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COGValidation:SINBAD BenchmarkProblems

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Abstract

WevalidatedCOG,a3DMonteCarloradiationtra nsportcode,againstexperimental dataandMNCP4CsimulationsfromtheShieldingIntegralBenchmarkArchiveDatabase (SINBAD)compiledbyRSICC.Wemodeledthreeexperiments:theOsakaNickeland AluminiumsphereexperimentsconductedattheOKTAVIANfaci lity,andtheliquid oxygenexperimentconductedattheFNSfacility.COGresultsareingoodagreement withexperimentaldataandgenerallywithinafew%ofMCNPresults. ThereareseveralpossiblesourcesofdiscrepancybetweenMCNPandCOGresults:1)

thecross -section databaseversions are different, MCNP uses ENDFBVI1.1 while COG uses ENDFBVIR7,2) the code implementations are different, and 3) the models may differs lightly. We also limited the use of variance reduction methods when running the COG version of the problems.

Background

COGisahigh -resolutioncodefortheMonteCarlosimulationofcoupledneutron, proton, gamma-ray.andelectrontransportinarbitrarv3 -D.[1]Inthiswork.wedidnotconsider protons.COGtransportsneutronswithe nergiesintherangeof10 -5eVto150MeV. andphotonswithenergiesintherangeof10eVto100GeV.Italsotransportselectrons intherangeof10keVtoafewthousandGeVviatheEGS4electrontransportkernel.[2] COGisdesignedtoallowcalculati onsofdeeppenetration(shielding)problems, criticalityproblems, and neutron activation problems. The geometry of the problem is specifiedwithanalyticalsurfacesandpseudo -surfacesandthefinalmodelisbasedon combinatorialgeometry.Pulseheight spectrumtallyareavailableinadditiontostandard tallies.COGuseshigh -resolutionpointwisecross -sectiondatabases.Thereareseveral COGneutroncross -sectionlibrariesavailable:ENDFB6R7,theENDF/B -VIRelease7 database.ENDL -90.TheLLNLEvaluat edNuclearDataLibrary,andRED2002,ahybrid basedonacombinationoftheENDFBlibrarycross -sections(goodatlowerenergies) andENDLkinematics(goodathigherenergies).[3] -5]Finally,thedefaultgammacross sectionslibraryisEPDL97,theLLNLEva luatedPhotonDataLibrary.[6]Pleaseseethe TransportsectionoftheCOGmanualfordetailsofparticlephysicsanddatabases.[1]

Methods

COGhasbeenextensivelytestedandvalidatedin -houseovertheyears.[7,8]However, sinceCOGwillbemadeavai labletothepublicthroughRSICC,itsauthorswantedto validatethecodeagainstreadilyavailableandwell -documentedbenchmarkexperiments suchastheonesintheShieldingIntegralBenchmarkArchiveDatabase(SINBAD) compiledbyRSICC.[9]

SINBADisa compilationof41fissionandfusionshieldingexperiments,21ofwhich havebeenmodeledwithMonteCarlo(McBEND,TRIPOLI,MCNP)ordeterministic codes(ANISNandDOT3.5).

COGhasbeenvalidatedagainstthreeSINBADexperimentsmodeledwithMCNP.[10] Theproblemswerechosentotestseveralfeaturesofthecodesuchasneutronand photontransport, secondary photon production, coupling of the photon -electron transport, point detector, boundary crossing detector or surface detector, and angular flux.

Abriefdescriptionoftheseexperimentsisgivenbelow. Theyaredescribed indetails in SINBAD. We used the MCNP inputs given in the SINBAD database. All problems were runonasing leprocessor with COG version 10.19 and the ENDF/BVIR7 neutron cross section library, and with MCNP4C and an earlier release of ENDF/BVI1.1. All COG and MCNP inputs are given in the appendix.

Thefollowingplottingconventionwasadopted.COGresultsareplottedinred,MCNP resultsinblack,andthemeasurementsinblue.Fo reachcase,thefirstseriesofplot showacomparisonoftheCOGandMCNPsimulationswithstatisticaluncertainties(one standarddeviation),whilethesecondseriesofplotsshowacomparisonbetweenCOG andthemeasurements.

1.OsakaNickelsphereBe nchmarkexperiment(1983)SBE7.002 Experimentdescription

Neutronleakagespectrafroma32cmdiameternickelsphereweremeasuredbetween 30keVand15MeVbyTOFtechniques.A2.5cmdiameteraircavityisatthecenterof thesphere.Thesourcewasa 14.1MeVD -Tneutrongenerator.Thedetectorcouldsee thewholesurfaceofthesphereandwaslocated9.5mfromthespherecenter.Two seriesofmeasurementswereobtained,inthehighenergyregion[1 -15MeV]andinthe lowenergyregion[0.03 -15MeV].

