Welton	For Neutron Spectra
H	0.0	0.559
C	0.0407	0.0407
Mn	0.0197	0.0197
Cr	0.0205	0.0205
Ni	0.019	0.019
Fe	0.0214	0.0214
Ta	0.0111	0.0111
Al	0.0291	0.0291
Zr	0.0155	0.0155
U^{235}	0.0091	0.0091
U^{238}	0.0091	0.0091
Ti	0.0219	0.0219
Be	0.0717	0.0717
Pb	0.0108	0.0108
B	0.054	0.054
W	0.0082	0.0082
N	0.0448	0.0448
O	0.0405	0.0405
Cl	0.0252	0.0252

TABLE 9-6

ALBERT-WELTON CONSTANTS FOR INPUT TO THE KAP-VI PROBLEM

Constant	Value
α_1	1.6×10^{-4}
α_2	0.29
α_3	0.778
α_4	0.58
α_5	3.5×10^{-5}
α_6	10.0
α_7	0.0958

NOTE: α_1 and α_5 yield a neutron dose rate in units of rads (ethylene)/hour. α_6 must be input in units of cm.

TABLE 9-7

BIVARIANT POLYNOMIAL COEFFICIENTS, B_{ki}, FOR CALCULATING NEUTRON SPECTRA IN CARBON

Energy Range: 1.0 Mev $\leq E_n \leq$ 10.0 Mev

	i = 0	i = 1	i = 2
k = 0	9.2058(-1)	-2.52297(-2)	-1.31193(-4)
k = 1	-7.35248(-1)	3.55550(-3)	-2.92013(-5)
k = 2	-3.33736(-3)	-2.40152(-3)	1.44410(-5)
k = 3	-1.49290(-4)	1.85572(-4)	-9.78989(-7)

Energy Range: 0.1 Mev $\leq E_n \leq$ 1.0 Mev

	i = 0	i = 1	i = 2	i = 3
k = 0	2.02125(-1)	4.96364(-2)	-1.40544(-3)	6.0468(-6)
k = 1	3.27206(-1)	-1.29057(-1)	2.46613(-3)	-1.2386(-5)
k = 2	-6.57372(-1)	8.72040(-2)	-1.77728(-3)	9.12486(-6)

Energy Range: 0.01 Mev $\leq E_n \leq$ 0.1 Mev

	i = 0	i = 1	i = 2	i = 3
k = 0	2.48702(0)	9.47202(-2)	-1.65266(-3)	6.16259(-6)
k = 1	-2.80043(1)	-2.76004(0)	1.58054(-2)	3.62720(-6)
k = 2	-1.29332(2)	4.63051(1)	-2.69301(-1)	-1.28182(-4)
k = 3	1.91579(3)	-2.44706(2)	1.58900(0)	-3.36770(-4)

NOTE: Numbers in parentheses refer to powers of ten. A point isotropic U^{235} fission source of one neutron per second is assumed. Units of the polynomial are neutrons/sec-Mev. Limitation: $10 \leq X \leq 120 gm/cm^2$ k is the energy variable; i is the mass thickness variable.

TABLE 9-8

NEUTRON ENERGIES AND EXTRAPOLATION PARAMETERS FOR USE IN CALCULATING THE NEUTRON SPECTRA FUNCTION

Neutron Energy (Mev)	Extrapolation Parameter (λ)
10.0	0.0663
9.0	0.0663
8.0	0.0663
7.0	0.0663
6.0	0.0663
5.0	0.0663
4.0	0.0663
3.2	0.0573
2.5	0.0508
1.8	0.0490
1.3	0.0517
0.95	0.0523
0.7	0.0511
0.5	0.0520
0.4	0.0508
0.3	0.051
0.2	0.050
0.1	0.0493
0.09	0.048
0.08	0.048
0.07	0.0472
0.06	0.0464
0.05	0.0417
0.04	0.0438
0.03	0.0417
0.02	0.0412
0.01	0.0464

TABLE 9-9

GAMMA RAY RESPONSE FUNCTIONS

Average Energy (Mev)	Response 1	Response 2	Response 3	Response 4	Response 5
8.5	1.0	8.51(-7)	1.03(-6)	3.91(-15)	2.94(-15)
7.25	1.0	8.81(-7)	1.05(-6)	3.83(-15)	2.96(-15)
6.5	1.0	9.2(-7)	1.08(-6)	3.77(-15)	2.99(-15)
5.5	1.0	9.5(-7)	1.16(-6)	3.69(-15)	3.05(-15)
4.5	1.0	1.05(-6)	1.21(-6)	3.62(-15)	3.15(-15)
3.5	1.0	1.15(-6)	1.31(-6)	3.59(-15)	3.31(-15)
2.8	1.0	1.23(-6)	1.41(-6)	3.62(-15)	3.46(-15)
2.5	1.0	1.27(-6)	1.45(-6)	3.65(-15)	3.58(-15)
2.0	1.0	1.37(-6)	1.56(-6)	3.70(-15)	3.73(-15)
1.5	1.0	1.48(-6)	1.69(-6)	3.88(-15)	3.95(-15)
1.0	1.0	1.61(-6)	1.84(-6)	4.22(-15)	4.24(-15)
0.7	1.0	1.67(-6)	1.94(-6)	4.52(-15)	4.54(-15)
0.3	1.0	1.66(-6)	1.89(-6)	5.45(-15)	4.54(-15)

NOTE: Numbers in parentheses refer to powers of ten.

	Input Units	Output Units
Response 1	Unity	Mev/cm^2-sec
Response 2	Rem/hr/Mev-cm^2-sec	Rem/hour
Response 3	R/hr/Mev-cm^2-sec	R/hour
Response 4	Watts/gm/Mev-cm^2-sec	Watts/gm-steel
Response 5	Watts/gm/Mev-cm^2-sec	Watts/gm-aluminum

TABLE 9-10

NEUTRON RESPONSE FUNCTIONS FOR USE WITH THE NEUTRON SPECTRA KERNEL

Neutron Energy (Mev)	Response 1	Response 2	Response 3	Response 4	Response 5	Response 6	Response 7	Response 8
10.0	2.47	1.235	1.235	1.235	3.26(-5)	1.43(-4)	2.20(-5)	1.235(1)
9.0	2.47	2.47	2.47	2.47	6.175(-5)	2.72(-4)	4.17(-5)	2.223(1)
8.0	2.47	2.47	2.47	2.47	6.546(-5)	2.74(-4)	4.23(-5)	1.976(1)
7.0	2.47	2.47	2.47	2.47	5.928(-5)	2.64(-4)	4.00(-5)	1.729(1)
6.0	2.47	2.47	2.47	2.47	5.681(-5)	2.64(-4)	4.00(-5)	1.482(1)
5.0	2.47	2.47	2.47	2.47	5.434(-5)	2.62(-4)	3.96(-5)	1.235(1)
4.0	2.47	2.47	2.47	2.47	5.434(-5)	2.57(-4)	3.68(-5)	9.88(0)
3.2	2.47	1.482	1.482	1.482	2.964(-5)	1.45(-4)	2.04(-5)	4.74(0)
2.5	2.47	1.976	1.976	1.976	3.384(-5)	1.785(-4)	2.33(-5)	4.94(0)
1.8	2.47	1.482	1.482	1.482	2.238(-5)	1.425(-4)	1.58(-5)	2.67(0)
1.3	2.47	0.9888	0.9888	0.9888	1.284(-5)	9.23(-5)	9.32(-6)	1.28(0)
0.95	2.47	0.741	0	0.741	8.151(-6)	6.30(-5)	5.72(-6)	7.04(-1)
0.7	2.47	0.494	0	0.494	4.742(-6)	3.44(-5)	3.26(-6)	3.46(-1)
0.5	2.47	0.3705	0	0.2705	3.088(-6)	1.615(-5)	2.13(-6)	1.85(-1)
0.4	2.47	0.247	0	0.247	1.828(-6)	1.32(-5)	1.26(-6)	9.88(-2)
0.3	2.47	0.247	0	0.247	1.408(-6)	9.84(-6)	9.70(-7)	7.41(-2)
0.2	2.47	0.247	0	0.247	1.334(-6)	8.6(-6)	9.18(-7)	4.94(-2)
0.1	2.47	0.13585	0	0.1385	4.495(-7)	2.65(-6)	3.09(-7)	1.36(-2)
0.09	2.47	0.0247	0	0	7.657(-8)	4.40(-7)	5.27(-8)	2.23(-3)
0.08	2.47	0.0247	0	0	6.916(-8)	4.13(-7)	4.77(-8)	1.98(-3)
0.07	2.47	0.0247	0	0	6.298(-8)	3.39(-7)	4.35(-8)	1.73(-3)
0.06	2.47	0.0247	0	0	5.558(-8)	2.82(-7)	3.84(-8)	1.48(-3)
0.05	2.47	0.0247	0	0	4.816(-8)	2.32(-7)	3.32(-8)	1.24(-3)
0.04	2.47	0.0247	0	0	4.076(-8)	1.78(-7)	2.81(-8)	9.80(-4)
0.03	2.47	0.0247	0	0	3.211(-8)	1.26(-7)	2.21(-8)	7.41(-4)
0.02	2.47	0.0247	0	0	2.29(-8)	7.55(-8)	1.58(-8)	4.94(-4)
0.01	2.47	0.01235	0	0	6.175(-9)	1.455(-8)	4.25(-9)	1.24(-4)

NOTE: Numbers in parentheses refer to powers of ten.

	Input Units	Output Units
Response 1	Neutrons/fission	Neutrons/cm^2-sec-Mev
Response 2	Mev (ΔE)-neutrons/fission	Neutrons/cm^2-sec
Response 3	Mev (ΔE)-neutrons/fission	n/cm^2-sec for E > 1.0 Mev
Response 4	Mev (ΔE)-neutrons/fission	n/cm^2-sec for E > 0.1 Mev
Response 5	Mev (ΔE)-neutrons/fission/Rads(e)/hr/n/cm^2-sec	Rads (ethylene)/hour
Response 6	Mev (ΔE)-neutrons/fission/Rem/hr/n/cm^2-sec	Rem/hour
Response 7	Mev (ΔE)-neutrons/fission/Rads(t)/hr/n/cm^2-sec	Rads (tissue)/hour
Response 8	E x ΔE x neutron/fission	Mev/cm^2-sec

TABLE 9-11. INPUT DATA LISTING FOR THE NUCLEAR SUBSYSTEM KAP-VI PROBLEM WITH NOZZLE SOURCES

```
 5        1 KAP PROBLEM -MSFC- FOR NOZZLE SOURCE ON MERIDIAN RING
15       16 SOURCES FROM MARCH 1970 CRAM
15       46 SOURCE 1
15      106 TOTAL
15      136 MEV/CM2-SEC REM/HR      R/HR        WATT/GM-SST WATT/GM-AL
 3      226 30FT 0D
 3      229 30FT 2D
 3      232 30FT 4D
 3      235 30FT 6D
 3      238 30FT 8D
 3      241 30FT 10D
 3      244 30FT 11D
 3      247 30FT 11-43
 3      250 30FT 15D
31      253 30FT 20D
11        1 13  0 16 22  9 24 27  5  0  0 16
15       19  1  1  0  0  0  0 24  1  1  1  3  0 -1  2  0
 3       50  1  1 10
20      100  6  6  6  6  6  6  6  6  6  6  6  3  3  3  3  3  3  3  3  3
 4      120  3  3  3  6
20      200  3  4  4  4  4  4  4  4  4  4  4  3  4  4  3  3  3  3  3  3
 7      220  3  3  4  3 -1 -1 -3
20      300  1  2  3  4  5  6  7  8  8  9 10 11 12 16 13 14 15 17 18 19
 7      320 20 21 22 22 22 22 22
 6      500  3 12  2
 6     1100 15  2 12
 6      506  3 13  2 12
 6     1106 15  3 12  1
 6      512  3 14  2 13
 6     1112 15  4 12  2
 6      518  3 15  2 14
 6     1118 15  5 12  3
 6      524  3 16  2 15
 6     1124 15  6 12  4
 6      530  3 17  2 16
 6     1130 15  7 13  5
 6      536  3 18  2 17
 6     1136 15  8 13  6
 6      542  3 19  2 18
 6     1142 14  9 13  7
 6      548  3 20  2 19
 6     1148 14 10 13  8
 6      554  3 21  2 20
```

TABLE 9-11 (CONT)

```
6       1154 14 11 13  9
6        560 11 22  2 21
6       1160 25 23 13 10
6        566  2 16  1
6       1166  1 13 24
6        572  2 22  1 16
6       1172  6 23 24 12
6        578  6 21  3 18
6       1178 18 11  8 15
6        584  4 18  3
6       1184 16 14  1
6        590  5 18  4
6       1190 17 14 15
6        596  6 18  5
6       1196 18 14 16
6        602  7 21  6
6       1202 19 11 17
6        608  8 21  7
6       1208 20 11 18
6        614  9 21  8
6       1214 21 11 19
6        620 10 21  9
6       1220 22 11 20
6        626 11 21 10
6       1226 25 11 21
6        632  1 23 11 22
6       1232 24 27 25 11
6        638 24 23  1
6       1238 26 27 23
6        644 11
6       1244 22
6        650 24
6       1250 24
6        656 24 23 11
61      1256 26 23 25
2          1 1.0            1.0
2          7        51.115      52.385
2         28 1.0            7.31
2         49 0.0            3.14159
5       1400 0.749     +17 0.877     +16 0.265     +17 0.236     +17 0.275     +17
5       1405 0.242     +17 0.761     +16 0.171     +17 0.639     +16 0.260     +17
3       1410 0.144     +17 0.280     +17 0.399     +16
5       2060 0.0           -5.08        -137.16       -146.05       -161.29
5       2065 -164.67       -166.83      -197.31       -197.94       -227.94
```

TABLE 9-11 (CONT)

5	2070	-230.48	29.184	36.094	40.971	44.654
5	2075	46.99	53.34	55.88	61.92	62.174
4	2080	68.58	71.12	150.0	530.0	
3	2160	1.0	0.0	-100.0		
3	2163	30.0	0.0	-100.0		
3	2166	40.0	0.0	-100.0		
3	2169	43.0	0.0	-100.0		
3	2172	45.0	0.0	-100.0		
3	2175	50.0	0.0	-100.0		
3	2178	54.0	0.0	-100.0		
3	2181	60.0	0.0	-100.0		
3	2184	62.0	0.0	-100.0		
3	2187	65.0	0.0	-100.0		
3	2190	70.0	0.0	-100.0		
3	2193	10.0	0.0	-1.0		
3	2196	50.0	0.0	-1.0		
3	2199	60.0	0.0	-150.0		
3	2202	10.0	0.0	-140.0		
3	2205	10.0	0.0	-150.0		
3	2208	10.0	0.0	-162.0		
3	2211	10.0	0.0	-165.0		
3	2214	10.0	0.0	-180.0		
3	2217	10.0	0.0	-197.5		
3	2220	10.0	0.0	-200.0		
3	2223	10.0	0.0	-229.0		
3	2226	80.0	0.0	-100.0		
3	2229	10.0	0.0	1.0		
3	2232	10.0	0.0	-250.0		
3	2235	1.0	0.0	600.0		
3	2238	200.0	0.0	100.0		
5	2460	.0005729	.889	.00125	.0122	.0199
5	2465	.0446	.003	0.0	1.109	.3099
5	2470	.0228	0.0	0.0	0.0	0.0
1	2475	0.0				
5	2480	.0005729	.892	.00136	.0133	.0216
5	2485	.0485	.003	0.0	1.107	.387
5	2490	.0285	0.0	0.0	0.0	0.0
1	2495	0.0				
5	2500	.0005729	.891	.00131	.0129	.0209
5	2505	.0469	.003	0.0	1.108	.416
5	2510	.0306	0.0	0.0	0.0	0.0
1	2515	0.0				
5	2520	.0005729	.895	.00151	.0148	.0239
5	2525	.0537	.003	0.0	1.103	.40

C.7

TABLE 9-11 (CONT)

5	2530	.0294	0.0	0.0	0.0	0.0
1	2535	0.0				
5	2540	.0005729	.906	.00197	.0193	.0314
5	2545	.0703	.003	0.0	1.093	.302
5	2550	.0222	0.0	0.0	0.0	0.0
1	2555	0.0				
5	2560	.0000478	1.112	0.0	0.0	0.0
5	2565	0.0	0.0	0.0	0.0	0.0
5	2570	0.0	0.0	0.0	0.0	0.0
1	2575	0.0				
5	2580	.0005	0.0	0.0	.0297	.0514
5	2585	.1085	0.0	2.617	0.0	0.0
5	2590	0.0	.00423	0.0	0.0	0.0
1	2595	0.0				
5	2600	.00253	0.0	0.0	.0161	.0278
5	2605	.0586	0.0	.224	0.0	0.0
5	2610	0.0	.00229	1.192	0.0	0.0
1	2615	0.0				
5	2620	.00253	0.0	0.0	.0496	.0857
5	2625	.181	0.0	.238	0.0	0.0
5	2630	0.0	.00705	1.209	0.0	0.0
1	2635	0.0				
5	2640	.00265	0.0	0.0	0.0	0.0
5	2645	0.0	0.0	2.249	0.0	0.0
5	2650	0.0	0.0	0.0	0.0	0.0
1	2655	0.0				
5	2660	.0016	.129	.00757	.0743	.1245
5	2665	.276	0.0	0.0	0.0	0.0
5	2670	0.0	.01	0.0	0.0	0.0
1	2675	2.336				
5	2680	.00984	0.0	.0331	.0353	.0581
5	2685	.267	0.0	1.026	0.0	0.0
5	2690	0.0	.00478	0.0	0.0	0.0
1	2695	0.0				
5	2700	.0056	0.0	.0239	.225	.153
5	2705	.839	0.0	0.0	0.0	0.0
5	2710	0.0	.494	0.0	0.0	.00453
1	2715	0.0				
5	2720	.0094	0.0	.0147	.14	.0792
5	2725	.514	0.0	1.41	0.0	0.0
5	2730	0.0	.001	0.0	0.0	0.0
1	2735	0.0				
5	2740	.0084	0.0	.019	.179	.091
5	2745	.657	0.0	0.0	0.0	0.0

TABLE 9-11 (CONT)

5	2750	0.0		0.0		0.0		0.0		0.0		
1	2755	0.0										
5	2760	.0097		0.0		.0116		.0539		.052		
5	2765	.226		0.0		.165		0.0		0.0		
5	2770	0.0		.003		0.0		0.0		0.0		
1	2775	0.0										
5	2780	.0011		0.0		0.0		0.0		0.0		
5	2785	0.0		0.0		2.27		0.0		0.0		
5	2790	0.0		0.0		0.0		0.0		0.0		
1	2795	0.0										
5	2800	.0305		.0283		0.0		0.0		0.0		
5	2805	0.0		0.0		1.654		0.0		0.0		
5	2810	0.0		.789		0.0		0.0		.102		
1	2815	0.0										
5	2820	.0011		0.0		0.0		0.0		0.0		
5	2825	0.0		0.0		0.0		0.0		0.0		
5	2830	0.0		0.0		0.0		9.46		0.0		
1	2835	0.0										
5	2840	.013		0.0		0.0		0.0		0.0		
5	2845	0.0		0.0		0.0		0.0		0.0		
5	2850	0.0		0.0		0.0		0.0		0.0		
1	2855	0.0										
5	2860	0.0		0.0		0.0		0.0		0.0		
5	2865	0.0		0.0		2.735		0.0		0.0		
5	2870	0.0		0.0		0.0		0.0		0.0		
1	2875	0.0										
5	2880	0.0		0.0		0.0		0.0		0.0		
5	2885	0.0		0.0		0.0		0.0		0.0		
5	2890	0.0		0.0		0.0		0.0		0.0		
1	2895	0.0										
5	3560	8.5		7.25		6.5		5.5		4.5		
5	3565	3.5		2.8		2.5		2.0		1.5		
3	3570	1.0		0.7		0.3						
4	4310	0.0		20.0		1.0	-06	1.0	-03			
50	4750	1.		1.		1.		1.		1.	RSPG	11
50	4755	1.		1.		1.		1.		1.	RSPG	12
30	4760	1.		1.		1.					RSPG	13
50	4780	8.5	-07	8.8	-07	9.2	-07	9.5	-07	1.05	-06RSPG	21
50	4785	1.15	-06	1.23	-06	1.27	-06	1.37	-06	1.48	-06RSPG	22
30	4790	1.61	-06	1.67	-06	1.66	-06				RSPG	23
50	4810	1.03	-06	1.05	-06	1.08	-06	1.16	-06	1.21	-06RSPG	31
50	4815	1.31	-06	1.41	-06	1.45	-06	1.56	-06	1.69	-06RSPG	32
30	4820	1.84	-06	1.94	-06	1.89	-06				RSPG	33
50	4840	3.91	-15	3.83	-15	3.77	-15	3.69	-15	3.62	-15RSPG	41

