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THE CENDL21 LIBRARY - NEUTRON DATA LIBRARY FOR MCNP

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China Nuclear Data Center

May 1998

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Abstract

During a visit to the IAEA Nuclear Data Section from 13 June to 12 December 1997, the author used the NJOY Nuclear Data Processing System, Version 94.66, together with the evaluated nuclear data library CENDL-2.1, to generate the working library CENDL21 in ACE format, for input to the continuous energy neutron-photon Monte Carlo Code MCNP. For validation purposes, the CENDL21 library was subjected to a number of integral benchmark tests.

Background

In early 1996, the China Nuclear Data Center submitted the evaluated nuclear data library CENDL-2.1 (Ref. 1) to the IAEA Nuclear Data Section (NDS). In order to demonstrate the reliability of the CENDL library, it was decided to subject it to benchmark testing against relevant integral experiments. Most analysts agree that the best transport code for performing such integral tests is the continuous-energy, generalized-geometry, time-dependent, coupled neutron/photon/electron Monte Carlo code MCNP (Ref. 2).

The CENDL-2.1 library had not previously been processed into the form of MCNP working libraries. The author was invited to the IAEA Nuclear Data Section for a 6-month consultant's visit in order to carry out this work. The work was performed on the Section's DEC AlphaServer 2100, using the widely respected, and de-facto standard, NJOY94 nuclear data processing code system (Ref. 3). During this consultancy, CENDL-2.1 was processed into "working libraries" for the continuous-energy Monte Carlo code MCNP. These working libraries were employed as input to a variety of data testing calculations, mainly performed on an IBM RS/6000 workstation in the NDS, in order to draw conclusions about the quality of the evaluated data in the CENDL-2.1 library.

I. Introduction

The CENDL21 working library is made up of 77 nuclides which includes the ACE thermal data of eight elements for S(alpha,beta) treatment. It is composed of "type-1" files, which are ASCII files that can be used on any computer platform. It requires approximately 150 megabytes of disk space to store the complete library.

These neutron cross-section data, which will be referred to as the "CENDL21 library", are designated by ZAID identifiers ending in .00C, and ending in .00t for thermal data. For some materials, photon-production data are included. The list of CENDL21 library is shown in **Table 1**.

Table 1. The MCNP CENDL21 Library.

Material	ZAID	Photon
H-1	1001.00c	Yes
H-2	1002.00c	Yes
H-3	1003.00c	No
He-3	2003.00c	No
He-4	2004.00c	No
Li-6	3006.00c	Yes
Li-7	3007.00c	Yes
Be-9	4009.00c	Yes
B-10	5010.00c	Yes
B-11	5011.00c	Yes
C-12	6012.00c	Yes
N-14	7014.00c	Yes
O-16	8016.00c	Yes
F-19	9019.00c	Yes
Na-23	11023.00c	Yes
Mg	12000.00c	Yes
Al-27	13027.00c	Yes
Si	14000.00c	Yes
P-31	15031.00c	Yes
S	16000.00c	Yes
Cl	17000.00c	Yes
K	19000.00c	Yes
Ca	20000.00c	Yes
Ti	22000.00c	Yes
V	23000.00c	Yes

Table [1](cont.) The MCNP CENDL21 Library.

Material	ZAID	Photon
Cr	24000.00c	Yes
Cr-50	24050.00c	Yes
Cr-52	24052.00c	Yes
Cr-53	24053.00c	Yes
Cr-54	24054.00c	Yes
Mn-55	25055.00c	Yes
Fe	26000.00c	Yes
Fe-54	26054.00c	Yes
Fe-56	26056.00c	Yes
Fe-57	26057.00c	Yes
Fe-58	26058.00c	Yes
Co-59	27059.00c	Yes
Ni	28000.00c	Yes
Cu	29000.00c	Yes
Cu-63	29063.00c	Yes
Cu-65	29065.00c	Yes
Zn	30000.00c	Yes
Zr	40000.00c	No
Nb-93	41093.00c	Yes
Mo	42000.00c	Yes
Ag-107	47107.00c	No
Ag-109	47109.00c	No
In	49000.00c	Yes
Sn	50000.00c	Yes
Sb	51000.00c	Yes
Hf	72000.00c	No
Ta-181	73181.00c	Yes

Table [1](cont.) The MCNP CENDL21 Library.

Material	ZAID	Photon
W	74000.00c	Yes
Au-197	79197.00c	Yes
Hg	80000.00c	Yes
Tl	81000.00c	Yes
Pb	82000.00c	Yes
Th-232	90232.00c	Yes
U-234	92234.00c	No
U-235	92235.00c	Yes
U-237	92237.00c	Yes
U-238	92238.00c	Yes
Np-237	93237.00c	Yes
Pu-239	94239.00c	Yes
Pu-240	94240.00c	Yes
Pu-241	94241.00c	Yes
Am-241	95241.00c	Yes
Bk-249	97249.00c	No
Cf-249	98249.00c	No
H(H2O)	lwtr.00t	Yes
D(D2O)	hwtr.00t	Yes
Be	be.00t	Yes
Be(BeO)	beo.00t	Yes
C	grap.00t	Yes
H(CH2CH2)	poly.00t	Yes
H(ZrH)	H/zr.00t	Yes
Zr(ZrH)	Zr/h.00t	No

For validation purposes, the CENDL21 library was subjected to a variety of integral benchmark tests. In several cases, the performance of CENDL21 was compared with processed libaries derived from other sources and with the "MCNP test library" that is distributed with the MCNP4B code package. In some cases, it was possible to compare CENDL21 with the results obtained by other authors with other data libraries.

II. Processing Code

The version of NJOY employed in this work was Version 94.66. Several modules of NJOY were executed: MODER, RECONR, BROADR, HEATR, THERMR, GROUPR and ACER.

Some of the key parameters are: The fractional reconstruction tolerance in RECONR is 0.002 (0.2%); the fractional tolerance for thinning in BROADR is 0.002; the upper boundary of thermal energy group is 4 eV. The tolerance for thinning secondary distribution in ACER is 0.05 for most materials.

Neutron cross sections have been generally been processed at 300K. The 30-by-20 photon production matrix is computed from input multigroup data. The 30-group option for neutrons and the CSEWG-94 group structure for photon were used in GROUPR.

The thermal data was calculated by using the thermal scatting law data of ENDF/B-VI.

III. Modifications

As a result of various problems encountered while processing the CENDL21 library, several modifications were made to the original evaluations. The problems and resulting modifications are summarized as follows.

(1) When processing O-16 from CENDL-2.1 using NJOY94.66, it stopped at ACER module, without creating an ACE file. It only gave the message "removed E=1.9500E+07 for MF=4 MT=67" in the output file. We adjusted the tolerance for thinning secondary distribution to be the same value of fractional tolerance for thinning in BROADR. The ACE file could then be generated.

(2) When processing F-19 from CENDL-2.1, we encountered an 'topfil' error message in ACER, it cannot convert multiple emissions to LAW7 with the F-19 of CENDL-2.1. The F-19 of CENDL-2.1 was replaced by the F-19 of JEF-2.2 in this work.

(3) When processing Fe-56 from CENDL-2.1 using NJOY94.66, we encountered an 'findf' error message in the HEATR module. It turned out that, at E=0, when MFD has been set to 15, the MTD value (MTD=102 in this case) is not present in the

PENDF file but it is present in the ENDF file. We removed some MTD values from MF=12 and MF=14 in the original evaluation. According to this modification, we also modified the input card of GROUPR, we removed some reactions of MF16 in the GROUPR input card, such as MT = 103, 104 and 107. With these changes made, HEATR ran successfully.

(4) When processing Nb-93, Hg, and Tl from CENDL-2.1, we encountered the same 'findf' error message as that of Fe-56. We also did the same modifications about the original evaluations of Nb-93, Hg and Tl as the Fe-56 modifications.

(5) When processing Fe-54 and Fe-58 from CENDL-2.1, we encountered the 'f6lab' error message "illegal lang" in the GROUPR, it means that the value of lang must be in the range 11-15 for tabulated angular distribution. We removed the reaction "16 107/" in the input card of GROUPR.

(6) When processing chlorine from CENDL-2.1, we encountered the error message 'MF6 MT16 doesn't give recoil ZA=16999' in the HEATR module. We used the chlorine from ENDF/B-VI instead of this material of CENDL-2.1.

IV. Testing of CENDL21 working library

In order to test the new working library, it was decided to perform benchmark testing by using MCNP4B.

IV.1 Infinite-medium tests

Most of nuclides of CENDL21 were used in MCNP4B to perform infinite-medium simulations. The results of the CENDL21 calculations were compared to results obtained using the "MCNP test library" that is distributed with the MCNP4B code package.

The infinite-medium simulation consisted of a 20-MeV neutron source in a 100-m radius sphere of a given nuclide. The neutron flux and heating were tallied, and comparison plots were made for the CENDL21 working library and MCNP4B recommended library.

Results:
Some results are shown in **Figs. 1-8**.

Conclusions:
In general, these infinite medium simulations demonstrate that for most materials, the CENDL21 library and the MCNP test library give similar results. The neutron fluxes are close.

However, the neutron heating is not close for some materials. This may come from differences in the NJOY versions, because there are improvements in modeling the recoil

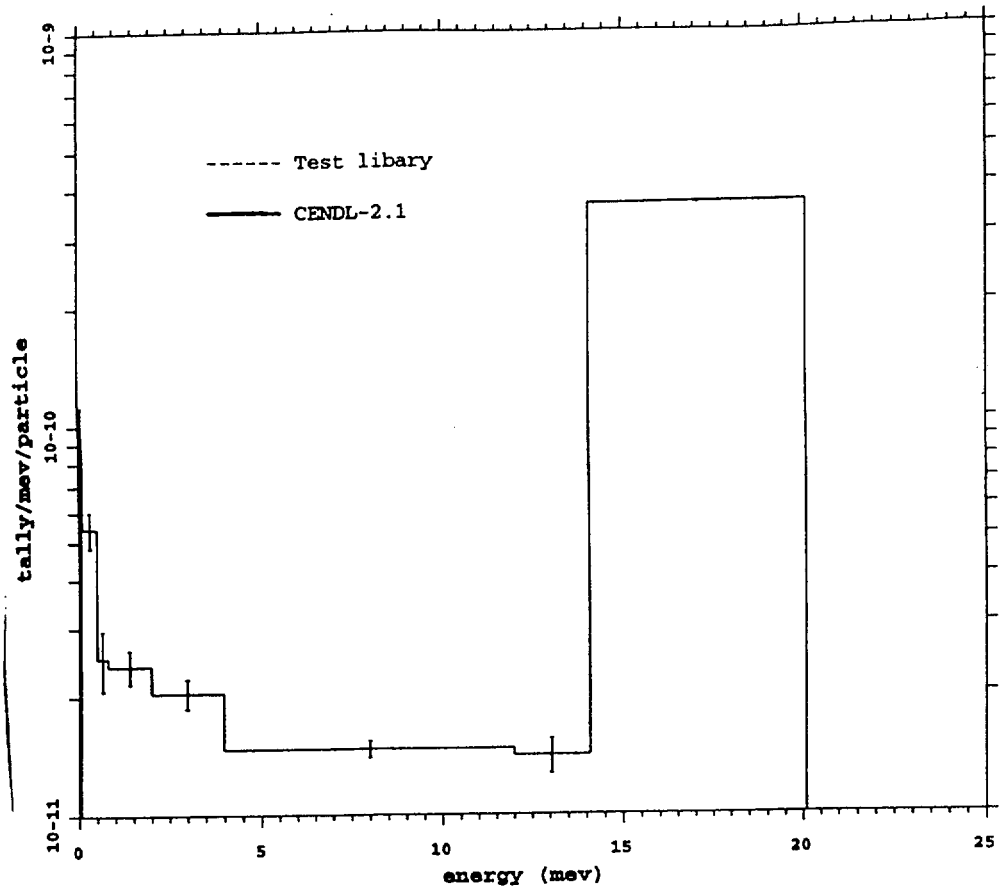

Figure 1: Plot of CENDL-2.1 and Test Library calculated neutron flux for a 100-m radius ^{1}H sphere.

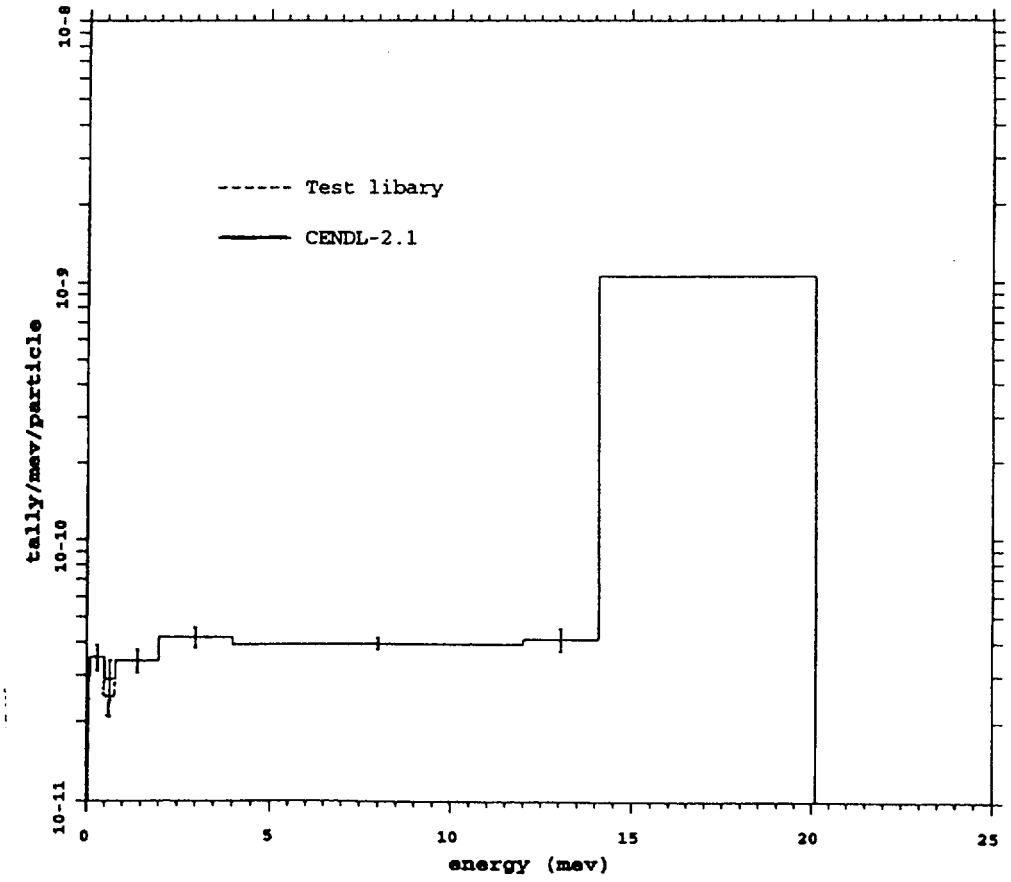

Figure 2: Plot of CENDL-2.1 and Test Library calculated neutron heating for the ^{1}H sphere.

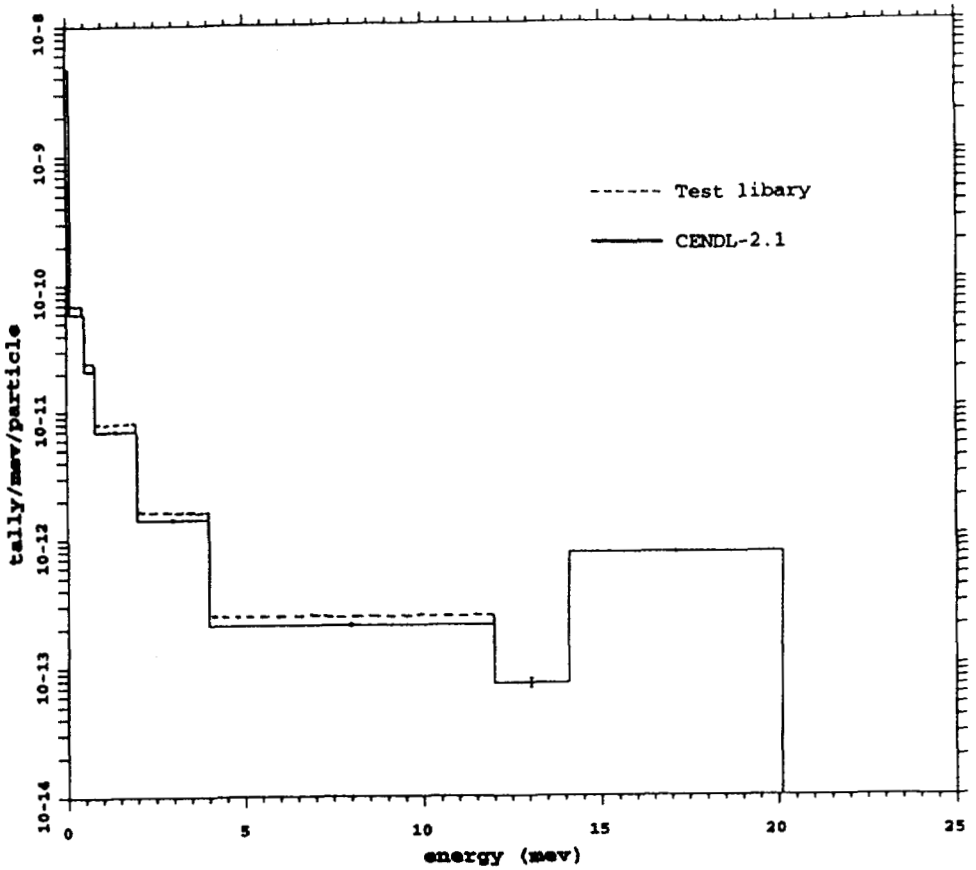

Figure 3: Plot of CENDL-2.1 and Test Library calculated neutron flux for a 100-m radius ^{27}Al sphere.

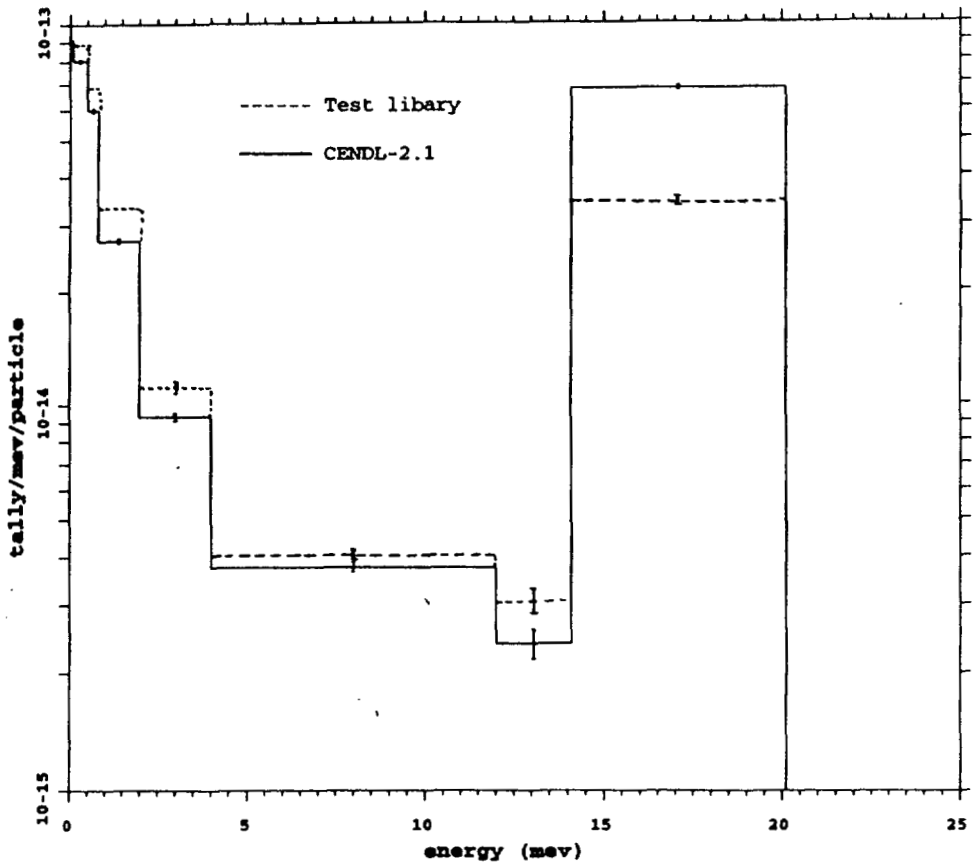

Figure 4: Plot of CENDL-2.1 and Test Library calculated neutron heating for the ^{27}Al sphere.

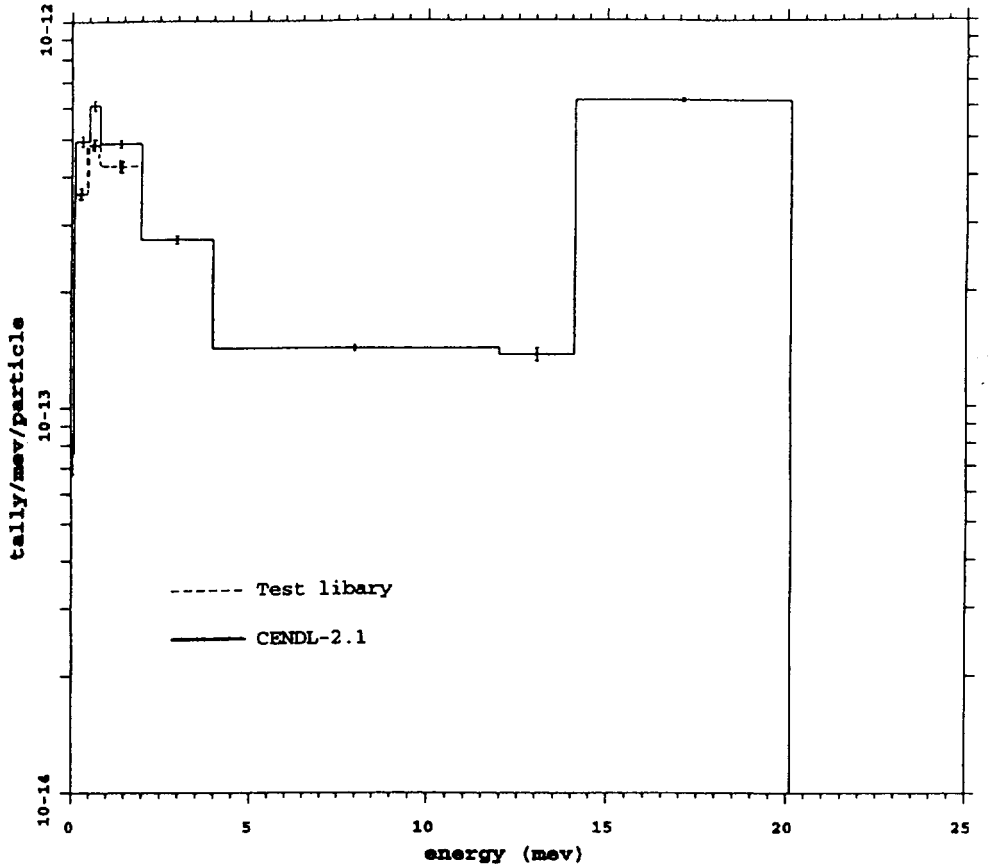

Figure 5: Plot of CENDL-2.1 and Test Library calculated neutron flux for a 100-m radius ^{10}B sphere.

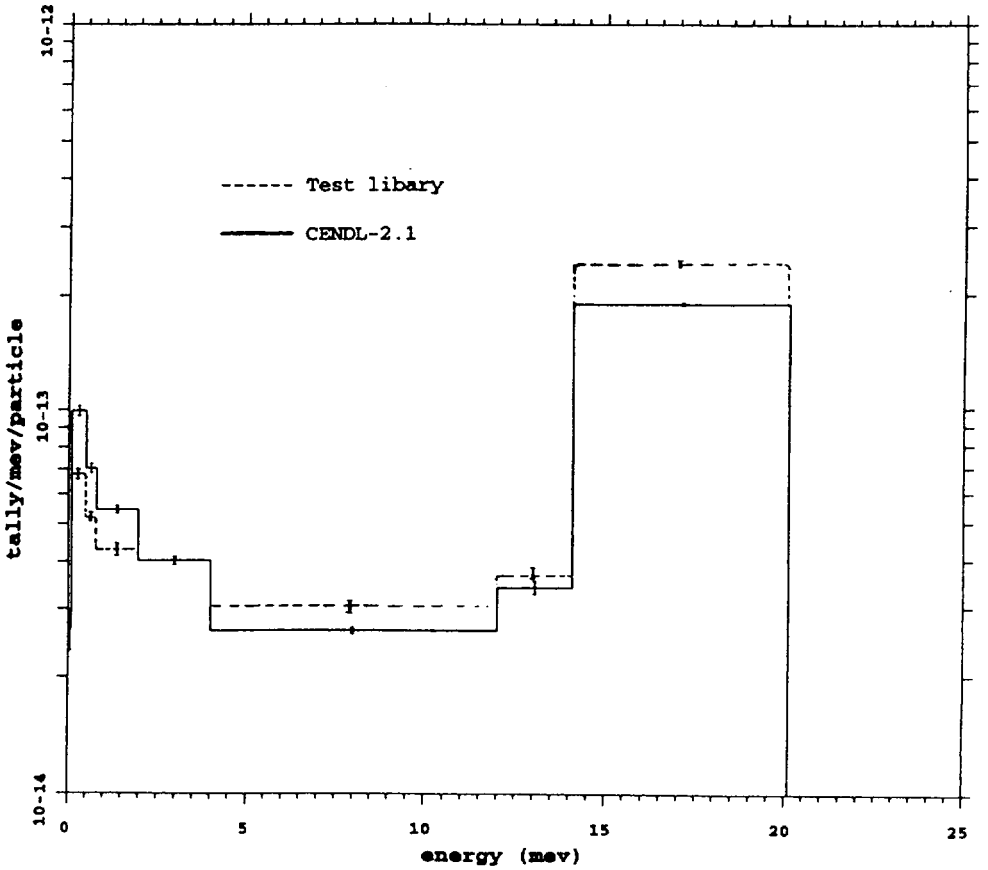

Figure 6: Plot of CENDL-2.1 and Test Library calculated neutron heating for the ^{10}B sphere.

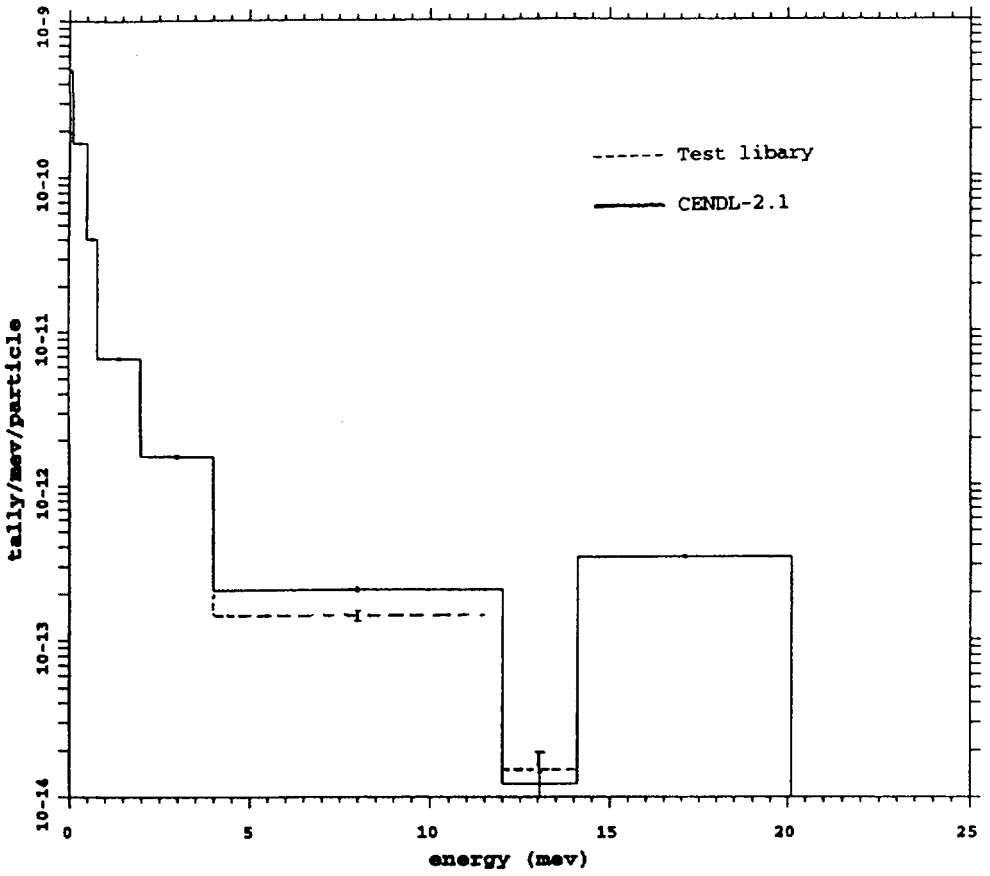

Figure 7: Plot of CENDL-2.1 and Test Library calculated neutron flux for a 100-m radius ^{238}U sphere.

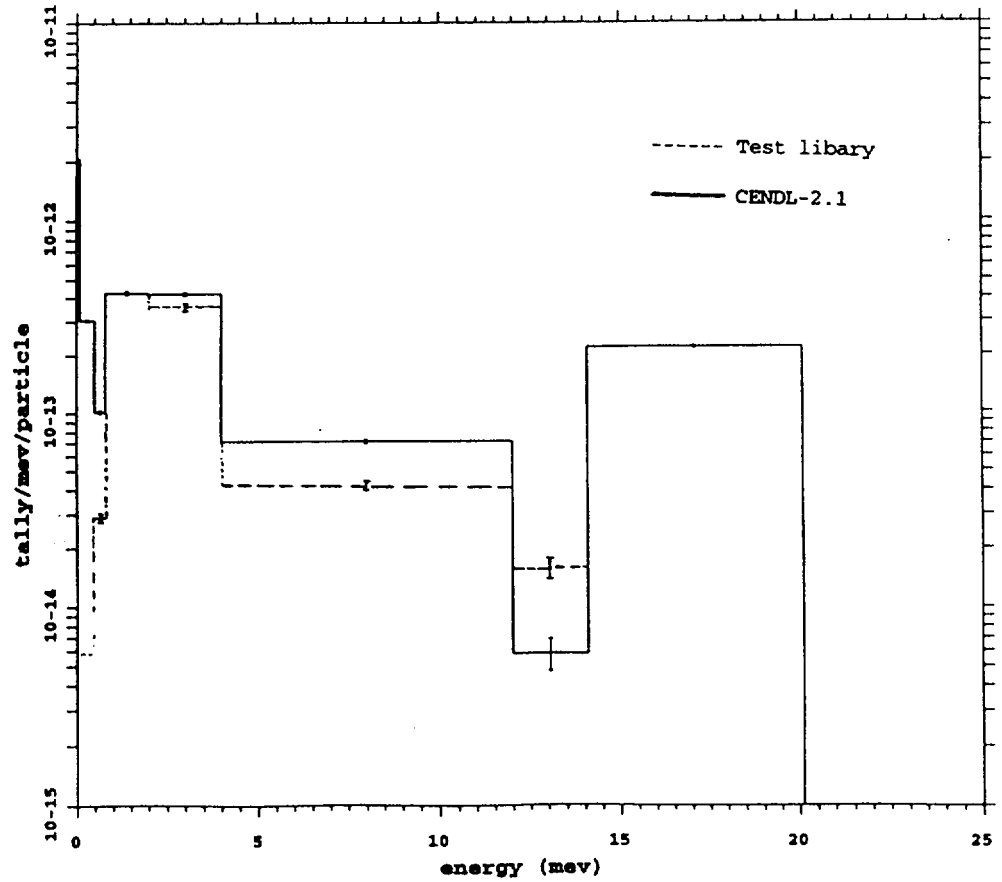

Figure 8: Plot of CENDL-2.1 and Test Library calculated neutron heating for the ^{238}U sphere.

effects that have been made in the NJOY code. In case where there is no photon production in the test library but it is present in CENDL21, the neutron heating is also not similar for both libraries. This is probably due to the use of energy-balance method of computing heating in the NJOY, which puts the missing gamma-ray energy into the neutron local-heating cross sections.