Problemdescription

Wesimulatedanisotropicpointsourceof14MeVneutronslocatedinasmallspherical aircavityatthecenterofanickelsphere.Weconsideredtwoconfigurations:asimple sphericalgeometryproblem(Figure1.a),anda3Dmodelincl udinganexplicitmodelof thesphereandcollimators,andanisotropicsource(Figure1.b).Weusedthesource energyspectrum2recommendedinSINBAD.Wetalliedneutronleakagecurrent spectrum.Thesphericalgeometryproblemwasrunusingaboundary -crossingdetector inparticlecountingmode,andMCNPwasrunwithanf1tally.Forthe3Dmodel,we usedapointdetectortally.

Results

AgreementbetweenCOGandMCNPisexcellentforthe1Dmodel(Figure2),andvery goodforthe3Dmodelforenergiesab ove300keV(Figure4.a&4.b). Regardlessofthemodels,COGsimulationsaregreaterthanthemeasurementsinthe range5 -12MeV,althoughthe3Dmodelresultsareclosertothedata.(Figure3.a&5.a) SimilarlytoMCNPresults,thesimplesphericalgeome trygavethebestagreementwith theexperimentaldataaroundthe14MeVpeak(Figure3.b&5.b).







experiment. Thenickelsphereisrepresentedinyellow, concrete wallsingray, the polyethylene collimatorinpink, and airinblue. The points our ceislocated at the center of the sphere, and the point detector is behind the collimator.



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Figure2.ComparisonofCOGandMCNPneutronleakagecurrentsasafunctionof energyfortheone -dimensionalmodeloftheOSAKANickelsphereexperiment.



Figue3.a ComparisonofCOGone -dimensionalmodelwithtwoseriesof measurementsobtainedinthehighandlowenergyrange.MCNPsimulationsareshown inblack.Thisplotfocusesonthelowenergyrange.



Figure3.b ComparisonofCOGone -dimensionalmode lwithtwoseriesof measurementsobtainedinthehighandlowenergyrange.MCNPsimulationsareshown inblack.Thisplotfocusesonthehighenergyrange



Figure4.a ComparisonofCOGandMCNPneutronleakagefluxesasafunctionof energyforthe Three -dimensionalmodeloftheOSAKANickelsphereexperiment.This plothighlightsthelowenergyrange.



Figure4.b ComparisonofCOGandMCNPneutronleakagefluxesasafunctionof energyfortheThree -dimensionalmodeloftheOSAKANickelsphe reexperiment.This plothighlightsthehighenergyrange.



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Figure5.a ComparisonofCOGthree -dimensionalmodelwithtwoseriesof measurementsobtainedinthehighandlowenergyrange.MCNPsimulationsareshown inblack.Thisplotfocusesonthe lowenergyrange.



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Figure5.b aComparisonofCOGthree -dimensionalmodelwithtwoseriesof measurementsobtainedinthehighandlowenergyrange.MCNPsimulationsareshown inblack.Thisplotfocusesonthelowenergyrange.

2.OsakaAluminium Sphere(1988)SBE7.003

Experimentdescription

Leakageneutronandgammaspectrafroma39.9cmdiameteraluminiumspherewere measured.Thesphereconsistsina20cmdiametercentralcavity,surroundedbya19.5 cmshellofaluminiumpowdersandwichedb etween2mmthicksteelwalls.Thesource wasa14.1MeVD -Tneutrongenerator.

Problemdescription

Theexperimentwasmodeledwithasimplesphericalgeometry(Figure6).Wesimulated twoisotropicpointsources, aneutronsourceandaphotonsource, loca tedinaspherical aircavityatthecenterofanaluminiumsphere.Thephotonsourcerepresentsthe gamma-raysproducedbyinteractionsofsourceneutronswiththetargetmaterials.The aluminiumlayerissandwichedbetweentwothinsteelwalls.Theneutr onandphoton sourceproblemswererunindependently.Electrontransportwasenabledforboth problemsandPEGSlibraryfileswerecreated.Weusedthesourcespectrumgivenin theMCNPinputcorrectedforanexponenterroraround0.5MeV.Wetalliedthene utron leakagecurrentandphotonfluenceexitingthesphere.Theneutrondetectorwasa boundary-crossingdetectorinparticlecountingmode, and thephotondetectorwasa boundary-crossingdetector.

Results

 $\label{eq:spectral} For energy greater than 3 MeV, neutron spectrasi mulated with COG and MCNP match nicely, while below 3 MeV, COG results are consistently lower than MCNP. (Figure 7) COG and MCNP photon spectra are ingood agreement, except for photons with energy between 0.4 - 0.9 MeV in the photon sourcesimulation (Figure 9). COG results for neutrons and photons are ingood agreement with the measurements (Figures 8&9). The main photon contribution is due to the (n,n'), (n,2n), reactions rather than the (n, xgamma) reactions.$



Figure6 .TheCOGmodeloftheOSAKA aluminiumsphereexperimentusesaspherical geometry.Aluminiumisshowningray,the2mmsteelwallsinblack,andairinblue.



Figure7. COGandMCNPneutronleakagespectrafortheOsakaaluminiumsphere experiment.



Figure8 .Comparis onofCOGneutronleakagecurrentwithmeasurements.MCNP simulationsareshowninblack.