TABLE 9-11 (CONT)

```
50     4845 3.59     -15 3.62     -15 3.65     -15 3.70     -15 3.88     -15RSPG  42
30     4850 4.22     -15 4.52     -15 5.45     -15                          RSPG  43
50     4870 2.94     -15 2.96     -15 2.99     -15 3.05     -15 3.15     -15RSPG  51
50     4875 3.31     -15 3.46     -15 3.58     -15 3.73     -15 3.95     -15RSPG  52
30     4880 4.24     -15 4.54     -15 4.54     -15                          RSPG  53
 3     5360 0.0          -721.97       0.0
 3     5363 31.913       -721.14       0.0
 3     5366 63.789       -719.74       0.0
 3     5369 95.582       -716.96       0.0
 3     5372 127.257      -713.08       0.0
 3     5375 158.786      -708.08       0.0
 3     5378 174.477      -705.18       0.0
 3     5381 185.687      -702.92       0.0
 3     5384 236.665      -690.82       0.0
 5     5513 1.0          6.0          25.0         24.0         28.0
 5     5518 26.0         73.0         13.0         40.0         92.0
 5     5523 92.0         22.0         4.0          82.0         5.0
11     5528 74.0
151      46 SOURCE 2
11       32  1
 2        7       51.115       52.385
 2       28 7.31         12.62
 5     1400 0.634    +17 0.746    +16 0.230    +17 0.208    +17 0.244    +17
 5     1405 0.221    +17 0.675    +16 0.152    +17 0.562    +16 0.213    +17
31     1410 0.113    +17 0.222    +17 0.345    +16
151      46 SOURCE 3
11       32  1
 2        7       51.115       52.385
 2       28 12.62        16.94
 5     1400 0.478    +17 0.589    +16 0.204    +17 0.201    +17 0.246    +17
 5     1405 0.233    +17 0.649    +16 0.167    +17 0.540    +16 0.207    +17
31     1410 0.954    +16 0.192    +17 0.326    +16
151      46 SOURCE 4
11       32  1
 2        7       50.81        52.69
 2       28 16.94        20.24
 5     1400 0.641    +17 0.698    +16 0.130    +17 0.142    +17 0.123    +17
 5     1405 0.162    +17 0.381    +16 0.140    +17 0.275    +16 0.206    +17
31     1410 0.949    +16 0.247    +17 0.217    +16
151      46 SOURCE 5
11       32  1
 2        7       52.38        55.24
 2       28 16.94        20.24
 5     1400 0.507    +17 0.547    +16 0.103    +17 0.116    +17 0.102    +17
```

TABLE 9-11 (CONT)

5	1405	0.138	+17	0.311	+16	0.125	+17	0.226	+16	0.186	+17
31	1410	0.896	+16	0.237	+17	0.196	+16				
151	46	SOURCE 6									
11	32	1									
2	7		55.24		58.1						
2	28	16.94		20.24							
5	1400	0.329	+17	0.368	+16	0.684	+16	0.836	+16	0.777	+16
5	1405	0.104	+17	0.223	+16	0.940	+16	0.159	+16	0.134	+17
31	1410	0.589	+16	0.162	+17	0.128	+16				
151	46	SOURCE 7									
11	32	1									
2	7		58.1		60.96						
2	28	15.93		20.24							
5	1400	0.319	+17	0.346	+16	0.660	+16	0.779	+16	0.713	+16
5	1405	0.103	+17	0.215	+16	0.103	+17	0.159	+16	0.162	+17
31	1410	0.863	+16	0.200	+17	0.138	+16				
151	46	SOURCE 8									
11	32	1									
2	7		46.33		47.68						
2	28	17.95		31.16							
5	1400	0.138	+18	0.153	+17	0.596	+17	0.561	+17	0.697	+17
5	1405	0.634	+17	0.181	+17	0.444	+17	0.150	+17	0.611	+17
31	1410	0.326	+17	0.664	+17	0.961	+16				
151	46	SOURCE 9									
11	32	1									
2	7		36.6		38.0						
2	28	31.16		42.09							
5	1400	0.767	+17	0.832	+16	0.332	+17	0.299	+17	0.373	+17
5	1405	0.319	+17	0.978	+16	0.218	+17	0.823	+16	0.304	+17
31	1410	0.174	+17	0.329	+17	0.516	+16				
151	46	SOURCE 10									
11	32	1									
2	7		28.3		29.31						
2	28	42.09		53.01							
5	1400	0.314	+17	0.339	+16	0.131	+17	0.116	+17	0.142	+17
5	1405	0.117	+17	0.375	+16	0.767	+16	0.314	+16	0.948	+16
31	1410	0.520	+16	0.966	+16	0.191	+16				
151	46	SOURCE 11									
11	32	1									
2	7		19.85		20.75						
2	28	53.01		63.93							
5	1400	0.973	+16	0.103	+16	0.617	+16	0.497	+16	0.693	+16
5	1405	0.486	+16	0.174	+16	0.260	+16	0.153	+16	0.276	+16
31	1410	0.191	+16	0.253	+16	0.858	+15				

TABLE 9-11 (CONT)

151	46	SOURCE 12									
11	32	1									
2	7		18.02		18.82						
2	28	63.93		75.14							
5	1400	0.500	+16	0.529	+15	0.286	+16	0.230	+16	0.314	+16
5	1405	0.222	+16	0.805	+15	0.116	+16	0.705	+15	0.136	+16
31	1410	0.875	+15	0.125	+16	0.398	+15				
151	46	SOURCE 13									
11	32	1									
2	7		24.18		25.02						
2	28	75.14		84.57							
5	1400	0.494	+16	0.518	+15	0.223	+16	0.185	+16	0.238	+16
5	1405	0.188	+16	0.641	+15	0.125	+16	0.553	+15	0.154	+16
31	1410	0.912	+15	0.156	+16	0.326	+15				
151	46	SOURCE 14									
11	32	1									
2	7		30.76		31.65						
2	28	84.57		94.16							
5	1400	0.443	+16	0.490	+15	0.344	+16	0.287	+16	0.416	+16
5	1405	0.308	+16	0.103	+16	0.184	+16	0.904	+15	0.225	+16
31	1410	0.143	+16	0.213	+16	0.521	+15				
151	46	SOURCE 15									
11	32	1									
2	7		34.09		37.51						
2	28	90.09		98.3							
5	1400	0.238	+17	0.250	+16	0.471	+16	0.482	+16	0.397	+16
5	1405	0.486	+16	0.127	+16	0.468	+16	0.930	+15	0.640	+16
31	1410	0.342	+16	0.905	+16	0.723	+15				
151	46	SOURCE 16									
11	32	1									
2	7		39.44		50.02						
2	28	90.8		99.2							
5	1400	0.136	+17	0.142	+16	0.263	+16	0.243	+16	0.192	+16
5	1405	0.209	+16	0.667	+15	0.575	+16	0.486	+15	0.223	+16
31	1410	0.104	+16	0.284	+16	0.323	+15				
151	46	SOURCE 17									
11	32	1									
2	7		32.69		35.92						
2	28	93.78		105.17							
5	1400	0.703	+16	0.786	+15	0.320	+16	0.253	+16	0.329	+16
5	1405	0.234	+16	0.880	+15	0.232	+16	0.749	+15	0.136	+16
31	1410	0.868	+15	0.127	+16	0.417	+15				
151	46	SOURCE 18									
11	32	1									

TABLE 9-11 (CONT)

2	7		38.78		42.03						
2	28	105.17		115.35							
5	1400	0.278	+16	0.312	+15	0.136	+16	0.109	+16	0.145	+16
5	1405	0.105	+16	0.384	+15	0.989	+15	0.330	+15	0.651	+15
31	1410	0.403	+15	0.570	+15	0.183	+15				
151	46	SOURCE 19									
11	32	1									
2	7		44.42		47.59						
2	28	115.35		125.53							
5	1400	0.116	+16	0.139	+15	0.115	+16	0.963	+15	0.144	+16
5	1405	0.105	+16	0.355	+15	0.736	+15	0.315	+15	0.654	+15
31	1410	0.383	+15	0.477	+15	0.169	+15				
151	46	SOURCE 20									
11	32	1									
2	7		49.48		52.52						
2	28	125.53		135.71							
5	1400	0.775	+15	0.945	+14	0.821	+15	0.711	+15	0.107	+16
5	1405	0.834	+15	0.264	+15	0.643	+15	0.237	+15	0.648	+15
31	1410	0.335	+15	0.489	+15	0.127	+15				
151	46	SOURCE 21									
11	32	1									
2	7		54.06		56.95						
2	28	135.71		145.89							
5	1400	0.111	+16	0.134	+15	0.845	+15	0.762	+15	0.109	+16
5	1405	0.943	+15	0.277	+15	0.797	+15	0.242	+15	0.756	+15
31	1410	0.361	+15	0.591	+15	0.134	+15				
151	46	SOURCE 22									
11	32	1									
2	7		58.96		61.65						
2	28	145.89		156.07							
5	1400	0.713	+15	0.860	+14	0.388	+15	0.325	+15	0.425	+15
5	1405	0.396	+15	0.112	+15	0.398	+15	0.944	+14	0.379	+15
31	1410	0.175	+15	0.335	+15	0.535	+14				
151	46	SOURCE 23									
11	32	1									
2	7		63.56		66.04						
2	28	156.07		166.25							
5	1400	0.154	+16	0.180	+15	0.105	+16	0.866	+15	0.124	+16
5	1405	0.974	+15	0.319	+15	0.807	+15	0.276	+15	0.650	+15
31	1410	0.346	+15	0.495	+15	0.150	+15				
151	46	SOURCE 24									
11	32	1									
2	7		67.47		69.73						
2	28	166.25		176.43							

TABLE 9-11 (CONT)

5	1400	0.140	+16	0.164	+15	0.561	+15	0.502	+15	0.618	+15
5	1405	0.554	+15	0.171	+15	0.618	+15	0.145	+15	0.513	+15
31	1410	0.246	+15	0.480	+15	0.848	+14				
151	46	SOURCE 25									
11	32	1									
2	7		71.67		74.33						
2	28	174.53		177.38							
5	1400	0.723	+15	0.115	+15	0.210	+15	0.521	+15	0.645	+15
5	1405	0.122	+16	0.170	+15	0.147	+16	0.109	+15	0.206	+16
31	1410	0.101	+16	0.219	+16	0.110	+15				
151	46	SOURCE 26									
11	32	1									
2	7		72.74		73.66						
2	28	176.43		199.87							
5	1400	0.297	+11	0.276	+10	0.484	+10	0.548	+10	0.202	+15
5	1405	0.353	+12	0.104	+10	0.166	+11	0.569	+09	0.170	+11
31	1410	0.348	+09	0.675	+13	0.387	+09				
151	46	SOURCE 27									
11	32	1									
2	7		80.48		81.12						
2	28	199.87		223.31							
5	1400	0.413	+11	0.424	+10	0.750	+10	0.113	+11	0.613	+15
5	1405	0.538	+12	0.145	+10	0.274	+11	0.794	+09	0.287	+11
31	1410	0.485	+09	0.941	+13	0.539	+09				
151	46	SOURCE 28									
11	32	1									
2	7		87.58		88.22						
2	28	223.31		246.75							
5	1400	0.411	+11	0.367	+10	0.638	+10	0.100	+11	0.594	+15
5	1405	0.544	+12	0.143	+10	0.201	+11	0.788	+09	0.197	+11
31	1410	0.481	+09	0.899	+13	0.535	+09				
151	46	SOURCE 29									
11	32	1									
2	7		94.18		94.82						
2	28	246.75		270.19							
5	1400	0.154	+11	0.133	+10	0.238	+10	0.723	+10	0.683	+15
5	1405	0.201	+12	0.542	+09	0.241	+11	0.297	+09	0.222	+11
31	1410	0.181	+09	0.356	+13	0.201	+09				
151	46	SOURCE 30									
11	32	1									
2	7		100.28		100.92						
2	28	270.19		293.63							
5	1400	0.134	+11	0.140	+10	0.244	+10	0.304	+10	0.132	+15
5	1405	0.163	+12	0.468	+09	0.660	+10	0.256	+09	0.747	+10

TABLE 9-11 (CONT)

31	1410	0.156	+09	0.315	+13	0.174	+09				
151	46	SOURCE 31									
11	32	1									
2	7	106.18		106.82							
2	28	293.63		317.07							
5	1400	0.817	+10	0.721	+09	0.125	+10	0.189	+10	0.110	+15
5	1405	0.103	+12	0.286	+09	0.563	+10	0.157	+09	0.553	+10
31	1410	0.960	+08	0.182	+13	0.106	+09				
151	46	SOURCE 32									
11	32	1									
2	7	111.48		112.12							
2	28	317.07		340.51							
5	1400	0.816	+10	0.109	+10	0.197	+10	0.343	+10	0.184	+15
5	1405	0.105	+12	0.286	+09	0.584	+10	0.156	+09	0.645	+10
31	1410	0.959	+08	0.180	+13	0.106	+09				
151	46	SOURCE 33									
11	32	1									
2	7	116.28		116.92							
2	28	340.51		363.95							
5	1400	0.468	+10	0.403	+09	0.700	+09	0.843	+09	0.434	+14
5	1405	0.478	+11	0.164	+09	0.351	+10	0.901	+08	0.341	+10
31	1410	0.551	+08	0.130	+13	0.612	+08				
151	46	SOURCE 34									
11	32	1									
2	7	120.28		120.92							
2	28	363.95		387.39							
5	1400	0.434	+10	0.524	+09	0.948	+09	0.138	+10	0.774	+14
5	1405	0.469	+11	0.149	+09	0.246	+10	0.817	+08	0.280	+10
31	1410	0.499	+08	0.977	+12	0.555	+08				
151	46	SOURCE 35									
11	32	1									
2	7	124.18		124.82							
2	28	387.39		410.83							
5	1400	0.365	+10	0.305	+09	0.527	+09	0.719	+09	0.341	+14
5	1405	0.296	+11	0.128	+09	0.168	+10	0.701	+08	0.177	+10
31	1410	0.429	+08	0.808	+12	0.476	+08				
151	46	SOURCE 36									
11	32	1									
2	7	127.98		128.62							
2	28	410.83		434.27							
5	1400	0.717	+10	0.786	+09	0.132	+10	0.161	+10	0.661	+14
5	1405	0.970	+11	0.248	+09	0.201	+10	0.136	+09	0.237	+10
31	1410	0.831	+08	0.154	+13	0.924	+08				
151	46	SOURCE 37									

TABLE 9-11 (CONT)

11	32	1									
2	7		134.28		134.92						
2	28	434.27		457.71							
5	1400	0.242	+10	0.203	+09	0.411	+09	0.593	+09	0.319	+14
5	1405	0.319	+11	0.851	+08	0.635	+10	0.466	+08	0.564	+10
31	1410	0.285	+08	0.626	+12	0.316	+08				
151	46	SOURCE 38									
11	32	1									
2	7		134.28		134.92						
2	28	457.71		481.15							
5	1400	0.523	+10	0.453	+09	0.825	+09	0.930	+09	0.274	+14
5	1405	0.632	+11	0.183	+09	0.232	+10	0.100	+09	0.230	+10
31	1410	0.614	+08	0.112	+13	0.683	+08				
151	46	SOURCE 39									
11	32	1									
2	7		137.68		138.32						
2	28	481.15		504.80							
5	1400	0.282	+10	0.406	+09	0.758	+09	0.136	+10	0.976	+14
5	1405	0.292	+11	0.955	+08	0.258	+10	0.523	+08	0.282	+10
31	1410	0.319	+08	0.754	+12	0.355	+08				
151	46	SOURCE 40									
21	31	3 1									
2	7		140.38		141.02						
2	28	504.80		528.09							
5	1400	0.504	+10	0.571	+09	0.102	+10	0.159	+10	0.962	+14
5	1405	0.629	+11	0.173	+09	0.351	+10	0.952	+08	0.356	+10
31	1410	0.582	+08	0.109	+13	0.646	+08				

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TABLE 9-12. INPUT DATA LISTING FOR THE PROPELLANT TANK GEOMETRY KAP-VI PROBLEM WITH NOZZLE SOURCES

```
 1
15     16 SOURCES FROM MARCH 1970 CRAM
15     31  TANK TOP AND CREW DOSE - TASK A
15     46 SOURCE 1
15    106 TOTAL
15    136 MEV/CM2-SEC REM/HR      R/HR          WATT/GM-SST WATT/GM-AL
 3    226 TANK TOP
 3    229 CREW R=0
31    232 CREW R=148
11      1 13  0 19 29  3 67 77  5  0  0 19
15     19  1  1  0  0  0  0 24  1  1  1  3  0 -1  2  0
 3     50  1  1 10
20    100  6  6  6  6  6  6  6  6  6  6  6  3  3  3  3  3  3  3  3  3
20    120  3  3  6  6  6  6  6  6  6  6  6  6  6  6  3  2  2  3  3  2
20    140  2  2  2  2  2  3  2  2  6  6  6  6  6  6  6  6  6  3  3  3
 7    160  2  2  2  2  3  6  6
20    200  3  4  4  4  4  4  4  4  4  4  4  3  4  4  3  3  3  3  3  3
20    220  3  3  4  3  3  4  3  2  3  4  4  3  4  4  2  3  4  3  2  3
20    240  4  3  4  4  3  4  4  3  4  3  3  4  3  4  2  3  3 -3  3  3
17    260  3  4  3  3  4  4  3  3  3  4  2  3  4  4  4 -1 -1
20    300  1  2  3  4  5  6  7  8  8  9 10 11 12 16 13 14 15 17 18 19
20    320 20 21 22 22 22 22 23 24 24 23 22 24 23 22 25 23 22 22 25 23
20    340 22 25 23 22 25 23 22 25 23 22 25 23 25 23 25 23 22 22 23 22
17    360 23 23 22 26 22 23 28 29 27 29 27 29 22 22 22 22 22
 6    500  3 12  2
 6   1100 15  2 12
 6    506  3 13  2 12
```

TABLE 9-12 (CONT)

6	1106	15	3	12	1
6	512	3	14	2	13
6	1112	15	4	12	2
6	518	3	15	2	14
6	1118	15	5	12	3
6	524	3	16	2	15
6	1124	15	6	12	4
6	530	3	17	2	16
6	1130	15	7	13	5
6	536	3	18	2	17
6	1136	15	8	13	6
6	542	3	19	2	18
6	1142	14	9	13	7
6	548	3	20	2	19
6	1148	14	10	13	8
6	554	3	21	2	20
6	1154	14	11	13	9
6	560	11	22	2	21
6	1160	25	23	13	10
6	566	2	16	1	
6	1166	1	13	24	
6	572	2	22	1	16
6	1172	6	23	24	12
6	578	6	21	3	18
6	1178	18	11	8	15
6	584	4	18	3	
6	1184	16	14	1	
6	590	5	18	4	
6	1190	17	14	15	
6	596	6	18	5	
6	1196	18	14	16	
6	602	7	21	6	
6	1202	19	11	17	
6	608	8	21	7	
6	1208	20	11	18	
6	614	9	21	8	
6	1214	21	11	19	
6	620	10	21	9	
6	1220	22	11	20	
6	626	11	21	10	
6	1226	25	11	21	
4	632	11	35	1	22
4	1232	25	58	24	11
3	638	1	35	67	