IV.2. Criticality tests

IV.2.1 The one-dimensional module of GODIVA.

GODIVA, a bare sphere of enriched uranium metal composed of 94% U-235, is especially suited for testing U-235 and U-238 cross section in the fission source energy range. It has a simple, single-region geometry and uniform composition.

Results:
The results are shown in **Tables 2a and 2b**. The experimental value for k-eff is 0.9996.

Table 2a. Results of k-eff Calculations

	CENDL-2.1	TEST LIBRARY	ENDF/B-VI
k-eff	0.99750	1.00139	0.99782
Relative error	0.18154E-02	0.20971E-02	0.21346E-02

Table 2b. Results of Prompt removal lifetime

	CENDL-2.1	TEST LIBRARY	ENDF/B-VI
Lifetime	6.19344E-09	5.68360E-09	6.18401E-09
Relative error	0.32507E-02	0.20997E-02	0.32123E-02

Conclusions:
The CENDL21 library appears to give results as good as, or better than, ENDF/B-VI and better results than those of test library.

This test reveals no problems with the use of the U-235 and U-238 data of CENDL-2.1 for this type of calculation.

IV.2.2 The model of JEZEBEL

JEZEBEL is a bare sphere of plutonium metal. The simple, single-region geometry and uniform composition are especially suited to testing plutonium isotope cross sections in the fission source energy range.

Results:
The results are shown in **Table 3**.

Table 3. Results of k-eff calculations

	CNDL-2.1	ENDF/B-V	Test Library	ENDF/B-VI
k-eff	1.00121	1.00151	0.99857	1.00228
Relative error	0.00204	0.00220	0.00212	0.00217

Conclusions:
CENDL-2.1 appears to give results as good as, or better than, ENDF/B-V and ENDF/B-VI, and better results than those of the test library.

This test reveals no problems with the use of the Pu-239 data of CENDL-2.1 for this type of calculation.

IV.3. The detectors tests

The problem consists of a spherical shell of concrete with a 390-cm outer radius and a 360-cm inner radius. A 14-MeV point isotropic neutron source is located at (x,y,z) = (0,0,0) (all source and detector coordinates in this section are given in centimeters), in the center of the void region, with a neutron lower-energy cutoff at 12 MeV. In this problem, the surface flux, particle flux at a point detector, and particle flux at a ring detector are tallied.

Results:
The results are shown in **Table 4 to Table 15**. Note that FOM ("figure of merit") is a measure of the efficiency of the MCNP calculation. It can be used, for a given case, to estimate the RS/6000 running time required to achieve a desired level of statistical precision, using the relation running time (minutes) = 1/[FOM*(relative error)**2].

In order to define confidence intervals for precision of a Monte Carlo result, the Central Limit Theorem of probability theory is used. The "shifted center" is the slope of a generalized Pareto function, it may reflect the estimate of the history score decrease.

Table 4. Results of surface flux calculations

(At the surface of 4000-cm radius sphere)

	Mean	Relative error	Variance of variance	Shifted center	FOM	Number of histories
CENDL-2.1	4.6970E-10	0.0237	0.0005	10.0	1641	14000
ENDF/B-VI	4.3241E-10	0.0244	0.0005	10.0	1683	14000

Table 5. Results of surface flux calculations

(At the surface of 420-cm radius sphere)

	Mean	Relative error	Variance of variance	Shifted center	FOM	Number of histories
CENDL-2.1	4.8021E-08	0.0239	0.0006	10.0	1619	14000
ENDF/B-VI	4.3519E-08	0.0244	0.0006	10.0	1681	14000

Table 6. Results of surface flux calculations

(At the surface of 390-cm radius sphere)

	Mean	Relative error	Variance of variance	Shifted center	FOM	Number of histories
CENDL-2.1	6.0704E-08	0.0296	0.0108	2.8	1052	14000
ENDF/B-VI	5.3284E-08	0.0266	0.0098	3.5	1430	14000

Table 7. Results of flux at a point detector

(detector located at x,y,z = 0,-4000,0)

	Mean	Relative error	Variance of variance	Shifted center	FOM	Number of histories
CENDL-2.1	4.4685E-10	0.0452	0.0200	5.1	451	14000
ENDF/B-VI	4.1441E-10	0.0444	0.0210	4.6	510	14000

Table 8. Results of flux at a point detector

(detector located at x,y,z = 0,4000,0)

	Mean	Relative error	Variance of variance	Shifted center	FOM	Number of histories
CENDL-2.1	4.6599E-10	0.0470	0.0240	5.1	416	14000
ENDF/B-VI	4.3043E-10	0.0438	0.0232	5.2	523	14000

Table 9. Results of flux at a point detector

(detector located at x,y,z = 0,-420,0)

	Mean	Relative error	Variance of variance	Shifted center	FOM	Number of histories
CENDL-2.1	4.1884E-08	0.3730	0.5005	1.4	6.0	14000
ENDF/B-VI	3.1520E-08	0.3236	0.4823	1.4	9.6	14000

Table 10. Results of flux at a point detector

(detector located at x,y,z = 0,420,0)

	Mean	Relative error	Variance of variance	Shifted center	FOM	Number of histories
CENDL-2.1	3.0843E-08	0.2301	0.4847	1.4	29	14000
ENDF/B-VI	2.4154E-08	0.1456	0.3420	1.4	47	14000

Table 11. Results of flux at a point detector

(detector located at x,y,z = 0,-390,0)

	Mean	Relative error	Variance of variance	Shifted center	FOM	Number of histories
CENDL-2.1	1.7814E-08	0.0701	0.8857	1.4	210	14000
ENDF/B-VI	1.5020E-08	0.0620	0.4479	1.4	262	14000

Table 12. Results of flux at a point detector

(detector located at x,y,z = 0,390,0)

	Mean	Relative error	Variance of variance	Shifted center	FOM	Number of histories
CENDL-2.1	1.6495E-08	0.1262	0.6175	1.3	58	14000
ENDF/B-VI	1.6359E-08	0.1087	0.6972	1.4	85	14000

Table 13. Results of flux at a ring detector

(detector symmetric about y-axis with radius=4000 cm)

	Mean	Relative error	Variance of variance	Shifted center	FOM	Number of histories
CENDL-2.1	4.6390E-10	0.0300	0.0110	10.0	1107	14000
ENDF/B-VI	4.3184E-10	0.0297	0.0102	10.0	1136	14000

Table 14. Results of flux at a ring detector

(detector symmetric about y-axis with radius=420 cm)

	Mean	Relative error	Variance of variance	Shifted center	FOM	Number of histories
CENDL-2.1	4.1100E-08	0.0684	0.0102	3.2	197	14000
ENDF/B-VI	3.8499E-08	0.0801	0.1235	2.8	157	14000

Table 15. Results of flux at a ring detector

(detector symmetric about y-axis with radius=390 cm)

	Mean	Relative error	Variance of variance	Shifted center	FOM	Number of histories
CENDL-2.1	3.0843E-08	0.1533	0.3200	2.2	39	14000
ENDF/B-VI	4.8699E-08	0.1614	0.2976	2.1	39	14000

Conclusions:

From **Table 4 to Table 6**, the relative error of both libraries was below 0.1, the tallies are generally reliable, and the results of CENDL-2.1 are in good agreement with ENDF/B-VI.

From **Table 7 to Table 12**, the neutron flux at (0,-4000,0) and (0,4000,0) are generally reliable, because the relative error of both libraries is below 0.05, and the results are close for two libraries.

From **Table 11**, the difference of results between CENDL-2.1 and ENDF/B-VI can be found, the relative error and variance of variance of CENDL-2.1 are higher than those of ENDF/B-VI. The difference may come from bad placement of the point detector. The point detector for this tally is placed on surface 2, at (0,-390,0), whereas the point detector usually should lie either inside or outside a surface.

From **Table 13 to Table 15**, the results of the ring detector are close for both libraries.

IV.4. Integral data testing for a fusion neutronics source

A number of integral benchmark calculations were performed using experimental data obtained at the Fusion Neutronics Source (FNS) located at the Japan Atomic Energy Research Institute (JAERI). Details of the experiments are given in **Ref. 4**.

IV.4.1 Neutron Angular Leakage Spectra from Slabs

Neutron angular leakage spectra were measured at the FNS for slabs of many materials (**Ref. 5**). These measurements provide useful tests of the reliability of evaluated data for fast neutron applications, so they were used to test CENDL21.

Measured Quantity:
Neutron Angular Leakage Spectra.

Experimental Method:
Pulsed neutron source time-of-flight method.

Error assessment:

(i) Systematic Error

1) Efficiency:

En > 200 keV	< 2%
80 < En <200 keV	5-10%
50 < En <80 keV	10-20%

2) Solid Angle << 1%

3) Effective measured area < 2%

(ii) Random Error
included in data list for counting statistics

MCNP Calculation

The point detector estimator was used in the MCNP calculations, and the calculations were made for five angles.

The source neutron spectrum emitted from the target is computed above 0.05 MeV using the measured source spectrum as input. An isotropic distribution was assumed for the source neutrons, based on the measured angular dependence of emission in 90 energy intervals.

(1) Testing and analysis of an angular neutron flux on a beryllium slab

The beryllium slab assemblies are 50.8 mm thick, and have an equivalent radius of 31.5 mm. The energy range is from 50 keV to 15 MeV. The angular neutron fluxes are computed at angles of 0.0, 12.2, 24.9, 41.8 and 66.8 degrees.

List of Figures and Tables

Conclusions:

From **Table 4.1.1**, one sees that the angular neutron fluxes at point detector are generally reliable, because the relative error of both libraries is less than 0.05, and the MCNP "variance of variance" estimator (VOV) is below 0.1.

The results of CENDL-2.1 and ENDF/B-VI at 0 degrees show good agreement with the experimental results as a whole energy parts.

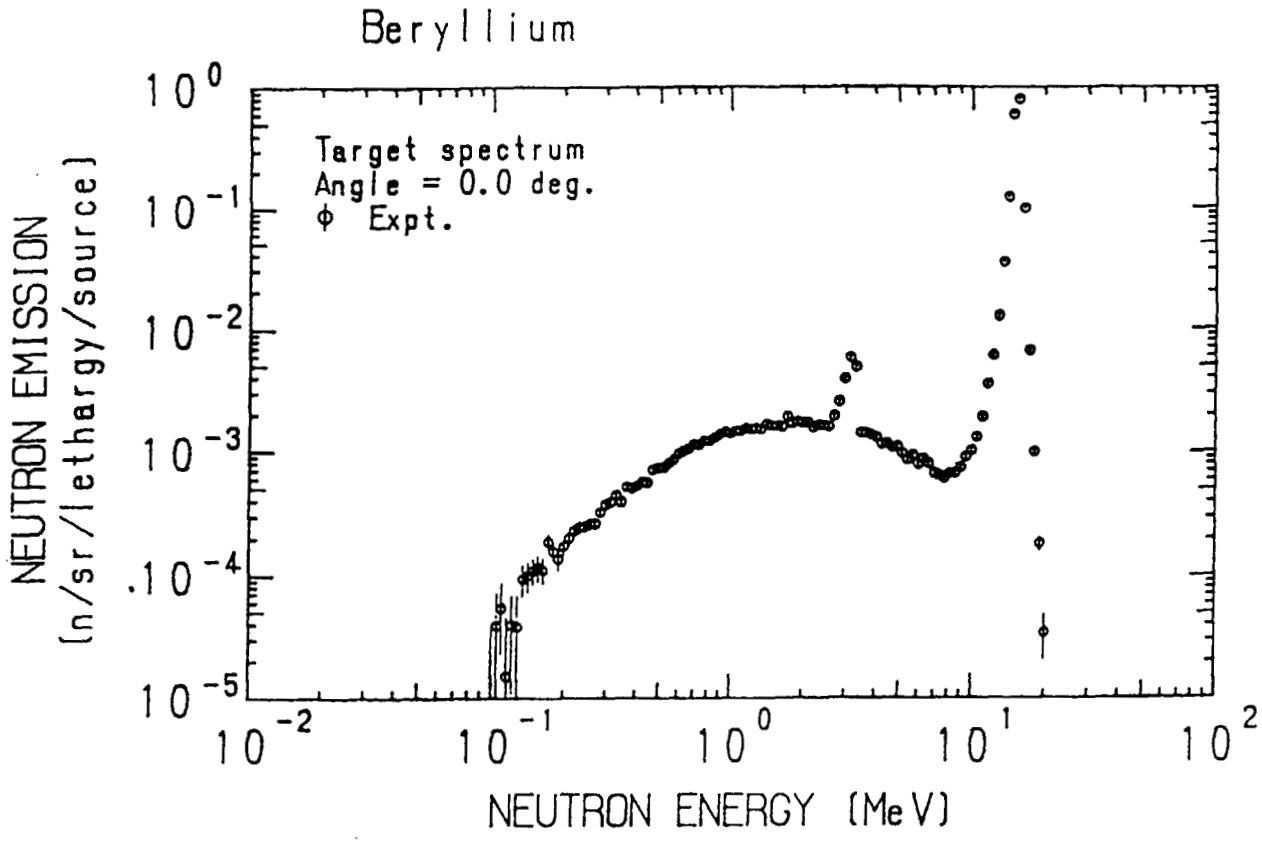
Beryllium
Target spectrum
Angle = 0.0 deg.
φ Expt.
NEUTRON EMISSION
(n/sr/lethargy/source)
NEUTRON ENERGY (MeV)
10^0
10^-1
10^-2
10^-3
10^-4
10^-5
10^-2
10^-1
10^0
10^1
10^2

Fig. 4.1.1

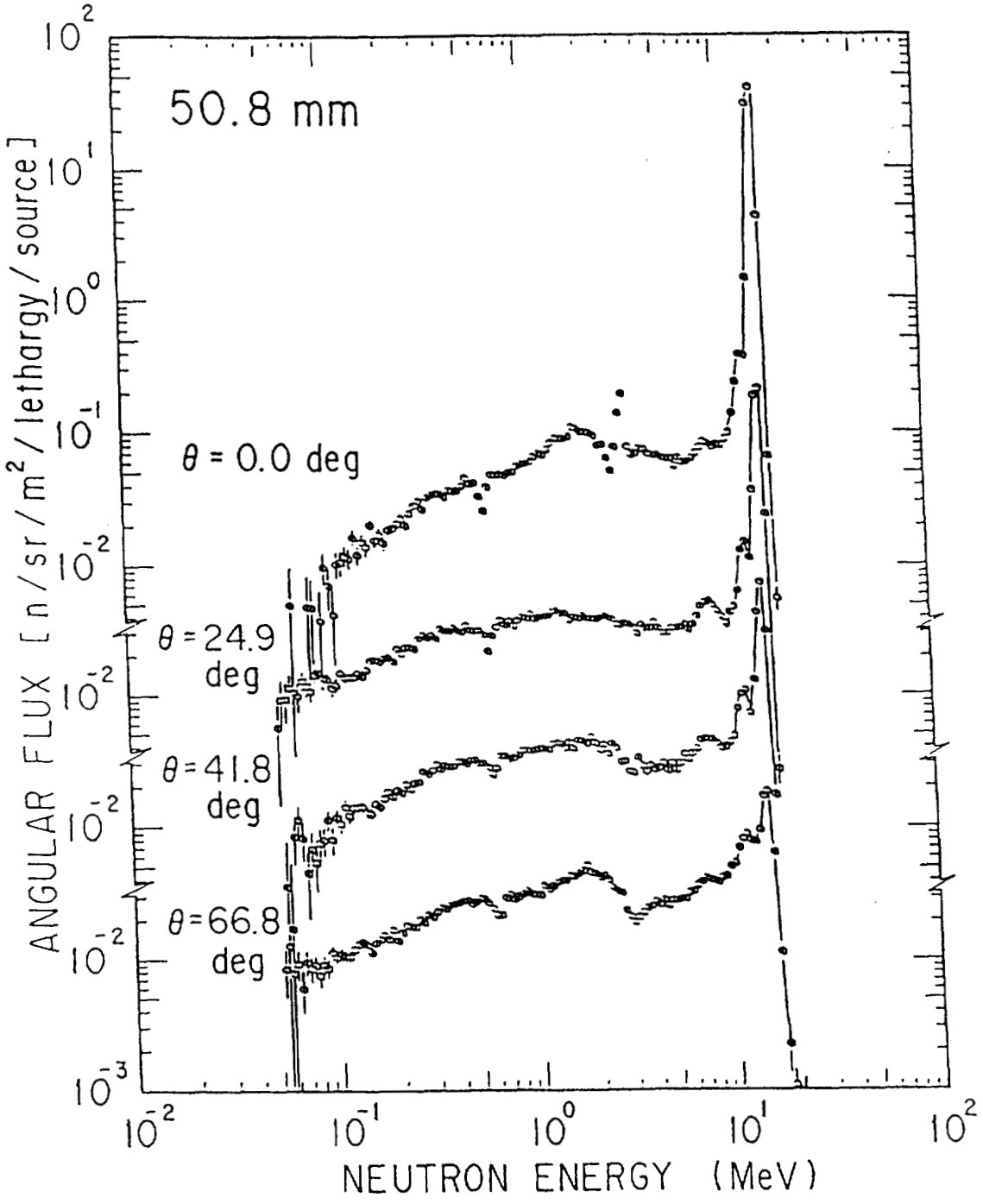
50.8 mm
θ = 0.0 deg
θ = 24.9 deg
θ = 41.8 deg
θ = 66.8 deg
ANGULAR FLUX [n / sr / m² / lethargy / source]
NEUTRON ENERGY (MeV)

Fig. 4.1.2 (a)

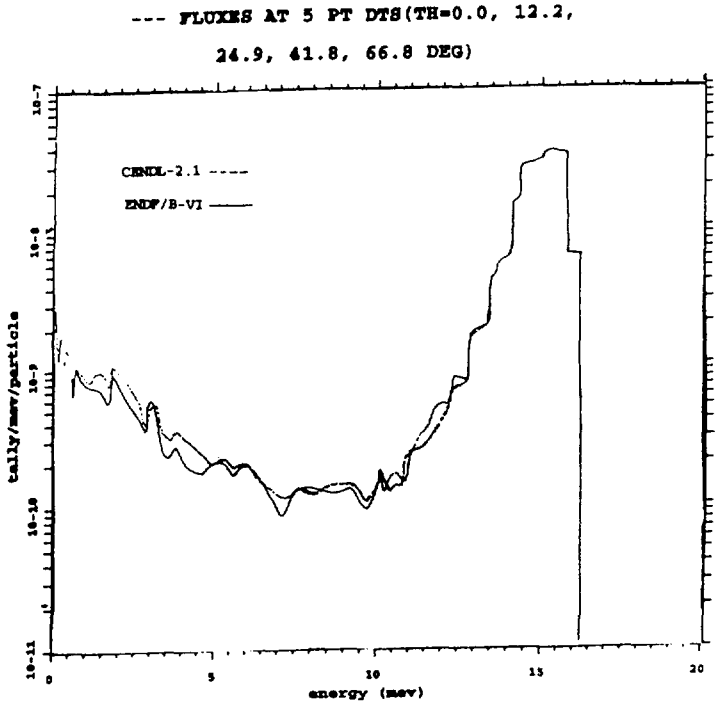

Fig. 4.1.3

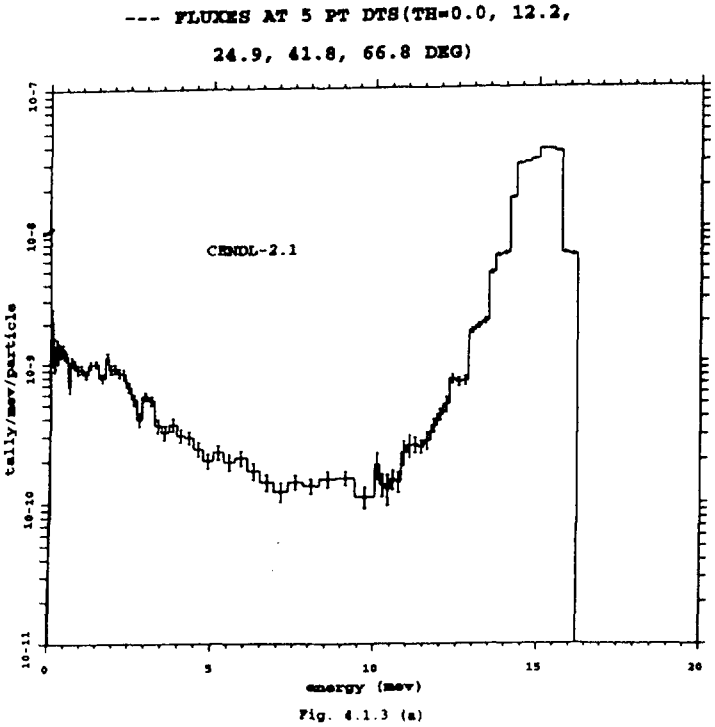

Fig. 4.1.3 (a)

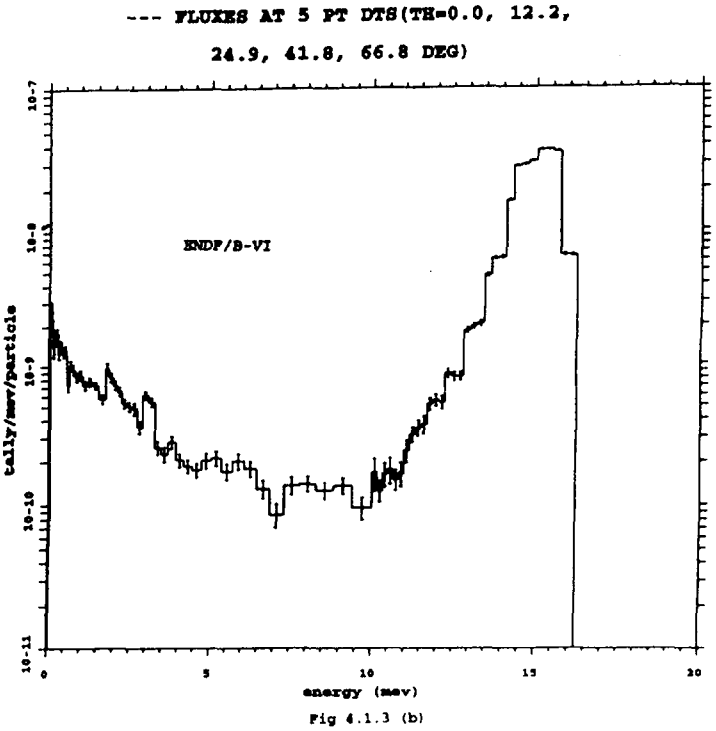

Fig 4.1.3 (b)

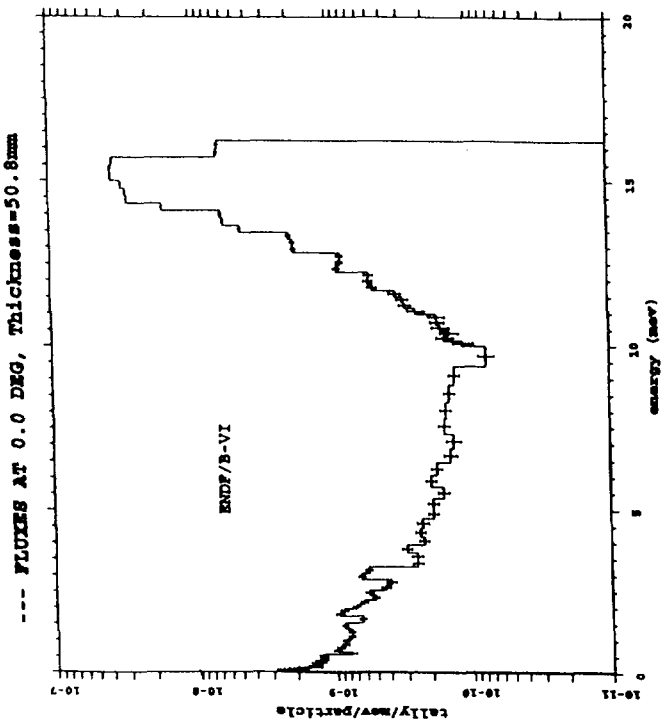

Fig. 4.1.4 (b)

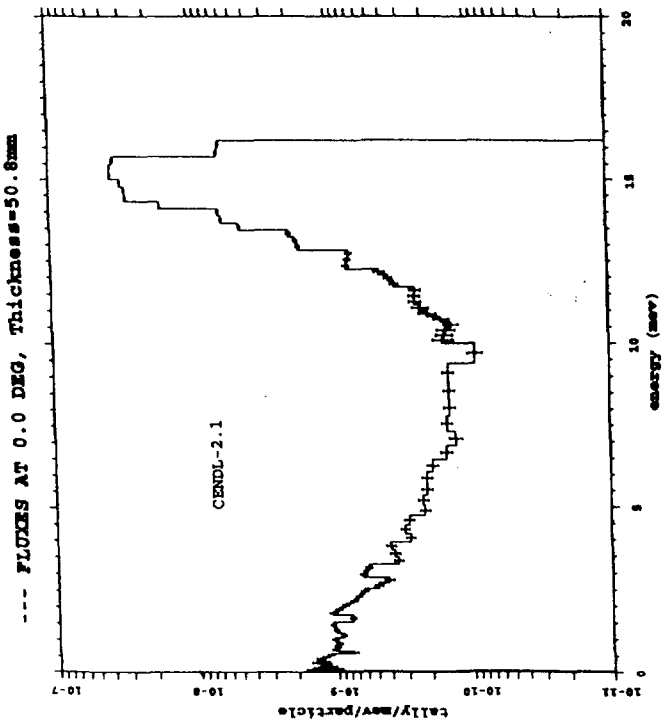

Fig. 4.1.4 (a)

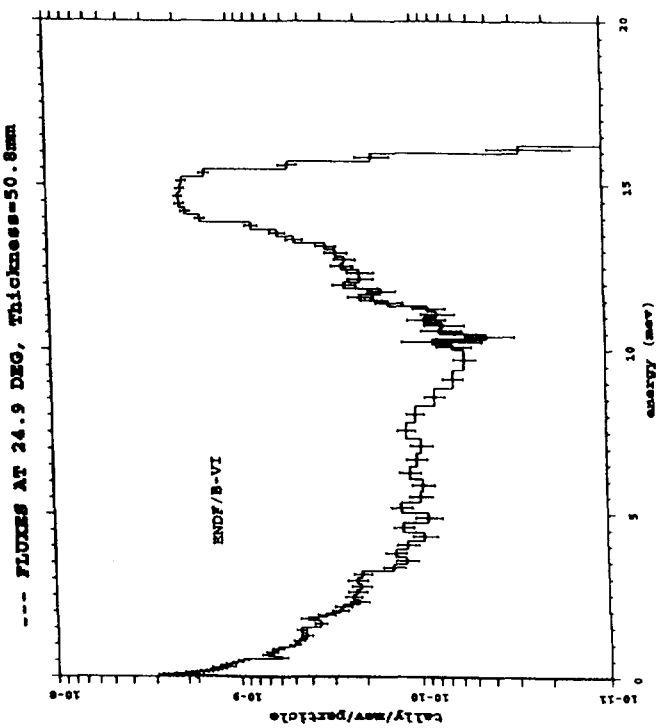

Fig 4.1.5 (b)

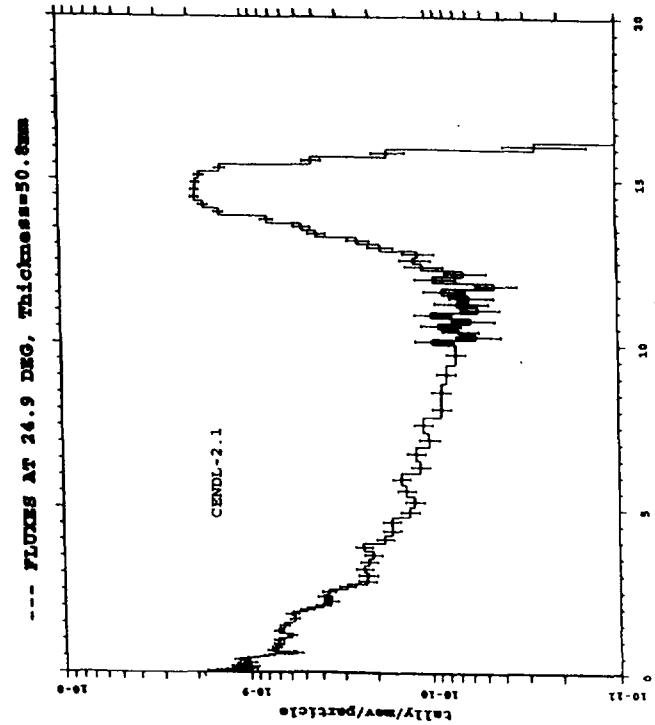

Fig. 4.1.5 (a)

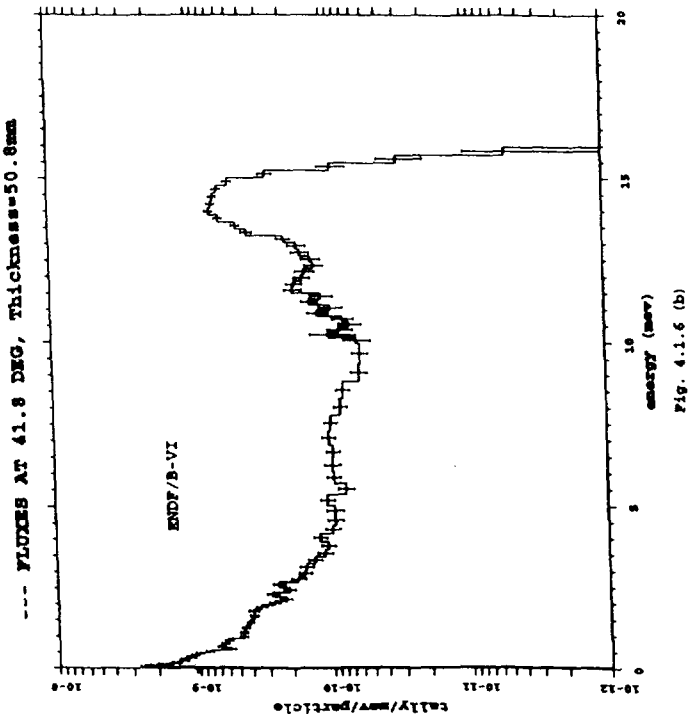

Fig. 4.1.6 (b)