Figure9. Comparisonofsimulatedandmeasuredphotonfluxasafunctionofenergyfor theOsakaaluminiumsphereexperiment. ThetopplotshowsCOGandMCNP simulationsfortwocontributingsources;a)photonsproducedbyneutroninteractionsin thespherematerialsandb)photonsgeneratedinthetargetitself. Forcomparisonto measurements, the two photons contributions shown in the topplot were added. The bottom plotshowsCOG results and measurements. MCNP simulations are shown in black.

3.FNSliquidoxygen(1989)SBE3.006

Experimentdescription

Angularneutronspectraleakingfroma20cmslabofliquidoxygenweremeasuredat fiveanglesrangingfr om0to66.8degreeswithrespecttothebeamaxis.Theslab assemblywaslocated20cmfromthe14MeVD -Tneutrongenerator,andthedetectors werelocatedatabout7mfromtheexitfaceoftheslab.Themeasuredenergyrange variedbetween0.05and15M eV.

Problemdescription

TheCOGmodelisshowninFigure10.Thesteelcanisterfilledwithliquidoxygenwas modeledindetailincludingthealuminiumfoilsinsertedtolimitthermalradiation.An isotropicpointsourceofneutronwasplacedononesideo fthecanister,andtheangular fluxspectraweretalliedwithpointdetectorsat0.,12.2,24.9,41.8,and66.8degreeson theotherside.WeusedamodifiedversionoftheMCNPsourcespectrumgivenin SINBAD,withsmoothedvaluesintwoenergybins,[1.5 3-1.74]and[9.39 -10]MeV. NotethattheMCNPinputhadtobemodifiedtorunwithMCNP4C.

Wedevelopedasimplerversionoftheproblem, in which the five point detectors are not collimated and are placed invoid.

Results

Forthecollimatedcase,COGand MCNPresultsaresimilarat0and12degrees.For largerangles,COGresultsarelowerthanMCNP's,andthedifferencebetweenthese twocodesincreaseswithangleasshowninFigure11and12.Whentheproblemisrun withoutdetectorcollimation,COGand MCNPareingoodagreement(Figure13).The discrepancyobservedinFigure11ad12couldbeduetomodelingdifferences.In particular,COGhandlesrotationinasimplerwaythanMCNP.Whenplotted,theMCNP modelshowedthatthecollimationlineswereno tcenteredonthesamepointonthe beamaxis.



Figure 10. COG model: topview of the liquidoxy genslabex periment. The beam axis is a ligned with the z - axis in the figure. An isotropic point source is in the region filled with air (light blue color) . A luminium is shown in pink, liquidoxy genindark blue, and steelin gray. Collimation is simulated with a pure absorbers hown here in black, while white regions represent vacuum. The point detectors are 7 m from the exit window of the canister.



Figure11.COGandMCNPneutronangularfluxasafunctionofenergyfordetector1 anddetector5.Detectorsarecollimated;detector1isonthebeamaxis(0.0degree), anddetector5isatanangleof66.8degreeswithrespecttothebeam.



Figre12.COGandMCNPneutronangularfluenceasafunctionofenergyforfive pointdetectorsplacedinthevacuumregion.Collimatorsareplacedbetweentheexit faceoftheliquidoxygenslabsandthedetectors.



Figure13.COGandMCNPneutronfl uenceasafunctionofenergyforfivepoint detectorsplacedinthevacuumregion.Thereisnocollimation,thepureabsorbershown infigure10isreplacedbyvacuum.

4.Others



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Figure14 .COGandMCNPneutronleakagecurrentandphotonfluenceforapureiron sphere.



Figure15 .COG and MCNP neutron leakage current and photon fluence for a pure nickels phere.



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Figre16 .COGandMCNPneutronleakagecurrentandphotonfluenceforapure aluminiumsphere.

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APPENDIX

1. OsakaNickelsphereBenchmarkexperiment(1983)SBE7.002

OktavianNisphereR=16cm,Sphericalmodel,ENDF/B -VI,Source -2/Isotropic \$COGinputBasedonsimplifiedMCNP/4BinputbyA.TRKOV,IJS,ANDREJ.TRKOV@IJS.SI

neutron SURFACES 1SPHERE2.50 2SPHERE10.00 3SPHERE16.00 \$addsphere4 4SPHERE17.00 GEOMETRY

BASIC

sector1sec1 -1 sector2sec21 -2 sector3sec32 -3 sector4sec4+3 -4 BOUNDARYVACUUM+4

\$Pictures picturecsmaterialcolor -400 -40 -4004040040

MIX

 NILX

 \$Nickelwithimpurities(expressedasweightpercent).