TABLE 9-12 (CONT)

3	1238	12	58	77	
3	644	23	35	11	
3	1244	26	58	23	
4	650	24	35	23	37
4	1250	31	58	25	27
3	656	24	37	36	
3	1256	30	26	28	
2	662	24	36		
2	1262	29	27		
3	668	25	38	24	
3	1268	32	30	28	
4	674	25	39	24	38
4	1274	33	31	27	29
4	680	25	35	24	39
4	1280	34	58	26	30
3	686	26	40	25	
3	1286	35	33	29	
4	692	26	41	25	40
4	1292	36	34	30	32
4	698	26	35	25	41
4	1298	37	58	31	33
2	704	40	26		
2	1304	36	32		
3	710	41	26	40	
3	1310	37	33	35	
4	716	27	35	26	41
4	1316	38	58	34	36
3	722	28	35	27	
3	1322	41	58	37	
2	728	29	42		
2	1328	42	40		
3	734	29	43	42	
3	1334	43	41	39	
4	740	29	35	28	43
4	1340	44	58	38	40
3	746	30	42	29	
3	1346	45	43	39	
4	752	30	43	29	42
4	1352	46	44	40	42
4	758	30	35	29	43
4	1358	47	58	41	43
3	764	31	44	30	
3	1364	48	46	42	
4	770	31	45	30	44

TABLE 9-12 (CONT)

4	1370	49	47	43	45
4	776	31	35	30	45
4	1376	50	58	44	46
3	782	32	44	31	
3	1382	51	49	45	
4	788	32	45	31	44
4	1388	52	50	46	48
3	794	35	31	45	
3	1394	58	47	49	
3	800	33	46	32	
3	1400	53	52	48	
4	806	33	35	32	46
4	1406	54	58	49	51
3	812	34	46	33	
3	1412	55	54	51	
4	818	34	35	33	46
4	1418	56	58	49	53
2	824	47	34		
2	1424	56	53		
3	830	48	34	47	
3	1430	57	54	55	
3	836	49	35	48	
3	1436	59	58	56	
3	842	66	35	67	
3	1442	76	23	77	
3	848	50	58	49	
3	1448	60	62	57	
3	854	51	58	50	
3	1454	61	62	59	
3	860	52	58	51	
3	1460	63	62	60	
4	866	52	59	49	58
4	1466	66	73	57	60
3	872	53	65	52	
3	1472	64	65	61	
3	878	54	65	53	
3	1478	67	65	63	
4	884	54	61	52	65
4	1484	67	66	61	63
4	890	54	62	52	61
4	1490	67	74	62	65
3	896	55	64	54	
3	1496	68	75	64	
3	902	56	60	55	

TABLE 9-12 (CONT)

```
3       1502 69 70 67
3        908 57 60 56
3       1508 71 70 68
4        914 57 64 55 60
4       1514 72 75 67 68
2        920 63 57
2       1520 72 69
3        926 64 57 63
3       1526 75 70 71
4        932 52 35 49 59
4       1532 74 58 57 62
4        938 54 35 52 62
4       1538 75 58 73 66
4        944 66 35 54 64
4       1544 76 58 74 67
1        950 66
1       1550 75
1        956 67
11      1556 24
2          1 1.0           1.0
2          7      51.115       52.385
2         28 1.0           7.31
2         49 0.0           3.14159
5       1400 0.749     +17 0.877     +16 0.265     +17 0.236     +17 0.275     +17
5       1405 0.242     +17 0.761     +16 0.171     +17 0.639     +16 0.260     +17
3       1410 0.144     +17 0.280     +17 0.399     +16
2       1495 1.0           1.0
5       1499 1.0           1.0           1.0           1.0           1.0
1       1504 1.0
2       1506 1.0           1.0
4       1520 1.0           1.0           1.0           1.0
2       1595 1.0           1.0
5       1599 1.0           1.0           1.0           1.0           1.0
1       1604 1.0
2       1606 1.0           1.0
4       1620 1.0           1.0           1.0           1.0
2       1695 1.0           1.0
5       1699 1.0           1.0           1.0           1.0           -.18547
1       1704 -.1856
2       1706 1.0           1.0
4       1720 2.6424        2.64676       0.4874        .4887
2       1795 0.0           0.0
5       1799 0.0           0.0           0.0           0.0           0.0
1       1804 0.0
```

TABLE 9-12 (CONT)

2	1806	0.0	0.0			
4	1820	0.0	0.0	0.0	0.0	
2	1895	0.0	0.0			
5	1899	0.0	0.0	0.0	0.0	0.0
1	1904	0.0				
2	1906	0.0	0.0			
4	1920	0.0	0.0	0.0	0.0	
2	1995	-777.24	-777.24			
5	1999	-1066.80	-1066.80	-1717.04	-1717.04	-1717.04
1	2004	-1717.04				
2	2006	-3888.74	-3888.74			
4	2020	-4483.68	-4483.68	-4760.12	-4760.12	
5	2060	0.0	-5.08	-137.16	-146.05	-161.29
5	2065	-164.67	-166.83	-197.31	-197.94	-227.94
5	2070	-230.48	29.184	36.094	40.971	44.654
5	2075	46.99	53.34	55.88	61.92	62.174
5	2080	68.58	71.12	-574.04	-777.24	-1066.80
5	2085	-1118.90	-1270.0	-1361.44	-1500.0	-1717.04
5	2090	-2000.0	-2542.54	-3500.0	-3888.74	502.92
5	2095	203.126	203.2	203.126	203.2	203.12
5	2100	203.2	355.42	355.60	355.30	355.60
5	2105	502.62	457.045	457.2	-4391.82	-4392.24
5	2110	-4483.26	-4483.68	-4531.52	-4622.96	-4628.04
5	2115	-4638.20	-4760.12	330.20	330.62	148.70
5	2120	330.2	330.62	148.70	168.43	106.68
2	2125	-6000.0	600.0			
3	2160	1.0	0.0	-100.0		
3	2163	30.0	0.0	-100.0		
3	2166	40.0	0.0	-100.0		
3	2169	43.0	0.0	-100.0		
3	2172	45.0	0.0	-100.0		
3	2175	50.0	0.0	-100.0		
3	2178	54.0	0.0	-100.0		
3	2181	60.0	0.0	-100.0		
3	2184	62.0	0.0	-100.0		
3	2187	65.0	0.0	-100.0		
3	2190	70.0	0.0	-100.0		
3	2193	10.0	0.0	-1.0		
3	2196	50.0	0.0	-1.0		
3	2199	60.0	0.0	-150.0		
3	2202	10.0	0.0	-140.0		
3	2205	10.0	0.0	-150.0		
3	2208	10.0	0.0	-162.0		
3	2211	10.0	0.0	-165.0		

3	2214	10.0	0.0	-180.0
3	2217	10.0	0.0	-197.5
3	2220	10.0	0.0	-200.0
3	2223	10.0	0.0	-229.0
3	2226	80.0	0.0	-100.0
3	2229	10.0	0.0	1.0
3	2232	100.0	0.0	-300.0
3	2235	300.0	0.0	-700.0
3	2238	0.1	0.0	-574.08
3	2241	1.0	0.0	-600.0
3	2244	1.0	0.0	-800.0
3	2247	203.15	0.0	-800.0
3	2250	300.0	0.0	-800.0
3	2253	0.1	0.0	-1100.0
3	2256	203.15	0.0	-1066.9
3	2259	300.0	0.0	-1100.0
3	2262	0.1	0.0	-1120.0
3	2265	0.1	0.0	-1269.95
3	2268	300.0	0.0	-1200.0
3	2271	0.1	0.0	-1300.0
3	2274	0.1	0.0	-1362.0
3	2277	0.1	0.0	-1361.5
3	2280	360.0	0.0	-1400.0
3	2283	0.1	0.0	-1600.0
3	2286	355.5	0.0	-1717.0
3	2289	360.0	0.0	-1600.0
3	2292	0.1	0.0	-1800.0
3	2295	355.5	0.0	-1717.1
3	2298	500.0	0.0	-1800.0
3	2301	0.1	0.0	-2200.0
3	2304	502.8	0.0	-2542.5
3	2307	502.8	0.0	-2001.0
3	2310	0.1	0.0	-3000.0
3	2313	502.8	0.0	-3000.0
3	2316	0.1	0.0	-3800.0
3	2319	502.8	0.0	-3800.0
3	2322	0.1	0.0	-4000.0
3	2325	0.1	0.0	-4391.6
3	2328	0.1	0.0	-4391.7
3	2331	510.0	0.0	-2000.0
3	2334	0.1	0.0	-4392.0
3	2337	0.1	0.0	-4400.0
3	2340	0.1	0.0	-4483.5
3	2343	330.3	0.0	-4400.0

TABLE 9-12 (CONT)

3	2346	0.1	0.0	-4500.0		
3	2349	0.1	0.0	-4600.0		
3	2352	110.0	0.0	-4500.0		
3	2355	330.3	0.0	-4484.0		
3	2358	0.1	0.0	-4625.0		
3	2361	0.1	0.0	-4630.0		
3	2364	0.1	0.0	-4700.0		
3	2367	149.0	0.0	-4629.0		
3	2370	0.1	0.0	-4800.0		
3	2373	0.1	0.0	-4975.0		
3	2376	331.0	0.0	-4400.0		
3	2379	331.0	0.0	-4500.0		
3	2382	241.0	0.0	-4700.0		
3	2385	1.0	0.0	-6001.0		
3	2388	1.0	0.0	700.0		
5	2460	.0005729	.889	.00125	.0122	.0199
5	2465	.0446	.003	0.0	1.109	.3099
5	2470	.0228	0.0	0.0	0.0	0.0
4	2475	0.0	0.0	0.0	0.0	
5	2480	.0005729	.892	.00136	.0133	.0216
5	2485	.0485	.003	0.0	1.107	.387
5	2490	.0285	0.0	0.0	0.0	0.0
4	2495	0.0	0.0	0.0	0.0	
5	2500	.0005729	.891	.00131	.0129	.0209
5	2505	.0469	.003	0.0	1.108	.416
5	2510	.0306	0.0	0.0	0.0	0.0
4	2515	0.0	0.0	0.0	0.0	
5	2520	.0005729	.895	.00151	.0148	.0239
5	2525	.0537	.003	0.0	1.103	.40
5	2530	.0294	0.0	0.0	0.0	0.0
4	2535	0.0	0.0	0.0	0.0	
5	2540	.0005729	.906	.00197	.0193	.0314
5	2545	.0703	.003	0.0	1.093	.302
5	2550	.0222	0.0	0.0	0.0	0.0
4	2555	0.0	0.0	0.0	0.0	
5	2560	.0000478	1.112	0.0	0.0	0.0
5	2565	0.0	0.0	0.0	0.0	0.0
5	2570	0.0	0.0	0.0	0.0	0.0
4	2575	0.0	0.0	0.0	0.0	
5	2580	.0005	0.0	0.0	.0297	.0514
5	2585	.1085	0.0	2.617	0.0	0.0
5	2590	0.0	.00423	0.0	0.0	0.0
4	2595	0.0	0.0	0.0	0.0	
5	2600	.00253	0.0	0.0	.0161	.0278

TABLE 9-12 (CONT)

5	2605	.0586	0.0	.224	0.0	0.0
5	2610	0.0	.00229	1.192	0.0	0.0
4	2615	0.0	0.0	0.0	0.0	
5	2620	.00253	0.0	0.0	.0496	.0857
5	2625	.181	0.0	.238	0.0	0.0
5	2630	0.0	.00705	1.209	0.0	0.0
4	2635	0.0	0.0	0.0	0.0	
5	2640	.00265	0.0	0.0	0.0	0.0
5	2645	0.0	0.0	2.249	0.0	0.0
5	2650	0.0	0.0	0.0	0.0	0.0
4	2655	0.0	0.0	0.0	0.0	
5	2660	.0016	.129	.00757	.0743	.1245
5	2665	.276	0.0	0.0	0.0	0.0
5	2670	0.0	.01	0.0	0.0	0.0
4	2675	2.336	0.0	0.0	0.0	
5	2680	.00984	0.0	.0331	.0353	.0581
5	2685	.267	0.0	1.026	0.0	0.0
5	2690	0.0	.00478	0.0	0.0	0.0
4	2695	0.0	0.0	0.0	0.0	
5	2700	.0056	0.0	.0239	.225	.153
5	2705	.839	0.0	0.0	0.0	0.0
5	2710	0.0	.494	0.0	0.0	.00453
4	2715	0.0	0.0	0.0	0.0	
5	2720	.0094	0.0	.0147	.14	.0792
5	2725	.514	0.0	1.41	0.0	0.0
5	2730	0.0	.001	0.0	0.0	0.0
4	2735	0.0	0.0	0.0	0.0	
5	2740	.0084	0.0	.019	.179	.091
5	2745	.657	0.0	0.0	0.0	0.0
5	2750	0.0	0.0	0.0	0.0	0.0
4	2755	0.0	0.0	0.0	0.0	
5	2760	.0097	0.0	.0116	.0539	.052
5	2765	.226	0.0	.165	0.0	0.0
5	2770	0.0	.003	0.0	0.0	0.0
4	2775	0.0	0.0	0.0	0.0	
5	2780	.0011	0.0	0.0	0.0	0.0
5	2785	0.0	0.0	2.27	0.0	0.0
5	2790	0.0	0.0	0.0	0.0	0.0
4	2795	0.0	0.0	0.0	0.0	
5	2800	.0305	.0283	0.0	0.0	0.0
5	2805	0.0	0.0	1.654	0.0	0.0
5	2810	0.0	.789	0.0	0.0	.102
4	2815	0.0	0.0	0.0	0.0	
5	2820	.0011	0.0	0.0	0.0	0.0

TABLE 9-12 (CONT)

5	2825	0.0	0.0	0.0	0.0	0.0
5	2830	0.0	0.0	0.0	9.46	0.0
4	2835	0.0	0.0	0.0	0.0	
5	2840	.013	0.0	0.0	0.0	0.0
5	2845	0.0	0.0	0.0	0.0	0.0
5	2850	0.0	0.0	0.0	0.0	0.0
4	2855	0.0	0.0	0.0	0.0	
5	2860	0.0	0.0	0.0	0.0	0.0
5	2865	0.0	0.0	2.735	0.0	0.0
5	2870	0.0	0.0	0.0	0.0	0.0
4	2875	0.0	0.0	0.0	0.0	
5	2880	0.0	0.0	0.0	0.0	0.0
5	2885	0.0	0.0	0.0	0.0	0.0
5	2890	0.0	0.0	0.0	0.0	0.0
4	2895	0.0	0.0	0.0	0.0	
5	2900	0.0	0.0	0.0	0.0	0.0
5	2905	0.0	0.0	2.7	0.0	0.0
5	2910	0.0	0.0	0.0	0.0	0.0
4	2915	0.0	0.0	0.0	0.0	
5	2920	.07	0.0	0.0	0.0	0.0
5	2925	0.0	0.0	0.0	0.0	0.0
5	2930	0.0	0.0	0.0	0.0	0.0
4	2935	0.0	0.0	0.0	0.0	
5	2940	.00088	0.0	0.0	0.0	0.0
5	2945	0.0	0.0	0.0	0.0	0.0
5	2950	0.0	0.0	0.0	0.0	0.0
4	2955	0.0	0.0	0.0	0.0	
5	2960	.0101	.0484	0.0	0.0	0.0
5	2965	0.0	0.0	0.0	0.0	0.0
5	2970	0.0	0.0	0.0	0.0	0.0
4	2975	0.0	.0323	.1425	.0582	
5	2980	.000011	0.0	0.0	0.0	0.0
5	2985	0.0	0.0	0.0	0.0	0.0
5	2990	0.0	0.0	0.0	0.0	0.0
4	2995	0.0	.00028	.000404	0.0	
5	3000	.0387	.3642	0.0	0.0	0.0
5	3005	0.0	0.0	0.0	0.0	0.0
5	3010	0.0	0.0	0.0	0.0	0.0
4	3015	0.0	.0283	.1294	0.0	
5	3020	0.0	0.0	0.0	0.0	0.0
5	3025	0.0	0.0	.072	0.0	0.0
5	3030	0.0	0.0	0.0	0.0	0.0
4	3035	0.0	0.0	0.0	0.0	
5	3560	8.5	7.25	6.5	5.5	4.5

TABLE 9-12 (CONT)

5	3565	3.5		2.8		2.5		2.0		1.5		
3	3570	1.0		0.7		0.3						
4	4310	0.0		20.0		1.0	-06	1.0	-03			
50	4750	1.		1.		1.		1.		1.	RSPG	11
50	4755	1.		1.		1.		1.		1.	RSPG	12
30	4760	1.		1.		1.					RSPG	13
50	4780	8.5	-07	8.8	-07	9.2	-07	9.5	-07	1.05	-06RSPG	21
50	4785	1.15	-06	1.23	-06	1.27	-06	1.37	-06	1.48	-06RSPG	22
30	4790	1.61	-06	1.67	-06	1.66	-06				RSPG	23
50	4810	1.03	-06	1.05	-06	1.08	-06	1.16	-06	1.21	-06RSPG	31
50	4815	1.31	-06	1.41	-06	1.45	-06	1.56	-06	1.69	-06RSPG	32
30	4820	1.84	-06	1.94	-06	1.89	-06				RSPG	33
50	4840	3.91	-15	3.83	-15	3.77	-15	3.69	-15	3.62	-15RSPG	41
50	4845	3.59	-15	3.62	-15	3.65	-15	3.70	-15	3.88	-15RSPG	42
30	4850	4.22	-15	4.52	-15	5.45	-15				RSPG	43
50	4870	2.94	-15	2.96	-15	2.99	-15	3.05	-15	3.15	-15RSPG	51
50	4875	3.31	-15	3.46	-15	3.58	-15	3.73	-15	3.95	-15RSPG	52
30	4880	4.24	-15	4.54	-15	4.54	-15				RSPG	53
3	5360	0.0		-4391.8		0.0						
3	5363	0.0		-4639.0		0.0						
3	5366	148.0		-4639.0		0.0						
5	5513	1.0		6.0		25.0		24.0		28.0		
5	5518	26.0		73.0		13.0		40.0		92.0		
5	5523	92.0		22.0		4.0		82.0		5.0		
41	5528	74.0		7.0		8.0		17.0				
151	46	SOURCE 2										
11	32	1										
2	7	51.115		52.385								
2	28	7.31		12.62								
5	1400	0.634	+17	0.746	+16	0.230	+17	0.208	+17	0.244	+17	
5	1405	0.221	+17	0.675	+16	0.152	+17	0.562	+16	0.213	+17	
31	1410	0.113	+17	0.222	+17	0.345	+16					
151	46	SOURCE 3										
11	32	1										
2	7	51.115		52.385								
2	28	12.62		16.94								
5	1400	0.478	+17	0.589	+16	0.204	+17	0.201	+17	0.246	+17	
5	1405	0.233	+17	0.649	+16	0.167	+17	0.540	+16	0.207	+17	
31	1410	0.954	+16	0.192	+17	0.326	+16					
151	46	SOURCE 4										
11	32	1										
2	7	50.81		52.69								
2	28	16.94		20.24								
5	1400	0.641	+17	0.698	+16	0.130	+17	0.142	+17	0.123	+17	

TABLE 9-12 (CONT)