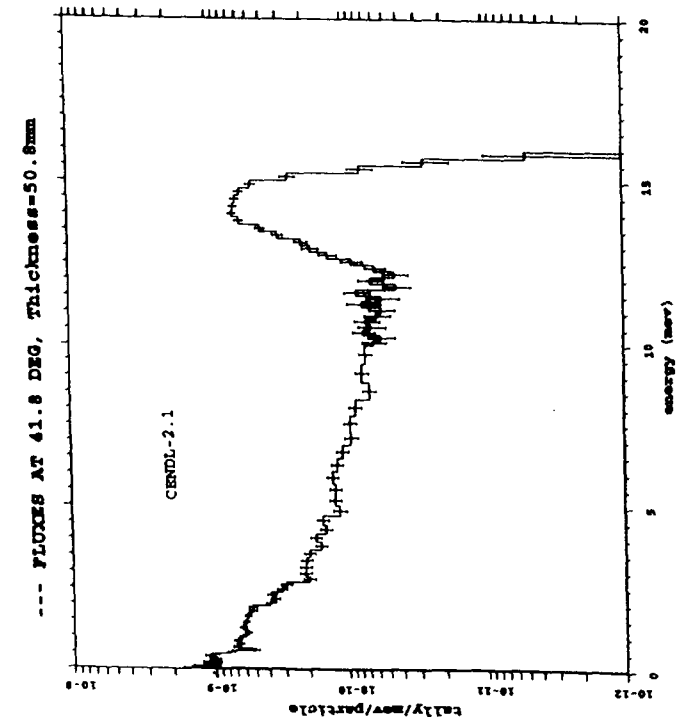

Fig. 4.1.6 (a)

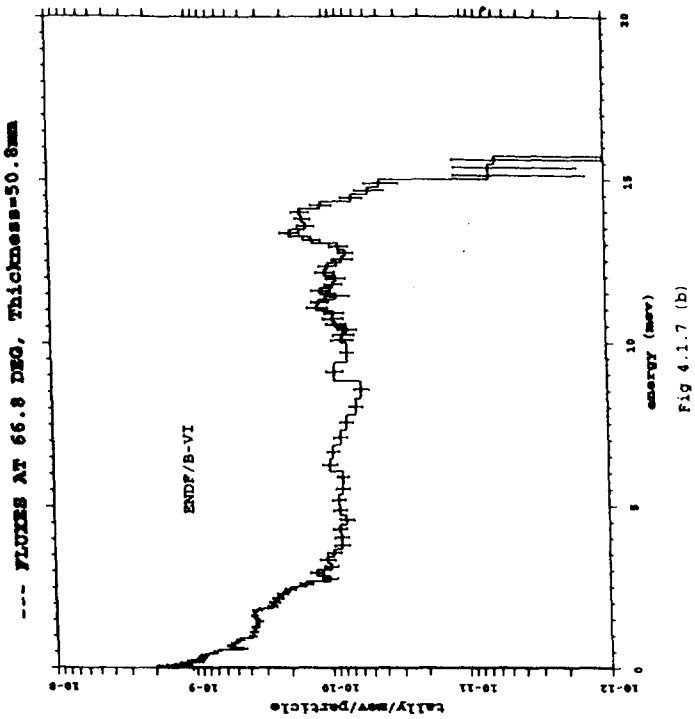

Fig 4.1.7 (b)

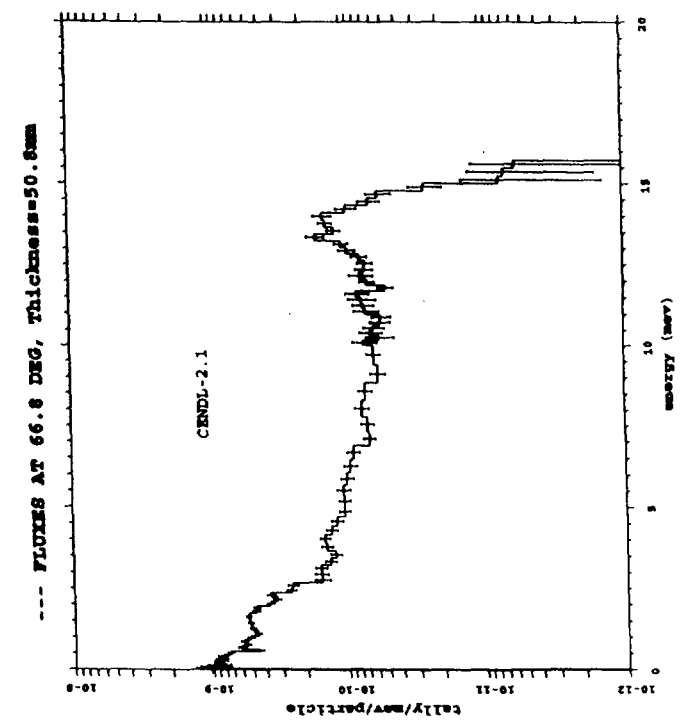

Fig. 4.1.7 (a)

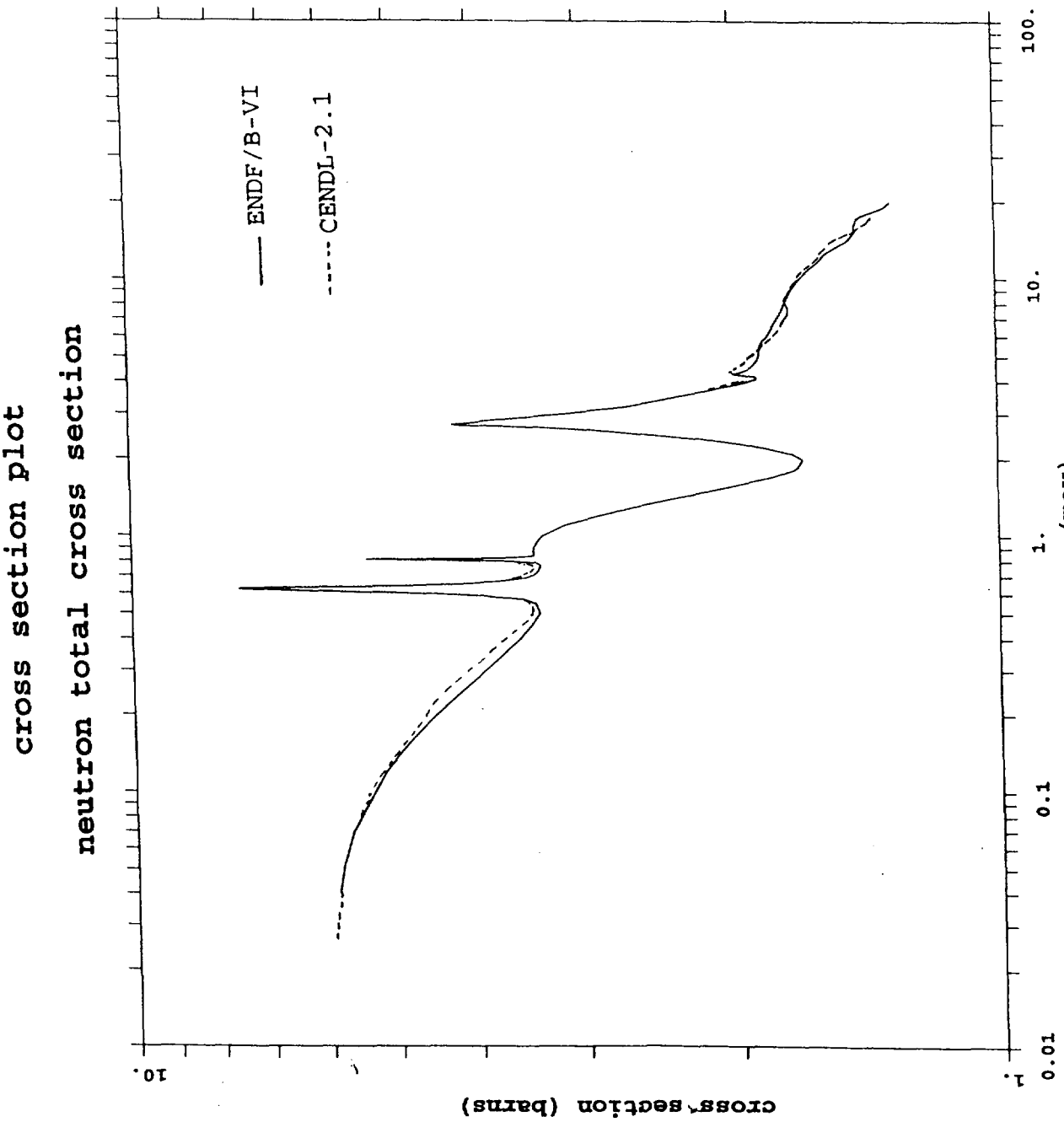
cross section plot
neutron total cross section
ENDF/B-VI
CENDL-2.1
cross section (barns)
energy (mev)
10.
1.
0.1
0.01
1.
10.
100.

Fig. 4.1.8

Table 4.1.1

The results of Beryllium (Thickness=50.8mm)

tally fluctuation charts

library	nps	mean	error	vov	slope	fom
CENDL-2.1	16000	6.1795E-08	.0093	.0097	10.0	14572
ENDF/B-VI	16000	6.1414E-08	.0098	.0098	10.0	13159
CENDL-2.1	32000	6.3004E-08	.0072	.0045	10.0	12233
ENDF/B-VI	32000	6.2658E-08	.0076	.0046	10.0	10883
CENDL-2.1	48000	6.3113E-08	.0060	.0031	10.0	12034
ENDF/B-VI	48000	6.2794E-08	.0062	.0031	10.0	10738
CENDL-2.1	64000	6.3124E-08	.0052	.0025	10.0	11811
ENDF/B-VI	64000	6.2786E-08	.0055	.0025	10.0	10588
CENDL-2.1	80000	6.3260E-08	.0047	.0020	10.0	11650
ENDF/B-VI	80000	6.2920E-08	.0049	.0020	10.0	10547
CENDL-2.1	96000	6.3245E-08	.0043	.0016	10.0	11640
ENDF/B-VI	96000	6.3008E-08	.0045	.0017	10.0	10427
CENDL-2.1	112000	6.3173E-08	.0040	.0014	10.0	11770
ENDF/B-VI	112000	6.2887E-08	.0042	.0014	10.0	10537
CENDL-2.1	128000	6.3217E-08	.0037	.0012	10.0	11682
ENDF/B-VI	128000	6.2885E-08	.0039	.0013	10.0	10542
CENDL-2.1	144000	6.3207E-08	.0035	.0011	10.0	11690
ENDF/B-VI	144000	6.2850E-08	.0037	.0011	10.0	10582
CENDL-2.1	160000	6.3189E-08	.0033	.0010	10.0	11805
ENDF/B-VI	160000	6.2828E-08	.0035	.0010	10.0	10670
CENDL-2.1	164446	6.3167E-08	.0033	.0009	10.0	11801
ENDF/B-VI	163051	6.2834E-08	.0034	.0010	10.0	10650

Table 4.1.2 The results of Beryllium (CENDL-2.1)

FLUXES AT 5 PT DTS(TH=0.0,12.2,24.9,41.8,66.8 DEG)(Thickness=50.8mm)

detector:	1		2		3		4		5	
energy	flux	error	flux	error	flux	error	flux	error	flux	error
4.6308E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.2474E-02	1.37790E-11	.1709	1.37954E-11	.1696	1.42584E-11	.1699	1.58682E-11	.1669	1.22639E-11	.1638
5.9461E-02	1.05998E-11	.1873	1.11681E-11	.1849	1.31262E-11	.1563	1.19890E-11	.1701	8.14019E-12	.2116
6.7378E-02	1.39333E-11	.1623	1.43240E-11	.1633	1.27503E-11	.1655	1.18851E-11	.1684	8.50165E-12	.1636
7.6349E-02	1.52059E-11	.1622	1.42200E-11	.1683	1.61095E-11	.1588	1.40953E-11	.1535	1.17986E-11	.1716
8.6515E-02	1.83421E-11	.1516	1.82674E-11	.1389	1.67717E-11	.1407	1.19995E-11	.1435	1.00664E-11	.1644
9.8035E-02	1.81738E-11	.1689	1.63962E-11	.1744	1.77259E-11	.1629	1.81748E-11	.1488	1.08638E-11	.1491
1.1109E-01	1.52127E-11	.1520	1.28586E-11	.1653	1.21753E-11	.1561	1.32798E-11	.1573	1.14841E-11	.1458
1.2588E-01	2.01914E-11	.1447	1.98169E-11	.1391	2.04299E-11	.1268	1.56656E-11	.1287	1.14282E-11	.1435
1.4264E-01	1.91953E-11	.1577	1.95071E-11	.1590	1.97165E-11	.1560	2.05011E-11	.1416	1.76281E-11	.1322
1.6163E-01	1.94263E-11	.1388	2.13003E-11	.1282	2.02087E-11	.1264	2.08763E-11	.1302	1.59592E-11	.1356
1.8315E-01	2.31852E-11	.1379	2.55873E-11	.1252	2.44167E-11	.1275	2.25927E-11	.1294	2.01178E-11	.1232
2.0754E-01	2.96560E-11	.1134	2.81255E-11	.1152	2.65300E-11	.1172	2.85890E-11	.1126	2.07727E-11	.1236
2.3517E-01	3.80243E-11	.1133	3.69599E-11	.1143	3.45116E-11	.1168	3.25917E-11	.1099	2.77350E-11	.1100
2.6649E-01	3.51087E-11	.1050	3.89906E-11	.1074	3.54962E-11	.1052	3.61238E-11	.1054	2.53965E-11	.1185
3.0197E-01	4.55196E-11	.1040	4.62605E-11	.1002	4.21847E-11	.1016	4.36708E-11	.1007	3.07921E-11	.1129
3.4217E-01	4.91372E-11	.0976	5.26365E-11	.0923	4.38866E-11	.1006	4.35686E-11	.0995	3.94679E-11	.0967
3.8774E-01	5.58765E-11	.0915	5.61319E-11	.0895	5.12961E-11	.0977	5.52781E-11	.0921	4.21296E-11	.0919
4.3936E-01	6.63470E-11	.0854	7.00259E-11	.0839	5.54052E-11	.0949	4.84518E-11	.1003	4.81397E-11	.0917
4.9786E-01	6.90429E-11	.0855	7.22404E-11	.0826	5.62478E-11	.0971	6.06617E-11	.0832	4.55739E-11	.0861
5.6415E-01	7.50220E-11	.0767	7.59413E-11	.0746	5.45316E-11	.0942	5.49507E-11	.0905	5.50513E-11	.0875
6.3927E-01	5.12412E-11	.0947	4.96423E-11	.0925	4.25953E-11	.1008	4.13528E-11	.0970	3.64168E-11	.0941
7.2438E-01	8.85618E-11	.0748	8.25263E-11	.0757	6.12074E-11	.0943	5.79146E-11	.0922	5.38860E-11	.0905
8.2084E-01	9.55376E-11	.0706	1.02510E-10	.0719	7.79402E-11	.0863	7.25895E-11	.0849	5.85446E-11	.0903
9.3013E-01	9.92688E-11	.0759	1.00754E-10	.0742	7.70213E-11	.0901	8.59001E-11	.0840	6.90364E-11	.0912
1.0540E+00	1.13122E-10	.0703	1.15968E-10	.0709	8.03316E-11	.0921	7.36287E-11	.0871	6.42332E-11	.0837
1.1943E+00	1.17160E-10	.0648	1.23318E-10	.0629	8.03361E-11	.0876	7.68202E-11	.0842	6.54904E-11	.0856
1.3533E+00	1.55448E-10	.0622	1.55056E-10	.0619	9.88547E-11	.0855	9.77189E-11	.0818	8.04400E-11	.0759
1.5335E+00	1.78968E-10	.0562	1.76885E-10	.0570	9.64201E-11	.0941	1.00991E-10	.0855	1.01056E-10	.0763
1.7377E+00	1.58771E-10	.0717	1.71403E-10	.0695	1.29806E-10	.0851	1.26384E-10	.0779	1.11549E-10	.0673
1.8498E+00	1.24538E-10	.0782	1.24194E-10	.0765	7.04436E-11	.1189	6.64509E-11	.1113	6.14073E-11	.0914
1.9691E+00	1.07883E-10	.0744	1.08855E-10	.0728	5.42459E-11	.1224	5.79623E-11	.1111	5.15792E-11	.0985
2.0961E+00	1.16749E-10	.0739	1.15111E-10	.0734	4.75741E-11	.1321	4.91377E-11	.1164	4.96063E-11	.1011
2.2313E+00	1.15861E-10	.0774	1.15881E-10	.0746	5.43351E-11	.1303	4.69486E-11	.1307	4.83083E-11	.1118
2.3752E+00	1.20176E-10	.0822	1.17871E-10	.0828	6.88827E-11	.1236	7.22555E-11	.1162	6.19881E-11	.1052
2.5284E+00	1.02923E-10	.0826	1.06942E-10	.0801	6.25130E-11	.1207	5.30787E-11	.1199	4.50733E-11	.1254
2.6914E+00	9.00223E-11	.0901	7.97689E-11	.0921	5.47289E-11	.1377	4.29103E-11	.1624	3.72133E-11	.1521
2.8650E+00	6.79817E-11	.1051	7.13511E-11	.1010	3.16401E-11	.1622	2.50147E-11	.1726	2.11156E-11	.2431
3.0498E+00	1.07554E-10	.0694	1.09585E-10	.0666	4.25710E-11	.1573	4.07503E-11	.1594	3.28591E-11	.1731
3.2465E+00	1.05428E-10	.0749	1.15774E-10	.0730	4.72490E-11	.1513	3.95305E-11	.1512	3.29662E-11	.1586
3.4559E+00	7.44022E-11	.1085	8.05448E-11	.1039	4.99787E-11	.1534	4.95104E-11	.1513	3.17431E-11	.1561
3.6787E+00	7.11051E-11	.1158	7.02095E-11	.1090	4.36960E-11	.1539	4.18100E-11	.1508	2.94183E-11	.1371
3.9160E+00	8.59611E-11	.1036	8.50849E-11	.0980	5.13347E-11	.1512	4.03996E-11	.1525	2.74472E-11	.1614
4.1686E+00	7.67309E-11	.1037	8.09241E-11	.1058	4.75897E-11	.1592	4.10990E-11	.1578	3.70971E-11	.1385
4.4374E+00	7.88065E-11	.1013	7.06060E-11	.1028	4.19539E-11	.1684	4.34538E-11	.1570	3.86244E-11	.1512
4.7236E+00	6.96707E-11	.1135	6.82310E-11	.1134	4.08142E-11	.1734	4.12469E-11	.1657	3.23788E-11	.1481
5.0282E+00	6.13134E-11	.1191	6.40057E-11	.1135	3.51217E-11	.1757	2.84222E-11	.1841	3.39927E-11	.1557
5.3525E+00	7.50939E-11	.1180	8.33179E-11	.1148	5.31054E-11	.1576	5.14586E-11	.1433	3.21819E-11	.1517
5.6978E+00	6.79215E-11	.1273	6.50861E-11	.1203	3.65113E-11	.1769	3.36392E-11	.1614	3.81013E-11	.2046
6.0652E+00	7.74055E-11	.1222	8.80193E-11	.1204	5.67569E-11	.1770	4.66262E-11	.1995	3.10264E-11	.1856
6.4564E+00	6.66075E-11	.1304	7.22598E-11	.1233	4.67193E-11	.1709	4.59398E-11	.1539	3.72794E-11	.1677
6.8728E+00	5.90471E-11	.1316	5.48385E-11	.1404	3.94484E-11	.1986	4.09247E-11	.1754	2.93516E-11	.1706
7.3161E+00	5.37911E-11	.1553	5.33072E-11	.1528	4.15060E-11	.1926	3.40479E-11	.2118	2.82293E-11	.1656
7.7879E+00	6.65661E-11	.1197	6.42446E-11	.1206	3.69049E-11	.1822	3.54929E-11	.1862	2.89590E-11	.1754
8.2902E+00	6.66079E-11	.1180	7.75224E-11	.1110	5.08762E-11	.1606	5.27552E-11	.1617	4.58349E-11	.1603

Table 4.1.2 (cont.)

8.8249E+00	7.92211E-11	.1319	7.91800E-11	.1235	4.29594E-11	.1797	3.10617E-11	.1660	4.59989E-11	.2128
9.3940E+00	8.57958E-11	.1100	9.06465E-11	.1114	5.07575E-11	.1718	4.61409E-11	.1746	3.41231E-11	.1894
9.9999E+00	6.70114E-11	.1698	6.02069E-11	.1707	5.32794E-11	.1744	4.69762E-11	.1688	4.11061E-11	.1846
1.0157E+01	2.92816E-11	.2092	2.72810E-11	.1919	1.23085E-11	.3055	1.40830E-11	.2743	1.73794E-11	.2722
1.0317E+01	2.16633E-11	.1739	2.24369E-11	.1870	6.15718E-12	.4737	9.60871E-12	.3282	1.10740E-11	.2654
1.0480E+01	2.07546E-11	.2369	1.89259E-11	.1959	8.48188E-12	.3653	8.55710E-12	.3144	9.36475E-12	.2306
1.0645E+01	2.41233E-11	.1553	2.57713E-11	.1616	1.33123E-11	.3077	1.23532E-11	.4329	1.34439E-11	.2590
1.0812E+01	2.32928E-11	.1611	2.55303E-11	.1845	4.74069E-12	.5332	9.94135E-12	.4036	1.12112E-11	.4608
1.0983E+01	3.88228E-11	.1940	2.93589E-11	.1588	1.63586E-11	.3296	9.49220E-12	.3074	1.46395E-11	.2480
1.1156E+01	4.42064E-11	.1781	4.76913E-11	.1735	7.42883E-12	.3340	7.05370E-12	.2980	1.39272E-11	.3152
1.1331E+01	4.50964E-11	.1240	4.08244E-11	.1139	1.50534E-11	.4814	1.34475E-11	.4887	1.14737E-11	.3162
1.1510E+01	4.46415E-11	.1026	4.37764E-11	.0992	1.05777E-11	.3353	6.46086E-12	.3428	1.21282E-11	.3265
1.1691E+01	4.97874E-11	.1368	5.08508E-11	.1287	1.58145E-11	.3155	1.90163E-11	.3050	1.85210E-11	.3287
1.1875E+01	6.41448E-11	.1055	6.97866E-11	.1149	1.12473E-11	.3263	7.06694E-12	.4028	9.76650E-12	.2506
1.2062E+01	7.79151E-11	.0921	9.17417E-11	.1153	2.17799E-11	.3434	9.17326E-12	.3340	1.51839E-11	.2021
1.2252E+01	9.41317E-11	.1233	8.24938E-11	.1013	7.43906E-12	.3937	7.72948E-12	.2622	8.27829E-12	.1204
1.2445E+01	1.46178E-10	.0755	1.38852E-10	.0714	2.17353E-11	.3250	1.46093E-11	.2665	1.24100E-11	.2003
1.2641E+01	1.40453E-10	.0698	1.36304E-10	.0638	2.15808E-11	.3067	1.54199E-11	.2380	1.35295E-11	.2380
1.2840E+01	1.43278E-10	.0701	1.35936E-10	.0641	2.59787E-11	.2320	2.92347E-11	.2536	1.47679E-11	.1613
1.3042E+01	3.43177E-10	.0488	3.55113E-10	.0476	3.88213E-11	.2303	3.81438E-11	.2545	1.72381E-11	.1777
1.3248E+01	3.81088E-10	.0464	3.74548E-10	.0441	5.64028E-11	.1808	5.12088E-11	.1619	2.33760E-11	.2185
1.3456E+01	4.17039E-10	.0506	3.91093E-10	.0453	8.66238E-11	.1742	5.73150E-11	.1532	3.23412E-11	.3634
1.3668E+01	9.77875E-10	.0290	9.71643E-10	.0277	9.94728E-11	.1424	8.38620E-11	.1054	2.31739E-11	.2137
1.3883E+01	1.32837E-09	.0247	1.29608E-09	.0236	1.70172E-10	.1111	1.25778E-10	.0971	2.95628E-11	.1830
1.4102E+01	1.40264E-09	.0267	1.41319E-09	.0255	2.76863E-10	.0881	1.55765E-10	.1003	3.25410E-11	.2629
1.4324E+01	3.66105E-09	.0149	3.59125E-09	.0142	3.99935E-10	.0832	1.63284E-10	.0918	2.82203E-11	.2957
1.4550E+01	6.53099E-09	.0110	6.35910E-09	.0107	4.61691E-10	.0788	1.37425E-10	.1074	1.40173E-11	.3052
1.4779E+01	6.76810E-09	.0108	6.59196E-09	.0104	4.70697E-10	.0738	1.27292E-10	.1201	1.43161E-11	.3715
1.5012E+01	7.22553E-09	.0104	7.04008E-09	.0098	4.08996E-10	.0812	8.90237E-11	.1310	9.85086E-12	.3401
1.5248E+01	8.60475E-09	.0095	8.24314E-09	.0087	3.97789E-10	.0806	6.59258E-11	.1816	9.71931E-13	1.0000
1.5488E+01	8.74764E-09	.0089	8.50877E-09	.0085	2.91606E-10	.1087	1.93462E-11	.3533	1.19079E-12	1.0000
1.5732E+01	8.55757E-09	.0090	8.17235E-09	.0082	1.08663E-10	.1790	6.93333E-12	.6011	3.61366E-12	1.0000
1.5980E+01	1.59704E-09	.0220	1.53556E-09	.0210	4.12134E-11	.3342	3.01357E-12	1.0000	0.00000E+00	.0000
1.6231E+01	1.56551E-09	.0213	1.47736E-09	.0185	9.05092E-12	.6066	0.00000E+00	.0000	0.00000E+00	.0000
1.6487E+01	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
total	6.31674E-08	.0033	6.14250E-08	.0031	6.22378E-09	.0223	3.87672E-09	.0236	2.61649E-09	.0245

uncollided neutron flux

detector:	1		2		3		4		5	
energy	flux	error	flux	error	flux	error	flux	error	flux	error
4.6308E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.2474E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.9461E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
6.7378E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
7.6349E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
8.6515E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
9.8035E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1109E-01	1.92001E-13	1.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2588E-01	7.68088E-13	.5000	3.73700E-13	.7071	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.4264E-01	1.15184E-12	.4082	5.59820E-13	.5773	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.6163E-01	7.64020E-13	.5000	1.48792E-12	.3536	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.8315E-01	1.34337E-12	.3780	1.11789E-12	.4082	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.0754E-01	3.30803E-12	.2391	3.22039E-12	.2392	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.3517E-01	3.46406E-12	.2357	2.23475E-12	.2887	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.6649E-01	4.98598E-12	.1961	3.16964E-12	.2425	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.0197E-01	5.95759E-12	.1796	5.22464E-12	.1890	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.4217E-01	6.72729E-12	.1690	5.97089E-12	.1768	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.8774E-01	1.32413E-11	.1204	1.11954E-11	.1291	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
4.3936E-01	1.33332E-11	.1197	1.27652E-11	.1206	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
4.9786E-01	1.68655E-11	.1066	1.84697E-11	.1005	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000

Table 4.1.2 (cont.)

5.6415E-01	2.34037E-11	.0905	2.10925E-11	.0940	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
6.3927E-01	1.28485E-11	.1221	1.11915E-11	.1291	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
7.2438E-01	2.31903E-11	.0909	2.08898E-11	.0945	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
8.2084E-01	2.68676E-11	.0845	2.74380E-11	.0824	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
9.3013E-01	3.10612E-11	.0785	2.74254E-11	.0824	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0540E+00	3.43463E-11	.0747	3.28638E-11	.0753	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1943E+00	4.05753E-11	.0687	4.26066E-11	.0661	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.3533E+00	5.31210E-11	.0600	5.03715E-11	.0608	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5335E+00	7.81966E-11	.0515	7.62412E-11	.0514	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.7377E+00	4.76150E-11	.0732	4.63605E-11	.0732	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.8498E+00	5.71813E-11	.0707	5.58126E-11	.0707	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.9691E+00	6.15153E-11	.0691	6.00804E-11	.0691	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.0961E+00	6.14472E-11	.0691	6.00125E-11	.0691	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.2313E+00	5.84226E-11	.0688	5.69851E-11	.0688	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.3752E+00	4.85556E-11	.0711	4.72375E-11	.0711	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.5284E+00	4.24844E-11	.0687	4.14349E-11	.0686	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.6914E+00	3.60644E-11	.0729	3.09835E-11	.0776	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.8650E+00	2.95385E-11	.0805	2.85401E-11	.0808	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.0498E+00	6.94805E-11	.0525	7.13306E-11	.0511	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.2465E+00	6.30227E-11	.0551	6.50434E-11	.0535	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.4559E+00	2.76512E-11	.0833	2.85706E-11	.0808	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.6787E+00	2.60234E-11	.0888	2.52192E-11	.0888	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.9160E+00	3.55610E-11	.0806	3.45504E-11	.0806	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
4.1686E+00	3.17861E-11	.0894	3.09469E-11	.0894	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
4.4374E+00	3.40493E-11	.0857	3.31393E-11	.0857	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
4.7236E+00	2.96739E-11	.0928	2.88941E-11	.0928	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.0282E+00	2.89413E-11	.0949	2.81923E-11	.0949	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.3525E+00	2.78557E-11	.0971	2.71395E-11	.0971	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.6978E+00	2.71406E-11	.0985	2.64443E-11	.0985	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
6.0652E+00	2.74992E-11	.0985	2.68013E-11	.0985	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
6.4564E+00	2.41646E-11	.1060	2.35598E-11	.1060	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
6.8728E+00	1.89777E-11	.1204	1.85079E-11	.1204	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
7.3161E+00	1.25314E-11	.1491	1.22244E-11	.1491	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
7.7879E+00	2.61761E-11	.1037	2.55408E-11	.1037	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
8.2902E+00	2.55647E-11	.1054	2.49492E-11	.1054	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
8.8249E+00	2.83470E-11	.1005	2.76693E-11	.1005	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
9.3940E+00	3.44457E-11	.0916	3.36301E-11	.0916	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
9.9999E+00	7.92155E-12	.1924	7.73624E-12	.1924	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0157E+01	1.15651E-11	.1601	1.12971E-11	.1601	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0317E+01	1.48970E-11	.1414	1.45534E-11	.1414	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0480E+01	1.04746E-11	.1690	1.02340E-11	.1690	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0645E+01	1.47438E-11	.1428	1.44067E-11	.1428	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0812E+01	1.60249E-11	.1373	1.56602E-11	.1373	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0983E+01	1.70165E-11	.1336	1.66310E-11	.1336	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1156E+01	2.74953E-11	.1054	2.68755E-11	.1054	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1331E+01	3.43980E-11	.0945	3.36265E-11	.0945	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1510E+01	3.86101E-11	.0894	3.77488E-11	.0894	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1691E+01	3.57263E-11	.0932	3.49337E-11	.0932	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1875E+01	5.18107E-11	.0776	5.06663E-11	.0776	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2062E+01	6.23900E-11	.0708	6.10179E-11	.0708	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2252E+01	6.42161E-11	.0700	6.28093E-11	.0700	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2445E+01	1.21331E-10	.0510	1.18682E-10	.0510	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2641E+01	1.18732E-10	.0517	1.16152E-10	.0517	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2840E+01	1.18870E-10	.0518	1.16303E-10	.0518	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.3042E+01	2.97259E-10	.0328	2.90884E-10	.0328	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.3248E+01	3.29928E-10	.0312	3.22904E-10	.0312	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.3456E+01	3.22940E-10	.0317	3.16115E-10	.0317	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.3668E+01	8.41129E-10	.0196	8.23491E-10	.0196	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.3883E+01	1.16262E-09	.0167	1.13843E-09	.0167	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.4102E+01	1.16677E-09	.0167	1.14268E-09	.0167	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000

Table 4.1.2 (cont.)