 NLIB=ENDFB6R7

 mat1280580.67144280600.26554280610.0116

 9

 280620.03775280640.00988

 140000.0016250550.0015260560.0004

 120000.0001290637e

 -05290653e

 rot140.792

ASSIGN-MD\$sector#material#density 120.0012218.85318.854 00

ASSIGN-MC

1yellow \$NickelSphere 2sky \$air

SOURCE npart=3000000		
INCREMENT1.F	P=1E=1	
DEFINEPOSITIO	DN=1	
POINTO.0.0.		
DEFINEENERG	Y=1NEUTRON	
BIN		
1.1200E -016.55	41E-06 1.2600E-01	4 50005 04
6.5541E-04	1.4100E-012.2939E -03	1.5900E-01
2.6216E-03	1.7800E-013.9928E -03	2.0000E-01
1.0296E-02	2.2400E-011.1968E -02	2.5200E-01
1.1850E-02	2.8300E-011.0906E -02	3.1700E-01
1.4629E-02	3.5600E-011.4091E -02	4.0000E-01
1.2735E-02	4.4900E-011.6339E -02	5.0400E-01
1.6221E-02	5.6600E-011.7565E -02	6.3500E-01
1.6536E-02	7.1300E-011.6936E -02	8.0000E-01
1.7598E-02	8.7800E-011.6490E -02	9.6400E-01
1.5481E-02	1.0580E+001.5717E -02	1.1620E+00
1.4557E-02	1.2750E+001.3338E -02	1.4000E+00
1.3095E-02	1.5420E+001.1253E -02	1.6980E+00
1.1312E-02	1.8710E+001.0349E -02	2.0610E+00
8.8415E-03	2.2700E+008.0550E -03	2.5000E+00
8.3761E-03	2.7040E+001.0585E -02	2.9240E+00
6.3286E-03	3.1620E+005.6850E -03	3.4190E+00
5.0775E-03	3.6990E+004.6849E -03	4.0000E+00
4.4279E-03	4.1650E+004.2779E -03	4.3370E+00
3.6906E-03	4.5160E+003.6801E -03	4.7030E+00

3.6637E-03	4.8970E+003.6336E -03	5.0990E+00
3.3079E-03	5.3100E+003.5877E -03	5.5290E+00
3.0103E-03	5.7570E+002.9408E -03	5.9950E+00
3.0824E-03	6.2420E+003.1080E -03	6.5000E+00
3.2377E-03	6.7650E+003. 0522E-03	7.0410E+00
2.9520E-03	7.3270E+003.2109E -03	7.6270E+00
2.8320E-03	7.9380E+002.6518E -03	8.2610E+00
3.1650E-03	8.5980E+003.1211E -03	8.9490E+00
2.9828E-03	9.3140E+003.6074E -03	9.6930E+00
3.7018E-03	1.0089E+013.8754E -03	1.0500E+01
4.5793E-03	1.0817E+015.0132E -03	1.1143E+01
5.2859E-03	1.1479E+016.1353E -03	1.1825E+01
6.8621E-03	1.2182E+018.4810E -03	1.2549E+01
9.8180E-03	1.2775E+011.1627E -02	1.3005E+01
1.4255E-02	1.3239E+011.9066E -02	1.3477E+01
2.7396E-02	1.3720E+015.0001E -02	1.3967E+01
1.3141E-01	1.4218E+013.9515E -01	1.4474E+01
7.1112E-01	1.4735E+018.2254E -01	1.5000E+01
6.3109E-01	1.5270E+014.3880E -01	1.5545E+01
1.7250E-01	1.5825E+015.0801E -02	1.6110E+01
1.0493E-02	1.6399E+01	

DETECTOR

\$LeakageNeutronSpectrumonsurfaceofsphere3 n umber=bc1 Boundarycounts343217. BINENERGY=neutron 6.000E -057.740E -051.000E -041.290E -041.670E -042.150E -04 2.780E -043.590E -044.640E -045.990E -047.740E -041.000E -03 1.290E -031.670E -032.150E -032.780E -033.590E -034.640E -03 -037.740E -031.000E -021.290E -021.670E -022.150E -02 5.990E 2.445E -022.780E -023.159E -023.590E -024.081E -024.640E -02 -025.990E -026.809E -027.740E -028.798E -021.000E -01 5.272E 1.120E -011.260E -011.410E -011. 590E-011.780E -012.000E -01 -012.520E -012.830E -013.170E -013.560E -014.000E -01 2.240E 4.490E -015.040E -015.660E -016.350E -017.130E -018.000E -01 -019.640E -011.058E+001.162E+001.275E+001.400E+00 8.780E 1.542E+001.698E +001.871E+002.061E+002.270E+002.500E+00 2.704E+002.924E+003.162E+003.419E+003.699E+00 4.000E+004.165E+004.337E+004.516E+004.703E+004.897E+00 5.099E+005.310E+005.529E+005.757E+005.995E+006.242E+00 6.500E+00 6.765E+007.041E+007.327E+007.627E+007.938E+00 8.261E+008.598E+008.949E+009.314E+009.693E+001.009E+01 1.050E+011.082E+011.114E+011.148E+011.183E+011.218E+01 1.255E+011.277E+011.300E+011.324E+011.348E+011.372E+01 1.397E+011.422E+011.447E+011.474E+011.500E+011.527E+01 1.555E+011.583E+011.611E+011.640E+01