5	1405	0.162	+17	0.381	+16	0.140	+17	0.275	+16	0.206	+17
31	1410	0.949	+16	0.247	+17	0.217	+16				
151	46	SOURCE 5									
11	32	1									
2	7		52.38		55.24						
2	28	16.94		20.24							
5	1400	0.507	+17	0.547	+16	0.103	+17	0.116	+17	0.102	+17
5	1405	0.138	+17	0.311	+16	0.125	+17	0.226	+16	0.186	+17
31	1410	0.896	+16	0.237	+17	0.196	+16				
151	46	SOURCE 6									
11	32	1									
2	7		55.24		58.1						
2	28	16.94		20.24							
5	1400	0.329	+17	0.368	+16	0.684	+16	0.836	+16	0.777	+16
5	1405	0.104	+17	0.223	+16	0.940	+16	0.159	+16	0.134	+17
31	1410	0.589	+16	0.162	+17	0.128	+16				
151	46	SOURCE 7									
11	32	1									
2	7		58.1		60.96						
2	28	15.93		20.24							
5	1400	0.319	+17	0.346	+16	0.660	+16	0.779	+16	0.713	+16
5	1405	0.103	+17	0.215	+16	0.103	+17	0.159	+16	0.162	+17
31	1410	0.863	+16	0.200	+17	0.138	+16				
151	46	SOURCE 8									
11	32	1									
2	7		46.33		47.68						
2	28	17.95		31.16							
5	1400	0.138	+18	0.153	+17	0.596	+17	0.561	+17	0.697	+17
5	1405	0.634	+17	0.181	+17	0.444	+17	0.150	+17	0.611	+17
31	1410	0.326	+17	0.664	+17	0.961	+16				
151	46	SOURCE 9									
11	32	1									
2	7		36.6		38.0						
2	28	31.16		42.09							
5	1400	0.767	+17	0.832	+16	0.332	+17	0.299	+17	0.373	+17
5	1405	0.319	+17	0.978	+16	0.218	+17	0.823	+16	0.304	+17
31	1410	0.174	+17	0.329	+17	0.516	+16				
151	46	SOURCE 10									
11	32	1									
2	7		28.3		29.31						
2	28	42.09		53.01							
5	1400	0.314	+17	0.339	+16	0.131	+17	0.116	+17	0.142	+17
5	1405	0.117	+17	0.375	+16	0.767	+16	0.314	+16	0.948	+16
31	1410	0.520	+16	0.966	+16	0.191	+16				

TABLE 9-12 (CONT)

151	46	SOURCE 11									
11	32	1									
2	7		19.85		20.75						
2	28	53.01		63.93							
5	1400	0.973	+16	0.103	+16	0.617	+16	0.497	+16	0.693	+16
5	1405	0.486	+16	0.174	+16	0.260	+16	0.153	+16	0.276	+16
31	1410	0.191	+16	0.253	+16	0.858	+15				
151	46	SOURCE 12									
11	32	1									
2	7		18.02		18.82						
2	28	63.93		75.14							
5	1400	0.500	+16	0.529	+15	0.286	+16	0.230	+16	0.314	+16
5	1405	0.222	+16	0.805	+15	0.116	+16	0.705	+15	0.136	+16
31	1410	0.875	+15	0.125	+16	0.398	+15				
151	46	SOURCE 13									
11	32	1									
2	7		24.18		25.02						
2	28	75.14		84.57							
5	1400	0.494	+16	0.518	+15	0.223	+16	0.185	+16	0.238	+16
5	1405	0.188	+16	0.641	+15	0.125	+16	0.553	+15	0.154	+16
31	1410	0.912	+15	0.156	+16	0.326	+15				
151	46	SOURCE 14									
11	32	1									
2	7		30.76		31.65						
2	28	84.57		94.16							
5	1400	0.443	+16	0.490	+15	0.344	+16	0.287	+16	0.416	+16
5	1405	0.308	+16	0.103	+16	0.184	+16	0.904	+15	0.225	+16
31	1410	0.143	+16	0.213	+16	0.521	+15				
151	46	SOURCE 15									
11	32	1									
2	7		34.09		37.51						
2	28	90.09		98.3							
5	1400	0.238	+17	0.250	+16	0.471	+16	0.482	+16	0.397	+16
5	1405	0.486	+16	0.127	+16	0.468	+16	0.930	+15	0.640	+16
31	1410	0.342	+16	0.905	+16	0.723	+15				
151	46	SOURCE 16									
11	32	1									
2	7		39.44		50.02						
2	28	90.8		99.2							
5	1400	0.136	+17	0.142	+16	0.263	+16	0.243	+16	0.192	+16
5	1405	0.209	+16	0.667	+15	0.575	+16	0.486	+15	0.223	+16
31	1410	0.104	+16	0.284	+16	0.323	+15				
151	46	SOURCE 17									
11	32	1									

TABLE 9-12 (CONT)

2	7		32.69	35.92							
2	28	93.78		105.17							
5	1400	0.703	+16	0.786	+15	0.320	+16	0.253	+16	0.329	+16
5	1405	0.234	+16	0.880	+15	0.232	+16	0.749	+15	0.136	+16
31	1410	0.868	+15	0.127	+16	0.417	+15				
151	46	SOURCE 18									
11	32	1									
2	7		38.78	42.03							
2	28	105.17		115.35							
5	1400	0.278	+16	0.312	+15	0.136	+16	0.109	+16	0.145	+16
5	1405	0.105	+16	0.384	+15	0.989	+15	0.330	+15	0.651	+15
31	1410	0.403	+15	0.570	+15	0.183	+15				
151	46	SOURCE 19									
11	32	1									
2	7		44.42	47.59							
2	28	115.35		125.53							
5	1400	0.116	+16	0.139	+15	0.115	+16	0.963	+15	0.144	+16
5	1405	0.105	+16	0.355	+15	0.736	+15	0.315	+15	0.654	+15
31	1410	0.383	+15	0.477	+15	0.169	+15				
151	46	SOURCE 20									
11	32	1									
2	7		49.48	52.52							
2	28	125.53		135.71							
5	1400	0.775	+15	0.945	+14	0.821	+15	0.711	+15	0.107	+16
5	1405	0.834	+15	0.264	+15	0.643	+15	0.237	+15	0.648	+15
31	1410	0.335	+15	0.489	+15	0.127	+15				
151	46	SOURCE 21									
11	32	1									
2	7		54.06	56.95							
2	28	135.71		145.89							
5	1400	0.111	+16	0.134	+15	0.845	+15	0.762	+15	0.109	+16
5	1405	0.943	+15	0.277	+15	0.797	+15	0.242	+15	0.756	+15
31	1410	0.361	+15	0.591	+15	0.134	+15				
151	46	SOURCE 22									
11	32	1									
2	7		58.96	61.65							
2	28	145.89		156.07							
5	1400	0.713	+15	0.860	+14	0.388	+15	0.325	+15	0.425	+15
5	1405	0.396	+15	0.112	+15	0.398	+15	0.944	+14	0.379	+15
31	1410	0.175	+15	0.335	+15	0.535	+14				
151	46	SOURCE 23									
11	32	1									
2	7		63.56	66.04							
2	28	156.07		166.25							

TABLE 9-12 (CONT)

5	1400	0.154	+16	0.180	+15	0.105	+16	0.866	+15	0.124	+16
5	1405	0.974	+15	0.319	+15	0.807	+15	0.276	+15	0.650	+15
31	1410	0.346	+15	0.495	+15	0.150	+15				
151	46	SOURCE 24									
11	32	1									
2	7		67.47		69.73						
2	28	166.25		176.43							
5	1400	0.140	+16	0.164	+15	0.561	+15	0.502	+15	0.618	+15
5	1405	0.554	+15	0.171	+15	0.618	+15	0.145	+15	0.513	+15
31	1410	0.246	+15	0.480	+15	0.848	+14				
151	46	SOURCE 25									
11	32	1									
2	7		71.67		74.33						
2	28	174.56		177.38							
5	1400	0.723	+15	0.115	+15	0.210	+15	0.521	+15	0.645	+15
5	1405	0.122	+16	0.170	+15	0.147	+16	0.109	+15	0.206	+16
31	1410	0.101	+16	0.219	+16	0.110	+15				
151	46	SOURCE 26									
11	32	1									
2	7		72.74		73.66						
2	28	176.43		199.87							
5	1400	0.297	+11	0.276	+10	0.484	+10	0.548	+10	0.202	+15
5	1405	0.353	+12	0.104	+10	0.166	+11	0.569	+09	0.170	+11
31	1410	0.348	+09	0.675	+13	0.387	+09				
151	46	SOURCE 27									
11	32	1									
2	7		80.48		81.12						
2	28	199.87		223.31							
5	1400	0.413	+11	0.424	+10	0.750	+10	0.113	+11	0.613	+15
5	1405	0.538	+12	0.145	+10	0.274	+11	0.794	+09	0.287	+11
31	1410	0.485	+09	0.941	+13	0.539	+09				
151	46	SOURCE 28									
11	32	1									
2	7		87.58		88.22						
2	28	223.31		246.75							
5	1400	0.411	+11	0.367	+10	0.638	+10	0.100	+11	0.594	+15
5	1405	0.544	+12	0.143	+10	0.201	+11	0.788	+09	0.197	+11
31	1410	0.481	+09	0.899	+13	0.535	+09				
151	46	SOURCE 29									
11	32	1									
2	7		94.18		94.82						
2	28	246.75		270.19							
5	1400	0.154	+11	0.133	+10	0.238	+10	0.723	+10	0.683	+15
5	1405	0.201	+12	0.542	+09	0.241	+11	0.297	+09	0.222	+11

TABLE 9-12 (CONT)

31	1410	0.181	+09	0.356	+13	0.201	+09				
151	46	SOURCE 30									
11	32	1									
2	7	100.28		100.92							
2	28	270.19		293.63							
5	1400	0.134	+11	0.140	+10	0.244	+10	0.304	+10	0.132	+15
5	1405	0.163	+12	0.468	+09	0.660	+10	0.256	+09	0.747	+10
31	1410	0.156	+09	0.315	+13	0.174	+09				
151	46	SOURCE 31									
11	32	1									
2	7	106.18		106.82							
2	28	293.63		317.07							
5	1400	0.817	+10	0.721	+09	0.125	+10	0.189	+10	0.110	+15
5	1405	0.103	+12	0.286	+09	0.563	+10	0.157	+09	0.553	+10
31	1410	0.960	+08	0.182	+13	0.106	+09				
151	46	SOURCE 32									
11	32	1									
2	7	111.48		112.12							
2	28	317.07		340.51							
5	1400	0.816	+10	0.109	+10	0.197	+10	0.343	+10	0.184	+15
5	1405	0.105	+12	0.286	+09	0.584	+10	0.156	+09	0.645	+10
31	1410	0.959	+08	0.180	+13	0.106	+09				
151	46	SOURCE 33									
11	32	1									
2	7	116.28		116.92							
2	28	340.51		363.95							
5	1400	0.468	+10	0.403	+09	0.700	+09	0.843	+09	0.434	+14
5	1405	0.478	+11	0.164	+09	0.351	+10	0.901	+08	0.341	+10
31	1410	0.551	+08	0.130	+13	0.612	+08				
151	46	SOURCE 34									
11	32	1									
2	7	120.28		120.92							
2	28	363.95		387.39							
5	1400	0.434	+10	0.524	+09	0.948	+09	0.138	+10	0.774	+14
5	1405	0.469	+11	0.149	+09	0.248	+10	0.817	+08	0.280	+10
31	1410	0.499	+08	0.977	+12	0.555	+08				
151	46	SOURCE 35									
11	32	1									
2	7	124.18		124.82							
2	28	387.39		410.83							
5	1400	0.365	+10	0.305	+09	0.527	+09	0.719	+09	0.341	+14
5	1405	0.296	+11	0.128	+09	0.168	+10	0.701	+08	0.177	+10
31	1410	0.429	+08	0.808	+12	0.476	+08				
151	46	SOURCE 36									

TABLE 9-12 (CONT)

```
 11      32  1
  2       7      127.98      128.62
  2      28 410.83       434.27
  5    1400 0.717    +10 0.786    +09 0.132    +10 0.161    +10 0.661    +14
  5    1405 0.970    +11 0.248    +09 0.201    +10 0.136    +09 0.237    +10
 31    1410 0.831    +08 0.154    +13 0.924    +08
151      46 SOURCE 37
 11      32  1
  2       7      134.28      134.92
  2      28 434.27       457.71
  5    1400 0.242    +10 0.203    +09 0.411    +09 0.593    +09 0.319    +14
  5    1405 0.319    +11 0.851    +08 0.635    +10 0.466    +08 0.564    +10
 31    1410 0.285    +08 0.626    +12 0.316    +08
151      46 SOURCE 38
 11      32  1
  2       7      134.28      134.92
  2      28 457.71       481.15
  5    1400 0.523    +10 0.453    +09 0.825    +09 0.930    +09 0.274    +14
  5    1405 0.632    +11 0.183    +09 0.232    +10 0.100    +09 0.230    +10
 31    1410 0.614    +08 0.112    +13 0.683    +08
151      46 SOURCE 39
 11      32  1
  2       7      137.68      138.32
  2      28 481.15       504.80
  5    1400 0.282    +10 0.406    +09 0.758    +09 0.136    +10 0.976    +14
  5    1405 0.292    +11 0.955    +08 0.258    +10 0.523    +08 0.282    +10
 31    1410 0.319    +08 0.754    +12 0.355    +08
151      46 SOURCE 40
 21      31  3  1
  2       7      140.38      141.02
  2      28 504.80       528.09
  5    1400 0.504    +10 0.571    +09 0.102    +10 0.159    +10 0.962    +14
  5    1405 0.629    +11 0.173    +09 0.351    +10 0.952    +08 0.356    +10
 31    1410 0.582    +08 0.109    +13 0.646    +08
√
√
```

TABLE 9-13

DATA REQUIRED FOR NOZZLE SOURCE* INPUT TO THE KAP-VI PROBLEM

Source Region Number	Axial Coordinates (cm)		ΔZ (cm)	Radial Coordinates (cm)			ΔR (cm)	Volume (cc)	Component
	Z_l	Z_u		$\bar{R}$	R_i	R_o			
1	1.0	7.31	6.31	51.75	51.115	52.385	1.27	2606.35	Core Support Ring
2	7.31	12.62	5.31	51.75	51.115	52.385	1.27	2193.37	↓
3	12.62	16.94	4.32	51.75	51.115	52.385	1.27	1783.27	↓
4	16.94	20.24	3.30	51.75	50.81	52.69	1.88	2014.86	Nozzle Flange
5	16.94	20.24	3.30	53.61	52.38	55.24	2.86	3188.90	↓
6	16.94	20.24	3.30	56.67	55.24	58.1	2.86	3358.14	↓
7	15.93	20.24	4.31	59.53	58.1	60.96	2.86	4616.02	↓
8	17.95	31.16	13.21	47.0	46.33	47.68	1.35	5260.14	Convergent Cone
9	31.16	42.09	10.93	37.3	36.60	38.00	1.41	3627.48	↓
10	42.09	53.01	10.92	28.2	28.30	29.31	1.16	2293.41	↓
11	53.01	63.93	10.92	20.3	19.85	20.75	0.904	1258.22	↓
12	63.93	75.14	11.21	18.42	18.02	18.82	0.80	1036.13	Divergent Cone
13	75.14	84.57	9.43	24.6	24.18	25.02	0.84	1219.85	↓
14	84.57	94.16	9.59	31.2	30.76	31.65	0.89	1669.18	↓
15	90.09	98.3	8.21	35.8	34.09	37.51	3.42	6320.01	Aft Flange and Fore Ring
16	90.8	99.2	8.39	44.73	39.44	50.02	10.58	24955.19	Torus
17	93.78	105.17	11.39	34.3	32.69	35.92	3.33	7938.13	Skirt
18	105.17	115.35	10.18	40.4	38.78	42.03	3.25	8528.52	Aft Flange and Retainer
19	115.35	125.53	10.18	46.0	44.47	47.59	3.17	9329.50	Skirt Extension
20	125.53	135.71	10.18	51.0	49.48	52.52	3.04	9912.01	↓
21	135.71	145.89	10.18	55.5	54.06	56.95	2.89	10263.60	↓
22	145.89	156.07	10.18	60.3	58.96	61.65	2.69	10388.60	↓
23	156.07	166.25	10.18	64.8	63.56	66.04	2.48	10287.10	↓
24	166.25	176.43	10.18	68.6	67.47	69.73	2.26	9957.78	↓
25	174.53	177.38	2.85	73.0	71.67	74.33	2.66	3482.21	↓
26	176.43	199.87	23.44	73.2	72.74	73.66	0.92	7078.81	↓
27	199.87	223.31	23.44	80.8	80.48	81.12	0.64	7714.56	↓
28	223.31	246.75	23.44	87.9	87.58	88.22	0.64	8327.12	↓
29	246.75	270.19	23.44	94.5	94.18	94.82	0.64	8900.0	↓
30	270.19	293.63	23.44	100.0	100.28	100.92	0.64	9447.87	↓
31	293.63	317.07	23.44	106.5	106.18	106.82	0.64	9959.50	↓
32	317.07	340.51	23.44	111.8	111.48	112.12	0.64	10438.70	↓
33	340.51	363.95	23.44	116.6	116.28	116.92	0.64	10886.30	↓
34	363.95	387.39	23.44	120.6	120.28	120.92	0.64	11301.70	↓
35	387.39	410.83	23.44	124.5	124.18	124.92	0.64	11684.20	↓
36	410.83	434.27	23.44	128.3	127.98	128.62	0.64	12036.00	↓
37	434.27	457.71	23.44	131.3	130.98	131.52	0.64	12355.00	↓
38	457.71	481.15	23.44	134.6	134.28	134.92	0.64	12641.20	↓
39	481.15	504.80	23.55	138.0	137.68	138.32	0.64	12896.70	↓
40	504.80	528.09	23.39	140.7	140.38	141.02	0.64	13153.50	↓

*All Source Data from the March, 1970 Common Radiation Analysis Model, RN-S-0551.

10.0 The SCAP Code

SCAP is a point kernel code employing energy dependent single or albedo-scatter methods to calculate the radiation level at a detector point located within or outside a complex scattering geometry describable by a combination of quadratic surfaces. The code evaluates the material thickness and scatter points in materials intercepted along lines-of-sight from an anisotropic energy dependent source point. The material thicknesses (or path lengths) to each point is used in an exponential attenuation function to calculate the radiation level at each scatter point.

Three options exist in the treatment of particle scattering to a detector point. Photon scattering at the scatter point to the detector point can be treated as a Compton scatter event using the differential form of the Klein Nishina for the inelastic scattering of a photon with a free electron, or as a simple albedo scatter event at the surface of a geometric zone. Neutron scattering at the scatter point to the detector point can be treated only as an albedo scatter event at the surface of the geometric zone.

The attenuation function for the scattered particle (photon or neutron) on the scatter leg to the detector point is an exponential attenuation function with a buildup factor to account for multiple scatter on the scatter leg for photons only.

The code handles a series of anisotropic energy dependent point sources with the anisotropy of the point sources represented as the pointwise variation of flux levels on a spherical detector (meridian ring).

10.1 Options Utilized in the Seminar/Workshop Problems

In the MSFC Seminar/Workshop problems, the photon scattering was treated as a Compton scatter event. Cross sections input to the SCAP code were obtained from the GAMLEG-W code. The simple albedo scatter options were not used.

Three photon SCAP problems were run to analyze the dose at the crew location. The first problem calculated the contribution of the Nuclear Subsystem sources generated by the KAP-VI code. The second problem calculated the contribution of the nozzle sources obtained from the March, 1970 Common Radiation Analysis Model. The third problem calculated the contribution of the pump discharge line sources which were also obtained from the Common Radiation Analysis Model. Each of the three SCAP problems included "stacked cases" so that the effect of various levels of liquid hydrogen propellant could be analyzed. From these cases, a dose rate versus time curve was developed. The SCAP input data for each of the three problems are described in detail in the sections which follow.

10.2 General Description of the Input Data

The input data for the SCAP code are divided into the following three data sets:

1. Overall problem storage allocation
2. Overall problem title and parameters
3. Problem geometry, source, and detector data

The first data set is entered on a single formatted card which is the first physical card of each problem deck. The second data set consists of the title card and five cards of integer and real data on formatted cards in data fields of 12 columns each. This set of data is always required as input to a SCAP problem and all input data must be entered in the correct field of each card since a fixed FORTRAN format is used to read all cards.