1.4324E+01	3.20445E-09	.0099	3.13868E-09	.0099	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.4550E+01	5.79488E-09	.0072	5.67645E-09	.0072	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.4779E+01	5.99905E-09	.0071	5.87690E-09	.0071	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5012E+01	6.43051E-09	.0068	6.30008E-09	.0068	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5248E+01	7.70640E-09	.0062	7.55044E-09	.0062	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5488E+01	7.94752E-09	.0061	7.78682E-09	.0061	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5732E+01	7.86215E-09	.0061	7.70325E-09	.0061	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5980E+01	1.43902E-09	.0152	1.40994E-09	.0152	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.6231E+01	1.45221E-09	.0151	1.42287E-09	.0151	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.6487E+01	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
total	5.41605E-08	.0003	5.30450E-08	.0003	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000

Table 4.1.3.

```
FNS-TOF/31.5 CM(R)*5.08 CM(Z)-BE CYL./FIXED CONE BIAS/5 PT DETECTORS
C     ****************************************
C     *   CELL CARAD                         *
C     ****************************************
C     ******* EXTERNAL VOID ****************
 1     0           -4 : +4 -2 +3 : +10 : +2 -10 +5 +6 +7 +8 +9
C     ******* SOURCE VACUUM REGION *********
 2     0              -3  +4  -1
C     ******* MATERIAL REGION **************
 3     1    1.215-1   -3  +1  -2
C     ******* DETECTOR VACUUM REGION *******
 4     0  +2  -10 -5 : +2 -10 -6 : +2 -10 -7 : +2 -10 -8 : +2 -10 -9
C     ------- THE FOLLOWING IS A BLANK DELIMETER

C     ****************************************
C     * SURFACE CARD                         *
C     ****************************************
 1             PZ          -5.08
 2             PZ              0
 3             CZ           31.5
 4             PZ            -50
 5             CZ          5.228
 6           1 CZ          5.235
 7           2 CZ          5.242
 8           3 CZ          5.270
 9           4 CZ          5.332
10             SO           1000
C      ------- THE FOLLOWING IS A BLANK DELIMETER

C     ****************************************
C     *  MODE CARD       - NEUTRON ONLY      *
C     ****************************************
MODE   N
C     ****************************************
C     *  TRANSFORMATION CARDS                *
C     *  ROTATION ABOUT THE Y AXIS BY THETA*
C     ****************************************
*TR1    0  0  0        12.2  90  102.2   90   0  90
                       77.8  90   12.2   +1
*TR2    0  0  0        24.9  90  114.9   90   0  90
                       65.1  90   24.9   +1
*TR3    0  0  0        41.8  90  131.8   90   0  90
                       48.2  90   41.8   +1
*TR4    0  0  0        66.8  90  156.8   90   0  90
                       23.2  90   66.8   +1
C     ****************************************
C     *   CELL PARAMETER CARDS               *
C     ****************************************
IMP:N  0    1   1  1
C     ******************************************************
C     *  SOURCE SPECIFICATION CARDS                        *
C     *  SRC1=POINT ISOTROPIC OPTION                       *
C     *  SDIR DIRC. BIASING - HEIGHT REDUCTION CONSIDERED*
C     *  SI(ENG.) AND SP(PROB.) TAKEN FROM BETOF SOURCE   *
C     *  EXPT. DATA                                        *
C     ******************************************************
sdef  pos=0 0 -25.08 cel=2 wgt=1.0  erg=d1 dir=d2 vec=0 0 1
SI1   4.6308-02
      5.2474-02  5.9461-02  6.7378-02  7.6349-02  8.6515-02
      9.8035-02  1.1109-01  1.2588-01  1.4264-01  1.6163-01
```

Table 4.1.3. (cont.)

```
      1.8315-01  2.0754-01  2.3517-01  2.6649-01  3.0197-01
      3.4217-01  3.8774-01  4.3936-01  4.9786-01  5.6415-01
      6.3927-01  7.2438-01  8.2084-01  9.3013-01  1.0540+00
      1.1943+00  1.3533+00  1.5335+00  1.7377+00  1.8498+00
      1.9691+00  2.0961+00  2.2313+00  2.3752+00  2.5284+00
      2.6914+00  2.8650+00  3.0498+00  3.2465+00  3.4559+00
      3.6787+00  3.9160+00  4.1686+00  4.4374+00  4.7236+00
      5.0282+00  5.3525+00  5.6978+00  6.0652+00  6.4564+00
      6.8728+00  7.3161+00  7.7879+00  8.2902+00  8.8249+00
      9.3940+00  9.9999+00  1.0157+01  1.0317+01  1.0480+01
      1.0645+01  1.0812+01  1.0983+01  1.1156+01  1.1331+01
      1.1510+01  1.1691+01  1.1875+01  1.2062+01  1.2252+01
      1.2445+01  1.2641+01  1.2840+01  1.3042+01  1.3248+01
      1.3456+01  1.3668+01  1.3883+01  1.4102+01  1.4324+01
      1.4550+01  1.4779+01  1.5012+01  1.5248+01  1.5488+01
      1.5732+01  1.5980+01  1.6231+01  1.6487+01
SP1   0
      0          0          0          0          0
      0          5.045-05   1.197-04   1.745-04   2.433-04
      2.511-04   3.572-04   4.063-04   5.016-04   6.489-04
      7.416-04   8.517-04   1.041-03   1.208-03   1.454-03
      1.694-03   1.851-03   2.077-03   2.229-03   2.337-03
      2.381-03   2.537-03   2.614-03   1.386-03   1.362-03
      1.333-03   1.278-03   1.262-03   1.267-03   1.326-03
      1.757-03   2.744-03   4.302-03   2.974-03   1.100-03
      1.072-03   1.009-03   8.938-04   8.675-04   8.483-04
      7.534-04   6.830-04   6.709-04   6.652-04   6.191-04
      5.136-04   4.860-04   5.057-04   5.266-04   6.163-04
      7.539-04   2.027-04   2.446-04   2.567-04   2.599-04
      3.287-04   3.745-04   3.789-04   5.094-04   6.856-04
      6.933-04   8.102-04   1.166-03   1.184-03   1.248-03
      2.430-03   2.467-03   2.504-03   5.970-03   6.696-03
      6.824-03   1.731-02   2.364-02   2.396-02   6.401-02
      1.159-01   1.180-01   1.271-01   1.538-01   1.564-01
      1.535-01   2.881-02   2.918-02   0
sb2   -31 0.5372231
C     ***********************************************
C     *  MATERIAL SPECIFICATION CARDS               *
C     ***********************************************
C     ----  BERYLLIUM ----------------------------
M1    4009.00C 1.0
C     DRXS
C     ***********************************************
C     *  TALLY SPECIFICATION CARDS                  *
C     ***********************************************
FC5   --- FLUXES AT 5 PT DTS(TH=0.0, 12.2, 24.9, 41.8, 66.8 DEG)
F5:N        0.0          0     738.0000         1
          156.16903      0     722.31035        1
          311.5665       0     671.21257        1
          495.90016      0     554.63414        1
          692.10891      0     296.63826        1
DD    0.5   100
E0    4.6308-02
      5.2474-02  5.9461-02  6.7378-02  7.6349-02  8.6515-02
      9.8035-02  1.1109-01  1.2588-01  1.4264-01  1.6163-01
      1.8315-01  2.0754-01  2.3517-01  2.6649-01  3.0197-01
      3.4217-01  3.8774-01  4.3936-01  4.9786-01  5.6415-01
      6.3927-01  7.2438-01  8.2084-01  9.3013-01  1.0540+00
      1.1943+00  1.3533+00  1.5335+00  1.7377+00  1.8498+00
      1.9691+00  2.0961+00  2.2313+00  2.3752+00  2.5284+00
```

Table 4.1.3. (cont.)

```
      2.6914+00  2.8650+00  3.0498+00  3.2465+00  3.4559+00
      3.6787+00  3.9160+00  4.1686+00  4.4374+00  4.7236+00
      5.0282+00  5.3525+00  5.6978+00  6.0652+00  6.4564+00
      6.8728+00  7.3161+00  7.7879+00  8.2902+00  8.8249+00
      9.3940+00  9.9999+00  1.0157+01  1.0317+01  1.0480+01
      1.0645+01  1.0812+01  1.0983+01  1.1156+01  1.1331+01
      1.1510+01  1.1691+01  1.1875+01  1.2062+01  1.2252+01
      1.2445+01  1.2641+01  1.2840+01  1.3042+01  1.3248+01
      1.3456+01  1.3668+01  1.3883+01  1.4102+01  1.4324+01
      1.4550+01  1.4779+01  1.5012+01  1.5248+01  1.5488+01
      1.5732+01  1.5980+01  1.6231+01  1.6487+01
FQ5     E     F
C     ***********************************************
C     * ENERGY AND THERMAL CARDS                    *
C     ***********************************************
C     ***********************************************
CUT:N          0      4.6308-02    -10    -0.01
NPS         1000000
CTME        8
C     ***********************************************
C     * PERIPHERAL CRADS                            *
C     ***********************************************
PRDMP         100000  100000
LOST      10          10
PRINT
```

Table 4.1.4 Comparison of integrated angular flux

for 50.8 mm-thick Beryllium Assembly

Angle	Expt.	CENDL-2.1	C/E	ENDF/B-VI	C/E
>10 Mev					
0.0	3.92370	3.74912	0.9555	3.75220	0.9563
24.9	0.25730	0.22452	0.873	0.25114	0.976
41.8	0.10240	0.083731	0.7595	0.09832	0.960
66.8	0.046623	0.027967	0.600	0.03247	0.696
2-10 Mev					
0.0	0.12646	0.13286	1.051	0.11121	0.879
24.9	0.060269	0.077879	1.292	0.05723	0.9496
41.8	0.055711	0.071306	1.280	0.053364	0.958
66.8	0.052344	0.060722	1.160	0.04708	0.899
0.5-2 Mev					
0.0	0.091218	0.088183	0.967	0.07568	0.830
24.9	0.052268	0.059342	1.135	0.045469	0.870
41.8	0.051627	0.058174	1.127	0.04404	0.853
66.8	0.048394	0.051306	1.06	0.037193	0.769
0.1-0.5 Mev					
0.0	0.037633	0.030859	0.820	0.037749	1.003
24.9	0.036902	0.027769	0.753	0.033605	0.986
41.8	0.034073	0.027323	0.802	0.03101	0.910
66.8	0.030698	0.022641	0.738	0.02554	0.832

Large differences exit between CENDL-2.1 and ENDF/B-VI at 24.9 degrees and 41.8 degrees. CENDL-2.1 overpredicts the flux from 0.5 - 10 MeV, and underestimates the flux from 0.1-0.5 MeV and above 10 MeV. However, ENDF/B-VI shows good agreement with the experiment over the whole energy range.

At 66.8 degrees, smaller differences exist between CENDL-2.1 and ENDF/B-VI from 0.1-0.5 MeV and above 10 MeV, but both of them underestimate the flux. CENDL-2.1 overpredicts the flux from 0.5-10 MeV, ENDF/B-VI underpredicts the flux from 0.5-10 MeV.

Better agreement with the experiment was obtained with ENDF/B-VI than with CENDL-2.1. Further improvement will be needed for the secondary energy-angle distributions of Be-9.

(2) Testing and analysis of angular neutron flux on an iron slab

The iron slab assemblies are 200 mm and 400 mm in thickness, with a 50-mm equivalent radius. The energy range is from 50 keV to 15 MeV. Angular neutron fluxes are computed at angles of 0.0, 12.2, 24.9, 41.8 and 66.8 degrees.

List of Figures and Tables

Conclusions:

From **Table 4.2.1**, we see that the angular neutron fluxes at point detector are generally reliable, because the relative error of both libraries is less than 0.05, and VOV is below 0.1.

CENDL-2.1 gives better results than those of the MCNP test library over the whole energy range for the 20 cm thick slab.

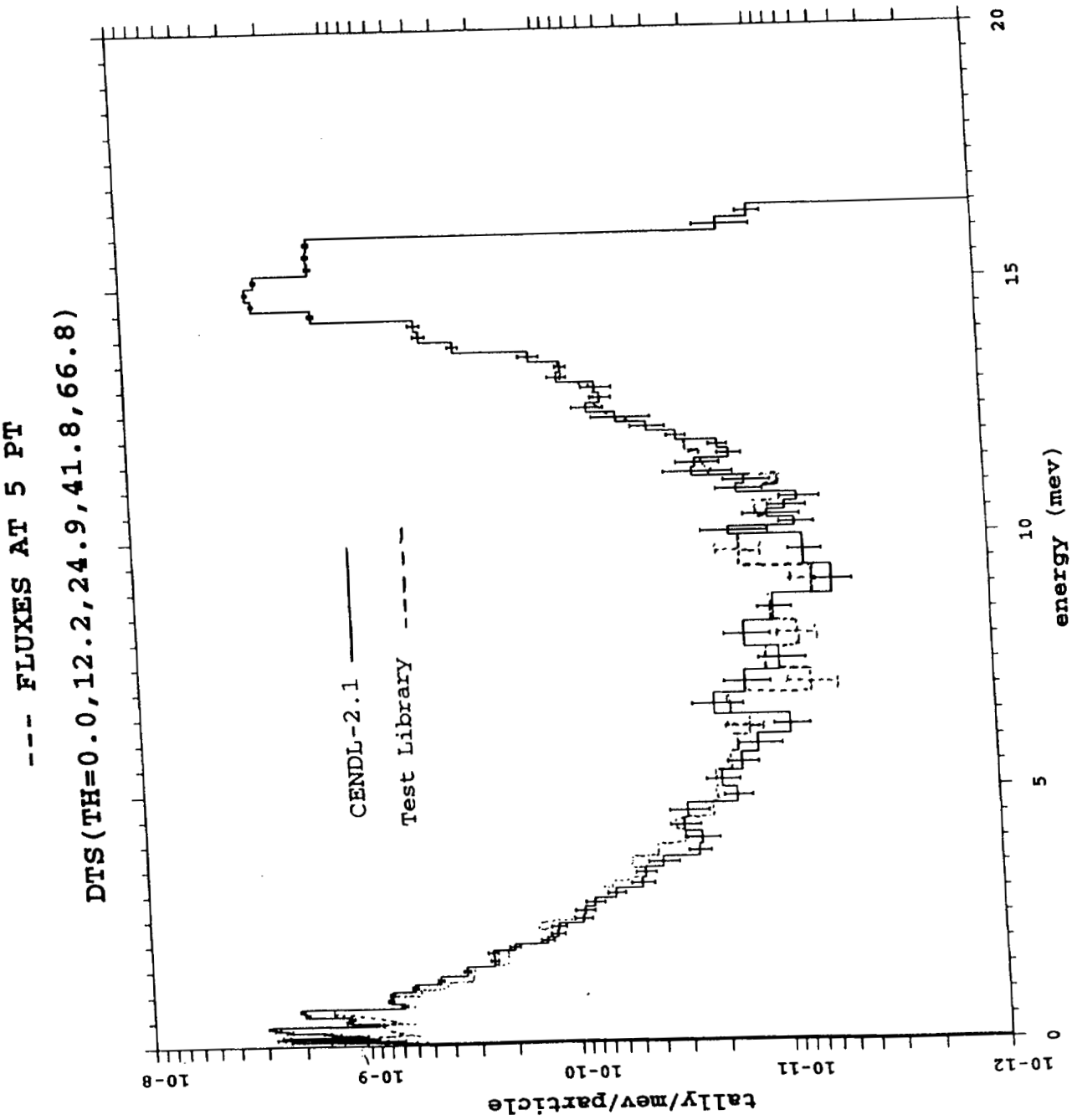
--- FLUXES AT 5 PT
DTS(TH=0.0,12.2,24.9,41.8,66.8)
CENDL-2.1
Test Library
tally/mev/particle
energy (mev)
10-8
10-9
10-10
10-11
10-12
0
5
10
15
20

Fig. 4.2.1

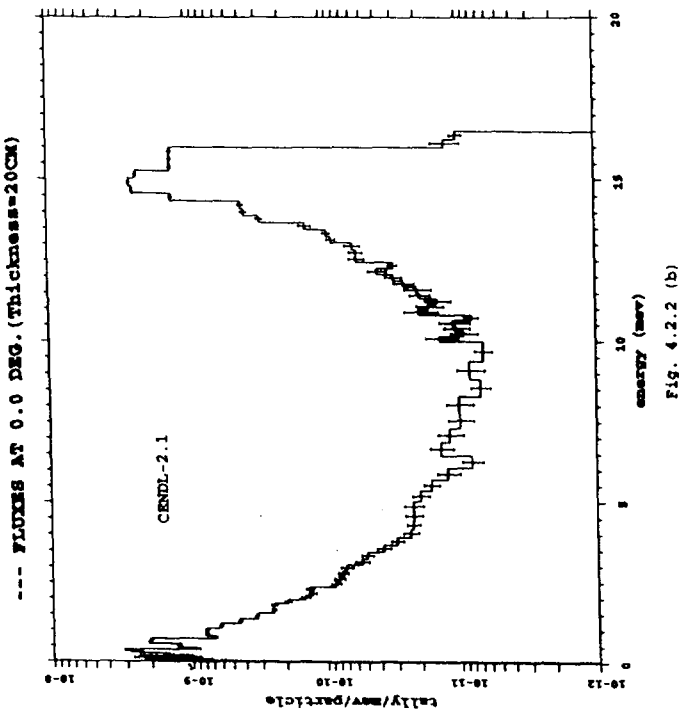

Fig. 4.2.2 (b)

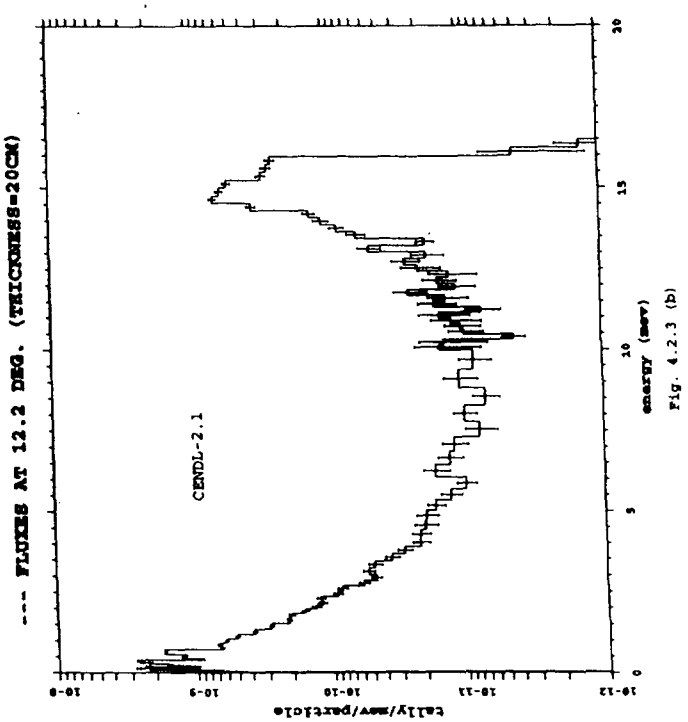

Fig. 4.2.3 (b)

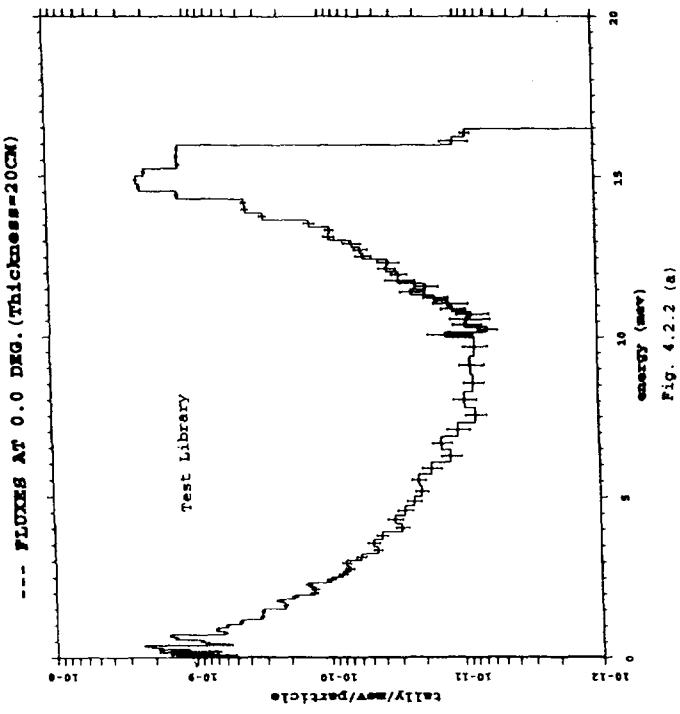

Fig. 4.2.2 (a)

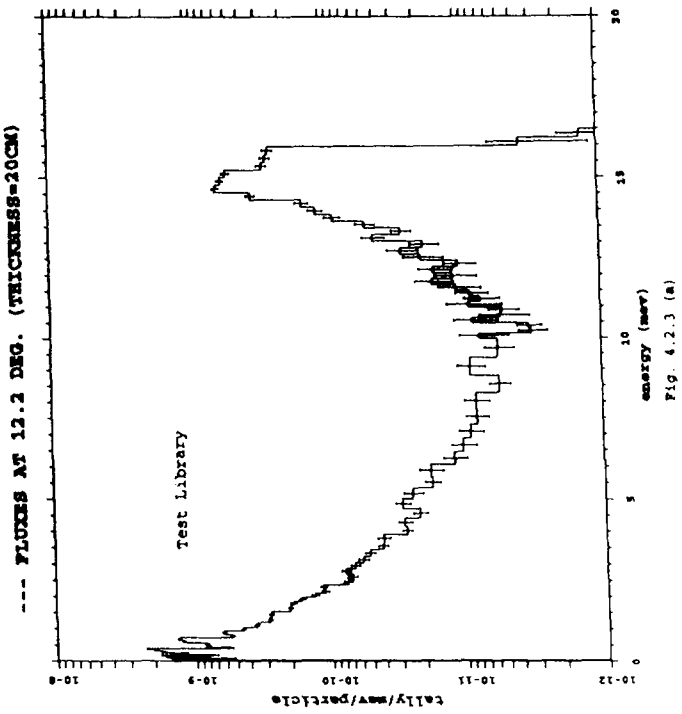

Fig. 4.2.3 (a)

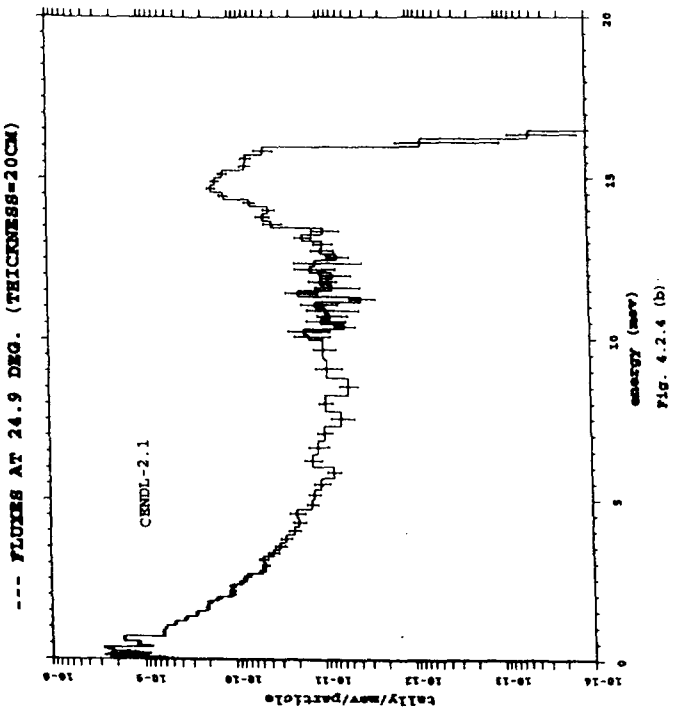

Fig. 4.2.4 (b)

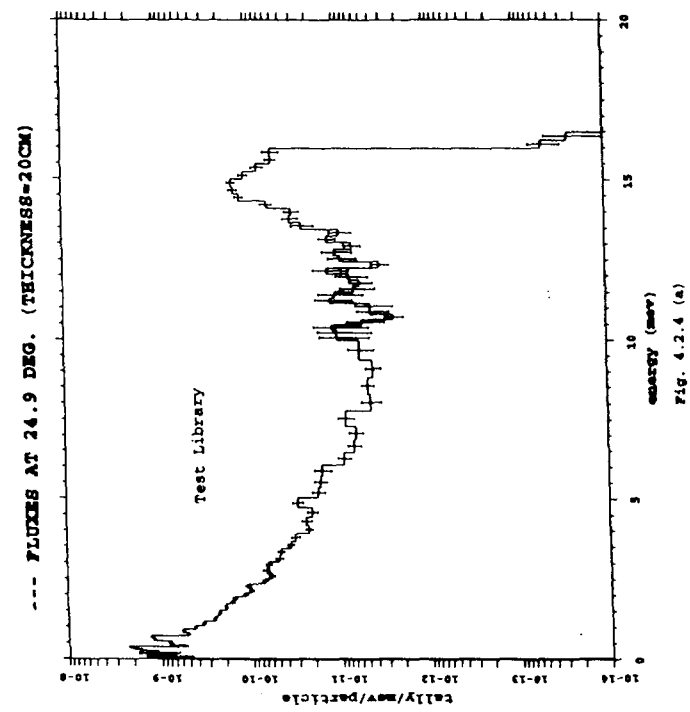

Fig. 4.2.4 (a)

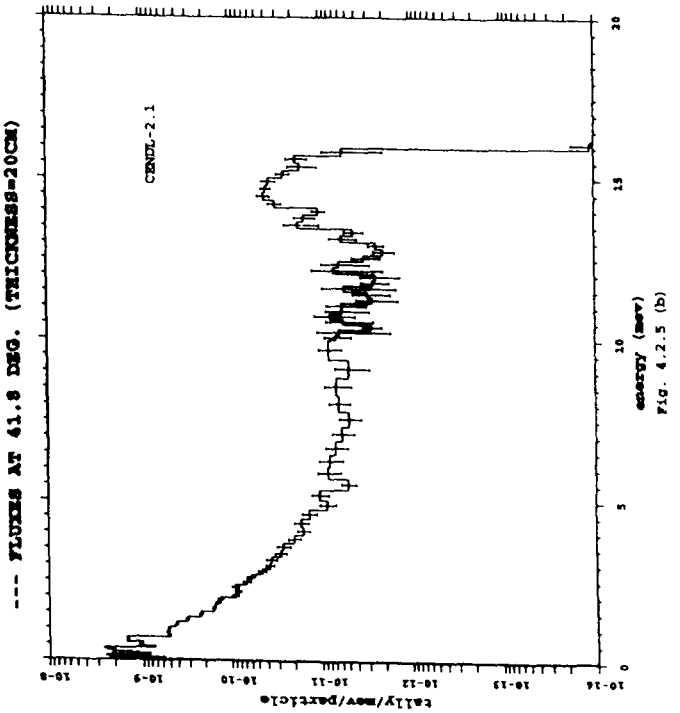

Fig. 4.2.5 (b)

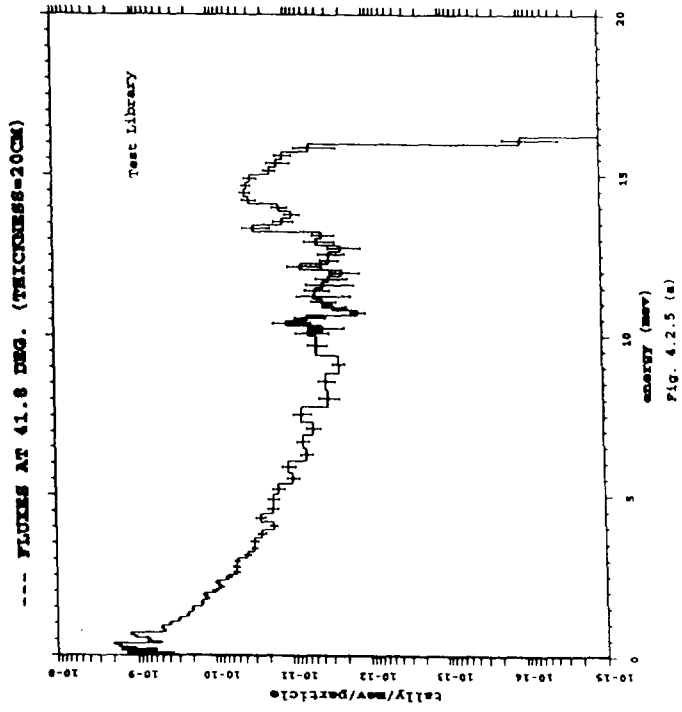

Fig. 4.2.5 (a)

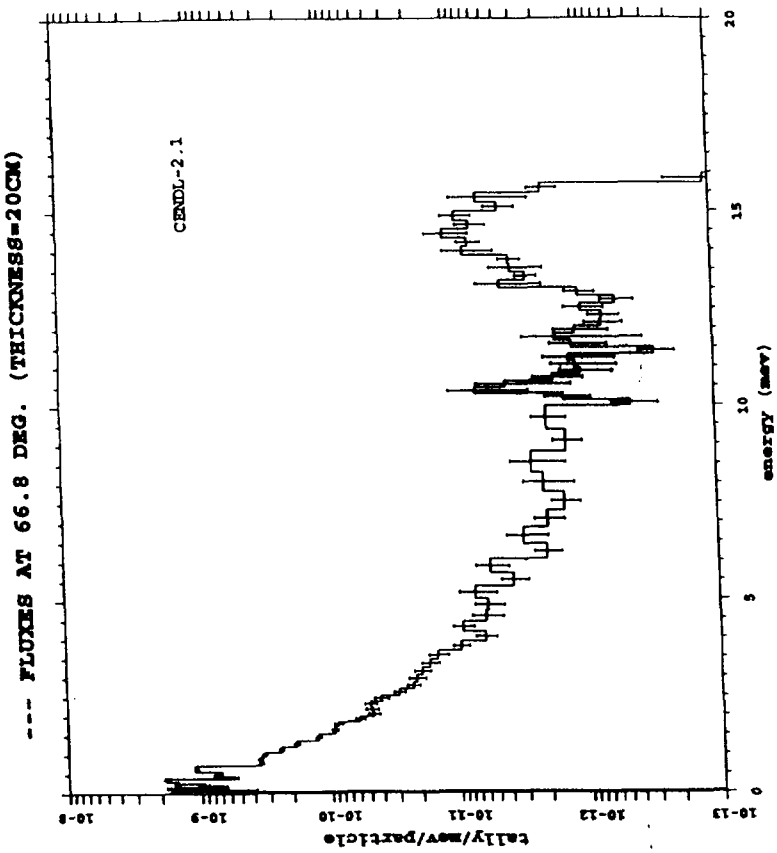

Fig 4.2.6 (b)