END

OktavianNisphereR=16cm,Sphericalmodel,ENDF/B -VI,Source -2/Isotropic CSimplifiedMCNP/4BinputbyA.Trkov,IJS,andrej.trkov@ijs si -0.0012 -1imp:n=1 12 -8.851 -2imp:n=1 21 31 -8.852 -3imp:n=1.4 403imp:n=0 1so2.50 2so10.00 3so16.00 moden sdeferg=d1pos=000 CSourcespectrum -2(fromsampleMCNPinput) SI1H 1.1200E -011.2600E -011.4100E -011.5900E -011.7800E -01 2.0000E -012.2400E -012.5200E -012.8300E -013.1700E -01 -014.0000E -014.4900E -015.0400E -015.6600E -01 -017.1300E -018.0000 E-018.7800E -019.6400E -01 3.5600E 6.3500E 1.0580E+001.1620E+001.2750E+001.4000E+001.5420E+00 1.6980E+001.8710E+002.0610E+002.2700E+002.5000E+00 2.7040E+002.9240E+003.1620E+003.4190E+003.6990E+00 4.0000E+004.1650E+004.3370E+004.5 160E+004.7030E+00 4.8970E+005.0990E+005.3100E+005.5290E+005.7570E+00 5.9950E+006.2420E+006.5000E+006.7650E+007.0410E+00 7.3270E+007.6270E+007.9380E+008.2610E+008.5980E+00 8.9490E+009.3140E+009.6930E+001.0089E+01 1.0500E+01 1.0817E+011.1143E+011.1479E+011.1825E+011.2182E+01 1.2549E+011.2775E+011.3005E+011.3239E+011.3477E+01 1.3720E+011.3967E+011.4218E+011.4474E+011.4735E+01 1.5000E+011.5270E+011.5545E+011.5825E+011.6110E+ 01 1.6399E+01 SP1 0.0000E+009.1757E -089.8311E -064.1291E -054.9811E -05 -052.4712E -043.3510E -043.6734E -043.7080E -04 8.7841E -046.2002E -046.2400E -048.9866E -041.0057E -03 5.7052E 1.2120E -031.2898E -031.4734E -031.372 6E-031.4181E -03 1.4552E -031.6345E -031.6449E -031.6672E -031.8595E -03 -031.9570E -031.9663E -031.8479E -031.8526E -03 1.7555F -032.3287E -031.5062E -031.4611E -031.4217E -03 1.7087E -037.3061E -047.3579E -046.6062E -046. 8818E-04 1.4101E 7.1076E -047.3399E -046.9796E -047.8571E -046.8635E -04 -047.6135E -048.0185E -048.5800E -048.4242E -04 6.9992E 8.4426E -049.6325E -048.8076E -048.5653E -041.0666E -03 -031.0887E -031.3672E -031.4659E -031.5928E -03 1.0955E 1.4517E -031.6343E -031.7761E -032.1228E -032.4498E -03 -032.2189E -032.6742E -033.3357E -034.5377E -03 3.1125E 6.6573E -031.2350E -023.2984E -021.0116E -011.8560E -01 -011.7040E -011.2067E -014.8301E -021.4478E -02 2.1797E 3.0325E-03 CNickelwithimpurities(expressedasweightpercent). M128058.60C -0.6714428060.60C -0.2655428061.60C -0.01169 28062.60C -0.0377528064.60C -0.00988 14000.60C -0.001625055.60C -0.001526056.60C -0.0004 00.60C -0.000129063.60C -0.0000729065.60C -0.00003 120 M28016.60C0.208 7014.60C0.792 fc1LeakageNeutronSpectrumontheSphereSurface f1:n3 e16.000E -057.740E -051.000E -041.290E -041.670E -042.150E -04 -043.590E -044 .640E-045.990E -047.740E -041.000E -03 2.780E -031.670E -032.150E -032.780E -033.590E -034.640E -03 1.290E 5.990E -037.740E -031.000E -021.290E -021.670E -022.150E -02 -022.780E -023.159E -023.590E -024.081E -024.640E -02 -025.990E -026.809E -027.740E -028.798E -021.000E -01 2.445E 5.272F -011.260E -011.410E -011.590E -011.780E -012.000E -01 1.120E 2.240E -012.520E -012.830E -013.170E -013.560E -014.000E -01 -015.040E -015.660E -016.350E -017.130E -018.000E -01 4.490E 8.780E -019.640E -011.058E+001.162E+001.275E+001.400E+00

1.542E+001.698E+001.871E+002.061E+002.270E+002.500E+00 2.704E+002.924E+003.162E+003.419E+003.699E+00 4.000E+004.165E+004.337E+004.516E+004.703E+004.897E+00 5.099E+005.310E+005.529E+005.757E+005.995E+006.242E+00 6.500E+006.765E+007.041E+007.327E+007.627E+007.938E+00 8.261E+008.598E+008.949E+009.314E+009.693E+001.009E+01 1.050E+011.082E+011.114E+011.148E+011.183E+01 1.21 1.218E+01 1.255E+011.277E+011.300E+011.324E+011.348E+011.372E+01 1.397E+011.422E+011.447E+011.474E+011.500E+011.527E+01 1.555E+011.583E+011.611E+011.640E+01T nps3000000 . cdeactivateenergycutoff,printoutandcp -time limits ccut:n01.0e -2 cctme300 print