Data Set 3 of a SCAP problem input is written in one of three possible FORTRAN type formats. The integer data arrays (denoted by a dollar sign) must always be input in the standard SCAP (FIDO)* format capability of six fields of 12

*FIDO is a generalized input routine capable of performing operations to prepare data arrays. This routine is standardized through the DOT-IIW, ANISN-W and MAP codes.

columns in each field. Each field in the standard format is subdivided into three subfields. Integer data must be entered as right adjusted* in the third subfield of each data field. Real data may be entered in the standard SCAP or one of two non-standard format capabilities.

It is assumed that the reader will utilize the SCAP user's manual during the discussion of the input data to follow. The SCAP user's manual is published in a separate document (WANL-PR(LL)-034, Volume 6, Point Kernel Techniques).

10.3 Input Data Description for the NSS Source Problem

A listing of the SCAP input data for the NSS source problem is given in Table 10-1. Each input data set is described in detail below.

10.3.1 Data Set 1 - Problem Storage Allocation

Only one data card is needed in Data Set 1. This describes the number of core memory locations to be allocated for problem data storage. On the MSFC UNIVAC-1108, the maximum value is 35,000. However, for the Seminar problem a value of only 4096 is required as input. Page 3-22 of the SCAP user's manual provides an equation which can be evaluated to determine this input quantity.

10.3.2 Data Set 2 - Overall Problem Title and Parameters

The first card of this data set is an appropriate title card. From the title card in Table 10-1, note that the first SCAP case applies to a condition in which there is liquid hydrogen only in the small run tank.

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*"right adjusted" means that the least significant digit of an integer number is at the extreme right of the field.

The second card of Data Set 2 contains six pieces of data as follows:

1. The number of output energy groups; this quantity was input as 8.
2. The number of source energy groups; this quantity is input as 13 which is consistent with the KAP-VI output data.
3. The number of polar angles in the source input; this value is input as a minus eight which indicates that KAP-VI punched card output data is input by energy group and by polar angle for a total of eight polar angles.
4. The number of energy points in the pointwise absorption cross section data; twenty energy points were selected for this study.
5. The number of elements in the zone composition-element table; from Table 10-2, the number of elements is shown as six.
6. The number of compositions in the zone composition-element table; from Table 10-2, the number of compositions is shown as eight.

The third card of Data Set 2 contains the following six pieces of data:

1. The number of zones in the problem, i.e., 46. Figures 10-1 and 10-2 schematically illustrate the propellant tank and crew compartment geometry input to the SCAP code. For the NSS source problem, zones 47, 48, and 49 were not employed;

zone 1 was enclosed by boundaries 1, 15, and 2. (Zones 47, 48 and 49 were employed only in the PDL source problem described later in this section.)

2. The number of boundary surfaces in the problem, i.e., 45. This input quantity can be determined from Figures 10-1 and 10-2. Note that boundaries 46, 47 and 48 were not used in the NSS source problem; these boundaries were used only in the PDL source problem.

3. The number of initial source rays emanating in polar angle from the anisotropic point source; this quantity is input as a plus 25. The values of 25 is based on previous experience using the SCAP code (see Volume I, WANL-PR(LL)-034). The plus sign indicates that the range of the input polar angle is subdivided equally into the number of input internals, i.e., 25.

4. The order of integration in azimuthal angle of the anisotropic point source. This quantity is input as a one so that the 2π symmetry condition for an on-axis point source and detector point is applied.

5. The most probable zone which contains the anisotropic point source; this quantity is input as a one (for zone 1) which can be determined from the geometry (Figure 10-1) for the NSS source problem.

6. The library option; this quantity is input as a one--this indicates that a library data tape previously generated by the GAMLEG-W code must be mounted on tape unit 11 to generate gamma ray absorption cross section data.

The fourth card of this data set contains three pieces as follows:

1. The number of source points in the problem; this quantity is a one for the NSS source problem.

2. Type of buildup desired; this quantity is set equal to 1 so that water buildup factors are used for all materials. (Table 2-2 of the KAP-VI user's manual is used to determine this input quantity at the discretion of the user.)

3. Type of scatter technique; this quantity is input as a zero to select the single scatter technique rather than the albedo technique.

The fifth card of Data Set 2 contains the following four pieces of data:

1. The lower limit in polar angle at which source rays will emanate from the point source. This quantity is input as 168.28333 degrees. The SCAP code assumes a polar angle of 0° in the positive Z direction. Referring to Figure 10-1 is is noted that the propellant tank geometry is input in terms of the negative Z direction. Hence, the 0° degree angle is towards the nozzle end of the geometry. Since the tank substends an angle of 11° 43' with the center of the core, this angle is converted to 168.28333° for the SCAP input.

2. The upper limit in polar angle. For the reasons stated above, this quantity is input as 180 degrees.

3. The lower limit in azimuthal angle at which source rays will emanate from the point source. This quantity is input as zero degrees.

4. The upper limit in azimuthal angle; this quantity is input as 180 degrees.

The last card of this data set contains the following five pieces of data:

1. The radius of the meridian ring at which the anisotropic point source data is defined. For the Seminar problem, this quantity is 914.4 cm, i.e., the meridian ring is located 30 feet from the center of the core. This is the same radius at which the KAP-VI data were generated.

2. The electron path length (electrons/$cm^2 \times 10^{24}$) per scatter point. This quantity was input as 12.0. However, the user of the code should run test cases in which this parameter is a variable to insure the validity of the results. (Previous WANL studies, Volume 1, WANL-PR(LL)-034, indicate that 6.0 or 12.0 is probably adequate for this geometry.)

3. Radius of a sphere which contains all scatter points in the problem. This quantity is input as 10,000 which is larger than the maximum boundary of -6000.0 shown in Figure 10-2.

4. Multiplication factor applied to all source data. This quantity is input as 1.0 since the source data punched on cards from the KAP-VI problem is already in the proper units.

5. The exclusion radius on the primary leg. This quantity was input as 0.0 for the Seminar problem.

10.3.3 Data Set 3 - Geometry, Source, and Detector Data

The first set of input in Data Set 3 is the 1$ array to describe the number of boundaries per zone in the geometry. These data are developed from the geometries shown in Figures 10-1 and 10-2. There are 46 entries in the 1$ array, one for each zone in the problem. Note that a minus sign precedes the data for zones 44, 45, and 46 indicating that these three zones are "outside" zones.

The next set of data is the 2$ array. Each card of the 2$ array is used to describe one zone in the problem; thus, there are 46 cards in this array. Six boundary numbers must be entered on each card--if the zone requires less than six boundaries, the remaining data must be entered as integer zeros. In this data array, the user must specify the ambiguity indices for each boundary for each zone. Ambiguity indices are assigned as <u>negative</u> for boundaries which are in a negative direction in relation to the ray leaving the zone and crossing the boundary. This data array is developed from the geometries shown in Figures 10-1 and 10-2.

The next entry is the 3$ array which describes the zones entered upon crossing each boundary previously described in the 2$ array. One card must be entered for each zone; thus, a total of 46 cards are entered in this array. Six numbers must be entered on each card--if there are less than six zones, the remaining quantities must be input as integer zeros. This input array is developed from the geometries shown in Figures 10-1 and 10-2.

The 4$ array describes the equation number for each boundary surface. The equations are defined in Table 3-2 of the SCAP user's manual. The repeat option was used in setting up this input array. There are 45 entries in this array, one for each boundary.

Data arrays 7*, 8*, 9*, 10*, and 11U describe the boundary surface coefficients Z, A, B, C, and D, respectively. The coefficients for each surface are conveniently listed in Table 10-3. The above data arrays can be simply developed from this table.

The 12U array describes the energy values at which the cross section data is calculated from the GAMLEG-W input data tape. As shown in Table 10-1, these values range from 10.0 Mev to 0.02 Mev and are entered in descending order. Twenty values are entered as defined previously.

The 13U array describes the electrons per atom for each element in the problem. These data are given in Table 10-2.

The 14* array contains the density (gm/cc) for each element in each composition. This input array is developed from the data in Table 10-2.

The 15$ array contains the composition number for each zone in the problem. There are 46 entries, one for each zone. For convenience, the compositions are listed in Table 10-4.

The 16U array contains the energy values (Mev) for the point source meridian ring input data. These thirteen values are the average energies for each of the KAP-VI output groups and are entered in descending order.

The 17U array contains the energy group limits for the scattered results at the detector point, i.e., the output group structure. Nine values are entered to describe the eight group output structure.

In the 18U array, the polar angles are input corresponding to the meridian ring data used to describe the anisotropic point source. Recall from Data Set 2, that the angles ranged from 168.2833 degrees to 180° and that there are eight polar angles. The 180° angle corresponds to the KAP-VI output at 0°, 178° corresponds to the KAP-VI output at 2°, etc.

The data cards input in the 19U array are the KAP-VI punched card output data. A set of 13 values (one for each energy group) are entered for each polar angle in the same order as defined in the 18 U array.

The 20U array defines the source point coordinates--in terms of X, Y and Z. The source point is located at the center of the reactor core, i.e., 0.0, 0.0, -71.12 cm.

The 21U array defines the coordinates of the detector point in terms of X, Y, and Z. The detector defines a crew location on the centerline of 0.0, 0.0, -4638.3 cm.

Data Set 3 must be followed by a terminate card (T in column 3) as shown in the input data listing.

10.3.4 Stacked Cases

For the Seminar/Workshop problems, three stacked cases are run behind the first SCAP problem. Each of these three cases describe a different level of liquid hydrogen in the propellant tank.

In order to run a stacked problem, the LIM1 card is not input for each case. However, all of the Data Set 2 cards must be input as part of each stacked case. For each stacked problem these are identical to the initial SCAP problem input with one exception, the minus sign preceding the third word on card two is deleted from the input. Of course, the title cards were changed to provide meaningful labeling of the output data.

For the Seminar problem the 15$ array--the zone composition table--is changed for each stacked case. The changes required are defined in Table 10-4. For each stacked case, a terminate card must be input immediately following the 15$ array before reading in the next case.

10.4 Input Data Description for the Nozzle Source Problems

The purpose of this SCAP problem is to calculate the contribution at the crew location due to the scattered radiation from the nozzle sources. The reader will recall that the direct radiation due to this component was calculated in the KAP-VI problem. Furthermore, KAP-VI calculated the contribution from this source on a meridian ring located 30 feet roughly from the geometric center of the nozzle geometry.

A listing of the input data for this problem is given in Table 10-5. The majority of the input data is identical to that described for the NSS source problem. Only those changes required to run the nozzle source problem are described in this section.

The title card was changed to provide meaningful labeling of the output data.

The number of polar angles (third word, card 2, Data Set 2) was changed to a 9, since this encompasses the possible angles intercepted by propellant tank. The lower limit of the polar angle was changed to 165.0 degrees (the first word, card 5, Data Set 2).

The 165.0 degree lower polar angle limit was also inserted in the 18U array.

The KAP-VI punched card output data for the nozzle meridian ring problem were inserted into the 19U array.

The axial location of the source point was changed to 192.0 cm in the 20U array.

The three stacked cases, following the first problem, are similar to those described previously in Section 10.3.4.

10.5 Input Data Description for the PDL Source Problem

Table 10-6 is a listing of the SCAP input data to describe the problems containing the pump discharge line (PDL) sources. This problem calculated the direct and scattered contribution to the crew location due to this source of radiation.

Only those data in Table 10-6 which differ from the NSS source problem previously discussed in Section 10.3 are discussed in this section.

The PDL source data were developed from the March, 1970 Common Radiation Analysis Model. Six geometrical source points were selected from the CRAM to represent the PDL. However, the CRAM total source for the PDL was preserved. Only six points were selected since the computer time required to run this problem is roughly directly propertional to the number of source points. Table 10-7 summarizes the PDL source data required as input to the SCAP problem.

On card 2 of Data Set 2, the third piece of data is input as a two to indicate that two polar angles must be input, i.e., 0 and π for each PDL source point.

On card 3 of Data Set 2, the number of regions and boundaries are 49 and 48, respectively. Referring to Figure 10-1, it can be seen that regions 47, 48, and 49 and boundaries 46, 47 and 48 were added to the geometry. This is required because of the relationship between the PDL source geometry and the NSS geometry. Rays from the source points can intersect the NSS geometry. In fact, the last of the six PDL source points is located below the NSS and never "sees" the detector. (This was done in the Seminar problem to demonstrate one of the available options in SCAP. From the SCAP output data, one can observe an answer of "zero" from the 6th source point.)

The order of integration in the azimuthal angle is now input as a four. (Fourth word, card three.) This is needed because the source point is not on the centerline.

The most probable zone containing the source point is input as 47 (see Figure 10-1) on data card three.

On the fourth data card of Data Set 2, the number of source points is input as six.

On the fifth data card of Data Set 2, the lower limit of the source polar angle is input as 120.0 degrees so that all sources ray will intercept the propellant tank geometry.

On the sixth data card of Data Set 2, the radius of the meridian ring at which the source point data is defined was arbitrarily input as 10.0 cm. Also on this card, the source normalization constant is input as 7.958×10^{-4}. Note that this constant is derived on Table 10-7.

In the 1$ array, which describes the number of boundaries per zone, data were added for zones 47, 48 and 49. Data for zone 1 was modified to agree with the geometry shown in Figure 10-1.

In the 2$ array, which describes the boundary numbers for each surface of a zone, data were added for zones 47, 48 and 49. Zone 1 data was modified per Figure 10-1.

Similar modifications were also made in the 3$ array which describes the zone entered upon crossing the boundary. The 3$ data input for zone 48 (the NSS region) should be carefully noted. The first quantity input on this card is preceeded by a minus sign. This indicates to the code that zone 48 is a "black absorber" zone, i.e., a zone at which the source leg calculation is terminated.

In the 4$ array, the appropriate equation numbers were added for boundaries 46, 47 and 48.

In the 7, 8, 9, 10 and 11* arrays the coefficients for boundaries 46, 47 and 48 were added. (These coefficients are given in Table 10-3.)

In the 15$ array, the compositions for zones 47, 48 and 49 were added.

In the 18U array, the polar angles are simply input as 0 degrees and 180 degrees. The code interpolates between these limits to obtain the source point data.

The source energy data from Table 10-7 are input in the 19U array. Notice that 12 sets of data are entered and that two sets are entered for each source point. These two sets correspond to the two polar angles of 0^{o} and 180^{o}.

The coordinates of the six source points are input in the 20U array. These coordinates can be obtained from Table 10-7.

Three stacked cases, similar to those described in Section 10.3.4, were also input for the PDL source problem as shown in Table 10-6.

10.6 Problem Set Up Description

Three tapes are generally used in running a typical SCAP problem. Tapes 5 and 6 are the input and output discs, respectively. Tape 11 is an input tape generated by the GAMLEG-W code and contains the pair production and photoelectric pointwise cross section data.

10.7 Output Data Description

Output data from the SCAP code consists of the printed output of the input data, and the calculated results.

The printed output of the SCAP code is:

1. The title card and a listing of the input data of Data Sets 1 and 2.

2. The data storage requirements and limits (LIM1) for the problem,

3. The FIDO subroutines edit of reading all input data arrays consisting of the type of format, the array number, and the number of entries input.

4. If the input quantity NL = 1, a tabulation describing the microscopic cross section data read from the input data tape.

5. An organized printout of input data consisting of the geometry data, cross section energy points, atomic number of element data (electrons per atom), electron density by zone material (electrons per cm^3), and zone material compositions.

6. A tabulation of the cross section data by energy point and material. If this is a gamma ray problem then these data are the macroscopic absorption cross section (photoelectric plus pair production). If this is a neutron problem the cross sections are macroscopic total (or removal) cross sections.

7. The input surface equation types and their coefficients.

8. The source energy values, flux group energy bounds, and the albedo data by source energy group.

9. The input anisotropic point source data by angle and source group energy for each source point including the source input Cartesian coordinates.

10. The detector point Cartesian coordinates.

11. The calculated results of the point source data (including the source polar angle interval limits) in units of MeV/second (or particles/second) by angle and group.

12. The single scattered or reflected results by scatter or albedo zone and flux group, with and without buildup for each source point.

13. The summary results of the SCAP calculation of the dose rates with and without buildup by scatter or albedo zone, dose rates by source ray, dose rates by composition, scatter zone volume or albedo scatter zone area, and for gamma ray single scatter calculations the heat deposition by scatter zone and material composition.

14. The total number of scatter or albedo points in the problem for the source point.

15. The total direct (uncollided) dose rate and the total (direct plus scattered) dose rate at the detector point.

16. The final summary results of the summation of dose rates (total direct, and scattered) for all source points in the problem.

The calculated results of the SCAP code are in the units of Rads (carbon)/hour for all gamma ray calculations. This requires that the input source data be in units of MeV/cm^2-second. Neutron data are labeled as Rads (carbon)/hour but the units are defined by the input data DOC specified by the user.

TABLE 10-1. INPUT DATA LISTING FOR THE SCAP NSS SOURCE PROBLEM

```
     4096
MSFC SCAP PROBLEM - KAP INPUT - LH2 IN RUN TANK       NSS SOURCES
          8        13         -8        20          6          8
         46        45         25         1          1          1
          1         1          0
168.2833333 180.0     0.0          180.0
914.4       12.0      10000.0      1.0        0.0
1$
          3         4          4         4          3          4
          3         2          3         3          2          3
          3         4          3         2          3          3
          3         3          3         2          4          3
          4         4          4         4          4          3
          3         3          4         3          3          4
          4         3          3         4          3          2
          3        -1         -1        -3
2$
          1        15         -2         0          0          0  1
          2        15         -3       -16          0          0  2
          3        15         -4       -28          0          0  3
          4        15         -6       -19          0          0  4
         16        -3        -17         0          0          0  5
          3        28         -4       -27          0          0  6
        -18         4         19         0          0          0  7
         17        -3          0         0          0          0  8
          3        27         -4         0          0          0  9
          4        18         -5         0          0          0 10
          5        18          0         0          0          0 11
          6        15         -7         0          0          0 12
         20        -9        -21         0          0          0 13
          7        15         -9       -20          0          0 14
          9        15        -22         0          0          0 15
         21        -8          0         0          0          0 16
          8        21         -9         0          0          0 17
          9        23        -10         0          0          0 18
         10        23        -11         0          0          0 19
         11        24        -12         0          0          0 20
         12        24        -13         0          0          0 21
         13        25          0         0          0          0 22
         11        15        -13       -24          0          0 23
         13        26        -25         0          0          0 24
```

TABLE 10-1 (CONT)

15	-14	-26	13	0	0	25
9	22	-11	-23	0	0	26
14	15	-29	-37	0	0	27
29	15	-31	-39	0	0	28
31	15	-35	-42	0	0	29
14	36	-44	0	0	0	30
44	36	-45	0	0	0	31
45	36	-29	0	0	0	32
14	37	-29	-36	0	0	33
29	40	-30	0	0	0	34
30	40	-31	0	0	0	35
29	38	-31	-40	0	0	36
29	39	-31	-38	0	0	37
31	42	-32	0	0	0	38
32	41	-33	0	0	0	39
32	42	-34	-41	0	0	40
33	41	-34	0	0	0	41
34	43	0	0	0	0	42
34	42	-43	0	0	0	43
35	0	0	0	0	0	44
-1	0	0	0	0	0	45
1	-35	-15	0	0	0	46
45	46	2	0	0	0	1
1	46	3	5	0	0	2
2	46	4	6	0	0	3
3	46	12	7	0	0	4
2	6	8	0	0	0	5
5	3	7	9	0	0	6
10	6	4	0	0	0	7
5	9	0	0	0	0	8
8	6	10	0	0	0	9
9	7	11	0	0	0	10
10	7	0	0	0	0	11
4	46	14	0	0	0	12
14	26	16	0	0	0	13
12	46	15	13	0	0	14
14	46	26	0	0	0	15
13	17	0	0	0	0	16
16	13	18	0	0	0	17
17	26	19	0	0	0	18
18	26	20	0	0	0	19
19	23	21	0	0	0	20
20	23	22	0	0	0	21