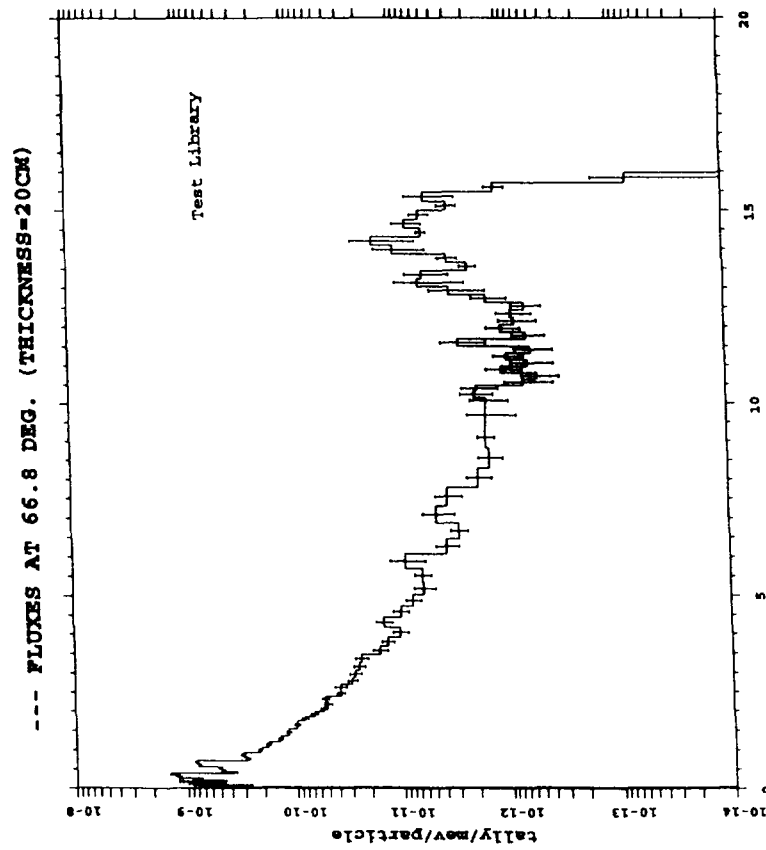

Fig. 4.2.6 (a)

Table 4.2.1

The results of Iron(Thickness=20CM)

tally fluctuation charts

	nps	mean	error	vov	slope	fom
CENDL-2.1	128000	5.1632E-09	.0211	.0160	3.4	195
TESTLIB	128000	4.4624E-09	.0215	.0191	3.7	198
CENDL-2.1	256000	5.2933E-09	.0151	.0071	3.8	190
TESTLIB	256000	4.5789E-09	.0159	.0076	9.3	182
CENDL-2.1	384000	5.3100E-09	.0124	.0054	6.8	188
TESTLIB	384000	4.5854E-09	.0129	.0051	10.0	185
CENDL-2.1	512000	5.3245E-09	.0109	.0042	10.0	184
TESTLIB	512000	4.6302E-09	.0114	.0043	10.0	176
CENDL-2.1	640000	5.3365E-09	.0097	.0036	10.0	184
TESTLIB	640000	4.6525E-09	.0102	.0034	10.0	175
CENDL-2.1	768000	5.3452E-09	.0089	.0029	10.0	185
TESTLIB	768000	4.6671E-09	.0094	.0028	10.0	174
CENDL-2.1	896000	5.3273E-09	.0082	.0024	10.0	186
TESTLIB	896000	4.6511E-09	.0086	.0024	10.0	176
CENDL-2.1	1024000	5.3347E-09	.0077	.0021	10.0	185
TESTLIB	1024000	4.6742E-09	.0081	.0021	10.0	173
CENDL-2.1	1152000	5.3574E-09	.0073	.0018	10.0	184
TESTLIB	1152000	4.6809E-09	.0077	.0018	10.0	172
CENDL-2.1	1280000	5.3506E-09	.0069	.0016	10.0	186
TESTLIB	1280000	4.6738E-09	.0073	.0016	10.0	173
CENDL-2.1	1344640	5.3576E-09	.0067	.0015	10.0	185
TESTLIB	1408000	4.6567E-09	.0069	.0014	10.0	174

Table 4.2.2 The results of Iron(Thickness=20CM) (CENDL-2.1)

FLUXES AT 5 PT DTS(TH=0.0,12.2,24.9,41.8,66.8)
units 1/cm**2

detector:	1		2		3		4		5	
energy	flux	error	flux	error	flux	error	flux	error	flux	error
4.6308E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.2474E-02	3.99858E-12	.1550	4.19422E-12	.1552	4.55985E-12	.1470	4.22872E-12	.1451	2.67989E-12	.1435
5.9461E-02	4.86511E-12	.1205	5.11223E-12	.1174	5.38924E-12	.1146	5.04728E-12	.1188	3.39714E-12	.1362
6.7378E-02	7.56421E-12	.0985	7.46220E-12	.0958	7.21162E-12	.0929	6.39704E-12	.1011	3.98631E-12	.1147
7.6349E-02	1.30457E-11	.0748	1.26290E-11	.0756	1.24095E-11	.0745	1.21546E-11	.0729	8.19767E-12	.0812
8.6515E-02	2.26117E-11	.0618	2.29241E-11	.0602	2.22937E-11	.0591	2.02456E-11	.0597	1.50175E-11	.0639
9.8035E-02	8.84922E-12	.0946	8.56777E-12	.0960	7.83027E-12	.1000	6.94462E-12	.1048	5.51920E-12	.1116
1.1109E-01	1.37112E-11	.0699	1.39894E-11	.0696	1.38131E-11	.0699	1.24099E-11	.0756	9.91350E-12	.0860
1.2588E-01	2.65617E-11	.0491	2.64266E-11	.0491	2.54293E-11	.0494	2.27847E-11	.0505	1.59911E-11	.0585
1.4264E-01	4.41099E-11	.0394	4.34209E-11	.0404	4.32999E-11	.0399	3.87583E-11	.0410	2.91277E-11	.0452
1.6163E-01	1.85683E-11	.0616	1.87669E-11	.0610	1.84195E-11	.0618	1.60861E-11	.0670	1.32999E-11	.0713
1.8315E-01	5.35993E-11	.0374	5.35948E-11	.0379	5.03868E-11	.0390	4.65794E-11	.0394	3.25667E-11	.0449
2.0754E-01	2.67721E-11	.0527	2.74437E-11	.0523	2.61583E-11	.0529	2.38339E-11	.0522	1.63655E-11	.0589
2.3517E-01	4.03363E-11	.0423	3.69058E-11	.0454	3.58314E-11	.0456	3.37754E-11	.0459	2.47002E-11	.0510
2.6649E-01	5.07253E-11	.0356	5.02648E-11	.0365	4.94429E-11	.0374	4.32127E-11	.0386	3.16073E-11	.0448
3.0197E-01	8.52905E-11	.0297	7.85417E-11	.0318	7.77404E-11	.0317	7.25901E-11	.0323	5.68343E-11	.0349
3.4217E-01	1.09623E-10	.0266	1.04844E-10	.0280	1.00327E-10	.0282	9.06718E-11	.0288	7.09895E-11	.0309
3.8774E-01	1.32716E-10	.0247	1.22775E-10	.0265	1.20182E-10	.0263	1.12081E-10	.0266	8.09758E-11	.0298
4.3936E-01	4.70860E-11	.0412	4.61789E-11	.0425	4.33698E-11	.0433	3.89818E-11	.0460	2.72666E-11	.0537
4.9786E-01	7.38148E-11	.0320	6.93067E-11	.0334	6.44120E-11	.0338	5.88362E-11	.0345	4.13394E-11	.0397
5.6415E-01	8.14981E-11	.0302	7.85989E-11	.0317	7.39751E-11	.0325	6.76865E-11	.0337	4.94464E-11	.0377
6.3927E-01	1.47622E-10	.0222	1.33975E-10	.0247	1.27150E-10	.0251	1.15263E-10	.0262	8.39143E-11	.0297
7.2438E-01	1.76336E-10	.0216	1.56603E-10	.0235	1.46988E-10	.0237	1.32264E-10	.0242	9.26851E-11	.0285
8.2084E-01	6.61781E-11	.0343	6.64348E-11	.0356	6.22092E-11	.0365	5.33784E-11	.0386	3.26189E-11	.0479
9.3013E-01	8.68400E-11	.0287	7.65914E-11	.0326	7.07655E-11	.0334	6.00399E-11	.0352	3.64691E-11	.0431
1.0540E+00	9.63976E-11	.0265	7.89163E-11	.0325	7.45705E-11	.0331	6.25189E-11	.0350	3.98582E-11	.0427
1.1943E+00	8.48420E-11	.0301	7.35575E-11	.0367	7.02213E-11	.0387	5.95963E-11	.0403	3.67196E-11	.0490
1.3533E+00	7.22331E-11	.0342	6.39134E-11	.0386	5.74959E-11	.0393	4.86409E-11	.0426	2.73211E-11	.0513
1.5335E+00	6.14670E-11	.0341	5.16730E-11	.0393	4.76990E-11	.0413	3.88553E-11	.0465	2.23020E-11	.0605
1.7377E+00	5.16513E-11	.0420	4.55321E-11	.0463	4.01242E-11	.0484	3.19389E-11	.0524	1.97875E-11	.0696
1.8498E+00	2.87788E-11	.0576	2.56606E-11	.0643	2.33991E-11	.0663	1.93257E-11	.0748	1.15277E-11	.1030
1.9691E+00	2.38688E-11	.0612	2.18532E-11	.0716	1.95466E-11	.0793	1.46296E-11	.0877	8.33502E-12	.1036
2.0961E+00	1.76153E-11	.0696	1.67763E-11	.0752	1.58162E-11	.0836	1.38882E-11	.0929	7.00627E-12	.1112
2.2313E+00	1.67320E-11	.0740	1.62870E-11	.0815	1.46880E-11	.0866	1.14662E-11	.0985	7.18684E-12	.1277
2.3752E+00	1.75281E-11	.0818	1.61856E-11	.0865	1.34905E-11	.0895	1.03265E-11	.1010	6.42897E-12	.1311
2.5284E+00	1.42603E-11	.0968	1.36773E-11	.0965	1.19928E-11	.0975	8.80053E-12	.1020	4.72332E-12	.1246
2.6914E+00	1.48514E-11	.1102	1.32179E-11	.1110	1.11589E-11	.1153	8.73231E-12	.1144	5.91970E-12	.1886
2.8650E+00	1.41123E-11	.1068	1.28552E-11	.1130	1.06016E-11	.1179	8.22273E-12	.1490	4.02547E-12	.1701
3.0498E+00	1.18197E-11	.0989	9.54736E-12	.1114	8.42240E-12	.1235	6.79267E-12	.1502	3.37650E-12	.1743
3.2465E+00	9.42013E-12	.1236	9.26517E-12	.1578	7.85021E-12	.1785	6.21099E-12	.1718	3.82069E-12	.1746
3.4559E+00	9.62726E-12	.1081	9.36484E-12	.1235	7.81251E-12	.1460	6.82598E-12	.1674	3.72847E-12	.2141
3.6787E+00	8.48670E-12	.1607	7.71643E-12	.1668	8.06432E-12	.1436	5.81050E-12	.1500	3.28965E-12	.1904
3.9160E+00	6.06518E-12	.1211	5.41010E-12	.1189	5.29212E-12	.1719	4.08357E-12	.1996	2.06639E-12	.3763
4.1686E+00	6.25964E-12	.1773	6.37593E-12	.1873	5.75735E-12	.2026	4.82105E-12	.2195	4.31889E-12	.4466
4.4374E+00	7.99726E-12	.1631	7.34361E-12	.1691	6.02061E-12	.1818	4.45653E-12	.2057	2.24871E-12	.2913
4.7236E+00	8.16963E-12	.2101	8.79197E-12	.2153	7.46215E-12	.2233	5.45335E-12	.1960	2.50363E-12	.3040
5.0282E+00	4.99250E-12	.1556	4.94793E-12	.1949	4.52243E-12	.1898	2.94733E-12	.2121	1.56581E-12	.2095
5.3525E+00	6.25162E-12	.1803	5.39194E-12	.1800	4.05793E-12	.1724	2.42665E-12	.1543	7.49321E-13	.2103
5.6978E+00	5.29581E-12	.1687	5.78770E-12	.1958	5.01249E-12	.2115	3.11476E-12	.2223	1.78340E-12	.3191
6.0652E+00	4.67798E-12	.2344	3.78537E-12	.2455	3.16311E-12	.2367	2.80265E-12	.3051	1.28785E-12	.2846
6.4564E+00	3.46275E-12	.1916	3.10471E-12	.1880	2.94065E-12	.2205	2.57603E-12	.3119	9.78401E-13	.2475
6.8728E+00	8.36275E-12	.2713	8.14367E-12	.2662	5.70473E-12	.2758	2.83817E-12	.2879	2.72921E-12	.5204
7.3161E+00	6.30299E-12	.2485	5.83293E-12	.2480	4.23667E-12	.2481	2.31309E-12	.2309	8.52180E-13	.2808

Table 4.2.2 (cont.)

7.7879E+00	4.54369E-12	.2507	3.16235E-12	.2011	2.88848E-12	.2978	1.69485E-12	.3375	1.59739E-12	.3647
8.2902E+00	6.99484E-12	.2498	6.04867E-12	.2708	4.92733E-12	.2647	3.57721E-12	.3070	2.45964E-12	.4296
8.8249E+00	5.34521E-12	.1826	4.84102E-12	.2652	3.96405E-12	.2680	2.28611E-12	.2414	1.99666E-12	.6569
9.3940E+00	3.01159E-12	.1899	2.20749E-12	.1991	1.56600E-12	.1713	1.57601E-12	.2909	2.26455E-12	.6252
9.9999E+00	4.25065E-12	.1719	3.71705E-12	.2257	2.84901E-12	.2101	1.51413E-12	.1807	7.16712E-13	.2429
1.0157E+01	2.45286E-12	.3503	2.32931E-12	.4116	2.03845E-12	.4506	9.62602E-13	.4750	2.36219E-13	.6033
1.0317E+01	1.20823E-12	.1813	1.49884E-12	.4859	1.88789E-12	.7451	2.52103E-12	.8403	1.61903E-12	.9057
1.0480E+01	1.65357E-12	.3000	9.50932E-13	.3575	8.70160E-13	.3111	5.50748E-13	.2621	3.70420E-13	.5837
1.0645E+01	1.37485E-12	.2022	9.48306E-13	.2410	9.15180E-13	.2300	2.94857E-13	.3731	2.70365E-13	.5097
1.0812E+01	1.20952E-12	.2083	1.06428E-12	.3253	6.33983E-13	.3888	8.40453E-13	.5139	6.12037E-14	.4732
1.0983E+01	2.39000E-12	.2492	1.29415E-12	.3015	9.33338E-13	.4202	1.93207E-13	.3641	1.16387E-13	.4577
1.1156E+01	2.20961E-12	.2525	1.24753E-12	.4758	4.54912E-13	.3367	4.28108E-13	.4760	3.88913E-13	.6843
1.1331E+01	3.91939E-12	.3597	3.19206E-12	.5322	1.57614E-12	.5829	5.14034E-13	.4595	1.47913E-13	.4012
1.1510E+01	3.84576E-12	.2307	1.98635E-12	.3435	1.06273E-12	.3100	3.84791E-13	.4464	5.95172E-14	.3815
1.1691E+01	2.69010E-12	.1278	9.35521E-13	.2579	3.52787E-13	.3020	1.50842E-13	.3347	2.12166E-14	.3242
1.1875E+01	3.07523E-12	.1008	7.71780E-13	.2908	3.86120E-13	.2900	1.08191E-13	.2514	4.52836E-14	.4828
1.2062E+01	4.88658E-12	.1018	2.09141E-12	.2813	9.00070E-13	.4744	4.59939E-13	.4998	1.18821E-13	.3908
1.2252E+01	6.75389E-12	.1816	3.03521E-12	.3281	1.32740E-12	.5018	3.61718E-13	.5299	5.52736E-14	.4409
1.2445E+01	9.44092E-12	.3060	5.67725E-12	.5335	1.60103E-12	.6922	1.55349E-13	.2525	1.09447E-13	.3516
1.2641E+01	1.31783E-11	.1718	4.77583E-12	.3692	1.91771E-12	.4406	9.50298E-13	.4097	1.62736E-13	.4136
1.2840E+01	1.14624E-11	.1147	3.95833E-12	.2421	1.50396E-12	.2893	3.25856E-13	.2659	1.52435E-13	.3965
1.3042E+01	1.22367E-11	.1668	3.21821E-12	.2323	1.71681E-12	.2763	5.72536E-13	.3151	1.10039E-13	.3679
1.3248E+01	1.89950E-11	.1014	5.88283E-12	.2177	1.91196E-12	.2946	6.90185E-13	.2603	3.95635E-13	.2397
1.3456E+01	1.82487E-11	.0596	7.44541E-12	.1863	3.21299E-12	.2641	1.22700E-12	.2294	5.09860E-13	.2493
1.3668E+01	2.61644E-11	.1101	1.04747E-11	.2177	4.41866E-12	.2265	1.67287E-12	.2468	5.09020E-13	.2201
1.3883E+01	6.02120E-11	.0612	1.96479E-11	.1382	8.92365E-12	.2049	4.04433E-12	.2898	9.56440E-13	.1999
1.4102E+01	8.78374E-11	.0639	2.57092E-11	.1544	9.00279E-12	.1884	2.42791E-12	.2173	1.07410E-12	.1675
1.4324E+01	9.35489E-11	.0620	3.35983E-11	.1382	1.64826E-11	.1598	6.57388E-12	.2216	1.89209E-12	.2503
1.4550E+01	2.92515E-10	.0277	7.65435E-11	.0792	2.43971E-11	.1368	6.84040E-12	.1925	2.84117E-12	.4815
1.4779E+01	5.59497E-10	.0188	1.25471E-10	.0595	3.19461E-11	.1015	7.37979E-12	.1939	2.68615E-12	.4186
1.5012E+01	6.05121E-10	.0205	1.32013E-10	.0624	3.09107E-11	.1119	6.70600E-12	.1857	1.05114E-12	.2168
1.5248E+01	5.54518E-10	.0215	1.17559E-10	.0668	2.43904E-11	.1141	4.42555E-12	.1709	8.85195E-13	.2046
1.5488E+01	3.14059E-10	.0298	7.61356E-11	.0961	1.87969E-11	.1652	3.45074E-12	.2016	7.51558E-13	.1654
1.5732E+01	3.23589E-10	.0264	6.82159E-11	.1010	1.88936E-11	.1983	6.71931E-12	.3288	7.82921E-13	.7324
1.5980E+01	3.24837E-10	.0266	5.72455E-11	.0936	8.16764E-12	.2199	4.21930E-13	.3134	0.00000E+00	.0000
1.6231E+01	3.75772E-12	.3000	1.50964E-12	.6617	5.30556E-13	.7746	2.45846E-14	.7879	8.83234E-15	1.0000
1.6487E+01	2.72390E-12	.1341	3.11443E-13	.5093	1.75091E-14	.7303	0.00000E+00	.0000	0.00000E+00	.0000
total	5.35761E-09	.0067	2.63318E-09	.0110	1.94500E-09	.0101	1.56769E-09	.0100	1.04877E-09	.0112

uncollided neutron flux

detector:	1		2		3		4		5	
energy	flux	error	flux	error	flux	error	flux	error	flux	error
4.6308E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.2474E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.9461E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
6.7378E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
7.6349E-02	1.13704E-13	.2398	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
8.6515E-02	5.75256E-13	.2845	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
9.8035E-02	9.93610E-15	.4472	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1109E-01	1.51600E-13	.1140	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2588E-01	7.19641E-13	.0691	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.4264E-01	1.89877E-12	.0895	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.6163E-01	9.89409E-15	.4472	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.8315E-01	2.77665E-12	.0823	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.0754E-01	1.19676E-12	.1360	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.3517E-01	2.68917E-12	.1230	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.6649E-01	1.95888E-12	.0554	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.0197E-01	9.44794E-12	.0563	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.4217E-01	1.04534E-11	.0523	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.8774E-01	1.19926E-11	.0448	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000

Table 4.2.2 (cont.)

4.3936E-01	8.93054E-13	.0825	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
4.9786E-01	3.35066E-12	.0578	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.6415E-01	5.09141E-12	.0368	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
6.3927E-01	1.90252E-11	.0289	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
7.2438E-01	2.11869E-11	.0321	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
8.2084E-01	3.03320E-12	.0409	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
9.3013E-01	1.19383E-11	.0251	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0540E+00	1.87000E-11	.0267	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1943E+00	1.48120E-11	.0230	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.3533E+00	1.08651E-11	.0295	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5335E+00	9.55212E-12	.0224	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.7377E+00	6.15162E-12	.0241	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.8498E+00	3.68160E-12	.0285	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.9691E+00	3.00444E-12	.0379	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.0961E+00	1.44253E-12	.0400	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.2313E+00	1.54325E-12	.0363	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.3752E+00	1.58646E-12	.0353	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.5284E+00	6.78533E-13	.0539	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.6914E+00	7.64601E-13	.0508	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.8650E+00	8.16620E-13	.0491	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.0498E+00	9.02018E-13	.0468	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.2465E+00	8.56737E-13	.0480	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.4559E+00	8.04887E-13	.0495	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.6787E+00	7.00915E-13	.0530	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.9160E+00	5.39394E-13	.0604	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
4.1686E+00	4.46931E-13	.0665	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
4.4374E+00	4.76905E-13	.0643	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
4.7236E+00	3.88636E-13	.0712	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.0282E+00	3.59264E-13	.0741	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.3525E+00	3.98611E-13	.0703	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.6978E+00	3.39292E-13	.0763	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
6.0652E+00	2.66093E-13	.0861	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
6.4564E+00	2.94034E-13	.0819	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
6.8728E+00	3.40683E-13	.0760	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
7.3161E+00	3.14696E-13	.0791	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
7.7879E+00	3.57000E-13	.0743	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
8.2902E+00	4.00505E-13	.0701	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
8.8249E+00	4.97305E-13	.0629	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
9.3940E+00	6.30128E-13	.0559	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
9.9999E+00	8.01484E-13	.0496	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0157E+01	2.61379E-13	.0867	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0317E+01	2.64328E-13	.0864	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0480E+01	3.21138E-13	.0783	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0645E+01	2.94990E-13	.0817	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0812E+01	5.12460E-13	.0620	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0983E+01	5.99141E-13	.0574	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1156E+01	6.99853E-13	.0531	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1331E+01	8.92033E-13	.0470	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1510E+01	1.35768E-12	.0381	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1691E+01	1.43395E-12	.0371	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1875E+01	1.79422E-12	.0331	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2062E+01	2.87239E-12	.0262	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2252E+01	3.06648E-12	.0253	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2445E+01	3.22756E-12	.0247	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2641E+01	5.18005E-12	.0195	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2840E+01	5.60461E-12	.0187	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.3042E+01	5.86281E-12	.0183	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.3248E+01	9.67812E-12	.0142	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.3456E+01	1.08541E-11	.0134	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.3668E+01	1.14613E-11	.0131	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000

Table 4.2.2 (cont.)

1.3883E+01	3.07676E-11	.0080	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.4102E+01	4.47727E-11	.0066	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.4324E+01	4.68849E-11	.0064	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.4550E+01	1.73003E-10	.0033	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.4779E+01	3.44896E-10	.0022	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5012E+01	3.64241E-10	.0022	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5248E+01	3.34631E-10	.0023	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5488E+01	1.90410E-10	.0031	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5732E+01	2.02184E-10	.0030	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5980E+01	2.04122E-10	.0030	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.6231E+01	1.74289E-12	.0336	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.6487E+01	1.98985E-12	.0315	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
total	2.19811E-09	.0008	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000

Table 4.2.3.

```
FNS-TOF/50.0 CM(R)*20.0 CM(Z)-FE CYL./FIXED CONE BIAS/5 PT DETECTORS
C    ***************************************
C    *   CELL CARAD                        *
C    ***************************************
C    ******* EXTERNAL VOID ****************
 1    0           -4 : +4 -2 +3 : +10 : +2 -10 +5 +6 +7 +8 +9
C    ******* SOURCE VACUUM REGION *********
 2    0              -3  +4  -1
C    ******* MATERIAL REGION **************
 3    1    8.391-2   -3  +1  -2
C    ******* DETECTOR VACUUM REGION *******
 4    0  +2  -10 -5 : +2 -10 -6 : +2 -10 -7 : +2 -10 -8 : +2 -10 -9
C    ------- THE FOLLOWING IS A BLANK DELIMETER

C    ***************************************
C    * SURFACE CARD                        *
C    ***************************************
 1            PZ          -20.0
 2            PZ              0
 3            CZ           50.0
 4            PZ            -50
 5            CZ          5.122
 6          1 CZ          5.128
 7          2 CZ          5.146
 8          3 CZ          5.189
 9          4 CZ          5.282
10            SO           1000
C     ------- THE FOLLOWING IS A BLANK DELIMETER

C    ***************************************
C    *  MODE CARD       - NEUTRON ONLY     *
C    ***************************************
MODE   N
C    ***************************************
C    *  TRANSFORMATION CARDS               *
C    *  ROTATION ABOUT THE Y AXIS BY THETA*
C    ***************************************
*TR1   0  0  0        12.2  90  102.2   90   0  90
                      77.8  90   12.2   +1
*TR2   0  0  0        24.9  90  114.9   90   0  90
                      65.1  90   24.9   +1
*TR3   0  0  0        41.8  90  131.8   90   0  90
                      48.2  90   41.8   +1
*TR4   0  0  0        66.8  90  156.8   90   0  90
                      23.2  90   66.8   +1
C    ***************************************
C    *   CELL PARAMETER CARDS              *
C    ***************************************
IMP:N  0   1   1  1
C    ******************************************************
C    *  SOURCE SPECIFICATION CARDS                        *
C    *  SRC1=POINT ISOTROPIC OPTION                       *
C    *  SDIR DIRC. BIASING - HEIGHT REDUCTION CONSIDERED*
C    *  SI(ENG.) AND SP(PROB.) TAKEN FROM BETOF SOURCE  *
C    *  EXPT. DATA                                        *
C    ******************************************************
sdef  pos=0 0 -40.00 cel=2 wgt=1.0  erg=d1 dir=d2 vec=0 0 1
SI1   4.6308-02
      5.2474-02  5.9461-02  6.7378-02  7.6349-02  8.6515-02
      9.8035-02  1.1109-01  1.2588-01  1.4264-01  1.6163-01
```

Table 4.2.3. (cont.)

```
      1.8315-01  2.0754-01  2.3517-01  2.6649-01  3.0197-01
      3.4217-01  3.8774-01  4.3936-01  4.9786-01  5.6415-01
      6.3927-01  7.2438-01  8.2084-01  9.3013-01  1.0540+00
      1.1943+00  1.3533+00  1.5335+00  1.7377+00  1.8498+00
      1.9691+00  2.0961+00  2.2313+00  2.3752+00  2.5284+00
      2.6914+00  2.8650+00  3.0498+00  3.2465+00  3.4559+00
      3.6787+00  3.9160+00  4.1686+00  4.4374+00  4.7236+00
      5.0282+00  5.3525+00  5.6978+00  6.0652+00  6.4564+00
      6.8728+00  7.3161+00  7.7879+00  8.2902+00  8.8249+00
      9.3940+00  9.9999+00  1.0157+01  1.0317+01  1.0480+01
      1.0645+01  1.0812+01  1.0983+01  1.1156+01  1.1331+01
      1.1510+01  1.1691+01  1.1875+01  1.2062+01  1.2252+01
      1.2445+01  1.2641+01  1.2840+01  1.3042+01  1.3248+01
      1.3456+01  1.3668+01  1.3883+01  1.4102+01  1.4324+01
      1.4550+01  1.4779+01  1.5012+01  1.5248+01  1.5488+01
      1.5732+01  1.5980+01  1.6231+01  1.6487+01
SP1   0
      0          0          0          2.672-05   3.767-05
      9.514-05   1.678-04   1.993-04   2.518-04   2.852-05
      3.690-04   4.198-04   5.345-04   5.945-04   7.769-04
      8.991-04   1.156-03   1.328-03   1.535-03   1.828-03
      2.088-03   2.322-03   2.639-03   2.993-03   3.203-03
      3.468-03   3.648-03   3.690-03   3.809-03   2.043-03
      1.989-03   1.975-03   2.005-03   2.033-03   1.963-03
      1.941-03   1.903-03   1.920-03   2.033-03   1.874-03
      1.704-03   1.566-03   1.512-03   1.459-03   1.408-03
      1.349-03   1.259-03   1.188-03   1.081-03   9.973-04
      9.967-04   9.677-04   8.889-04   9.173-04   9.538-04
      1.065-03   1.198-03   3.088-04   3.905-04   4.130-04
      4.180-04   5.663-04   6.626-04   6.703-04   9.582-04
      1.346-03   1.361-03   1.646-03   2.523-03   2.564-03
      2.656-03   4.027-03   4.089-03   4.151-03   6.593-03
      7.119-03   7.256-03   1.892-02   2.595-02   2.631-02
      9.472-02   1.836-01   1.868-01   1.653-01   9.107-02
      9.259-02   9.046-02   7.991-04   8.150-04
sb2   -31 0.1736482
C     ************************************************
C     *  MATERIAL SPECIFICATION CARDS                *
C     ************************************************
C     ----  BERYLLIUM ----------------------------
M1    26000.40c 1.0
C     DRXS
C    ************************************************
C    *  TALLY SPECIFICATION CARDS                   *
C    ************************************************
FC5   --- FLUXES AT 5 PT DTS(TH=0.0,12.2,24.9,41.8,66.8)
F5:N        0.0          0     723.0000         1
          152.9543       0     707.4416         1
          305.8363       0     658.8680         1
          488.1535       0     545.9700         1
          685.3739       0     293.7516         1
DD    0.5   100
E0    4.6308-02
      5.2474-02  5.9461-02  6.7378-02  7.6349-02  8.6515-02
      9.8035-02  1.1109-01  1.2588-01  1.4264-01  1.6163-01
      1.8315-01  2.0754-01  2.3517-01  2.6649-01  3.0197-01
      3.4217-01  3.8774-01  4.3936-01  4.9786-01  5.6415-01
      6.3927-01  7.2438-01  8.2084-01  9.3013-01  1.0540+00
      1.1943+00  1.3533+00  1.5335+00  1.7377+00  1.8498+00
      1.9691+00  2.0961+00  2.2313+00  2.3752+00  2.5284+00
```

Table 4.2.3. (cont.)

```
      2.6914+00  2.8650+00  3.0498+00  3.2465+00  3.4559+00
      3.6787+00  3.9160+00  4.1686+00  4.4374+00  4.7236+00
      5.0282+00  5.3525+00  5.6978+00  6.0652+00  6.4564+00
      6.8728+00  7.3161+00  7.7879+00  8.2902+00  8.8249+00
      9.3940+00  9.9999+00  1.0157+01  1.0317+01  1.0480+01
      1.0645+01  1.0812+01  1.0983+01  1.1156+01  1.1331+01
      1.1510+01  1.1691+01  1.1875+01  1.2062+01  1.2252+01
      1.2445+01  1.2641+01  1.2840+01  1.3042+01  1.3248+01
      1.3456+01  1.3668+01  1.3883+01  1.4102+01  1.4324+01
      1.4550+01  1.4779+01  1.5012+01  1.5248+01  1.5488+01
      1.5732+01  1.5980+01  1.6231+01  1.6487+01
FQ5     E     F
C     ************************************************
C     * ENERGY AND THERMAL CARDS                      *
C     ************************************************
C     ************************************************
CUT:N         0      4.6308-02    -10    -0.01
NPS        2000000
CTME        120
C     ************************************************
C     * PERIPHERAL CRADS                              *
C     ************************************************
PRDMP         100000  100000
LOST      10          10
PRINT
```

Table 4.2.4 Comparison of integrated Angular Flux

for 200 mm-thick Iron Assembly

Angle	Expt.	CENDL-2.1	C/E	MCNP library	C/E
>10 Mev					
0.0	0.23133	0.21337	0.92236	0.19189	0.82990
12.2	0.058774	0.050342	0.85654	0.048496	0.82467
24.9	0.015778	0.014069	0.89168	0.012928	0.81937
41.8	0.0043323	0.0039688	0.91610	0.0031206	0.72031
66.8	0.0013660	0.0011666	0.85403	0.0011302	0.82738
1-10 Mev					
0.0	0.043233	0.036824	0.85176	0.033614	0.77751
12.2	0.036603	0.032863	0.89782	0.030067	0.82144
24.9	0.033660	0.029331	0.87139	0.027477	0.81631
41.8	0.027243	0.023327	0.85626	0.021936	0.80520
66.8	0.016531	0.013787	0.83401	0.012595	0.76190
0.4-1 Mev					
0.0	0.053056	0.046611	0.87852	0.036746	0.69259
12.2	0.043990	0.042544	0.96713	0.033007	0.75033
24.9	0.042253	0.039970	0.94597	0.031672	0.74958
41.8	0.038371	0.035587	0.92745	0.028004	0.72982
66.8	0.026721	0.024547	0.91864	0.018894	0.70708
0.1-0.4 Mev					
0.0	0.042385	0.038733	0.91384	0.029806	0.70322
12.2	0.035748	0.037136	1.03883	0.028676	0.80217
24.9	0.034351	0.036032	1.04894	0.027790	0.80900
41.8	0.034352	0.032949	0.95916	0.025320	0.73707
66.8	0.025132	0.024510	0.97525	0.018434	0.73349
0.05-0.4					
0.0	0.0053635	0.0038390	0.71576	0.0033264	0.62019
12.2	0.0043511	0.0038573	0.88651	0.0034191	0.78580
24.9	0.0040891	0.0037416	0.91502	0.0033484	0.81886
41.8	0.0046084	0.0034494	0.74851	0.0030135	0.65391
66.8	0.0033264	0.0024564	0.73846	0.0021102	0.63438

Table 4.2.5 Comparison of integrated Angular Flux

for 400 mm-thick Iron Assembly

Angle	Expt.	CENDL-2.1	C/E	JENDL-3.2	C/E
>10 Mev					
0.0	0.0052130	0.0051378	0.98557	0.0055730	1.0691
12.2	0.0021169	0.0017925	0.84674	0.0018317	0.86527
24.9	0.0006962	0.00067686	0.97222	0.00066086	0.94924
41.8	0.00021809	0.0001309	0.69656	0.00019241	0.88225
66.8	8.5131E-05	3.0923E-05	0.36325	6.5145E-05	0.76523
1-10 Mev					
0.0	0.0043863	0.0036065	0.82223	0.0044170	1.0070
12.2	0.0038303	0.0032158	0.82817	0.0039528	1.0318
24.9	0.0031953	0.0026115	0.81729	0.0032307	1.0111
41.8	0.0024482	0.0017053	0.69656	0.0020981	0.8470
66.8	0.0012860	0.00078714	0.61209	0.0009680	0.75272
0.4-1 Mev					
0.0	0.015683	0.014096	0.89880	0.014601	0.93101
12.2	0.014258	0.013628	0.95582	0.013584	0.95273
24.9	0.013237	0.012281	0.92775	0.011783	0.89016
41.8	0.010699	0.009328	0.87183	0.0083752	0.78280
66.8	0.0064569	0.0053806	0.83296	0.0043483	0.67315
0.1-0.4 Mev					
0.0	0.024540	0.023617	0.96240	0.020936	0.85314
12.2	0.021679	0.023018	1.06177	0.020241	0.93367
24.9	0.021580	0.021436	0.99331	0.018018	0.83494
41.8	0.019084	0.017368	0.91006	0.013480	0.70635
66.8	0.012363	0.010295	0.83272	0.007363	0.59557
0.05-0.4 Mev					
0.0	0.003864	0.0037282	0.96486	0.0030760	0.79607
12.2	0.0030003	0.0037048	1.23481	0.0030832	1.0276
24.9	0.0030540	0.0035273	1.15498	0.0028340	0.92796
41.8	0.0029790	0.0029897	1.00361	0.0022210	0.74555
66.8	0.0023510	0.0020371	0.86646	0.0012858	0.54692

CENDL-2.1 underpredicts the flux above 0.4 MeV and below 0.1 MeV for almost all angles. The underprediction amounts about 4-10% above 0.4 MeV, and up to 30% for some angles below 0.1 MeV for 20 cm thickness. We obtained good results from 0.1-0.4 MeV for almost all angles for 20 cm thickness.