OktavianNisphereR=16cm,3Dmodel,ENDF/B -VI,Source -2/isotropic \$COGinputbasedon3 -dimensionalMCNP/4BinputbyA.TRKOV,IJS,ANDREJ.TRKOV@IJS.SI BASIC neutron \$ 1SPHERE0.4 2SPHERE16.0 3CYLY0.4 4PLANEY0 5SPHERE1200.0 6CONE -1465.16916.0 -1465.169 -581.489TR0.1515.4890.0.1516.4890. 7PLANEY310.0 8PLANEY500.0 9PLANEY800.0 10PLANEY890.0 11PLANEY980.0 12CYLY10.0 13CYLY40.0 GEOMETRY sector1sec1 -1 sector2sec21 -2 -3 -4 \$Spheremainbody sector3sec3 -2+1+3 OR -2+1+4 \$Sourcecalculation(withoutthesphere) -0.0012 -2#1#2 \$32 \$Fromspheretothefirstcollimator sector4sec42 -7-5 \$Firstcollimatorbody sector5sec567 -8 -5 \$Firstcollimator gap sector6sec6 -67 -8 \$Spacebetweencollimators sector7sec78 -9-5 \$Maincollimatorbody sector8 sec869 -10 -5 \$Maincollimatorgap sector9sec9 -69 -10 \$Boratedparafin sector10sec1010 -1112 -13 \$Detectorregi on sector11sec1110 -5+11 OR10 -5 -12 OR10 -5+13 FILL2 \$Outervoid BOUNDARYVACUUM+5 \$GeometryPictureviews picturecssector0.1000 -40.01000500 -4050 -150. -540.150 -5401501000.0 picturecsmaterialcolor picturecsmateria lcolor0. -50150.0 -50 -15001000 -150 picturecsmaterialcolor -400 -40 -4004040040 picturecsmaterialcolor0 -40400 -40 -40040 -40 MIX NLIB=ENDFB6R7 \$Nickelwithimpurities(expressedasweightpercent) mat1280580.67144280600.26554280610.01169 280620.03775280640.00988 140000.0016250550.001526056 0.0004 -05290653.e -05 120000.0001290637.e \$Materialnumberinatom% \$Air mat2#180160.208 70140.792 \$Boratedparrafin mat3#160000.29 10010.58

50100.026 50110.104 \$Ironcollimator(pureFe -56) mat4#1260561 ASSIGN -MD\$sector#material#density 120.0012220.0012318.85420.0012 547.8826620.0 012720.0012847.8826 920.001210311120.00121200 ASSIGN -MC 1yellow \$NickelSphere \$air 2sky 3lavender\$bo ratedparaffin \$iron 4gray Oorange \$void SOURCE npart=3000000 INCREMENT1.P=1E=1 DEFINEPOSITION=1 POINT0.0.0. DEFINEENERGY=1NEUTRON BIN 1.1200E -016.5541E -06 1.2600E-01 6.5541E -04 1.4100E-012.2939E -03 1.5900E-01 2.6216E -03 1.7800E-013.9928E -03 2.0000E-01 1.0296E -02 2.2400E-011.1968E -02 2.5200E-01 1.1850E -02 2.8300E-011.0906E -02 3.1700E-01 1.4629E -02 3.5600E-011.4091E -02 4.0000E-01 1.2735E -02 4.4900E-011.6339E -02 5.0400E-01 1.6221E -02 5.6600E-011.7565E -02 6.3500E-01 1.6536E -02 7.1300E-011.6936E -02 8.0000E-01 1.7598E -02 8.7800E-011.649 0E-02 9.6400E-01 1.5481E -02 1.0580E+001.5717E -02 1.1620E+00 1.4557E -02 1.2750E+001.3338E -02 1.4000E+00 1.3095E -02 1.5420E+001.1253E -02 1.6980E+00 1.1312E -02 1.8710E+001.0349E -02 2.0610E+00 8.8415E -03 2.2700E+008.0550E -03 2.5000E+00 8.3761E-03 2.7040E+001.0585E -02 2.9240E+00 6.3286E -03 3.1620E+005.6850E -03 3.4190E+00 3.6990E+004.6849E -03 4.0000E+00 5.0775E -03 4.4279E -03 4.1650E+004.2779E -03 4.3370E+00 3.6906E -03 4.5160E+003.6801E -03 4.7030E+00 3.6637E -03 4.8970E+003.6336E -03 5.0990E+00 3.3079E -03 5.3100E+003.5877E -03 5.5290E+00 3.0103E -03 5.7570E+002.9408E -03 5.9950E+00 3.0824E -03 6.2420E+003.1080E -03 6.5000E+00 3.2377E -03 6.7650E+003.0522E -03 7.0410E+00 2.9520E -03 7.3270E+003.2109E -03 7.6270E+00 2.8320E -03 7.9380E+002.6518E -03 8.2610E+00 3.1650E -03 8.5980E+003.1211E -03 8.9490E+00 2.9828E -03 9.3140E+003.6074E -03 9.6930E+00 3.7018E -03 1.0089E+013.8754E -03 1.0500E+01 4.5793E -03 1.0817E+015.0132E -03 1.1143E+01 5.2859E -03 1.1479E+016.1353E -03 1.1825E+01 6.8621E -03 1.2182E+018.4810E -03 1.2549E+01 9.8180E -03 1.2775E+011.1627E -02 1.3005E+01 1.4255E -02 1.3239E+011.9066E -02 1.3477E+01 2.7396E -02 1.3720E+01 5.0001E-02 1.3967E+01 1.3141E -01 1.4218E+013.9515E -01 1.4474E+01 7.1112E -01 1.4735E+018.2254E -01 1.5000E+01 6.3109E -01 1.5270E+014.3880E -01 1.5545E+01 1.7250E -01 1.5825E+015.0801E -02 1.6110E+01 1.0493E -02 1.6399E+01