3$

TABLE 10-1 (CONT)

```
           21          24           0           0           0           0 22
           26          46          24          20           0           0 23
           23          25          22           0           0           0 24
           46          30          24          21           0           0 25
           13          15          23          18           0           0 26
           25          46          28          33           0           0 27
           27          46          29          37           0           0 28
           28          46          44          38           0           0 29
           25          33          31           0           0           0 30
           30          33          32           0           0           0 31
           31          33          34           0           0           0 32
           25          27          37          30           0           0 33
           32          36          35           0           0           0 34
           34          36          38           0           0           0 35
           32          37          38          34           0           0 36
           33          28          38          36           0           0 37
           35          29          39           0           0           0 38
           38          40          41           0           0           0 39
           38          29          43          39           0           0 40
           39          40          42           0           0           0 41
           41          43           0           0           0           0 42
           40          29          42           0           0           0 43
           29           0           0           0           0           0 44
            1           0           0           0           0           0 45
           45          44           1           0           0           0 46
 4$
14R         6           9 8R        8           9 2R        8 2R        9
 7R         6 2R        9 2R        8 2R        9 2R        8
 2R         6
 7*
15R0.0        2R -777.24  2R -1066.80 4R -1717.04  0.0        2R -3888.74
11R0.0        2R -4483.68 2R 0.0      2R -4760.12
 2R 0.0
 8*
15R 0.0       8R 1.0      0.0         2R 1.0     11R 0.0      2R 1.0
 2R 0.0       2R 1.0
 2R 0.0
 9*
15R 0.0       8R 1.0      0.0         2R 1.0     11R 0.0      2R 1.0
 2R 0.0       2R 1.0
 2R 0.0
10*
15R         0.0 6R       1.0    -.1856      -.18547     0.0        2R       1.0
11R         0.0   2.6424        2.64676   2R      0.0   0.4887       0.4874
```

TABLE 10-1 (CONT)

```
 2R 0.0
11U
 1000.0       -570.00      -777.24      -1066.80     -1118.90     -1271.0
 -1360.00     -1500.0      -1717.04     -2000.0      -2542.54     -3500.0
 -3888.74     -4391.82     502.92       203.20       203.126      203.12
 203.20       355.60       355.42       355.60       355.30       502.62
 457.045      457.20       203.126      203.2        -4483.68     -4531.52
 -4622.96     -4628.04     -4638.20     -4760.12     -6000.0      330.2
 330.6        330.2        330.62       106.68       148.70       168.43
 148.70
-4392.24     -4483.26
15$
 4R          8 3R         1 3R         2            3            8            1
 2R          8 7R         3 2R         1            8            1 3R         8
             1            8 2R         1            8            4            8
             1            6 2R         7 2R         5            7 3R         8
12U
 10.0         8.0          6.0          4.5          3.0          2.5
 2.0          1.5          1.0          .8           .7           .6
 .5           .4           .3           .2           .1           .08
 .04          .02
13U
 1.0          6.0          7.0          8.0          13.0         14.0
14*
 4R 0.0          2.7          0.0          0.07         5R 0.0          0.00088
 5R 0.0          0.0101       0.0484       0.0323          0.1425       0.0
    0.0582       0.000011     0.0          0.000028        0.000404 2R  0.0
    0.0387       0.3642       0.0283       0.1294       6R 0.0          0.072
 7R 0.0
16U
 8.0          7.25         6.5          5.5          4.5          3.5
 2.8          2.5          2.0          1.5          1.0          .5
 .3
17U
 10.0         8.0          6.0          4.0          2.0          1.0
 .5           .2           .02
18U
 168.2833332 169.0        170.0        172.0        174.0        176.0
 178.0        180.0
19U
  .93675E+11   .29299E+11   .41753E+11   .27526E+11   .30838E+11   .27937E+11
  .10058E+11   .13662E+11   .88593E+10   .71336E+10   .38548E+10   .85511E+10
  .25987E+09
  .87234E+11   .28923E+11   .39986E+11   .26869E+11   .29996E+11   .27394E+11
```

TABLE 10-1 (CONT)

```
  .98923E+10  .13351E+11  .87773E+10  .69641E+10  .37043E+10  .85649E+10
  .22446E+09
  .79211E+11  .28477E+11  .37827E+11  .26076E+11  .28946E+11  .26725E+11
  .96782E+10  .12974E+11  .86694E+10  .67533E+10  .34934E+10  .85923E+10
  .17815E+09
  .67633E+11  .27943E+11  .34952E+11  .24990E+11  .27087E+11  .25650E+11
  .92731E+10  .12373E+11  .84500E+10  .64045E+10  .30634E+10  .87302E+10
  .99533E+08
  .63429E+11  .27903E+11  .34166E+11  .24635E+11  .25569E+11  .24950E+11
  .89362E+10  .11959E+11  .82572E+10  .61583E+10  .26863E+10  .87924E+10
  .33411E+08
  .63773E+11  .28173E+11  .34442E+11  .24780E+11  .25235E+11  .24893E+11
  .88940E+10  .11940E+11  .82762E+10  .61652E+10  .26295E+10  .88950E+10
  .22706E+08
  .64348E+11  .28365E+11  .34669E+11  .24973E+11  .25490E+11  .25141E+11
  .89981E+10  .12078E+11  .83853E+10  .62534E+10  .26741E+10  .89770E+10
  .23188E+08
  .64702E+11  .28440E+11  .34780E+11  .25050E+11  .25570E+11  .25229E+11
  .90328E+10  .12123E+11  .84208E+10  .62813E+10  .26874E+10  .90042E+10
  .23448E+08
20U
 0.0         0.0         -71.12
21U
 0.0         0.0         -4638.3
 T
 MSFC SCAP PROBLEM - KAP INPUT - LH2 TO -1500 CM       NSS SOURCES
           8          13          8          20          6          8
          46          45         25           1          1          1
           1           1          0
 168.283333  180.0       0.0         180.0
 914.4       12.0        10000.0     1.0         0.0
15$
 4R        8 3R        1 3R        2          3          8          1
 2R        8           2 6R        3 2R       1          8          1
 3R        8           1           8 2R       1          8          4
           8           1           6 2R       7 2R       5          7
 3R        8
 T
 MSFC SCAP PROBLEM - KAP INPUT - LH2 TO-1717.04 CM     NSS SOURCES
           8          13          8          20          6          8
          46          45         25           1          1          1
           1           1          0
 168.283333  180.0       0.0         180.0
 914.4       12.0        10000.0     1.0         0.0
```

TABLE 10-1 (CONT)

```
15$
 4R         8  3R        1  3R        2            3            8            1
 2R         8  2R        2  5R        3  2R        1            8            1
 3R         8            1            8  2R        1            8            4
            8            1            6  2R        7  2R        5            7
 3R         8
  T
 MSFC SCAP PROBLEM - KAP INPUT - LH2 TO--2542.54 CM    NSS SOURCES
            8           13            8           20            6            8
           46           45           25            1            1            1
            1            1            0
 168.283333  180.0        0.0          180.0
 914.4       12.0         10000.0      1.0          0.0
15$
 4R         8  3R        1  3R        2            3            8            1
 2R         8  4R        2  3R        3  2R        1            8            1
 3R         8            1            8  2R        1            8            4
            8            1            6  2R        7  2R        5            7
 3R         8
  T
√
```

TABLE 10-2

ELEMENT DENSITIES FOR THE SCAP GEOMETRY MODEL
(GM/CC)

Composition Description	Composition Number	H	C	N	O	Al	Cl
Tank Wall	1	0.0	0.0	0.0	0.0	2.7	0.0
Liquid Hydrogen	2	0.07	0.0	0.0	0.0	0.0	0.0
Gaseous Hydrogen	3	0.00088	0.0	0.0	0.0	0.0	0.0
Retro Propellant	4	0.0101	0.0484	0.0323	0.1425	0.0	0.0582
Air	5	0.000011	0.0	0.000028	0.000404	0.0	0.0
Epoxy	6	0.0387	0.3642	0.0283	0.1294	0.0	0.0
Capsule Wall	7	0.0	0.0	0.0	0.0	0.072	0.0
"Void"	8	0.0	0.0	0.0	0.0	0.0	0.0
Element Atomic Number		1	6	7	8	13	14

TABLE 10-3

COEFFICIENTS FOR THE SCAP BOUNDARY SURFACE EQUATIONS FOR THE SEMINAR/WORKSHOP PROBLEM
(See Figures 10-1 and 10-2 for Boundary Locations)

Boundary Number	Equation No. (4$)	Z (7*)	A (8*)	B (9*)	C (10*)	D (11U)
1	6	0.0	0.0	0.0	0.0	1000.0
2	6	0.0	0.0	0.0	0.0	-570.0
3	6	0.0	0.0	0.0	0.0	-777.24
4	6	0.0	0.0	0.0	0.0	-1066.80
5	6	0.0	0.0	0.0	0.0	-1118.90
6	6	0.0	0.0	0.0	0.0	-1271.0
7	6	0.0	0.0	0.0	0.0	-1360.0
8	6	0.0	0.0	0.0	0.0	-1500.0
9	6	0.0	0.0	0.0	0.0	-1717.04
10	6	0.0	0.0	0.0	0.0	-2000.0
11	6	0.0	0.0	0.0	0.0	-2542.54
12	6	0.0	0.0	0.0	0.0	-3500.0
13	6	0.0	0.0	0.0	0.0	-3888.74
14	6	0.0	0.0	0.0	0.0	-4391.82
15	9	0.0	0.0	0.0	0.0	502.92
16	8	-777.24	1.0	1.0	1.0	203.2
17	8	-777.24	1.0	1.0	1.0	203.126
18	8	-1066.8	1.0	1.0	1.0	203.12
19	8	-1066.8	1.0	1.0	1.0	203.2
20	8	-1717.04	1.0	1.0	1.0	355.6
21	8	-1717.04	1.0	1.0	1.0	355.42
22	8	-1717.04	1.0	1.0	-0.1856	355.6
23	8	-1717.04	1.0	1.0	-0.18547	355.3
24	9	0.0	0.0	0.0	0.0	502.62

TABLE 10-3 (Cont)

Boundary Number	Equation No. (4$)	Z (7*)	A (8*)	B (9*)	C (10*)	D (11U)
25	8	-3888.74	1.0	1.0	1.0	457.045
26	8	-3888.74	1.0	1.0	1.0	457.2
27	9	0.0	0.0	0.0	0.0	203.126
28	9	0.0	0.0	0.0	0.0	203.2
29	6	0.0	0.0	0.0	0.0	-4483.68
30	6	0.0	0.0	0.0	0.0	-4531.52
31	6	0.0	0.0	0.0	0.0	-4622.96
32	6	0.0	0.0	0.0	0.0	-4628.04
33	6	0.0	0.0	0.0	0.0	-4638.20
34	6	0.0	0.0	0.0	0.0	-4760.12
35	6	0.0	0.0	0.0	0.0	-6000.0
36	9	0.0	0.0	0.0	0.0	330.2
37	9	0.0	0.0	0.0	0.0	330.6
38	8	-4483.68	1.0	1.0	2.6424	330.2
39	8	-4483.68	1.0	1.0	2.64676	330.62
40	9	0.0	0.0	0.0	0.0	106.68
41	9	0.0	0.0	0.0	0.0	148.70
42	8	-4760.12	1.0	1.0	0.4887	168.43
43	8	-4760.12	1.0	1.0	0.4874	148.70
44	6	0.0	0.0	0.0	0.0	-4392.24
45	6	0.0	0.0	0.0	0.0	-4483.26
46	6	0.0	0.0	0.0	0.0	0.0
47	6	0.0	0.0	0.0	0.0	-230.48
48	9	0.0	0.0	0.0	0.0	71.12

TABLE 10-4

REGION COMPOSITIONS FOR THE SCAP SEMINAR PROBLEM

Composition Number	Description	Zone Numbers
1	Tank Wall (Aluminum)	5,6,7,13,23,24,26,30,32,33,37
2	LH_2	8,9,10
3	GH_2	11,16,17,18,19,20,21,22
4	Retro Propellant	35
5	Air	41,42
6	Epoxy	38
7	Capsule Wall	39,40,43
8	"Void"	1,2,3,4,12,14,15,25,27,28,29,31,34,36,44, 45,46

NOTE: The above data apply to the NSS Source problem with only the run tank filled with LH_2. For the second NSS source problem, the composition of zone 16 is changed to 2. For the third NSS, source problem, the composition of zones 16 and 17 is changed to 2. For the fourth NSS source problem, the composition of zones 16, 17, 18 and 19 is changed to 2.

TABLE 10-5. INPUT DATA LISTING FOR THE SCAP NOZZLE SOURCE PROBLEM

```
      4096
MSFC SCAP PROBLEM - KAP INPUT NOZZLE SOURCES - LH2 IN RUN TANK
          8           13           -9           20           6           8   1
         46           45           25            1           1           1
          1            1            0
165.0       180.0        0.0          180.0
914.4       12.0         10000.0      1.0          0.0
1$
          3            4            4            4           3           4
          3            2            3            3           2           3
          3            4            3            2           3           3
          3            3            3            2           4           3
          4            4            4            4           4           3
          3            3            4            3           3           4
          4            3            3            4           3           2
          3           -1           -1           -3
2$
          1           15           -2            0           0           0   1
          2           15           -3          -16           0           0   2
          3           15           -4          -28           0           0   3
          4           15           -6          -19           0           0   4
         16           -3          -17            0           0           0   5
```

TABLE 10-5 (CONT)

3	28	-4	-27	0	0	6
-18	4	19	0	0	0	7
17	-3	0	0	0	0	8
3	27	-4	0	0	0	9
4	18	-5	0	0	0	10
5	18	0	0	0	0	11
6	15	-7	0	0	0	12
20	-9	-21	0	0	0	13
7	15	-9	-20	0	0	14
9	15	-22	0	0	0	15
21	-8	0	0	0	0	16
8	21	-9	0	0	0	17
9	23	-10	0	0	0	18
10	23	-11	0	0	0	19
11	24	-12	0	0	0	20
12	24	-13	0	0	0	21
13	25	0	0	0	0	22
11	15	-13	-24	0	0	23
13	26	-25	0	0	0	24
15	-14	-26	13	0	0	25
9	22	-11	-23	0	0	26
14	15	-29	-37	0	0	27
29	15	-31	-39	0	0	28
31	15	-35	-42	0	0	29
14	36	-44	0	0	0	30
44	36	-45	0	0	0	31
45	36	-29	0	0	0	32
14	37	-29	-36	0	0	33
29	40	-30	0	0	0	34
30	40	-31	0	0	0	35
29	38	-31	-40	0	0	36
29	39	-31	-38	0	0	37
31	42	-32	0	0	0	38
32	41	-33	0	0	0	39
32	42	-34	-41	0	0	40
33	41	-34	0	0	0	41
34	43	0	0	0	0	42
34	42	-43	0	0	0	43
35	0	0	0	0	0	44
-1	0	0	0	0	0	45
1	-35	-15	0	0	0	46

3$

45	46	2	0	0	0	1
1	46	3	5	0	0	2

TABLE 10-5 (CONT)

2	46	4	6	0	0	3
3	46	12	7	0	0	4
2	6	8	0	0	0	5
5	3	7	9	0	0	6
10	6	4	0	0	0	7
5	9	0	0	0	0	8
8	6	10	0	0	0	9
9	7	11	0	0	0	10
10	7	0	0	0	0	11
4	46	14	0	0	0	12
14	26	16	0	0	0	13
12	46	15	13	0	0	14
14	46	26	0	0	0	15
13	17	0	0	0	0	16
16	13	18	0	0	0	17
17	26	19	0	0	0	18
18	26	20	0	0	0	19
19	23	21	0	0	0	20
20	23	22	0	0	0	21
21	24	0	0	0	0	22
26	46	24	20	0	0	23
23	25	22	0	0	0	24
46	30	24	21	0	0	25
13	15	23	18	0	0	26
25	46	28	33	0	0	27
27	46	29	37	0	0	28
28	46	44	38	0	0	29
25	33	31.	0	0	0	30
30	33	32	0	0	0	31
31	33	34	0	0	0	32
25	27	37	30	0	0	33
32	36	35	0	0	0	34
34	36	38	0	0	0	35
32	37	38	34	0	0	36
33	28	38	36	0	0	37
35	29	39	0	0	0	38
38	40	41	0	0	0	39
38	29	43	39	0	0	40
39	40	42	0	0	0	41
41	43	0	0	0	0	42
40	29	42	0	0	0	43
29	0	0	0	0	0	44
1	0	0	0	0	0	45
45	44	1	0	0	0	46

TABLE 10-5 (CONT)

```
 4$
14R        6          9 6R         8           9 2R         8 2R         9
 7R        6 2R       9 2R         8 2R        9 2R         8
 2R        6
 7*
15R0.0       2R -777.24   2R -1066.80 4R -1717.04   0.0         2R -3888.74
11R0.0       2R -4483.68 2R 0.0       2R -4760.12
 2R 0.0
 8*
15R 0.0      8R 1.0       0.0         2R 1.0      11R 0.0       2R 1.0
 2R 0.0      2R 1.0
 2R 0.0
 9*
15R 0.0      8R 1.0       0.0         2R 1.0      11R 0.0       2R 1.0
 2R 0.0      2R 1.0
 2R 0.0
10*
15R      0.0 6R      1.0   -.1856        -.18547     0.0        2R       1.0
11R      0.0  2.6424       2.64676    2R      0.0   0.4887        0.4874
 2R 0.0
11U
 1000.0      -570.00      -777.24     -1066.80    -1118.90     -1271.0
 -1360.00    -1500.0      -1717.04    -2000.0     -2542.54     -3500.0
 -3888.74    -4391.82     502.92      203.20      203.126      203.12
 203.20      355.60       355.42      355.60      355.30       502.62
 457.045     457.20       203.126     203.2       -4483.68     -4531.52
 -4622.96    -4628.04     -4638.20    -4760.12    -6000.0      330.2
 330.6       330.2        330.62      106.68      148.70       168.43
 148.70
-4392.24    -4483.26
12U
 10.0        8.0          6.0         4.5         3.0          2.5
 2.0         1.5          1.0         .8          .7           .6
 .5          .4           .3          .2          .1           .08
 .04         .02
13U
 1.0         6.0          7.0         8.0         13.0         14.0
14*
 4R 0.0         2.7          0.0         0.07      5R 0.0         0.00088
 5R 0.0         0.0101       0.0484      0.0323       0.1425      0.0
    0.0582      0.000011     0.0         0.000028     0.000404 2R 0.0
    0.0387      0.3642       0.0283      0.1294    6R 0.0         0.072
 7R 0.0
15$
```

TABLE 10-5 (CONT)

```
 4R          8 3R        1 3R         2           3           8           1
 2R          8 7R        3 2R         1           8           1 3R        8
             1           8 2R         1           8           4           8
             1           6 2R         7 2R        5           7 3R        8
16U
 8.0         7.25        6.5          5.5         4.5         3.5
 2.8         2.5         2.0          1.5         1.0         .5
 .3
17U
 10.0        8.0         6.0          4.0         2.0         1.0
 .5          .2          .02
18U
 165.0
 168.2833332 169.0       170.0        172.0       174.0       176.0
 178.0       180.0
19U
  .48888E+10  .51436E+09  .14001E+10  .12702E+10  .14207E+10  .11092E+10
  .24917E+09  .83602E+09  .16171E+09  .69863E+09  .27657E+09  .50849E+09
  .53971E+08
  .17261E+10  .17791E+09  .48411E+09  .43645E+09  .58178E+09  .38870E+09
  .84312E+08  .30429E+09  .57675E+08  .27465E+09  .12036E+09  .22426E+09
  .26660E+08
  .12730E+10  .13081E+09  .35998E+09  .32565E+09  .47364E+09  .30053E+09
  .65326E+08  .24473E+09  .46011E+08  .23114E+09  .10476E+09  .19920E+09
  .23836E+08
  .77934E+09  .80433E+08  .23068E+09  .21110E+09  .36682E+09  .21204E+09
  .47299E+08  .18603E+09  .35002E+08  .18589E+09  .87566E+08  .17054E+09
  .19792E+08
  .25226E+09  .27645E+08  .89449E+08  .87609E+08  .23123E+09  .11157E+09
  .25255E+08  .11345E+09  .19643E+08  .12592E+09  .61893E+08  .12584E+09
  .12564E+08
  .10806E+09  .12103E+08  .32767E+08  .36675E+08  .15099E+09  .53545E+08
  .99390E+07  .59619E+08  .71860E+07  .73600E+08  .35931E+08  .77869E+08
  .52522E+07
  .54762E+08  .48670E+07  .11096E+08  .76658E+07  .68621E+08  .21992E+07
  .23078E+06  .41429E+06  .42842E+05  .42725E+05  .14982E+04  .80001E+06
  .45357E+02
  .32127E+08  .28996E+07  .60500E+07  .42417E+07  .11236E+08  .11887E+07
  .12503E+06  .22386E+06  .22642E+05  .21743E+05  .73812E+03  .11167E+06
  .65140E+01
  .65647E+07  .59617E+06  .10533E+07  .82205E+06  .73490E+06  .22096E+06
  .17897E+05  .37567E+05  .23246E+04  .19931E+04  .25037E+02  .16471E+02
  .52302E-05
20U
```