The recommended library underpredicts, by about 18-38%, the angular flux for almost all angles in the whole energy range.

For the 40 cm thick slab, CENDL-2.1 gives reasonable results below 10 MeV, but produces underestimates of up to 60% at 66.8 degrees.

Further improvement will be needed about the secondary energy-angle distributions of natural Fe below 0.1 MeV and above 10 MeV.

(3) Testing and analysis of angular neutron flux from a lithium oxide slab

The lithium-oxide slab thicknesses are 48 mm and 200 mm and their radius is 314 mm.

List of Figure and Tables

Fig. 4.3.1 - 4.3.3 Calculated angular neutron fluxes

Table 4.3.1 Comparison of integrated angular flux for 48 mm thickness

Table 4.3.2 Comparison of integrated angular flux for 200 mm thickness

Table 4.3.3 Calculated angular neutron fluxes of CENDL-2.1

Table 4.3.4 Tally fluctuation charts

Conclusions:

From Table 4.3.4, we see that the angular neutron fluxes at point detector are generally reliable, because the relative error is less than 0.05, and VOV is below 0.1.

Good agreement was obtained for thin (4.8 cm) and thick (20 cm) lithium oxide slabs. CENDL slightly underpredicts (by about 10%) the flux at some angles for 20 cm slab.

The Li-6 and Li-7 data contained in CENDL-2.1 looks satisfactory.

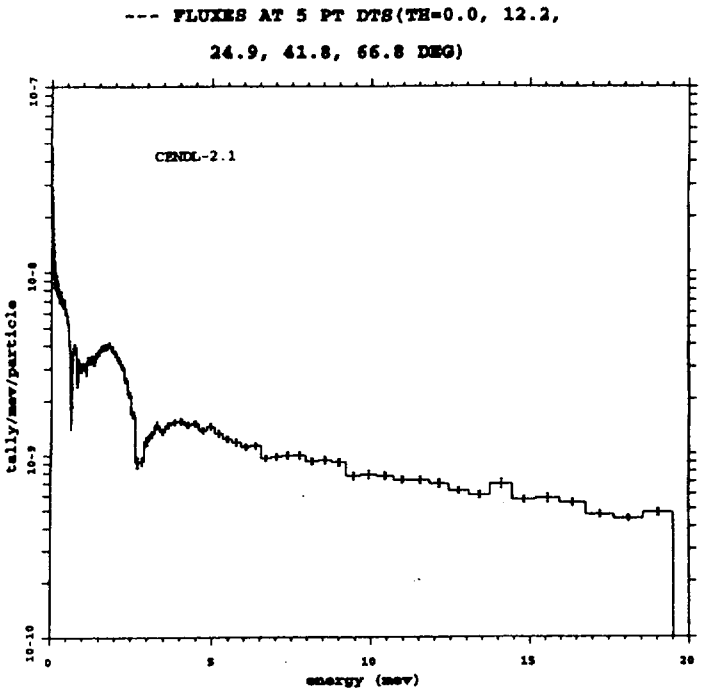

Fig. 4.3.1

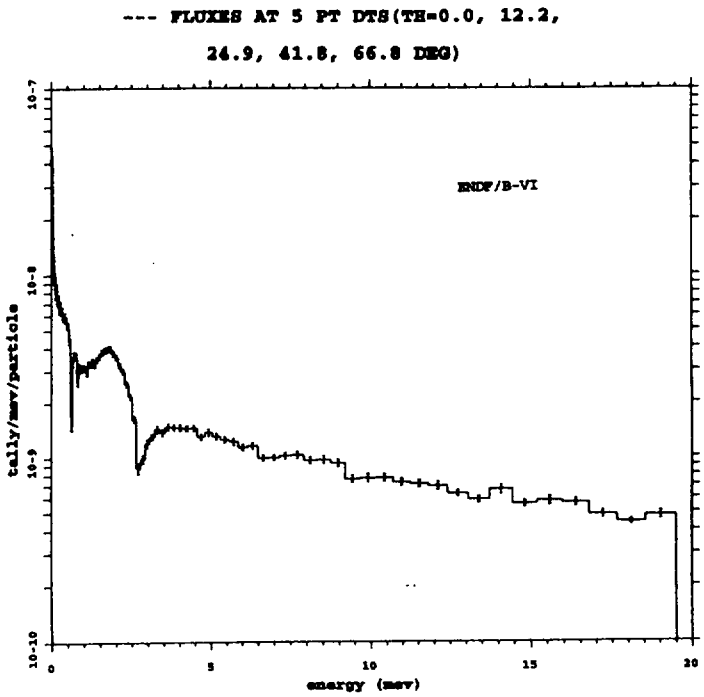

Fig 4.3.2

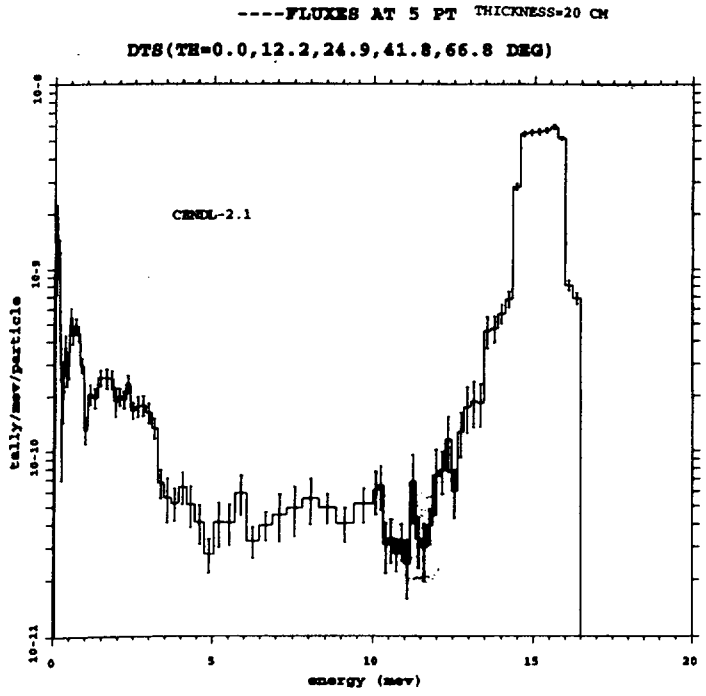

Fig. 4.3.3

Table 4.3.1 Comparison of integrated angular flux

for 48 mm-thick Lithium-oxide Assembly

Angle	Expt.	CENDL-2.1	C/E	JENDL-3.2	C/E
>11 Mev					
0.0	5.1188	4.4905	0.87726	5.1005	0.99642
24.9	0.18194	0.21353	1.17363	0.20352	1.1186
41.8	0.077240	0.075671	0.97969	0.072244	0.93532
66.8	0.027778	0.028556	1.02801	0.028855	1.0388
1-11 Mev					
0.0	0.19056	0.17893	0.93899	0.19801	1.0391
24.9	0.045563	0.044494	0.97653	0.050810	1.1152
41.8	0.048649	0.043685	0.89795	0.048619	0.99938
66.8	0.049517	0.044795	0.90463	0.048078	0.97094
0.1-11 Mev					
0.0	0.063130	0.051099	0.80943	0.057267	0.90713
24.9	0.011504	0.009533	0.82867	0.012668	1.1011
41.8	0.013280	0.010877	0.81904	0.013376	1.0072
66.8	0.011444	0.011793	1.03052	0.013983	1.2219

Table 4.3.2 Comparison of integrated angular flux

for 20 CM-thick Lithium-oxide Assembly

Angle	Expt.	CENDL-2.1	C/E	JENDL-3.2	C/E
>11 Mev					
0.0	0.75158	0.62439	0.83077	0.81395	1.0830
24.9	0.072925	0.70904	0.97229	0.070653	0.96884
66.8	0.0084406	0.73594	0.87191	0.007244	0.85823
1-11 Mev					
0.0	0.061901	0.052408	0.84083	0.062909	1.0163
24.9	0.044790	0.038463	0.85874	0.046206	1.0316
66.8	0.026035	0.022231	0.85388	0.024378	0.93635
0.1-1 Mev					
0.0	0.029788	0.025391	0.85238	0.029083	0.97633
24.9	0.025094	0.023493	0.93620	0.025783	1.0275
66.8	0.017522	0.015506	0.88493	0.016132	0.92067

Table 4.5.3

The results of LI2O (Thickness=20cm)

Fluxes at 5 PT DTS(TH=0.0,12.2,24.9,41.8,66.8 DEG)

detector:	1		2		3		4		5	
energy	flux	error	flux	error	flux	error	flux	error	flux	error
4.6308E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.2474E-02	7.16965E-12	.2462	6.65180E-12	.2338	7.07377E-12	.2177	8.73845E-12	.2029	7.65066E-12	.2198
5.9461E-02	8.96950E-12	.3017	9.83041E-12	.2421	9.60381E-12	.2663	9.42918E-12	.2385	7.62254E-12	.2225
6.7378E-02	1.46150E-11	.2135	1.74375E-11	.2124	1.50002E-11	.1911	1.21695E-11	.1940	7.97997E-12	.2168
7.6349E-02	8.82155E-12	.2572	8.15662E-12	.1965	1.29431E-11	.1929	1.68742E-11	.1694	1.39941E-11	.1814
8.6515E-02	1.26213E-11	.1736	1.30295E-11	.1866	8.83745E-12	.2095	1.27035E-11	.1869	9.37811E-12	.1976
9.8035E-02	1.89827E-11	.1724	2.02122E-11	.1544	1.90868E-11	.1508	1.22449E-11	.1802	9.80533E-12	.2346
1.1109E-01	1.56236E-11	.1746	1.49902E-11	.1663	1.70531E-11	.1693	1.90542E-11	.1697	1.39855E-11	.2028
1.2588E-01	1.72572E-11	.1714	2.00189E-11	.1784	1.96943E-11	.1734	1.55958E-11	.1535	1.11835E-11	.1656
1.4264E-01	1.92606E-11	.1503	1.94680E-11	.1492	1.83737E-11	.1471	1.53633E-11	.1353	1.12996E-11	.1789
1.6163E-01	2.37909E-11	.1570	2.39870E-11	.1617	2.02145E-11	.1685	1.96654E-11	.1693	1.22815E-11	.1722
1.8315E-01	2.30190E-11	.1652	2.04104E-11	.1719	1.94839E-11	.1754	1.93325E-11	.1695	1.64317E-11	.1550
2.0754E-01	1.21417E-11	.1804	1.59206E-11	.1860	1.40972E-11	.1825	1.48061E-11	.1773	1.07758E-11	.1949
2.3517E-01	8.49926E-12	.1957	8.98700E-12	.2099	9.11264E-12	.2071	1.02386E-11	.2040	6.24940E-12	.2544
2.6649E-01	2.93439E-12	.2670	3.69056E-12	.2598	3.54097E-12	.2846	3.07925E-12	.2889	4.89007E-12	.3164
3.0197E-01	7.05746E-12	.2628	6.92303E-12	.2619	7.72816E-12	.2389	8.52200E-12	.2201	7.81518E-12	.2320
3.4217E-01	1.07337E-11	.1866	1.12964E-11	.1922	1.17410E-11	.1782	1.44701E-11	.1690	1.09643E-11	.1664
3.8774E-01	1.71881E-11	.1552	1.70989E-11	.1549	1.61065E-11	.1507	1.50612E-11	.1521	9.99341E-12	.1821
4.3936E-01	1.47501E-11	.2132	1.50719E-11	.2073	1.53478E-11	.2307	1.59841E-11	.2235	9.86437E-12	.2169
4.9786E-01	1.81212E-11	.1650	1.82691E-11	.1770	1.73804E-11	.1844	1.91921E-11	.1626	1.18328E-11	.2253
5.6415E-01	3.63401E-11	.1132	3.45267E-11	.1264	3.51327E-11	.1370	2.64489E-11	.1489	1.92033E-11	.1739
6.3927E-01	3.29193E-11	.1098	2.80183E-11	.1344	2.63003E-11	.1304	2.36443E-11	.1475	1.73754E-11	.1699
7.2438E-01	4.12553E-11	.1018	3.91928E-11	.1194	3.58830E-11	.1241	3.02594E-11	.1310	2.10378E-11	.1378
8.2084E-01	4.27562E-11	.0958	3.81246E-11	.1074	3.65080E-11	.1087	2.81191E-11	.1171	2.26596E-11	.1434
9.3013E-01	3.26931E-11	.0905	3.10471E-11	.1189	3.21944E-11	.1288	2.85091E-11	.1353	1.93543E-11	.1640
1.0540E+00	1.65433E-11	.1656	1.38435E-11	.1712	1.23690E-11	.1573	9.34919E-12	.1652	1.19840E-11	.2568
1.1943E+00	2.86650E-11	.1241	2.74879E-11	.1421	2.68364E-11	.1255	2.56719E-11	.1291	1.73649E-11	.1446
1.3533E+00	3.10849E-11	.1209	2.68639E-11	.1475	2.78013E-11	.1466	2.34762E-11	.1610	1.88867E-11	.1673
1.5335E+00	4.52578E-11	.1032	3.64303E-11	.1198	3.00776E-11	.1152	2.17729E-11	.1216	2.00897E-11	.1478
1.7377E+00	5.10966E-11	.1247	3.70387E-11	.1415	3.63612E-11	.1223	3.51703E-11	.1256	2.76450E-11	.1469
1.8498E+00	2.75822E-11	.1168	2.37162E-11	.1484	2.08100E-11	.1466	1.53257E-11	.1668	1.09981E-11	.2529
1.9691E+00	2.23523E-11	.1781	1.99631E-11	.2128	1.93450E-11	.2158	2.05424E-11	.2066	1.40419E-11	.2092
2.0961E+00	2.52576E-11	.1082	1.54698E-11	.1680	1.51476E-11	.1731	1.31649E-11	.1702	9.53281E-12	.1699
2.2313E+00	2.58968E-11	.1045	1.98860E-11	.1560	1.55300E-11	.1481	1.77603E-11	.1560	8.39041E-12	.1971
2.3752E+00	3.35600E-11	.1088	1.97707E-11	.1708	1.87748E-11	.1705	1.88329E-11	.1578	1.52663E-11	.2689
2.5284E+00	2.58035E-11	.1020	1.89711E-11	.1357	2.16351E-11	.1431	1.93090E-11	.1646	1.18458E-11	.1994
2.6914E+00	2.86080E-11	.1259	1.76541E-11	.1616	1.41675E-11	.1877	1.28842E-11	.1821	1.26505E-11	.1762
2.8650E+00	3.08724E-11	.1272	2.05140E-11	.1642	1.98923E-11	.1803	1.66059E-11	.1904	9.67807E-12	.2317
3.0498E+00	2.99349E-11	.1266	2.92612E-11	.1879	2.29833E-11	.1960	1.72950E-11	.2174	1.09913E-11	.2605
3.2465E+00	2.62826E-11	.1307	1.81385E-11	.1738	1.86373E-11	.2032	1.53475E-11	.2211	1.18782E-11	.2511
3.4559E+00	1.40241E-11	.1775	1.24568E-11	.1899	1.02280E-11	.2053	9.69012E-12	.2820	6.98960E-12	.2499
3.6787E+00	1.24329E-11	.2683	1.12404E-11	.2957	1.12482E-11	.2684	1.36641E-11	.2602	5.73059E-12	.3396
3.9160E+00	1.23398E-11	.2019	1.29223E-11	.2239	1.15098E-11	.2306	5.88893E-12	.2385	2.26170E-12	.2705
4.1686E+00	1.60773E-11	.1942	1.25241E-11	.2658	1.42276E-11	.2386	1.19665E-11	.2715	6.77145E-12	.2451
4.4374E+00	1.37283E-11	.2467	1.26682E-11	.2674	1.32973E-11	.3144	1.06462E-11	.3307	5.66369E-12	.2831
4.7236E+00	1.17277E-11	.2396	9.53776E-12	.2785	7.87506E-12	.2449	1.16141E-11	.2776	4.70524E-12	.2767
5.0282E+00	8.35030E-12	.2114	8.59183E-12	.2235	7.51082E-12	.2137	4.75978E-12	.2452	3.92875E-12	.2961
5.3525E+00	1.32653E-11	.2709	1.05808E-11	.2542	9.32249E-12	.2246	4.93323E-12	.2369	3.38358E-12	.3206
5.6978E+00	1.40645E-11	.2494	1.74590E-11	.2870	1.54983E-11	.3254	1.34272E-11	.3592	7.22759E-12	.3406
6.0652E+00	2.16383E-11	.2392	1.80141E-11	.2342	1.28669E-11	.2650	7.13925E-12	.2348	8.70085E-12	.2969
6.4564E+00	1.25710E-11	.1971	1.33891E-11	.2834	1.39711E-11	.3277	1.61938E-11	.3491	7.07205E-12	.3335
6.8728E+00	1.63610E-11	.1783	1.27129E-11	.2049	9.87498E-12	.2247	8.51905E-12	.2677	5.51311E-12	.2950
7.3161E+00	1.98191E-11	.2864	1.89579E-11	.3705	1.39562E-11	.2938	7.49873E-12	.2879	8.19472E-12	.3854
7.7879E+00	2.29259E-11	.3018	1.97524E-11	.2836	2.30749E-11	.4162	2.09407E-11	.3981	7.87769E-12	.4052
8.2902E+00	2.75110E-11	.2798	2.59234E-11	.3483	2.86372E-11	.3000	1.47399E-11	.2534	1.17438E-11	.3769
8.8249E+00	2.61580E-11	.1837	2.90237E-11	.1839	2.05833E-11	.2082	2.01601E-11	.2204	1.51007E-11	.4220
9.3940E+00	2.27833E-11	.2144	2.18807E-11	.2037	2.01892E-11	.1823	9.18418E-12	.2466	9.59920E-12	.5342
9.9999E+00	3.11351E-11	.2113	2.77893E-11	.2508	2.40851E-11	.2976	1.64530E-11	.3208	9.39956E-12	.3559
1.0157E+01	9.50660E-12	.2603	5.47833E-12	.2618	3.57708E-12	.3570	1.41527E-12	.3556	5.86644E-12	.4403
1.0317E+01	1.02731E-11	.2658	8.61828E-12	.3498	6.50675E-12	.4437	3.33896E-12	.4515	3.07252E-12	.4186

Table 4.3.3 (cont.)

1.0480E+01	5.01238E-12	.3020	4.39855E-12	.2677	2.16827E-12	.3004	7.21950E-13	.3666	1.93750E-12	.5251
1.0645E+01	5.49075E-12	.2674	3.83824E-12	.3068	3.84391E-12	.3155	4.05628E-12	.3939	1.20767E-12	.3744
1.0812E+01	4.56903E-12	.2003	3.14309E-12	.3062	3.33369E-12	.3617	4.83065E-12	.4381	3.46573E-12	.3280
1.0983E+01	5.53651E-12	.2289	5.46448E-12	.3218	3.35283E-12	.3582	1.43793E-12	.2968	1.95525E-12	.3064
1.1156E+01	4.18305E-12	.3499	3.78232E-12	.4099	4.78720E-12	.4635	7.26907E-12	.3897	2.25891E-12	.3148
1.1331E+01	1.17828E-11	.3937	6.39466E-12	.5472	1.82128E-12	.3175	4.28178E-12	.5712	1.88922E-12	.3599
1.1510E+01	5.92792E-12	.3053	7.68109E-12	.4924	8.63088E-12	.6781	4.04245E-12	.3356	2.89855E-12	.3152
1.1691E+01	5.37194E-12	.3405	5.41318E-12	.4078	7.37197E-12	.4402	2.01426E-12	.3286	3.75170E-12	.2864
1.1875E+01	7.21112E-12	.2211	8.71531E-12	.5045	4.20146E-12	.3640	4.71186E-12	.2905	1.28528E-11	.4472
1.2062E+01	1.36146E-11	.3864	1.14500E-11	.3678	1.19812E-11	.3563	1.16379E-11	.5310	9.07331E-12	.4949
1.2252E+01	1.47770E-11	.2603	1.13749E-11	.3175	1.15067E-11	.3474	1.16177E-11	.4611	3.34403E-12	.2754
1.2445E+01	2.21349E-11	.3359	1.60242E-11	.4720	2.23815E-11	.3671	2.08338E-11	.2911	4.43376E-12	.3765
1.2641E+01	1.17945E-11	.2909	1.27474E-11	.3524	1.06133E-11	.3256	1.26506E-11	.3434	5.25008E-12	.2331
1.2840E+01	2.51265E-11	.2791	2.16978E-11	.3084	1.58316E-11	.3577	1.64492E-11	.2861	6.85012E-12	.3197
1.3042E+01	3.48897E-11	.2821	1.68035E-11	.3264	2.37270E-11	.2535	2.04475E-11	.2815	7.80572E-12	.4058
1.3248E+01	3.91111E-11	.2756	3.90195E-11	.3183	3.76370E-11	.2814	1.78367E-11	.1937	6.49122E-12	.5480
1.3456E+01	3.77925E-11	.2596	5.80717E-11	.2510	4.23507E-11	.1858	3.49474E-11	.2115	1.39139E-11	.3297
1.3668E+01	9.54322E-11	.1972	4.29017E-11	.3328	5.11631E-11	.2258	4.05030E-11	.2072	9.13266E-12	.2921
1.3883E+01	1.00251E-10	.1656	6.35174E-11	.2160	5.41493E-11	.1844	3.28245E-11	.2535	1.31770E-11	.3835
1.4102E+01	1.22966E-10	.1176	8.14640E-11	.1594	9.96156E-11	.1622	3.89450E-11	.2212	5.09221E-12	.3172
1.4324E+01	1.49493E-10	.0994	1.44227E-10	.1399	1.08806E-10	.1473	2.72863E-11	.2634	3.37523E-12	.3616
1.4550E+01	6.37295E-10	.0411	2.30626E-10	.1124	1.06957E-10	.1363	3.88678E-11	.3005	1.55570E-12	.3589
1.4779E+01	1.24012E-09	.0290	2.86426E-10	.1067	1.54951E-10	.1497	1.66873E-11	.3219	8.77035E-13	.4073
1.5012E+01	1.28542E-09	.0300	3.39409E-10	.1060	1.11178E-10	.1512	3.10331E-11	.2751	2.43990E-12	.9651
1.5248E+01	1.31080E-09	.0324	3.06337E-10	.1180	8.88959E-11	.1720	9.43158E-12	.3460	1.98917E-13	.9044
1.5488E+01	1.35499E-09	.0273	2.48811E-10	.1264	9.87360E-11	.2086	2.02829E-12	.7478	1.27212E-14	.7079
1.5732E+01	1.44021E-09	.0303	2.80634E-10	.1316	4.12412E-11	.3137	2.05471E-13	.6584	0.00000E+00	.0000
1.5980E+01	1.27617E-09	.0205	8.22693E-11	.1809	8.20682E-12	.6413	0.00000E+00	.0000	0.00000E+00	.0000
1.6231E+01	2.02597E-10	.0661	3.09760E-11	.3965	5.09464E-13	.7391	0.00000E+00	.0000	0.00000E+00	.0000
1.6487E+01	1.75259E-10	.0690	4.65677E-12	.7613	1.64370E-12	1.0000	0.00000E+00	.0000	0.00000E+00	.0000
total	1.08783E-08	.0122	3.47517E-09	.0340	2.16844E-09	.0363	1.31179E-09	.0376	7.68916E-10	.0409

uncollided neutron flux

detector:	1		2		3		4		5	
energy	flux	error	flux	error	flux	error	flux	error	flux	error
4.6308E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.2474E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.9461E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
6.7378E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
7.6349E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
8.6515E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
9.8035E-02	2.07440E-13	.5000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1109E-01	3.10691E-13	.4082	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2588E-01	2.06441E-13	.5000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.4264E-01	6.61433E-13	.2775	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.6163E-01	3.59724E-13	.3780	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.8315E-01	3.61339E-13	.3780	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.0754E-01	4.66289E-13	.3333	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.3517E-01	3.64227E-13	.3739	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.6649E-01	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.0197E-01	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.4217E-01	2.58187E-13	.4472	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.8774E-01	5.61064E-13	.3017	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
4.3936E-01	3.11086E-13	.4080	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
4.9786E-01	4.66656E-13	.3333	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.6415E-01	4.77688E-12	.1037	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
6.3927E-01	7.10234E-12	.0877	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
7.2438E-01	8.96099E-12	.0808	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
8.2084E-01	9.42710E-12	.0760	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
9.3013E-01	7.96594E-12	.0805	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0540E+00	1.39009E-12	.1924	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1943E+00	5.56823E-12	.0962	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.3533E+00	5.03354E-12	.1011	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5335E+00	9.68630E-12	.0735	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.7377E+00	1.48622E-11	.0627	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.8498E+00	6.28702E-12	.1013	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000

Table 4.3.3 (cont.)

1.9691E+00	5.95107E-12	.0951	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.0961E+00	9.80619E-12	.0814	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.2313E+00	9.52867E-12	.0867	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.3752E+00	1.24073E-11	.0946	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.5284E+00	1.08648E-11	.0891	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.6914E+00	8.80125E-12	.0873	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.8650E+00	9.38821E-12	.0822	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.0498E+00	9.19211E-12	.0791	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.2465E+00	7.88505E-12	.0808	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.4559E+00	2.02826E-12	.1590	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.6787E+00	1.76408E-12	.1702	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.9160E+00	1.60094E-12	.1793	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
4.1686E+00	2.05775E-12	.1581	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
4.4374E+00	1.28400E-12	.2000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
4.7236E+00	1.69527E-12	.1741	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.0282E+00	2.14135E-12	.1544	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.3525E+00	2.06672E-12	.1581	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.6978E+00	1.95403E-12	.1622	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
6.0652E+00	1.80184E-12	.1690	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
6.4564E+00	2.01186E-12	.1601	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
6.8728E+00	2.37324E-12	.1474	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
7.3161E+00	2.10563E-12	.1562	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
7.7879E+00	1.59717E-12	.1796	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
8.2902E+00	2.13756E-12	.1562	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
8.8249E+00	1.39509E-12	.1925	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
9.3940E+00	2.51589E-12	.1459	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
9.9999E+00	3.43941E-12	.1240	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0157E+01	9.33155E-13	.2357	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0317E+01	1.19058E-12	.2085	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0480E+01	9.69268E-13	.2357	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0645E+01	1.03609E-12	.2357	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0812E+01	1.24104E-12	.2182	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0983E+01	1.45356E-12	.1962	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1156E+01	1.02986E-12	.2236	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1331E+01	9.78080E-13	.2295	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1510E+01	9.81260E-13	.2294	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1691E+01	9.28054E-13	.2357	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1875E+01	2.47907E-12	.1443	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2062E+01	2.85365E-12	.1361	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2252E+01	3.36218E-12	.1291	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2445E+01	3.43230E-12	.1291	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2641E+01	3.78543E-12	.1231	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2840E+01	4.39934E-12	.1139	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.3042E+01	4.68328E-12	.1097	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.3248E+01	7.27943E-12	.0905	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.3456E+01	6.41713E-12	.0971	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.3668E+01	5.24532E-12	.1072	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.3883E+01	3.38356E-11	.0422	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.4102E+01	5.20694E-11	.0345	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.4324E+01	5.27499E-11	.0347	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.4550E+01	4.10731E-10	.0121	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.4779E+01	8.79181E-10	.0079	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5012E+01	8.89784E-10	.0078	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5248E+01	9.22854E-10	.0078	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5488E+01	1.00455E-09	.0078	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5732E+01	1.04829E-09	.0076	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5980E+01	1.05612E-09	.0077	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.6231E+01	1.58358E-10	.0218	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.6487E+01	1.54382E-10	.0222	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
total	6.92298E-09	.0005	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000

Table 4.3.4

The results of LI2O (CENDL-2.1)

tally fluctuation charts

nps	mean	error	vov	slope	fom
8000	1.0940E-08	.0504	.0971	2.8	635
16000	1.0483E-08	.0327	.0490	2.3	766
24000	1.0838E-08	.0266	.0266	3.7	771
32000	1.0924E-08	.0232	.0193	6.9	761
40000	1.0910E-08	.0207	.0163	7.7	765
48000	1.0810E-08	.0186	.0138	8.1	792
56000	1.0825E-08	.0173	.0120	6.7	782
64000	1.0783E-08	.0160	.0104	9.3	796
72000	1.0827E-08	.0149	.0089	10.0	817
80000	1.0816E-08	.0141	.0082	10.0	824
88000	1.0877E-08	.0134	.0071	10.0	820
96000	1.0878E-08	.0128	.0064	10.0	834
104000	1.0880E-08	.0123	.0059	10.0	836
104651	1.0878E-08	.0122	.0058	10.0	837

(4) Testing and analysis of angular neutron flux on carbon slab

The graphite assembly is 202.4 mm in thickness, and 31.4 cm equivalent radius. The energy range is from 50 keV to 15 MeV. The angles of angular neutron fluxes are calculated at 0.0,12.2,24.9,41.8 and 66.8 degrees.