DETECTOR

\$LeakageNeutronSpectrumatpointdetector number=pt1 Point0.934.0. BINENERGY=neut ron 6.000E -057.740E -051.000E -041.290E -041.670E -042.150E -04 2.780E -043.590E -044.640E -045.990E -047.740E -041.000E -03 1.290E -031.670E -032.150E -032.780E -033.590E -034.640E -03 -037.740E -031.000E -021.290E -021.670E -022.150E -02 5.990E 2.445E -022.780E -023.159E -023.590E -024.081E -024.640E -02 -025.990E -026.809E -027.740E -028.798E -021.000E -01 5.272E -011.260E -011.410E -011.590E -011.780E -012.000E -01 1.120E 2.240E -012.520E -012.830E -013.170E -013.560E -014.000E -01 -015.040E -015.660E -016.350E -017.130E -018.000E -01 4.490E -019.640E -011.058E+001.162E+001.275E+001.400E+00 8.780E 1.542E+0 01.698E+001.871E+002.061E+002.270E+002.500E+00 2.704E+002.924E+003.162E+003.419E+003.699E+00 4.000E+004.165E+004.337E+004.516E+004.703E+004.897E+00 5.099E+005.310E+005.529E+005.757E+005.995E+0 06.242E+00 6.500E+006.765E+007.041E+007.327E+007.627E+007.938E+00 8.261E+008.598E+008.949E+009.314E+009.693E+001.009E+01 1.050E+011.082E+011.114E+011.148E+011.183E+011.218E+01 1.255E +011.277E+011.300E+011.324E+011.348E+011.372E+01 1.397E+011.422E+011.447E+011.474E+011.500E+011.527E+01 1.555E+011.583E+011.611E+011.640E+01

END

OktavianNisphereR=16cm,3Dmodel,ENDF/B -VI,Source -2/Anisotropic C3 -dimensionalMCNP/4BinputbyA.Trkov,IJS,andrej.trkov@ijs.si **CCentralspherecavityandbeamduct** -0.0012 -1 12 22 -0.00121 -2 -3 -4 CSpheremainbody 31 -8.85 -2#1#2 CSourcecalculation(withoutthesphere) -0.0012 -2#1#2 c32 CFromspheretothefirstcollimator 42 . -0.00122 -7 -5 CFirstcollimatorbody 540.0848767 -8 -5 CFirstcollimatorgap 62 -0.0012 -67 -8 CSpacebetweencollimators -0.00128 72 -9 -5 CMaincollimatorbody 840.0848769 -10 -5 CMaincollimatorgap -0.0012 -69 92 -10 CBoratedparafin 103 -1.10 -11 12 -13 CDetectorregion -0.001210 -5#10 112 COutervoid 1205 1SO0.4 2SO16.0 3CY0.4 4PY0 5SO1200.0 6Y50.3216.0934.6.35 7PY310.0 8PY5 00.0 9PY800.0 10PY890.0 11PY980.0 12CY10.0 13CY40.0 CMaterials: CNickelwithimpurities(expressedasweightpercent) -0.6714428060.60C -0.2655428061.60C -0.01169 M128058.60C 28062.60C -0.0377528064.60C -0.00988 14000.60C -0.001625055.60C -0.001526056.60C -0.0004 -0.000129063.60C -0.0000729065.60C -0.00003 12000.60C CAir M28016.60C0.208 7014.60C0.792 cBoratedparrafin M36000.60c0.29 1001.60c0.58 5010.60c0.026 5011.60c0.104 CIroncollimator(pureFe -56) M426056.60C1. MODEN C****Sourcedefinition SDEFPOS=0.0.0.ERG=D1 ClsotropicSourcespectrum -2 SI1H 1.1200E -011.2600E -011.4100E -011.5900E -011.7800E -01 -012.2400E -012.5200E -012.8300E -013.1700E -01 -014.0000E -014.4900E -015.0400E -015.6600E -01 2.0000E 3.5600E -017.1300E -018.0000E -018.7800E -019.6400E -01 6.3500E 1.0580E+001.1620E+001.2750E+001.4000E +001.5420E+00 1.6980E+001.8710E+002.0610E+002.2700E+002.5000E+00 2.7040E+002.9240E+003.1620E+003.4190E+003.6990E+00