TABLE 10-5 (CONT)

```
 0.0          0.0          192.0
21U
 0.0          0.0          -4638.3
  T
 MSFC SCAP PROBLEM - KAP INPUT NOZZLE SOURCES - LH2 TO -1500 CM
             8          13          9          20          6          8   1
            46          45         25           1          1          1
             1           1          0
 165.0        180.0        0.0        180.0
 914.4        12.0         10000.0    1.0          0.0
15$
 4R          8 3R        1 3R       2           3          8          1
 2R          8           2 6R       3 2R        1          8          1
 3R          8           1          8 2R        1          8          4
             8           1          6 2R        7 2R       5          7
 3R          8
  T
 MSFC SCAP PROBLEM - KAP INPUT NOZZLE SOURCES - LH2 TO -1717 CM
             8          13          9          20          6          8   1
            46          45         25           1          1          1
             1           1          0
 165.0        180.0        0.0        180.0
 914.4        12.0         10000.0    1.0          0.0
15$
 4R          8 3R        1 3R       2           3          8          1
 2R          8 2R        2 5R       3 2R        1          8          1
 3R          8           1          8 2R        1          8          4
             8           1          6 2R        7 2R       5          7
 3R          8
  T
 MSFC SCAP PROBLEM - KAP INPUT NOZZLE SOURCES - LH2 TO -2542 CM
             8          13          9          20          6          8   1
            46          45         25           1          1          1
             1           1          0
 165.0        180.0        0.0        180.0
 914.4        12.0         10000.0    1.0          0.0
15$
 4R          8 3R        1 3R       2           3          8          1
 2R          8 4R        2 3R       3 2R        1          8          1
 3R          8           1          8 2R        1          8          4
             8           1          6 2R        7 2R       5          7
 3R          8
  T
```

✓

C.8

TABLE 10-6. INPUT DATA LISTING FOR THE SCAP PDL SOURCE PROBLEM

```
      5000
MSFC SCAP - PDL SOURCES FROM CRAM - LH2 IN RUN TANK - CREW ON AXIS
         8           13          -2          20          6          8
        49           48          25           4         47          1
         6            1           0
120.0       180.0       0.0         180.0
10.0        12.0        100000.0    7.958       -04         0.0
1$
         4            4           4           4          3          4
         3            2           3           3          2          3
         3            4           3           2          3          3
         3            3           3           2          4          3
         4            4           4           4          4          3
         3            3           4           3          3          4
         4            3           3           4          3          2
         3           -1          -1          -3          3          3
         3
2$
        46           15         -47         -48          0          0
         2           15          -3         -16          0          0  2
         3           15          -4         -28          0          0  3
         4           15          -6         -19          0          0  4
        16           -3         -17           0          0          0  5
         3           28          -4         -27          0          0  6
       -18            4          19           0          0          0  7
        17           -3           0           0          0          0  8
         3           27          -4           0          0          0  9
         4           18          -5           0          0          0 10
         5           18           0           0          0          0 11
         6           15          -7           0          0          0 12
        20           -9         -21           0          0          0 13
         7           15          -9         -20          0          0 14
         9           15         -22           0          0          0 15
        21           -8           0           0          0          0 16
         8           21          -9           0          0          0 17
         9           23         -10           0          0          0 18
        10           23         -11           0          0          0 19
        11           24         -12           0          0          0 20
        12           24         -13           0          0          0 21
        13           25           0           0          0          0 22
        11           15         -13         -24          0          0 23
        13           26         -25           0          0          0 24
        15          -14         -26          13          0          0 25
         9           22         -11         -23          0          0 26
```

TABLE 10-6 (CONT)

14	15	-29	-37	0	0	27
29	15	-31	-39	0	0	28
31	15	-35	-42	0	0	29
14	36	-44	0	0	0	30
44	36	-45	0	0	0	31
45	36	-29	0	0	0	32
14	37	-29	-36	0	0	33
29	40	-30	0	0	0	34
30	40	-31	0	0	0	35
29	38	-31	-40	0	0	36
29	39	-31	-38	0	0	37
31	42	-32	0	0	0	38
32	41	-33	0	0	0	39
32	42	-34	-41	0	0	40
33	41	-34	0	0	0	41
34	43	0	0	0	0	42
34	42	-43	0	0	0	43
35	0	0	0	0	0	44
-1	0	0	0	0	0	45
1	-35	-15	0	0	0	46
1	15	-46	0	0	0	
46	48	-47	0	0	0	
47	15	-2	0	0	0	

3$

47	46	49	48	0	0	
1	46	3	5	0	0	2
2	46	4	6	0	0	3
3	46	12	7	0	0	4
2	6	8	0	0	0	5
5	3	7	9	0	0	6
10	6	4	0	0	0	7
5	9	0	0	0	0	8
8	6	10	0	0	0	9
9	7	11	0	0	0	10
10	7	0	0	0	0	11
4	46	14	0	0	0	12
14	26	16	0	0	0	13
12	46	15	13	0	0	14
14	46	26	0	0	0	15
13	17	0	0	0	0	16
16	13	18	0	0	0	17
17	26	19	0	0	0	18
18	26	20	0	0	0	19
19	23	21	0	0	0	20

TABLE 10-6 (CONT)

```
           20          23          22           0           0           0 21
           21          24           0           0           0           0 22
           26          46          24          20           0           0 23
           23          25          22           0           0           0 24
           46          30          24          21           0           0 25
           13          15          23          18           0           0 26
           25          46          28          33           0           0 27
           27          46          29          37           0           0 28
           28          46          44          38           0           0 29
           25          33          31           0           0           0 30
           30          33          32           0           0           0 31
           31          33          34           0           0           0 32
           25          27          37          30           0           0 33
           32          36          35           0           0           0 34
           34          36          38           0           0           0 35
           32          37          38          34           0           0 36
           33          28          38          36           0           0 37
           35          29          39           0           0           0 38
           38          40          41           0           0           0 39
           38          29          43          39           0           0 40
           39          40          42           0           0           0 41
           41          43           0           0           0           0 42
           40          29          42           0           0           0 43
           29           0           0           0           0           0 44
            1           0           0           0           0           0 45
           45          44           1           0           0           0 46
           45          46           1           0           0           0
          -47           1          49           0           0           0
            1          46           2           0           0           0
 4$
14R         6           9 8R        8           9 2R        8 2R        9
 7R         6 2R        9 2R        8 2R        9 2R        8
 4R         6           9
 7*
15R0.0      2R -777.24  2R -1066.80 4R -1717.04  0.0        2R -3888.74
11R0.0      2R -4483.68 2R 0.0      2R -4760.12
 5R 0.0
 8*
15R 0.0     8R 1.0       0.0        2R 1.0      11R 0.0     2R 1.0
 2R 0.0     2R 1.0
 5R 0.0
 9*
15R 0.0     8R 1.0       0.0        2R 1.0      11R 0.0     2R 1.0
 2R 0.0     2R 1.0
```

TABLE 10-6 (CONT)

```
 5R 0.0
10*
15R       0.0 6R       1.0    -.1856      -.18547     0.0       2R       1.0
11R       0.0   2.6424        2.64676   2R      0.0   0.4887       0.4874
 5R 0.0
11U
 1000.0      -570.0       -777.24      -1066.80     -1118.90     -1271.0
 -1360.0     -1500.0      -1717.04     -2000.0      -2542.54     -3500.0
 -3888.74    -4391.82     502.92       203.20       203.126      203.12
 203.20      355.60       355.42       355.60       355.30       502.62
 457.045     457.20       203.126      203.2        -4483.68     -4531.52
 -4622.96    -4628.04     -4638.20     -4760.12     -6000.0      330.2
 330.6       330.2        330.62       106.68       148.70       168.43
 148.70
-4392.24    -4483.26
 0.0         -230.48      71.12
15$
 4R          8 3R         1 3R         2            3            8            1
 2R          8 7R         3 2R         1            8            1 3R         8
             1            8 2R         1            8            4            8
             1            6 2R         7 2R         5            7 3R         8
 3R          8
12U
 10.0        8.0          6.0          4.5          3.0          2.5
 2.0         1.5          1.0          .8           .7           .6
 .5          .4           .3           .2           .1           .08
 .04         .02
13U
 1.0         6.0          7.0          8.0          13.0         14.0
14*
 4R 0.0          2.7          0.0          0.07      5R 0.0          0.00088
 5R 0.0          0.0101       0.0484       0.0323       0.1425       0.0
    0.0582       0.000011     0.0          0.000028     0.000404 2R 0.0
    0.0387       0.3642       0.0283       0.1294    6R 0.0          0.072
 7R 0.0
16U
 8.0         7.25         6.5          5.5          4.5          3.5
 2.8         2.5          2.0          1.5          1.0          .5
 .3
17U
 10.0        8.0          6.0          4.0          2.0          1.0
 .5          .2           .02
18U
 0.0         180.0
```

TABLE 10-6 (CONT)

190												
2.50	+13	1.17	+13	2.86	+13	1.45	+13	2.53	+13	2.72	+13
1.85	+13	7.17	+14	4.75	+12	1.49	+13	1.39	+13	1.04	+13
2.93	+12										
2.50	+13	1.17	+13	2.86	+13	1.45	+13	2.53	+13	2.72	+13
1.85	+13	7.17	+14	4.75	+12	1.49	+13	1.39	+13	1.04	+13
2.93	+12										
2.50	+13	1.17	+13	2.86	+13	1.45	+13	2.53	+13	2.72	+13
1.85	+13	7.17	+14	4.75	+12	1.49	+13	1.39	+13	1.04	+13
2.93	+12										
2.50	+13	1.17	+13	2.86	+13	1.45	+13	2.53	+13	2.72	+13
1.85	+13	7.17	+14	4.75	+12	1.49	+13	1.39	+13	1.04	+13
2.93	+12										
4.09	+14	1.92	+14	4.69	+14	2.37	+14	4.15	+14	4.45	+14
3.03	+14	1.17	+16	7.78	+13	2.45	+14	2.29	+14	1.71	+14
4.80	+13										
4.09	+14	1.92	+14	4.69	+14	2.37	+14	4.15	+14	4.45	+14
3.03	+14	1.17	+16	7.78	+13	2.45	+14	2.29	+14	1.71	+14
4.80	+13										
1.48	+15	6.90	+14	1.69	+15	8.54	+14	1.49	+15	1.60	+15
1.09	+15	4.23	+16	2.80	+14	8.82	+14	8.25	+14	6.15	+14
1.73	+14										
1.48	+15	6.90	+14	1.69	+15	8.54	+14	1.49	+15	1.60	+15
1.09	+15	4.23	+16	2.80	+14	8.82	+14	8.25	+14	6.15	+14
1.73	+14										
6.88	+14	3.22	+14	7.88	+14	3.98	+14	6.97	+14	7.48	+14
5.09	+14	1.97	+16	1.31	+14	4.11	+14	3.85	+14	2.87	+14
8.07	+13										
6.88	+14	3.22	+14	7.88	+14	3.98	+14	6.97	+14	7.48	+14
5.09	+14	1.97	+16	1.31	+14	4.11	+14	3.85	+14	2.87	+14
8.07	+13										
4.09	+14	1.92	+14	4.69	+14	2.37	+14	4.15	+14	4.45	+14
3.03	+14	1.17	+16	7.78	+13	2.45	+14	2.29	+14	1.71	+14
4.80	+13										
4.09	+14	1.92	+14	4.69	+14	2.37	+14	4.15	+14	4.45	+14
3.03	+14	1.17	+16	7.78	+13	2.45	+14	2.29	+14	1.71	+14
4.80	+13										
200											
138.59		0.0		-307.42							
129.5		0.0		-272.66							
81.03		0.0		-124.0							
81.03		0.0		-73.22							
81.03		0.0		-22.46							
63.0		0.0		49.46							

TABLE 10-6 (CONT)

```
210
 0.0          0.0          -4638.3
 T
 MSFC SCAP - PDL SOURCES FROM CRAM - LH2 TO -1500 CM - CREW ON AXIS
            8          13           2          20          6          8
           49          48          25           4         47          1
            6           1           0
 120.0        180.0        0.0          180.0
 10.0        12.0          100000.0     7.958    -04        0.0
15$
 4R         8 3R        1 3R        2             3           8           1
 2R         8           2 6R        3 2R          1           8           1
 3R         8           1           8 2R          1           8           4
            8           1           6 2R          7 2R        5           7
 3R         8
 3R         8
 T
 MSFC SCAP - PDL SOURCES FROM CRAM - LH2 TO -1717 CM - CREW ON AXIS
            8          13           2          20          6          8
           49          48          25           4         47          1
            6           1           0
 120.0        180.0        0.0          180.0
 10.0        12.0          100000.0     7.958    -04        0.0
15$
 4R         8 3R        1 3R        2             3           8           1
 2R         8 2R        2 5R        3 2R          1           8           1
 3R         8           1           8 2R          1           8           4
            8           1           6 2R          7 2R        5           7
 3R         8
 3R         8
 T
 MSFC SCAP - PDL SOURCES FROM CRAM - LH2 TO -2542 CM - CREW ON AXIS
            8          13           2          20          6          8
           49          48          25           4         47          1
            6           1           0
 120.0        180.0        0.0          180.0
 10.0        12.0          100000.0     7.958    -04        0.0
15$
 4R         8 3R        1 3R        2             3           8           1
 2R         8 4R        2 3R        3 2R          1           8           1
 3R         8           1           8 2R          1           8           4
            8           1           6 2R          7 2R        5           7
 3R         8
 3R         8

 T
```

TABLE 10-7

PUMP DISCHARGE LINE (PDL) SOURCE DATA FOR INPUT TO THE SCAP PROBLEM
Units: Mev/Sec

Photon Energy Group Number	Source Point 1 R = 138.59 cm Z = -307.42 cm	Source Point 2 R = 129.5 cm Z = 272.66 cm	Source Point 3 R = 81.03 cm Z = -124.0 cm	Source Point 4 R = 81.03 cm Z = -73.72 cm	Source Point 5 R = 81.03 cm Z = -22.46 cm	Source Point 6 R = 63.0 cm Z = 49.46 cm
1	2.50(13)	2.50(13)	4.09(14)	1.48(15)	6.88(14)	4.09(14)
2	1.17(13)	1.17(13)	1.92(14)	6.90(14)	3.22(14)	1.92(14)
3	2.86(13)	2.86(13)	4.69(14)	1.69(15)	7.88(14)	4.69(14)
4	1.45(13)	1.45(13)	2.37(14)	8.54(14)	3.98(14)	2.37(14)
5	2.53(13)	2.53(13)	4.15(14)	1.49(15)	6.97(14)	4.15(14)
6	2.72(13)	2.72(13)	4.45(14)	1.60(15)	7.48(14)	4.45(14)
7	1.85(13)	1.85(13)	3.03(14)	1.09(15)	5.09(14)	3.03(14)
8	7.17(14)	7.17(14)	1.17(16)	4.23(16)	1.97(16)	1.17(16)
9	4.75(12)	4.75(12)	7.78(13)	2.80(14)	1.31(14)	7.78(13)
10	1.49(13)	1.49(13)	2.45(14)	8.82(14)	4.11(14)	2.45(14)
11	1.39(13)	1.39(13)	2.29(14)	8.25(14)	3.85(14)	2.29(14)
12	1.04(13)	1.04(13)	1.71(14)	6.15(14)	2.87(14)	1.71(14)
13	2.93(12)	2.93(12)	4.80(13)	1.73(14)	8.07(13)	4.80(13)
Total	9.15(14)	9.15(14)	1.48(16)	5.15(16)	2.51(16)	1.48(16)

NOTE: Numbers in parentheses refer to powers of ten. The normalization constant, C, input to the SCAP PDL source problem is as follows:

$$C = \frac{1}{4\pi\rho 2} = \frac{1}{4\pi(10)^2} = 7.958 \times 10^{-4}, \text{ where}$$

the radius of the meridian ring, ρ, is defined as 10.0 cm. Thus, the units at the source are Mev/cm^2-sec.