List of Figures and Tables

Conclusion:

From Table 4.4.1, it shows that the angular neutron fluxes at point detector are generally reliable, because the relative error of both libraries is less than 0.05, and VOV is below 0.1.

Good agreement was obtained for 20-cm graphite slab for almost all angles over the whole energy range. The carbon data of CENDL-2.1 looks satisfactory.

(5) Testing and analysis for a Liquid Oxygen assembly

List of Figures and Tables

Conclusions:

CENDL-2.1 underestimates the flux at whole energy parts for almost all angles. The underestimation amounts to about 20% for the low energy part (< 1 MeV) and up to 50% for high energy parts.

Further improvement will be needed in the secondary energy-angle distributions of O-16 of CENDL-2.1 at high energy range.

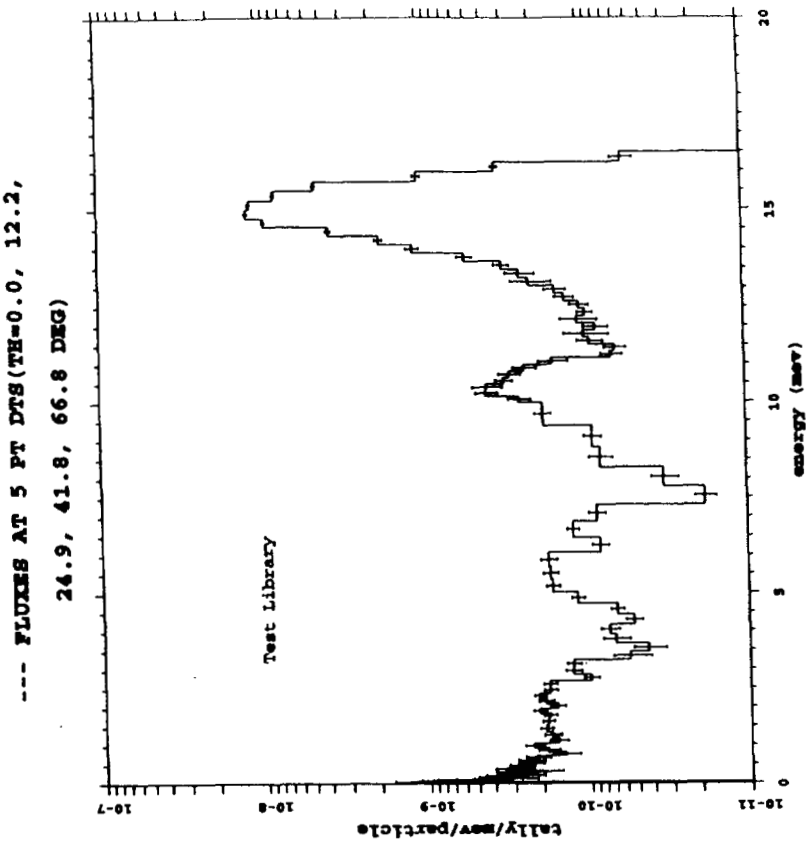

Fig 4.4.2

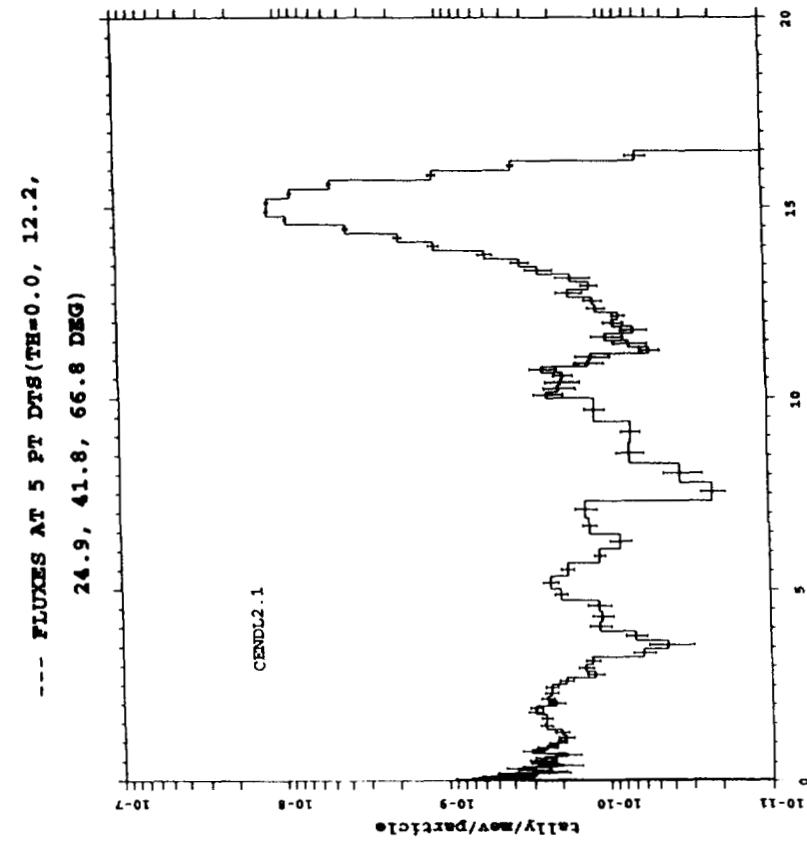

Fig. 4.4.1

Table 4.4.1

The results of graphite (Thickness=202.4mm)

Tally fluctuation charts

	nps	mean	error	vov	slope	fom
CENDL-2.1	8000	1.3582E-08	.0216	.0394	2.5	5191
TESTLIB	8000	1.3703E-08	.0242	.0363	2.4	4102
CENDL-2.1	16000	1.3756E-08	.0167	.0260	7.3	4279
TESTLIB	16000	1.3789E-08	.0180	.0244	5.4	3727
CENDL-2.1	24000	1.4031E-08	.0141	.0158	6.2	3955
TESTLIB	24000	1.4065E-08	.0153	.0159	4.4	3428
CENDL-2.1	32000	1.4307E-08	.0129	.0117	10.0	3535
TESTLIB	32000	1.4362E-08	.0142	.0137	5.8	2977
CENDL-2.1	40000	1.4359E-08	.0118	.0092	10.0	3414
TESTLIB	40000	1.4405E-08	.0131	.0105	10.0	2832
CENDL-2.1	48000	1.4378E-08	.0109	.0084	10.0	3356
TESTLIB	48000	1.4440E-08	.0119	.0083	10.0	2862
CENDL-2.1	56000	1.4318E-08	.0098	.0072	10.0	3537
TESTLIB	56000	1.4406E-08	.0108	.0072	10.0	2957
CENDL-2.1	64000	1.4344E-08	.0093	.0068	10.0	3442
TESTLIB	64000	1.4433E-08	.0103	.0068	10.0	2884
CENDL-2.1	72000	1.4384E-08	.0088	.0058	10.0	3393
TESTLIB	72000	1.4476E-08	.0097	.0058	10.0	2841
CENDL-2.1	80000	1.4465E-08	.0086	.0059	10.0	3182
TESTLIB	80000	1.4566E-08	.0095	.0060	10.0	2680
CENDL-2.1	88000	1.4492E-08	.0083	.0052	10.0	3110
TESTLIB	88000	1.4602E-08	.0092	.0056	10.0	2602
CENDL-2.1	96000	1.4506E-08	.0079	.0046	10.0	3150
TESTLIB	96000	1.4604E-08	.0088	.0050	10.0	2631
CENDL-2.1	100000	1.4536E-08	.0078	.0043	10.0	3114
TESTLIB	100000	1.4649E-08	.0086	.0046	10.0	2611

Table 4.4.2 (CENDL-2.1)

--- FLUXES AT 5 PT DTS(TH=0.0, 12.2, 24.9, 41.8, 66.8 DEG)
particle flux at a point detector. units 1/cm**2

detector:	1		2		3		4		5	
energy										
4.6308E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.2474E-02	4.25155E-12	.3383	4.54672E-12	.3478	4.39990E-12	.3961	4.05493E-12	.3975	3.10374E-12	.5092
5.9461E-02	3.67744E-12	.2760	3.79683E-12	.2708	2.13075E-12	.2416	1.84573E-12	.2788	2.97591E-12	.3456
6.7378E-02	3.23500E-12	.2396	4.69903E-12	.2349	5.08912E-12	.2631	4.25583E-12	.3082	4.60614E-12	.3849
7.6349E-02	5.08439E-12	.2923	5.67187E-12	.2685	5.73873E-12	.2773	4.13382E-12	.2764	2.56084E-12	.3831
8.6515E-02	5.20094E-12	.3042	4.17972E-12	.3147	4.90486E-12	.2919	3.45856E-12	.2744	2.36150E-12	.3318
9.8035E-02	5.52756E-12	.3156	5.57610E-12	.3194	6.04896E-12	.3268	6.43415E-12	.2940	4.00912E-12	.2863
1.1109E-01	6.33308E-12	.2649	6.19595E-12	.2726	6.92386E-12	.2453	5.86836E-12	.2383	5.69558E-12	.2833
1.2588E-01	7.10145E-12	.3188	7.72213E-12	.2967	6.21841E-12	.2655	6.09069E-12	.2905	5.71251E-12	.3284
1.4264E-01	6.85210E-12	.2489	5.29133E-12	.2352	4.58185E-12	.2557	5.38266E-12	.2576	4.45779E-12	.2757
1.6163E-01	7.49225E-12	.2380	9.11306E-12	.2498	9.43280E-12	.2491	9.22143E-12	.2481	6.26374E-12	.2762
1.8315E-01	8.57660E-12	.2580	9.09855E-12	.2305	9.24732E-12	.2249	8.91285E-12	.2484	6.54161E-12	.2717
2.0754E-01	9.74404E-12	.2667	1.15254E-11	.2391	1.06908E-11	.2422	1.07479E-11	.2305	7.21609E-12	.3083
2.3517E-01	6.71758E-12	.2512	7.43596E-12	.2217	8.77927E-12	.2448	8.94916E-12	.2109	6.49255E-12	.2683
2.6649E-01	7.63191E-12	.2177	8.66278E-12	.2002	8.71248E-12	.1926	7.58402E-12	.1997	5.25162E-12	.2402
3.0197E-01	1.09989E-11	.2353	1.03069E-11	.2080	1.19117E-11	.2122	1.01755E-11	.2166	7.19659E-12	.2499
3.4217E-01	1.52225E-11	.1977	1.38428E-11	.1886	1.58335E-11	.1715	1.26031E-11	.1851	9.66519E-12	.2429
3.8774E-01	1.36719E-11	.1886	1.59594E-11	.1953	1.37211E-11	.2056	1.57377E-11	.2217	1.05328E-11	.2525
4.3936E-01	1.02598E-11	.2397	1.24116E-11	.2197	1.11643E-11	.2040	1.06582E-11	.1901	7.16154E-12	.2247
4.9786E-01	1.56922E-11	.1763	1.61707E-11	.1777	1.60727E-11	.1789	1.46738E-11	.1633	1.13596E-11	.1985
5.6415E-01	1.80167E-11	.1845	1.84827E-11	.1824	1.67315E-11	.1730	1.62816E-11	.1775	1.00899E-11	.1975
6.3927E-01	1.95248E-11	.1451	1.73783E-11	.1648	1.72467E-11	.1715	1.67450E-11	.1926	8.74764E-12	.2447
7.2438E-01	1.60298E-11	.1812	1.76455E-11	.1785	1.88030E-11	.1700	1.80909E-11	.1795	1.19391E-11	.2295
8.2084E-01	3.00396E-11	.1499	2.59997E-11	.1652	2.12165E-11	.1795	2.03226E-11	.1703	1.44609E-11	.1809
9.3013E-01	2.75324E-11	.1425	2.61548E-11	.1511	3.00438E-11	.1445	2.21462E-11	.1616	1.25052E-11	.1883
1.0540E+00	2.67580E-11	.1250	2.24721E-11	.1475	1.84551E-11	.1557	1.66469E-11	.1651	1.22346E-11	.1816
1.1943E+00	2.67789E-11	.1108	2.42898E-11	.1314	2.46586E-11	.1295	2.28897E-11	.1361	1.27595E-11	.1801
1.3533E+00	3.21417E-11	.1008	2.45178E-11	.1303	2.19491E-11	.1239	2.09888E-11	.1300	1.98960E-11	.1464
1.5335E+00	4.55788E-11	.0859	3.21712E-11	.1174	3.22550E-11	.1406	2.55931E-11	.1297	2.11086E-11	.1497
1.7377E+00	5.09206E-11	.0774	3.35823E-11	.1126	2.90521E-11	.1205	2.38014E-11	.1314	2.08041E-11	.1690
1.8498E+00	3.27496E-11	.1045	1.96241E-11	.1574	1.98746E-11	.1560	1.45763E-11	.1769	9.05966E-12	.2094
1.9691E+00	3.45819E-11	.0896	1.66382E-11	.1593	1.42640E-11	.1554	1.46281E-11	.1720	8.15492E-12	.1892
2.0961E+00	2.75000E-11	.1215	1.80344E-11	.1772	1.39879E-11	.1864	1.21754E-11	.1884	1.12304E-11	.3135
2.2313E+00	3.30651E-11	.0955	1.77079E-11	.1586	1.93442E-11	.1688	1.46054E-11	.1847	1.52466E-11	.2758
2.3752E+00	3.33059E-11	.0953	1.67240E-11	.1602	1.67112E-11	.1479	1.41723E-11	.1767	1.22639E-11	.2098
2.5284E+00	3.52763E-11	.0918	2.09769E-11	.1577	1.97144E-11	.1694	1.68607E-11	.1736	8.58104E-12	.2046
2.6914E+00	3.03025E-11	.1003	1.53346E-11	.1637	1.22739E-11	.1561	1.03624E-11	.1924	1.02417E-11	.2041
2.8650E+00	2.12338E-11	.1192	1.17435E-11	.1840	9.98358E-12	.1670	9.57384E-12	.1559	4.89001E-12	.3162
3.0498E+00	2.60714E-11	.1097	1.29842E-11	.2093	1.31745E-11	.2079	9.17021E-12	.2119	9.45916E-12	.2462
3.2465E+00	2.50796E-11	.1000	1.43390E-11	.1987	1.21698E-11	.2226	8.37623E-12	.2039	4.27345E-12	.2416
3.4559E+00	1.27939E-11	.1607	9.89798E-12	.2746	8.32628E-12	.2969	5.14603E-12	.2469	3.04958E-12	.3334
3.6787E+00	9.57312E-12	.3213	4.71528E-12	.2497	6.73565E-12	.3079	8.10838E-12	.4198	1.03735E-11	.3788
3.9160E+00	1.62560E-11	.1472	1.19155E-11	.2278	1.04015E-11	.2313	1.08867E-11	.2273	9.02620E-12	.2159
4.1686E+00	2.85426E-11	.1519	2.00072E-11	.1878	1.78379E-11	.1921	1.61820E-11	.1821	9.41069E-12	.1895
4.4374E+00	2.94315E-11	.1482	2.47059E-11	.1917	2.07575E-11	.1727	1.16040E-11	.2199	6.16236E-12	.2842
4.7236E+00	3.27539E-11	.1633	2.12753E-11	.2204	2.18423E-11	.1772	2.27910E-11	.2212	1.08915E-11	.2594
5.0282E+00	5.99820E-11	.0926	2.97620E-11	.1544	2.45638E-11	.1580	9.90957E-12	.2135	7.83103E-12	.2910
5.3525E+00	7.34481E-11	.1049	4.10879E-11	.1561	3.63327E-11	.1687	1.78173E-11	.2288	1.23613E-11	.2489
5.6978E+00	6.11632E-11	.0946	2.57233E-11	.1745	1.16081E-11	.2369	9.79044E-12	.2437	5.97121E-12	.3118
6.0652E+00	4.11404E-11	.0793	1.03576E-11	.2168	1.31637E-11	.1960	7.22213E-12	.2171	3.81226E-12	.3908
6.4564E+00	3.27330E-11	.1523	9.80843E-12	.3403	6.50736E-12	.3267	5.86494E-12	.2714	4.66451E-12	.3205
6.8728E+00	5.34890E-11	.1002	1.92959E-11	.4185	1.75222E-11	.5367	1.49467E-11	.4877	2.82691E-12	.3364
7.3161E+00	5.96824E-11	.1530	3.02607E-11	.2734	1.66847E-11	.2461	9.77798E-12	.2686	6.65543E-12	.2163

Table 4.4.2 (cont.)

7.7879E+00	1.02799E-11	.1716	5.92367E-12	.3570	5.36088E-12	.4867	6.11612E-12	.3853	7.55529E-12	.4351
8.2902E+00	1.73456E-11	.2776	9.72992E-12	.5230	1.34907E-11	.3921	9.64744E-12	.2632	8.59469E-12	.2905
8.8249E+00	3.81733E-11	.1948	2.22033E-11	.3189	1.71061E-11	.2761	1.68959E-11	.2231	1.01215E-11	.2286
9.3940E+00	3.98159E-11	.1336	2.19390E-11	.1817	2.94347E-11	.1692	2.79697E-11	.1738	1.04656E-11	.2138
9.9999E+00	7.10300E-11	.1419	6.62573E-11	.1727	6.27480E-11	.1708	5.17257E-11	.1933	1.39472E-11	.2783
1.0157E+01	3.61054E-11	.2095	2.21289E-11	.2422	2.62105E-11	.2459	1.98621E-11	.3468	4.95142E-12	.6211
1.0317E+01	3.11869E-11	.2253	4.92846E-11	.2311	3.14830E-11	.3037	6.66161E-12	.3575	4.01795E-12	.5809
1.0480E+01	3.03702E-11	.2457	3.11288E-11	.1754	1.94111E-11	.2163	2.24534E-12	.4571	1.69149E-12	.3797
1.0645E+01	2.96812E-11	.1392	2.18294E-11	.2382	1.26799E-11	.2936	4.52571E-12	.4569	6.26996E-12	.7613
1.0812E+01	4.04064E-11	.1876	2.16804E-11	.2329	7.13398E-12	.4203	2.42320E-12	.4719	1.51488E-12	.3337
1.0983E+01	2.13587E-11	.2050	1.54995E-11	.2797	8.11567E-12	.3998	4.56739E-12	.8307	3.77844E-12	.7218
1.1156E+01	2.07232E-11	.2394	1.05850E-11	.4251	3.51972E-12	.6396	1.60433E-12	.4260	3.94987E-12	.6183
1.1331E+01	9.12694E-12	.1420	3.11090E-12	.5612	2.48169E-12	.4222	3.61965E-12	.7349	3.63216E-12	.5417
1.1510E+01	1.24926E-11	.2381	1.26631E-12	.4913	7.72220E-13	.4852	1.62281E-12	.3456	1.05821E-12	.5860
1.1691E+01	1.75743E-11	.2217	5.32268E-12	.6960	4.78965E-13	.3651	3.21103E-12	.3281	2.15057E-12	.2683
1.1875E+01	1.20411E-11	.1862	1.41913E-12	.5504	2.40799E-12	.3800	1.65255E-12	.5217	2.43328E-12	.3416
1.2062E+01	1.63400E-11	.1405	2.42918E-12	.5795	1.45966E-12	.3455	2.22272E-12	.3634	1.53789E-12	.2499
1.2252E+01	1.52001E-11	.0863	2.25417E-12	.4075	1.46412E-12	.4765	3.04177E-12	.4401	2.24744E-12	.2255
1.2445E+01	2.12116E-11	.1240	5.49757E-12	.4278	3.21367E-12	.5373	1.19578E-12	.2709	3.14400E-12	.2010
1.2641E+01	2.25304E-11	.1265	5.55024E-12	.5143	5.36163E-12	.7630	6.18672E-12	.3867	1.14258E-11	.4580
1.2840E+01	3.24737E-11	.1873	5.51465E-12	.6056	6.61222E-12	.5016	9.18631E-12	.6927	6.48164E-12	.2408
1.3042E+01	2.43888E-11	.1189	6.50279E-12	.5278	7.16569E-12	.4712	8.19988E-12	.2880	3.87752E-12	.1740
1.3248E+01	3.22848E-11	.2427	9.25629E-12	.6552	9.28218E-12	.5255	4.32819E-12	.1723	9.49613E-12	.5358
1.3456E+01	5.19790E-11	.1912	2.14404E-11	.4070	8.45625E-12	.3085	1.85430E-11	.2443	1.43913E-11	.6839
1.3668E+01	6.88437E-11	.1276	2.27637E-11	.2813	3.05918E-11	.2973	1.04730E-11	.1616	5.99456E-12	.2795
1.3883E+01	1.13922E-10	.1025	4.02425E-11	.2633	3.56728E-11	.2225	2.18213E-11	.2262	3.44851E-12	.2621
1.4102E+01	2.38082E-10	.0752	8.00642E-11	.1874	4.13466E-11	.1714	2.44002E-11	.1643	3.75052E-12	.3118
1.4324E+01	3.99513E-10	.0531	1.06525E-10	.1816	9.59995E-11	.1457	2.76389E-11	.1954	7.56802E-12	.7792
1.4550E+01	8.53018E-10	.0349	2.08467E-10	.1220	1.27559E-10	.1339	5.28524E-11	.2348	1.26765E-12	.8056
1.4779E+01	2.03507E-09	.0184	3.29948E-10	.0978	1.65843E-10	.1227	2.01722E-11	.2842	6.49711E-13	.7139
1.5012E+01	2.69602E-09	.0158	4.11016E-10	.0926	1.39570E-10	.1319	8.78599E-12	.3025	1.08309E-13	1.0000
1.5248E+01	2.71639E-09	.0157	2.89608E-10	.0978	7.25140E-11	.1686	3.42822E-12	.6269	0.00000E+00	.0000
1.5488E+01	1.98907E-09	.0175	2.05602E-10	.1242	3.45269E-11	.2637	2.07663E-12	.6574	0.00000E+00	.0000
1.5732E+01	1.14075E-09	.0225	8.62657E-11	.1801	1.38444E-11	.4632	1.67683E-12	.8528	0.00000E+00	.0000
1.5980E+01	2.70112E-10	.0521	1.86865E-11	.5024	1.37163E-12	1.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.6231E+01	8.91846E-11	.0410	3.45735E-12	.6495	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.6487E+01	1.54641E-11	.1501	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
total	1.45363E-08	.0078	2.99822E-09	.0327	1.80048E-09	.0363	1.01942E-09	.0409	6.05669E-10	.0491

uncollided neutron flux

detector:	1		2		3		4		5	
energy										
4.6308E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.2474E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.9461E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
6.7378E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
7.6349E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
8.6515E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
9.8035E-02	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1109E-01	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2588E-01	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.4264E-01	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.6163E-01	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.8315E-01	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.0754E-01	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.3517E-01	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.6649E-01	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.0197E-01	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.4217E-01	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.8774E-01	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000

Table 4.4.2 (cont.)

4.3936E-01	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
4.9786E-01	7.14993E-14	1.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.6415E-01	7.32536E-14	.9409	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
6.3927E-01	4.93703E-13	.3780	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
7.2438E-01	1.21642E-12	.2413	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
8.2084E-01	1.55841E-12	.2132	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
9.3013E-01	3.21405E-12	.1491	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0540E+00	4.13435E-12	.1313	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1943E+00	5.78277E-12	.1111	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.3533E+00	8.05303E-12	.0940	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5335E+00	1.26975E-11	.0749	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.7377E+00	1.90233E-11	.0612	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.8498E+00	1.18084E-11	.0776	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.9691E+00	1.42816E-11	.0707	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.0961E+00	1.04070E-11	.0827	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.2313E+00	1.50865E-11	.0698	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.3752E+00	1.64802E-11	.0700	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.5284E+00	1.62704E-11	.0710	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.6914E+00	1.30729E-11	.0758	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
2.8650E+00	9.05145E-12	.0887	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.0498E+00	1.38930E-11	.1032	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.2465E+00	1.34773E-11	.0800	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.4559E+00	3.79536E-12	.1373	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.6787E+00	1.56189E-12	.2132	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
3.9160E+00	4.81436E-12	.1216	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
4.1686E+00	9.62934E-12	.0860	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
4.4374E+00	6.62756E-12	.1037	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
4.7236E+00	1.26640E-11	.0876	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.0282E+00	2.35677E-11	.0792	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.3525E+00	3.28987E-11	.0762	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
5.6978E+00	2.70451E-11	.0828	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
6.0652E+00	2.98217E-11	.0824	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
6.4564E+00	1.78319E-11	.0974	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
6.8728E+00	3.98856E-11	.0895	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
7.3161E+00	3.21815E-11	.1025	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
7.7879E+00	4.28838E-12	.1292	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
8.2902E+00	6.78761E-12	.1149	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
8.8249E+00	1.93887E-11	.1013	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
9.3940E+00	1.51439E-11	.1052	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
9.9999E+00	1.38529E-11	.1067	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0157E+01	3.24168E-12	.2357	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0317E+01	5.23832E-12	.1890	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0480E+01	3.03722E-12	.2426	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0645E+01	6.42237E-12	.1564	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0812E+01	5.11571E-12	.1603	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.0983E+01	5.27654E-12	.1474	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1156E+01	4.93240E-12	.1507	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1331E+01	6.63263E-12	.1313	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1510E+01	8.44332E-12	.1187	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1691E+01	1.08976E-11	.1084	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.1875E+01	9.36431E-12	.1162	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2062E+01	1.22596E-11	.0946	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2252E+01	1.42062E-11	.0861	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2445E+01	1.72415E-11	.0848	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2641E+01	1.84297E-11	.0833	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.2840E+01	1.92493E-11	.0800	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.3042E+01	1.92987E-11	.0776	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.3248E+01	1.95278E-11	.0771	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.3456E+01	3.18639E-11	.0613	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.3668E+01	4.32954E-11	.0524	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000

Table 4.4.2 (cont.)

1.3883E+01	7.18636E-11	.0426	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.4102E+01	1.68082E-10	.0284	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.4324E+01	2.78392E-10	.0219	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.4550E+01	6.55938E-10	.0141	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.4779E+01	1.66479E-09	.0080	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5012E+01	2.20340E-09	.0065	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5248E+01	2.26221E-09	.0062	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5488E+01	1.68769E-09	.0073	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5732E+01	9.58179E-10	.0098	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.5980E+01	2.35580E-10	.0201	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.6231E+01	8.50072E-11	.0338	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
1.6487E+01	1.23218E-11	.0924	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000
total	1.10394E-08	.0007	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000	0.00000E+00	.0000

Table 4.4.3

```
FNS-TOF/31.4 CM(R)*20.24CM(Z)-C CYL./FIXED CONE BIAS/CENDL-2.12.1.1
C     ************************************
C     *   CELL CARAD                     *
C     ************************************
C     ******* EXTERNAL VOID ***************
 1     0           -4 : +4 -2 +3 : +10 : +2 -10 +5 +6 +7 +8 +9
C     ******* SOURCE VACUUM REGION *********
 2     0             -3  +4  -1
C     ******* MATERIAL REGION **************
 3     1    8.694-2   -3  +1  -2
C     ******* DETECTOR VACUUM REGION *******
 4     0  +2  -10 -5 : +2 -10 -6 : +2 -10 -7 : +2 -10 -8 : +2 -10 -9
C     ------- THE FOLLOWING IS A BLANK DELIMETER

C     ************************************
C     * SURFACE CARD                     *
C     ************************************
 1            PZ          -20.24
 2            PZ              0
 3            CZ           31.4
 4            PZ            -60
 5            CZ          5.122
 6          1 CZ          5.129
 7          2 CZ          5.143
 8          3 CZ          5.186
 9          4 CZ          5.284
10            SO           1000
C      ------- THE FOLLOWING IS A BLANK DELIMETER

C     ************************************
C     *  MODE CARD       - NEUTRON ONLY  *
C     ************************************
MODE   N
C     ************************************
C     *  TRANSFORMATION CARDS            *
C     *  ROTATION ABOUT THE Y AXIS BY THETA*
C     ************************************
*TR1   0  0  0        12.2  90  102.2   90   0  90
                      77.8  90   12.2   +1
*TR2   0  0  0        24.9  90  114.9   90   0  90
                      65.1  90   24.9   +1
*TR3   0  0  0        41.8  90  131.8   90   0  90
                      48.2  90   41.8   +1
*TR4   0  0  0        66.8  90  156.8   90   0  90
                      23.2  90   66.8   +1
C     ************************************
C     *   CELL PARAMETER CARDS           *
C     ************************************
IMP:N   0    1   1    1
C     ****************************************************
C     *  SOURCE SPECIFICATION CARDS                      *
C     *  SRC1=POINT ISOTROPIC OPTION                     *
C     *  SDIR DIRC. BIASING - HEIGHT REDUCTION CONSIDERED*
C     *  SI(ENG.) AND SP(PROB.) TAKEN FROM BETOF SOURCE  *
C     *  EXPT. DATA                                      *
C     ****************************************************
```

Table 4.4.3 (cont.)

```
sdef  pos=0 0 -40.24 cel=2 wgt=1.0 erg=d1 dir=d2 vec=0 0 1
si1   4.6308-02
      5.2474-02  5.9461-02  6.7378-02  7.6349-02  8.6515-02
      9.8035-02  1.1109-01  1.2588-01  1.4264-01  1.6163-01
      1.8315-01  2.0754-01  2.3517-01  2.6649-01  3.0197-01
      3.4217-01  3.8774-01  4.3936-01  4.9786-01  5.6415-01
      6.3927-01  7.2438-01  8.2084-01  9.3013-01  1.0540+00
      1.1943+00  1.3533+00  1.5335+00  1.7377+00  1.8498+00
      1.9691+00  2.0961+00  2.2313+00  2.3752+00  2.5284+00
      2.6914+00  2.8650+00  3.0498+00  3.2465+00  3.4559+00
      3.6787+00  3.9160+00  4.1686+00  4.4374+00  4.7236+00
      5.0282+00  5.3525+00  5.6978+00  6.0652+00  6.4564+00
      6.8728+00  7.3161+00  7.7879+00  8.2902+00  8.8249+00
      9.3940+00  9.9999+00  1.0157+01  1.0317+01  1.0480+01
      1.0645+01  1.0812+01  1.0983+01  1.1156+01  1.1331+01
      1.1510+01  1.1691+01  1.1875+01  1.2062+01  1.2252+01
      1.2445+01  1.2641+01  1.2840+01  1.3042+01  1.3248+01
      1.3456+01  1.3668+01  1.3883+01  1.4102+01  1.4324+01
      1.4550+01  1.4779+01  1.5012+01  1.5248+01  1.5488+01
      1.5732+01  1.5980+01  1.6231+01  1.6487+01
sp1   0
      0          0          0          0          0
      0          0          0          0          0
      0          0          0          0          0
      0          0          0          2.1438-04  9.1563-04
      1.5388-03  2.1627-03  2.5871-03  2.9698-03  3.3277-03
      3.7304-03  3.9914-03  4.1831-03  4.3067-03  2.2786-03
      2.1176-03  2.1039-03  2.0513-03  2.1117-03  2.0411-03
      2.0591-03  2.1096-03  2.1281-03  2.4053-03  2.0935-03
      1.8313-03  1.8008-03  1.7868-03  1.6668-03  1.6064-03
      1.5991-03  1.6805-03  1.6701-03  1.5432-03  1.2904-03
      1.2595-03  1.0310-03  9.2870-04  8.9403-04  8.8635-04
      8.7646-04  9.5094-04  2.2846-04  2.2733-04  2.9803-04
      3.5343-04  4.2411-04  4.5049-04  4.8501-04  5.7358-04
      6.6128-04  7.2272-04  1.0292-03  1.1708-03  1.3518-03
      1.5306-03  1.6062-03  1.6985-03  1.7860-03  1.8887-03
      2.6840-03  4.0301-03  5.7679-03  1.2112-02  2.2014-02
      5.0048-02  1.4342-01  1.9945-01  2.1655-01  1.6617-01
      9.8846-02  2.5913-02  9.2423-03  1.2696-03
sb2   -31 0.5372231
C     ***********************************************
C     *  MATERIAL SPECIFICATION CARDS                *
C     ***********************************************
C     ----  CARBON  -------------------------------
M1    6012.00C 1.0
C     DRXS
C    ***********************************************
C    *  TALLY SPECIFICATION CARDS                    *
C    ***********************************************
FC5   --- FLUXES AT 5 PT DTS(TH=0.0, 12.2, 24.9, 41.8, 66.8 DEG)
F5:N        0.0          0      723.0000         1
          152.999        0      707.649          1
          305.672        0      658.514          1
          487.901        0      545.688          1
          685.675        0      293.881          1
DD    0.5   100
```

Table 4.4.3 (cont.)

```
E0     4.6308-02
       5.2474-02  5.9461-02  6.7378-02  7.6349-02  8.6515-02
       9.8035-02  1.1109-01  1.2588-01  1.4264-01  1.6163-01
       1.8315-01  2.0754-01  2.3517-01  2.6649-01  3.0197-01
       3.4217-01  3.8774-01  4.3936-01  4.9786-01  5.6415-01
       6.3927-01  7.2438-01  8.2084-01  9.3013-01  1.0540+00
       1.1943+00  1.3533+00  1.5335+00  1.7377+00  1.8498+00
       1.9691+00  2.0961+00  2.2313+00  2.3752+00  2.5284+00
       2.6914+00  2.8650+00  3.0498+00  3.2465+00  3.4559+00
       3.6787+00  3.9160+00  4.1686+00  4.4374+00  4.7236+00
       5.0282+00  5.3525+00  5.6978+00  6.0652+00  6.4564+00
       6.8728+00  7.3161+00  7.7879+00  8.2902+00  8.8249+00
       9.3940+00  9.9999+00  1.0157+01  1.0317+01  1.0480+01
       1.0645+01  1.0812+01  1.0983+01  1.1156+01  1.1331+01
       1.1510+01  1.1691+01  1.1875+01  1.2062+01  1.2252+01
       1.2445+01  1.2641+01  1.2840+01  1.3042+01  1.3248+01
       1.3456+01  1.3668+01  1.3883+01  1.4102+01  1.4324+01
       1.4550+01  1.4779+01  1.5012+01  1.5248+01  1.5488+01
       1.5732+01  1.5980+01  1.6231+01  1.6487+01
FQ5     E    F
C     ***********************************************
C     * ENERGY AND THERMAL CARDS                    *
C     ***********************************************
C     ***********************************************
C     * PROBLEM CUTOFF CARDS                        *
C     ***********************************************
CUT:N         0      4.6308-02    -10     -0.01
NPS         100000
CTME        10
C     ***********************************************
C     * PERIPHERAL CRADS                            *
C     ***********************************************
PRDMP         50000   50000
LOST     10          10
PRINT
```

Table 4.4.4 Comparison of integrated Angular Flux

for 20 CM-thick Graphite Assembly

Angle	Expt.	CENDL-2.1	C/E	JENDL-3.2	C/E
>11 Mev					
0.0	0.98877	0.818976	0.82828	0.86653	0.87637
12.2	0.13101	0.119285	0.91050	0.12623	0.96352
24.9	0.054250	0.051449	0.94837	0.056720	1.0455
41.8	0.016322	0.015087	0.92434	0.017433	1.0680
66.8	0.005741	0.0056066	0.97659	0.005955	1.0373
1-11 Mev					
0.0	0.099221	0.085338	0.86008	0.090160	0.90868
12.2	0.055821	0.053204	0.95312	0.055311	0.99086
24.9	0.046210	0.045488	0.98438	0.048133	1.0416
41.8	0.034760	0.033732	0.97043	0.036327	1.0451
66.8	0.022383	0.021516	0.96127	0.021830	0.97529
0.5-1 Mev					
0.0	0.0081786	0.0080252	0.98124	0.0081035	0.99082
12.2	0.0064471	0.0076467	1.18607	0.0075291	1.1678
24.9	0.0065524	0.0071550	1.17364	0.0071320	1.0885
41.8	0.0060964	0.0062741	1.02915	0.0062596	1.0268
66.8	0.0042246	0.0038732	0.91682	0.0043682	1.0340

Table 4.5.1

The results of Liquid-Oxygen (Thickness=20cm)

Tally fluctuation charts

nps	mean	error	vov	slope	fom
64000	3.2447E-08	.0079	.0084	10.0	1899
128000	3.2359E-08	.0056	.0040	10.0	1942
192000	3.2381E-08	.0045	.0026	10.0	1984
256000	3.2350E-08	.0038	.0018	10.0	2043
320000	3.2404E-08	.0035	.0015	6.3	2015
384000	3.2397E-08	.0032	.0013	5.5	2008
448000	3.2385E-08	.0029	.0011	5.6	2012
512000	3.2393E-08	.0027	.0010	6.2	2011
576000	3.2375E-08	.0026	.0008	6.0	2026
640000	3.2391E-08	.0024	.0007	5.5	2029
704000	3.2363E-08	.0023	.0007	5.2	2038
768000	3.2326E-08	.0022	.0006	6.0	2049
832000	3.2332E-08	.0021	.0005	5.7	2053
896000	3.2323E-08	.0020	.0005	7.1	2057
925728	3.2349E-08	.0020	.0005	10.0	2046

Table 4.5.2 Comparison of integrated Angular Flux

for 200 mm-thick Liquid Oxygen Assembly

Angle	Expt.	JENDL-3.2	C/E	CENDL-2.1	C/E
>10 Mev					
0.0	2.1210	2.0669	0.97448	1.9015	0.89654
24.9	0.073253	0.045819	0.62549	0.048821	0.75099
41.8	0.028699	0.018299	0.63762	0.017980	0.62649
66.8	0.013267	0.006421	0.48398	0.006886	0.51902
1-10 Mev					
0.0	0.16226	0.15834	0.97584	0.13185	0.81257
24.9	0.040638	0.042515	1.0462	0.030519	0.75099
41.8	0.039873	0.035247	0.88398	0.027549	0.69093
66.8	0.026942	0.017780	0.65994	0.015254	0.56616
0.1-1 Mev					
0.0	0.02138	0.020505	0.95907	0.018671	0.87330
24.9	0.011537	0.011565	1.0024	0.010183	0.88260
41.8	0.011540	0.010476	0.90780	0.009126	0.79079
66.8	0.0089793	0.0066881	0.74484	0.0061407	0.68387

IV.6 Testing for leakage spectrum from aluminium spheres

he leakage current spectrum from the outer surface of a 40-cm diameter aluminium sphere with a central 14-MeV neutron source, normalized to a unit source strength, was calculated with CENDL-2.1, FENDL-1.0 and the MCNP test library.

List of figures and tables

Fig. 4.6.1 Comparison of calculated leakage neutron spectrum

Figs. 4.6.2(a)-4.6.2(c)
Calculated spectrum from 40-cm Al sphere.

Table 4.6.1 Tally fluctuation charts

Conclusions:

CENDL-2.1 shows good agreement with FENDL-1.0. The MCNP test library overestimates the spectrum from 8 to 10.5 MeV, and is slightly higher from 0.5 to 8 MeV. The CENDL Al-27 data look satisfactory.

IV.7 Testing for leakage spectrum from iron sphere

The leakage current spectrum from the outer surface of 100-cm diameter iron sphere with 14 MeV neutron source, normalized to a unit source, was calculated with CENDL-2.1 and MCNP4B recommended library.

List of figures and tables

Fig. 4.7.1 Comparison of calculated leakage spectrum

Table 4.7.1 Calculated results of leakage spectrum

Conclusions:

CENDL-2.1 underestimates the spectrum from 2.5 to 13 MeV, and slightly overestimates the spectrum below 2.5 MeV. There is a need for an improvement of the neutron emission cross section data in iron above 2.5 MeV.

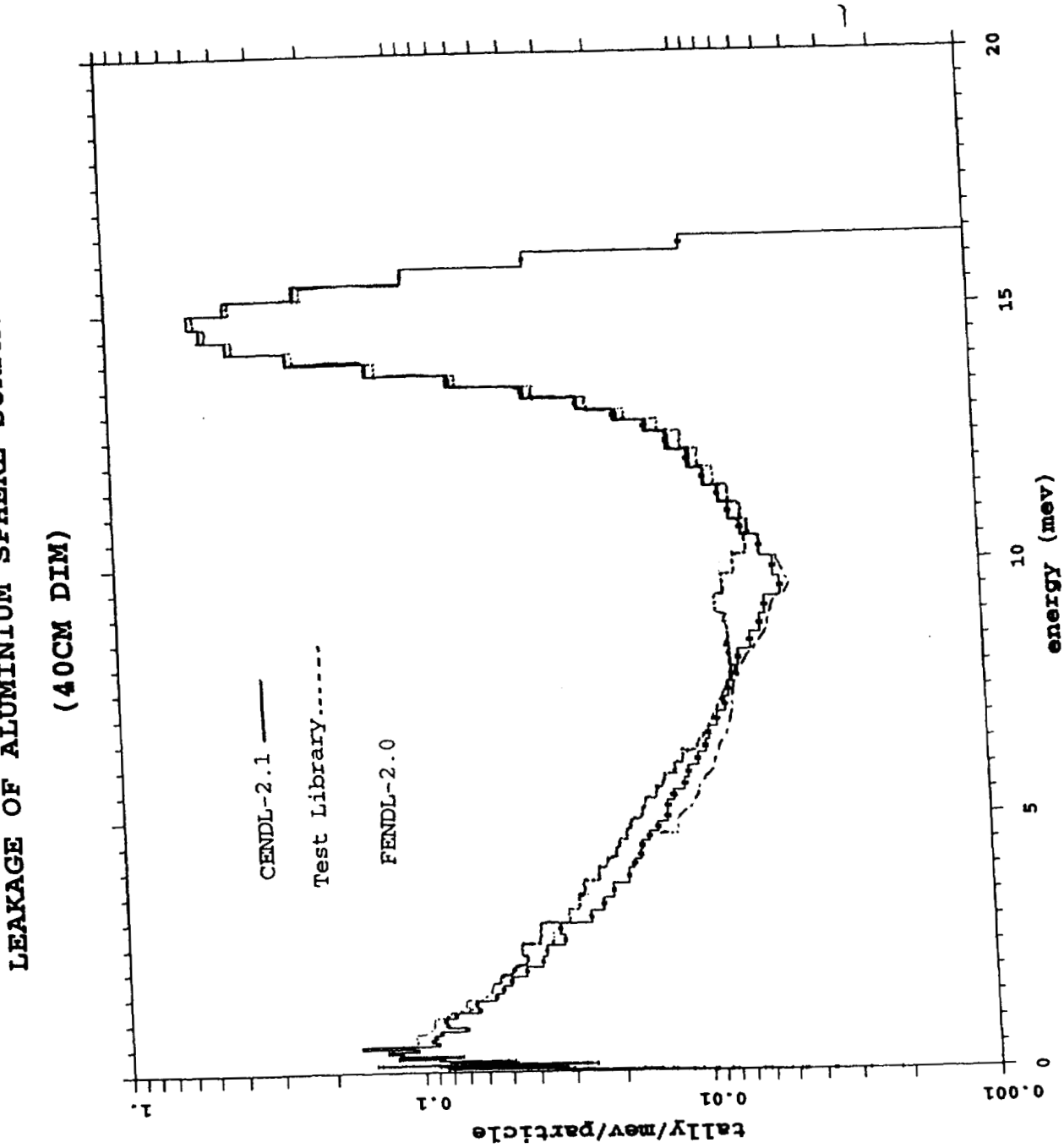
LEAKAGE OF ALUMINIUM SPHERE SURFACE
(40CM DIM)
CENDL-2.1
Test Library.....
FENDL-2.0
tally/mev/particle
energy (mev)
0.001
0.01
0.1
1.
0
5
10
15
20

Fig. 4.6.1

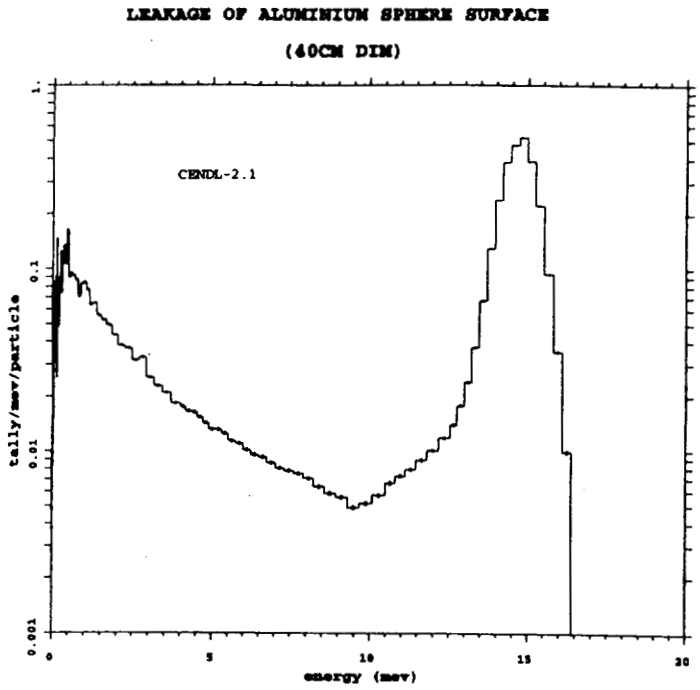

Fig. 4.6.2 (a)

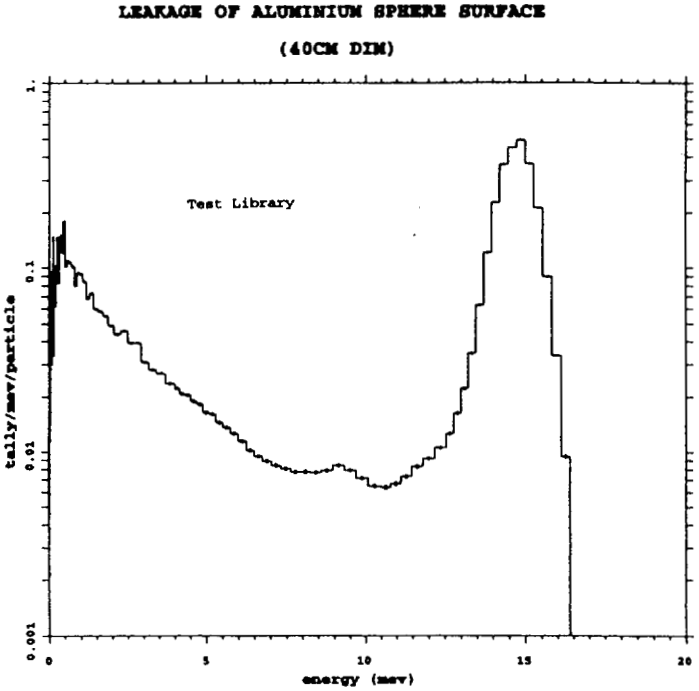

Fig. 4.6.2 (b)

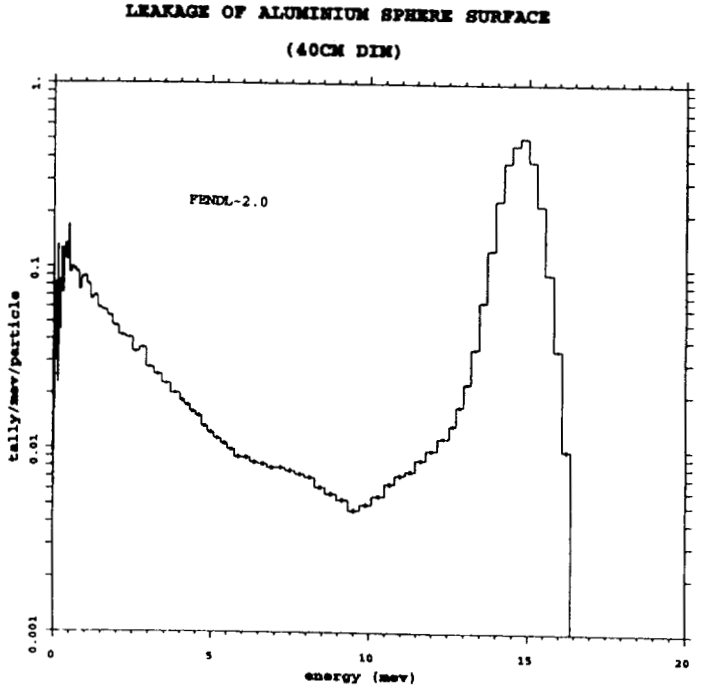

Fig. 4.6.2 (c)

Table 4.6.1 Calculated leakage current spectrum from Al Sphere

Energy [MEV]	Flux/leth	error
1.0000E-03	0.00000E+00	.0000
1.2900E-03	6.95372E-07	1.0000
1.6700E-03	0.00000E+00	.0000
2.1500E-03	8.93312E-07	1.0000
2.7800E-03	4.34017E-06	.4481
3.5900E-03	3.60185E-06	.5001
4.6400E-03	7.79777E-06	.3339
5.9900E-03	6.18641E-06	.3780
7.7400E-03	1.13562E-05	.2782
1.0000E-02	1.57942E-05	.2360
1.2900E-02	3.37731E-05	.1624
1.6700E-02	3.91204E-05	.1508
2.1500E-02	5.98642E-05	.1215
2.7800E-02	2.11381E-04	.0648
3.5900E-02	2.38390E-04	.0609
4.6400E-02	1.71547E-04	.0722
5.9900E-02	4.35591E-04	.0452
7.7400E-02	1.43477E-03	.0250
1.0000E-01	7.62905E-04	.0343
1.1200E-01	8.26937E-04	.0332
1.2600E-01	1.22438E-03	.0272
1.4100E-01	2.15604E-03	.0206
1.5900E-01	4.78527E-04	.0435
1.7800E-01	9.46807E-04	.0309
2.0000E-01	1.77718E-03	.0227
2.2400E-01	1.21416E-03	.0274
2.5200E-01	2.46811E-03	.0194
2.8300E-01	3.79840E-03	.0156
3.1700E-01	2.55919E-03	.0190
3.5600E-01	4.72195E-03	.0140
4.0000E-01	5.83545E-03	.0127
4.4900E-01	5.24974E-03	.0134
5.0400E-01	8.95796E-03	.0103
5.6600E-01	5.60588E-03	.0128
6.3500E-01	6.49144E-03	.0119
7.1300E-01	7.17253E-03	.0113
8.0000E-01	7.60695E-03	.0110
8.7800E-01	5.53495E-03	.0129
9.6400E-01	7.13287E-03	.0114
1.0580E+00	7.92408E-03	.0108
1.1620E+00	8.02099E-03	.0107
1.2750E+00	7.20655E-03	.0113
1.4000E+00	8.13664E-03	.0106
1.5420E+00	7.89267E-03	.0107
1.6980E+00	8.19459E-03	.0105
1.8710E+00	8.53802E-03	.0103
2.0610E+00	8.28357E-03	.0105
2.2700E+00	7.97193E-03	.0106
2.5000E+00	8.47845E-03	.0103
2.7040E+00	6.44135E-03	.0119
2.9240E+00	7.23096E-03	.0112
3.1620E+00	6.05764E-03	.0122

3.4190E+00	5.88044E-03	.0123
3.6990E+00	5.88440E-03	.0123
4.0000E+00	5.54935E-03	.0127
4.1650E+00	2.90704E-03	.0175
4.3370E+00	2.86858E-03	.0176
4.5160E+00	2.94513E-03	.0174
4.7030E+00	2.89074E-03	.0175
4.8970E+00	2.78440E-03	.0179
5.0990E+00	2.67558E-03	.0182
5.3100E+00	2.78241E-03	.0178
5.5290E+00	2.74262E-03	.0180
5.7570E+00	2.60378E-03	.0184
5.9950E+00	2.62751E-03	.0184
6.2420E+00	2.51408E-03	.0188
6.5000E+00	2.46407E-03	.0190
6.7650E+00	2.45848E-03	.0190
7.0410E+00	2.37653E-03	.0193
7.3270E+00	2.29711E-03	.0196
7.6270E+00	2.33045E-03	.0194
7.9380E+00	2.32966E-03	.0195
8.2610E+00	2.28163E-03	.0197
8.5980E+00	2.14440E-03	.0203
8.9490E+00	2.05392E-03	.0208
9.3140E+00	2.03514E-03	.0209
9.6930E+00	1.85668E-03	.0219
1.0089E+01	2.03750E-03	.0208
1.0500E+01	2.33784E-03	.0194
1.0817E+01	2.10325E-03	.0205
1.1143E+01	2.36736E-03	.0193
1.1479E+01	2.65173E-03	.0182
1.1825E+01	3.07201E-03	.0170
1.2182E+01	3.58870E-03	.0158
1.2549E+01	4.33621E-03	.0144
1.2775E+01	3.14904E-03	.0169
1.3005E+01	4.10324E-03	.0148
1.3239E+01	5.59699E-03	.0127
1.3477E+01	8.87875E-03	.0102
1.3720E+01	1.63367E-02	.0075
1.3967E+01	3.18763E-02	.0054
1.4218E+01	6.03265E-02	.0039
1.4470E+01	9.69116E-02	.0030
1.4740E+01	1.28142E-01	.0026
1.5000E+01	1.35527E-01	.0025
1.5270E+01	1.04946E-01	.0029
1.5540E+01	6.03119E-02	.0039
1.5830E+01	2.71276E-02	.0059
1.6110E+01	9.85486E-03	.0100
1.6400E+01	2.86016E-03	.0186
total	9.76302E-01	.0002

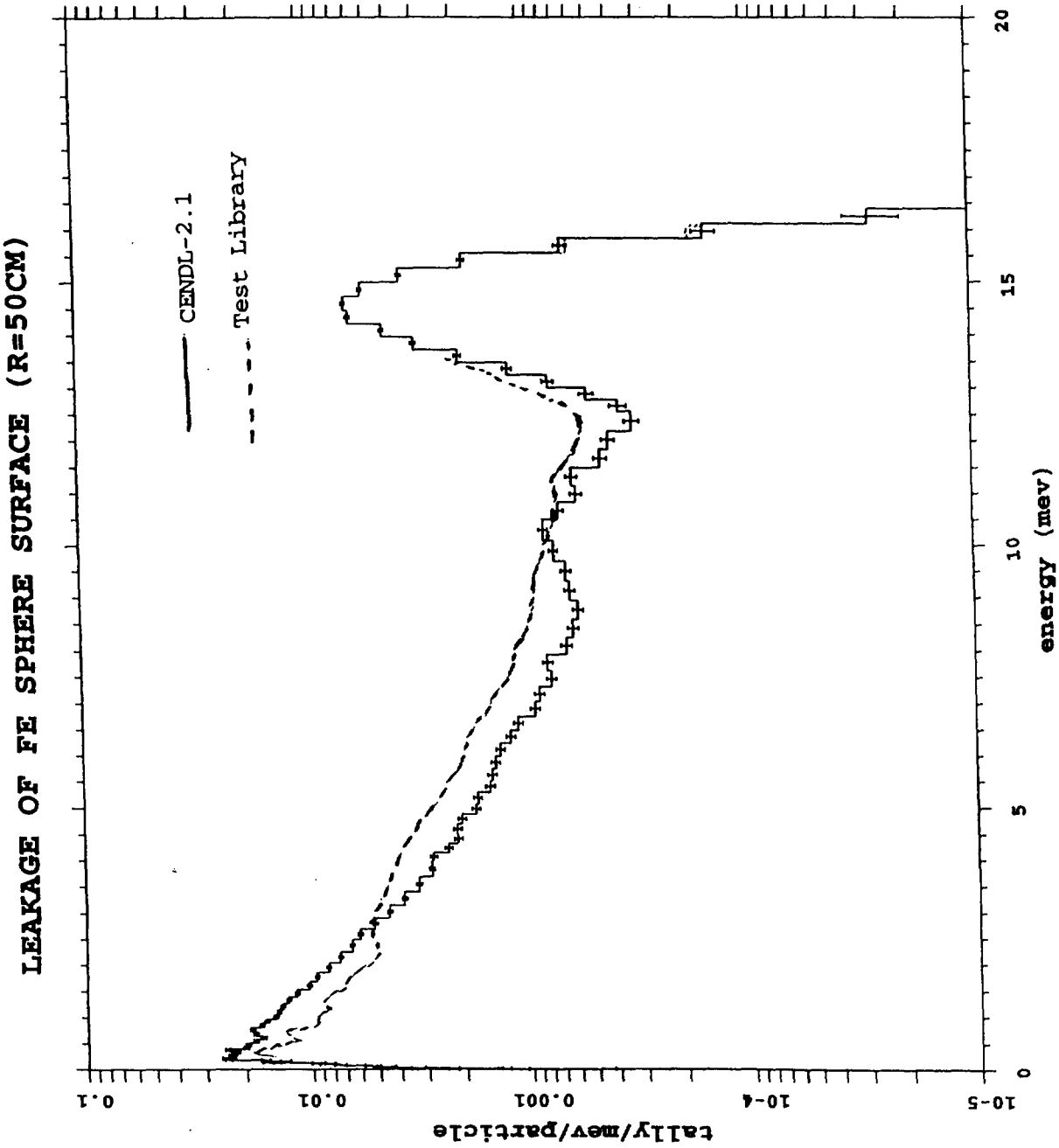
LEAKAGE OF FE SPHERE SURFACE (R=50CM)
CENDL-2.1
Test Library
tally/mev/particle
energy (mev)
0.1
0.01
0.001
10-4
10-5
0
5
10
15
20

Fig. 4.7.1

Table 4.7.1 Calculated leakage current spectrum from Iron sphere

Energy [MEV]	Flux/leth	Error
1.2900E-02	4.37744E-06	.3781
1.6700E-02	4.33150E-06	.3780
2.1500E-02	6.19112E-06	.3162
2.7800E-02	8.67032E-06	.2673
3.5900E-02	9.77896E-06	.2503
4.6400E-02	2.16934E-05	.1691
5.9900E-02	3.10122E-05	.1414
7.7400E-02	6.83793E-05	.0954
1.0000E-01	1.12644E-04	.0741
1.1200E-01	6.70939E-05	.0962
1.2600E-01	1.08087E-04	.0758
1.4100E-01	2.68934E-04	.0491
1.5900E-01	6.05394E-04	.0329
1.7800E-01	7.86592E-04	.0289
2.0000E-01	1.09354E-03	.0246
2.2400E-01	2.51555E-03	.0162
2.5200E-01	2.97690E-03	.0149
2.8300E-01	3.12780E-03	.0145
3.1700E-01	3.08299E-03	.0146
3.5600E-01	3.78152E-03	.0132
4.0000E-01	3.70168E-03	.0134
4.4900E-01	3.30422E-03	.0141
5.0400E-01	4.28758E-03	.0124
5.6600E-01	4.36024E-03	.0123
6.3500E-01	4.78573E-03	.0117
7.1300E-01	4.82080E-03	.0117
8.0000E-01	4.69495E-03	.0118
8.7800E-01	4.83819E-03	.0117
9.6400E-01	4.69315E-03	.0118
1.0580E+00	4.44793E-03	.0122
1.1620E+00	4.56941E-03	.0120
1.2750E+00	4.41918E-03	.0122
1.4000E+00	4.06918E-03	.0127
1.5420E+00	4.00193E-03	.0128
1.6980E+00	3.64639E-03	.0134
1.8710E+00	3.70146E-03	.0133
2.0610E+00	3.36127E-03	.0139
2.2700E+00	3.00747E-03	.0147
2.5000E+00	2.89020E-03	.0150
2.7040E+00	2.68105E-03	.0156
2.9240E+00	3.19037E-03	.0143
3.1620E+00	2.16943E-03	.0173
3.4190E+00	1.93252E-03	.0183
3.6990E+00	1.70445E-03	.0195
4.0000E+00	1.63657E-03	.0199
4.1650E+00	1.29388E-03	.0225
4.3370E+00	1.25222E-03	.0229
4.5160E+00	1.10009E-03	.0244
4.7030E+00	1.08892E-03	.0245
4.8970E+00	1.10685E-03	.0243
5.0990E+00	1.06384E-03	.0248
5.3100E+00	9.86227E-04	.0258
5.5290E+00	1.00278E-03	.0256
5.7570E+00	9.05430E-04	.0269

5.9950E+00	8.69419E-04	.0274
6.2420E+00	9.15902E-04	.0267
6.5000E+00	8.76590E-04	.0274
6.7650E+00	9.16596E-04	.0267
7.0410E+00	8.84718E-04	.0272
7.3270E+00	8.53457E-04	.0277
7.6270E+00	8.77801E-04	.0273
7.9380E+00	8.26214E-04	.0282
8.2610E+00	7.68626E-04	.0292
8.5980E+00	8.16137E-04	.0284
8.9490E+00	8.37287E-04	.0280
9.3140E+00	8.62152E-04	.0276
9.6930E+00	9.90219E-04	.0257
1.0090E+01	1.06738E-03	.0248
1.0500E+01	1.13498E-03	.0240
1.0820E+01	1.16798E-03	.0237
1.1140E+01	1.25801E-03	.0229
1.1480E+01	1.33489E-03	.0222
1.1830E+01	1.58683E-03	.0204
1.2180E+01	1.65451E-03	.0200
1.2550E+01	2.13667E-03	.0176
1.2770E+01	2.27943E-03	.0170
1.3000E+01	2.69043E-03	.0157
1.3240E+01	3.46276E-03	.0138
1.3480E+01	4.57865E-03	.0120
1.3720E+01	6.56091E-03	.0100
1.3970E+01	1.24308E-02	.0073
1.4220E+01	3.17529E-02	.0045
1.4470E+01	9.09129E-02	.0026
1.4740E+01	1.70391E-01	.0018
1.5000E+01	1.87297E-01	.0017
1.5270E+01	1.46411E-01	.0020
1.5550E+01	1.02815E-01	.0024
1.5830E+01	3.94813E-02	.0040
1.6110E+01	1.16593E-02	.0075
1.6400E+01	2.39728E-03	.0166
total	9.57153E-01	.0002

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