FIGURE 10-1. PROPELLANT TANK GEOMETRY MODEL FOR THE SCAP PROBLEM

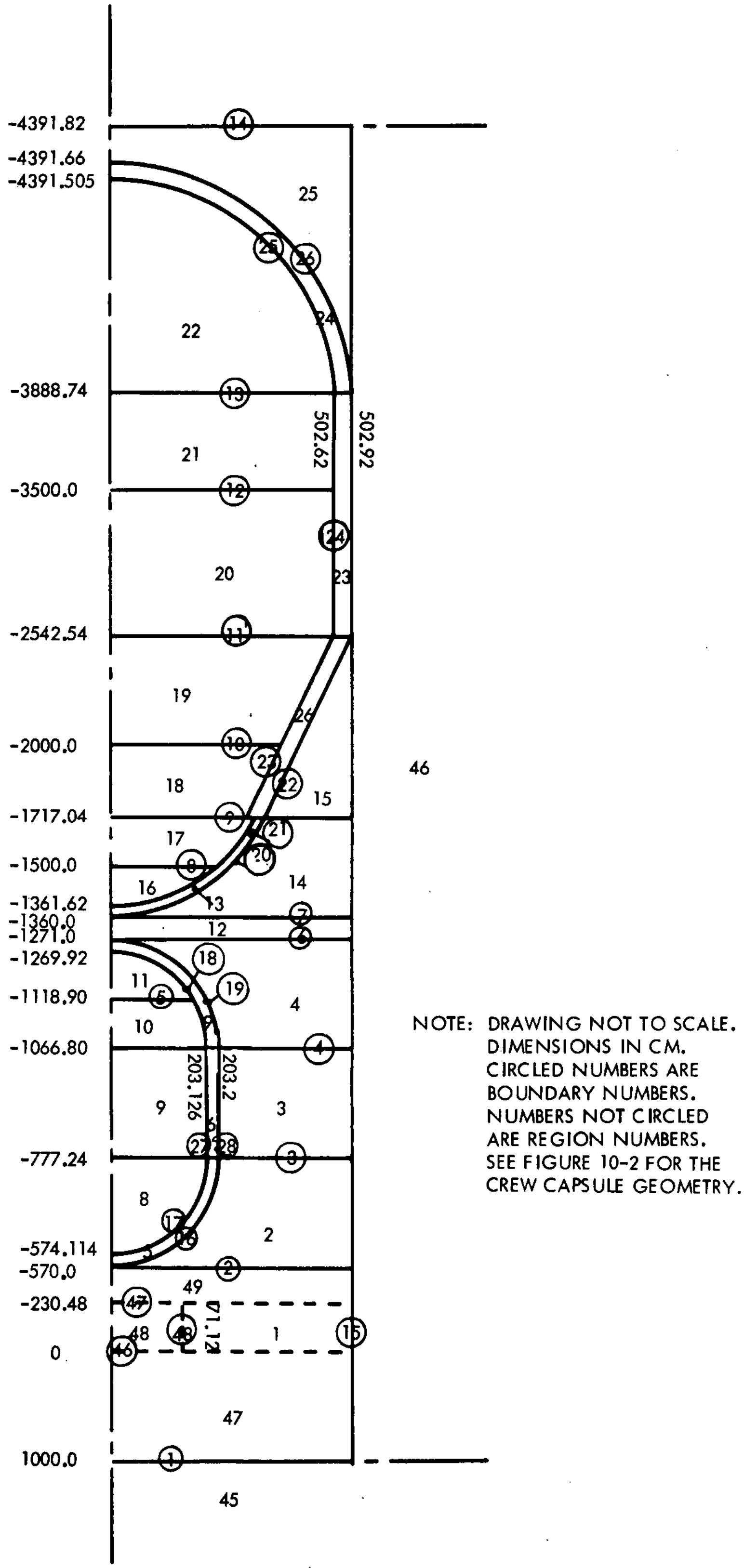
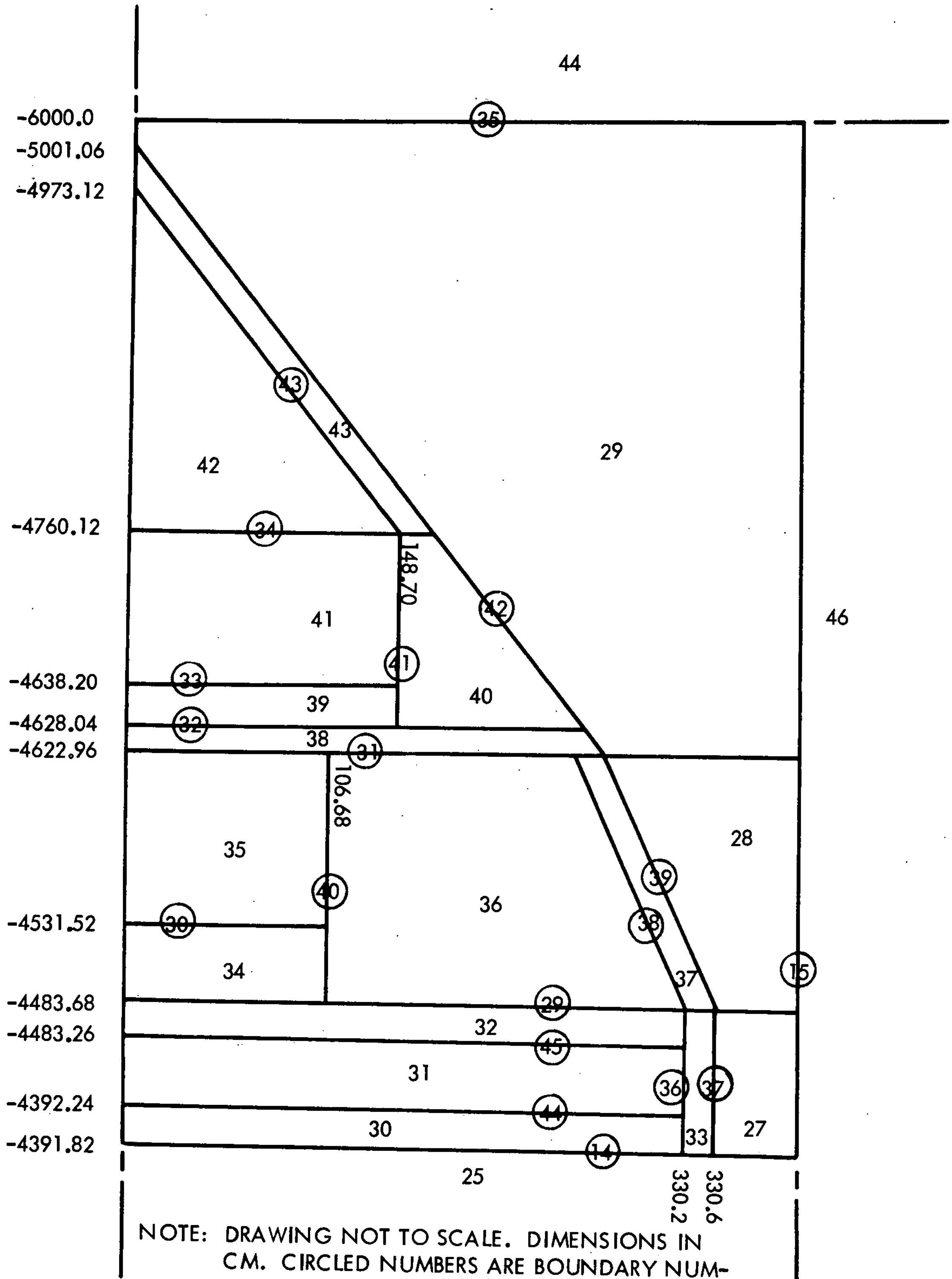


FIGURE 10-2. CREW COMPARTMENT GEOMETRY MODEL FOR THE SCAP PROBLEM



NOTE: DRAWING NOT TO SCALE. DIMENSIONS IN CM. CIRCLED NUMBERS ARE BOUNDARY NUMBERS. NUMBERS NOT CIRCLED ARE REGION NUMBERS.

11.0 The LHAP Code

The LHAP code calculates the dose rate in an arbitrary geometry due to capture gamma rays resulting from neutron capture in liquid hydrogen or in a thin wall neutron capture medium. Essentially, this code is a modified version of the SCAP code employing simple approximations.

The LHAP code accepts as input the neutron flux levels at a meridian ring as polar angle, energy dependent data. The code computes the uncollided flux at an arbitrary capture point determined by the entry point into an absorbing region. From this capture point, the uncollided energy dependent gamma ray flux at the detector is computed with or without buildup on the scattered leg as a function of emanating source ray and capture zone.

In the MSFC Seminar/Workshop problems, the LHAP code calculated the crew dose contribution due to the capture gamma rays in the liquid hydrogen. The meridian ring fluxes from the MAP code were employed as input to the LHAP code. The geometry input to the LHAP problem is identical to that for the SCAP NSS source problem described in Section 10.

11.1 Input Data Description

The listing of the input data for the MSFC Seminar/Workshop problem is given in Table 11-1. It can be quickly observed that this listing is very similar to the SCAP code listing described in Section 10. In fact, the identical geometry is input. The sections which follow briefly describe the input data. The LHAP user's manual (published in Volume 1 of this report) should be followed during the input data description.

11.1.1 Overall Problem Input Data

On the first data card, the number of locations available for core data storage is input as 4000.

The second card is a descriptive title card.

The third card contains six pieces of data as follows:

1. The number of energy groups describing the secondary gamma data in the final output. The quantity is input as one, since the only secondary gamma ray for liquid hydrogen is 2.23 Mev.
2. The number of energy groups in the neutron flux input data. This quantity is input as one, since the total neutron flux from the MAP code was input to LHAP. This yields an upper limit to the capture gamma ray source.
3. The number of polar angles in the source input data, i.e., nine which corresponds to the nine output angles from the MAP code. The quantity is proceeded by a plus sign indicating that the MAP data by angle and energy is input to LHAP.
4. The number of energy points in the gamma ray absorption cross section data. This quantity was input as three.
5. The number of elements in the zone composition-element table. This quantity is input as six, i.e., the same as in the SCAP problem.
6. The number of compositions in the zone composition-element table. This quantity is input as eight, i.e., the same as in the SCAP problem.

The fourth card contains the following six pieces of data:

1. The number of zones in the problem, i.e., 46 which is the same as in the SCAP NSS source problem.

2. The number of boundary surfaces in the problem, i.e., 45 which is the same as in the SCAP NSS source problem.

3. The number of initial source rays emanating in equal polar angle from the point source. This quantity was input as 25.

4. The order of azimuthal integration. This quantity is input as one for the 2π symmetry condition for an on axis source point and detector point.

5. The most probable zone which contains the source point, i.e., zone one. (See Figure 10-1 for the NSS source problem geometry.)

6. The library option. This quantity is input as a one which indicates that the GAMLEG-W generated library data tape is input on Tape Unit 11.

The fifth card contains the lower and upper limits in polar angle and in azimuthal angle. These quantities are similar to the SCAP problem input and are 165.0, 180.0, 0.0, and 180.0 degrees, respectively.

The last card of this data set contains the following four pieces of data:

1. Radius of the meridian ring at which the source data is defined. This must correspond to the MAP output meridian ring of 30 feet, i.e., 914.4 cm.

2. The electron path length per scatter point (electrons/$cm^2 \times 10^{-24}$). The quantity is input as 12.0, i.e., the same as in the SCAP problems.

3. The radius of the pseudo-sphere which contains <u>all</u> scatter points in the problem. This quantity is input as 10,000, i.e., the same as in the SCAP problems.

4. The total flux to fast flux ratio. This quantity is input as 1.0 since the total flux from the MAP code is supplied as input to the LHAP problem.

11.1.2 Geometry, Source and Detector Arrays

The following data arrays input to the LHAP problems were duplicated directly from the SCAP problem for the NSS source previously described in Section 10:

1. 1$ - the number of boundaries per zone
2. 2$ - the boundary numbers for each surface of a zone
3. 3$ - the zone numbers entered upon crossing each boundary of a zone
4. 4$ - equation numbers for each boundary surface
5. 7*, 8*, 9*, 10*, and 11U - the coefficients for the boundary surface equations
6. 13* - electrons per atom for each element in the composition table
7. 14* - the density for each element in each composition
8. 20U - the point source coordinate
9. 21U - the detector point coordinates

The 12* array describes the energy values for the cross section data. Three values are specified in descending energy order as: 3.0, 2.23 and 2.0 Mev. These data are input so that the code can interpolate from the cross section input data tape and obtain the cross sections for the 2.23 Mev gamma ray level.

The 15$ array, which describes the composition in each zone, is, with one exception, identical to the same array input to the SCAP NSS source problem. The one exception is that those zones which the user identifies to be an absorber zone must be preceded by a minus sign. Note that in the first LHAP problem zones 8, 9 and 10 are absorber zones. These three zones describe the liquid hydrogen in the run tank. (See Figure 10-1 for the location of these zones.)

The 16* array describes the energy values of the meridian ring source input data. Since the total flux is input from the MAP code, this input is simply 1.0.

The 17* array provides the energy values for the capture gamma ray. For the Seminar problem, this is simply 2.23 Mev for the liquid hydrogen propellant.

18U array describes the polar angles of the meridian ring. A total of 9 values between 165.0 and 180.0 degrees are input. These must be equivalent to the polar angles run in the MAP problem.

19U array contains the total flux which is output from the MAP code for each of the nine polar angles in units of neutrons/cm^2-sec.

The 28* array permits the user to input a relative capture rate in each capture zone per incident neutron as a function of polar angle and neutron energy groups. The array was "filled" with the values 0.4 using the F format. The value of 0.4 was determined from previous WANL studies. This, of course, implies that roughly half of the total neutrons incident on the LH_2 propellant are reflected and are not absorbed in the LH_2.

The 29* array provides the user with an option to input the relative gamma ray energy release for each gamma ray group. This quantity was input as 1.0 for the Seminar problem.

The last array in the first LHAP problem is followed by a terminate card.

11.1.3 Stacked Cases

The first LHAP problem calculated the dose rate due to the capture gamma ray source in the run tank only. The three stacked cases, listed in Table 11-1, calculate the dose rate due to the capture gamma ray source in three levels of propellant in the large tank. These levels are the same as were previously run in the SCAP problems and are identified by the title cards.

The stacked cases are run in the same manner as previously described in Section 10 for the SCAP problems.

The LIM1 card is not required as input to the change cases. The overall problem storage data cards (five cards) must be input for each case. The 15$ array is required so that the proper zones can be input as absorber zones. Each stacked case is followed by a terminate card.

11.2 Problem Set-Up Description

The LHAP problem set-up is identical to that previously described for the SCAP problems in Section 10.

11.3 Output Data Description

The LHAP output data format is essentially identical to the SCAP output data described in Section 10.

TABLE 11-1. INPUT DATA LISTING FOR THE LHAP SEMINAR/WORKSHOP PROBLEM

```
           4000
MSFC LHAP PROBLEM - MAP TOTAL NEUTRON SPECTRA INPUT - LH2 IN RUN TANK
            1           1           9           3           6           8
           46          45          25           1           1           1
165.0       180.0       0.0         180.0
914.4       12.0        10000.0     1.0
1$
            3           4           4           4           3           4
            3           2           3           3           2           3
            3           4           3           2           3           3
            3           3           3           2           4           3
            4           4           4           4           4           3
            3           3           4           3           3           4
            4           3           3           4           3           2
            3          -1          -1          -3
2$
            1          15          -2           0           0           0  1
            2          15          -3         -16           0           0  2
            3          15          -4         -28           0           0  3
            4          15          -6         -19           0           0  4
           16          -3         -17           0           0           0  5
            3          28          -4         -27           0           0  6
          -18           4          19           0           0           0  7
           17          -3           0           0           0           0  8
            3          27          -4           0           0           0  9
            4          18          -5           0           0           0 10
            5          18           0           0           0           0 11
            6          15          -7           0           0           0 12
           20          -9         -21           0           0           0 13
            7          15          -9         -20           0           0 14
            9          15         -22           0           0           0 15
           21          -8           0           0           0           0 16
            8          21          -9           0           0           0 17
            9          23         -10           0           0           0 18
           10          23         -11           0           0           0 19
           11          24         -12           0           0           0 20
           12          24         -13           0           0           0 21
           13          25           0           0           0           0 22
           11          15         -13         -24           0           0 23
           13          26         -25           0           0           0 24
           15         -14         -26          13           0           0 25
            9          22         -11         -23           0           0 26
           14          15         -29         -37           0           0 27
           29          15         -31         -39           0           0 28
```

TABLE 11-1 (CONT)

31	15	-35	-42	0	0	29
14	36	-44	0	0	0	30
44	36	-45	0	0	0	31
45	36	-29	0	0	0	32
14	37	-29	-36	0	0	33
29	40	-30	0	0	0	34
30	40	-31	0	0	0	35
29	38	-31	-40	0	0	36
29	39	-31	-38	0	0	37
31	42	-32	0	0	0	38
32	41	-33	0	0	0	39
32	42	-34	-41	0	0	40
33	41	-34	0	0	0	41
34	43	0	0	0	0	42
34	42	-43	0	0	0	43
35	0	0	0	0	0	44
-1	0	0	0	0	0	45
1	-35	-15	0	0	0	46
45	46	2	0	0	0	1
1	46	3	5	0	0	2
2	46	4	6	0	0	3
3	46	12	7	0	0	4
2	6	8	0	0	0	5
5	3	7	9	0	0	6
10	6	4	0	0	0	7
5	9	0	0	0	0	8
8	6	10	0	0	0	9
9	7	11	0	0	0	10
10	7	0	0	0	0	11
4	46	14	0	0	0	12
14	26	16	0	0	0	13
12	46	15	13	0	0	14
14	46	26	0	0	0	15
13	17	0	0	0	0	16
16	13	18	0	0	0	17
17	26	19	0	0	0	18
18	26	20	0	0	0	19
19	23	21	0	0	0	20
20	23	22	0	0	0	21
21	24	0	0	0	0	22
26	46	24	20	0	0	23
23	25	22	0	0	0	24
46	30	24	21	0	0	25

TABLE 11-1 (CONT)

```
          13        15        23        18         0         0 26
          25        46        28        33         0         0 27
          27        46        29        37         0         0 28
          28        46        44        38         0         0 29
          25        33        31         0         0         0 30
          30        33        32         0         0         0 31
          31        33        34         0         0         0 32
          25        27        37        30         0         0 33
          32        36        35         0         0         0 34
          34        36        38         0         0         0 35
          32        37        38        34         0         0 36
          33        28        38        36         0         0 37
          35        29        39         0         0         0 38
          38        40        41         0         0         0 39
          38        29        43        39         0         0 40
          39        40        42         0         0         0 41
          41        43         0         0         0         0 42
          40        29        42         0         0         0 43
          29         0         0         0         0         0 44
           1         0         0         0         0         0 45
          45        44         1         0         0         0 46
  4$
 14R       6         9 8R      8         9 2R      8 2R      9
  7R       6 2R      9 2R      8 2R      9 2R      8
  2R       6
  7*
 15R0.0      2R -777.24  2R -1066.80 4R -1717.04  0.0       2R -3888.74
 11R0.0      2R -4483.68 2R 0.0      2R -4760.12
  2R 0.0
  8*
 15R 0.0     8R 1.0      0.0         2R 1.0     11R 0.0     2R 1.0
  2R 0.0     2R 1.0
  2R 0.0
  9*
 15R 0.0     8R 1.0      0.0         2R 1.0     11R 0.0     2R 1.0
  2R 0.0     2R 1.0
  2R 0.0
 10*
 15R       0.0 6R     1.0  -.1856       -.18547    0.0      2R      1.0
 11R       0.0  2.6424      2.64676  2R      0.0   0.4887     0.4874
  2R 0.0
 11U
  1000.0     -570.0     -777.24     -1066.80    -1118.90    -1271.0
 -1360.0    -1500.0    -1717.04     -2000.0     -2542.54    -3500.0
```

TABLE 11-1 (CONT)

```
 -3888.74     -4391.82     502.92       203.20       203.126      203.12
 203.20       355.60       355.42       355.60       355.30       502.62
 457.045      457.20       203.126      203.2        -4483.68     -4351.52
 -4622.96     -4628.04     -4638.20     -4760.12     -6000.0      330.2
 330.6        330.2        330.62       106.68       148.70       168.43
 148.70
-4392.24     -4483.26
12*
   3.0          2.23         2.0
13U
 1.0          6.0          7.0          8.0          13.0         14.0
14*
 4R 0.0          2.7          0.0          0.07       5R 0.0          0.00088
 5R 0.0          0.0101       0.0484       0.0323        0.1425       0.0
    0.0582       0.000011     0.0          0.000028      0.000404  2R 0.0
    0.0387       0.3642       0.0283       0.1294     6R 0.0          0.072
 7R 0.0
15$
 4R          8 3R          1 3R         -2            3            8            1
 2R          8 7R          3 2R          1            8            1 3R         8
             1             8 2R          1            8            4            8
             1             6 2R          7 2R         5            7 3R         8
16*
   1.0
17*
   2.23
18U
 165.0
 168.2833332 169.0        170.0        172.0        174.0        176.0
 178.0        180.0
19U
 1.09     +10 1.15     +10 1.33     +10 3.45     +10 7.81     +10 1.17     +11
 1.42     +11 1.64     +11 2.60     +11
20U
 0.0          0.0          -71.12
21U
 0.0          0.0          -4638.3
28*
  F 0.4
29*
   1.0
  T
 MSFC LHAP PROBLEM - MAP TOTAL NEUTRON SPECTRA INPUT - LH2 TO -1500 CM
             1            1            9            3            6            8
```

TABLE 11-1 (CONT)

```
            46          45          25          1           1           1
 165.0         180.0       0.0         180.0
 914.4         12.0        10000.0     1.0         0.0
15$
 4R          8 3R        1 3R       -2          3           8           1
 2R          8          -2 6R        3 2R       1           8           1
 3R          8           1           8 2R       1           8           4
             8           1           6 2R       7 2R        5           7
 3R          8
  T
 MSFC LHAP PROBLEM - MAP TOTAL NEUTRON SPECTRA INPUT - LH2 TO -1717 CM
             1           1           9          3           6           8
            46          45          25          1           1           1
 165.0         180.0       0.0         180.0
 914.4         12.0        10000.0     1.0         0.0
15$
 4R          8 3R        1 3R       -2          3           8           1
 2R          8 2R       -2 5R        3 2R       1           8           1
 3R          8           1           8 2R       1           8           4
             8           1           6 2R       7 2R        5           7
 3R          8
  T
 MSFC LHAP PROBLEM - MAP TOTAL NEUTRON SPECTRA INPUT - LH2 TO -2542 CM
             1           1           9          3           6           8
            46          45          25          1           1           1
 165.0         180.0       0.0         180.0
 914.4         12.0        10000.0     1.0         0.0
15$
 4R          8 3R        1 3R       -2          3           8           1
 2R          8 4R       -2 3R        3 2R       1           8           1
 3R          8           1           8 2R       1           8           4
             8           1           6 2R       7 2R        5           7
 3R          8
  T
```