4.0000E+004.1650E+004.3370E+004.5160E+004.7030E+00 4.8970E+005.0990E+005.3100E+005.5290E+005.75 70E+00 5.9950E+006.2420E+006.5000E+006.7650E+007.0410E+00 7.3270E+007.6270E+007.9380E+008.2610E+008.5980E+00 8.9490E+009.3140E+009.6930E+001.0089E+011.0500E+01 1.0817E+011.1143E+011.1479E+011.1825E+011.2182E+01 1.2549E+011.2775E+011.3005E+011.3239E+011.3477E+01 1.3720E+011.3967E+011.4218E+011.4474E+011.4735E+01 1.5000E+011.5270E+011.5545E+011.5825E+011.6110E+01 1.6399E+01 SP1 0.0000E+009.1757E -089.8311E -064.1291E -054.9811E -05 8.7841E -052.4712E -043.3510E -043.6734E -043.7080E -04 -046.2002E -046.2400E -048.9866E -041.0057E -03 -031.2898E -031.4734E -031.3726E -031.4181E -03 5 7052E 1.2120E -031.6345E -031.6449E -031.6672E -031.8595 E-03 1.4552F -031.9570E -031.9663E -031.8479E -031.8526E -03 1.7555E -032.3287E -031.5062E -031.4611E -031.4217E -03 -037.3061E -047.3579E -046.6062E -046.8818E -04 1.7087E 1.4101E 7.1076E -047.3399E -046.9796E -047.8571E -046.8635E -04 6.9992E -047.6135E -048.0185E -048.5800E -048.4242E -04 8.4426E -049.6325E -048.8076E -048.5653E -041.0666E -03 -031.0887E -031.3672E -031.4659E -031.5928E -03 1.0955E 1.4517E -031.6343E -031.7761E -032.1228E -032.4498E -03 3.11 25E-032.2189E -032.6742E -033.3357E -034.5377E -03 -031.2350E -023.2984E -021.0116E -011.8560E -01 6.6573E -011.7040E -011.2067E -014.8301E -021.4478E -02 2.1797E 3.0325E -03 IMP:N111111111110 ALLY********** C******FLUXT FC5FLUXATAPOINTDETECTOR934CMFROMTHESPHERECENTRE F5:N093405 E56.000E -057.740E -051.000E -041.290E -041.670E -042.150E -04 -043.590E -044.640E -045.990E -047.740E -041.000E -03 2.780E -031.670E -032.150E -032.780E -033.590E -034.640E -03 1.290E 5.990E -037.740E -031.000E -021.290E -021.670E -022.150E -02 -022.780E -023.159E -023.590E -024.081E -024.640E -02 2.445E -025.990E -026.809E -027.740E -028.798E -021.000E -01 5.272E -011.260E -011.410E -011.590E -011.780E -012.000E -01 1.120E -012.520E -012.830E -013.170E -013.560E -014.000E -01 2.240E -015.040E -015.660E -016.350E -017.130E -018.000E -01 4.490E -019.640E -011.058E+001.162E+001.275E+001.400E+00 8.780F 1.542E+001.698E+001.871E+002.061E+002.270E+002.500E+00 2.704E+002.924E+003.162E+003.419E+003.699E+00 4.000E+004.165E+004.337E+004.516E+004.703E+004.897E+00 5.099E+005.310E+005.529E+005.757E+005.995E+006.242E+00 6.500E+006.765E+007.041E+007.327E+007.627E+007.938E+00 8.261E+008.598E+008.949E+009.314E+009.693E+001.009E+01 1.050E+011.082E+011.114E+011.148E+011.183E+011.218E+01 1.255E+011.277E+011.300E+011.324E+011.348E+ 011.372E+01 1.397E+011.422E+011.447E+011.474E+011.500E+011.527E+01 1.555E+011.583E+011.611E+011.640E+01T C******CUTOFFCARD****** CCUT:N1.00E161.00E -2 -0.5 -0.25 C******NEUTRONHISTORY****** NPS 3000000 CPRDMPJ -20111 CCTME2000 PRINT

2. OsakaAluminiumSphere(1988)SBE7.003

LEAKAGEFROMALUMINIUM(40CMDIA)SPHERE3 -DSURFACETALLY(ENDF/B -VI) \$COGinput/neutronsource BASIC \$trackneutrons,photonsandelectrons \$Length[cm] ;Energy[MeV];Time[sec] neutron photon electron cm MeV sec dnearON\$activate"dnear"option SURFACES 3SPHERE10.0 4SPHERE10.2 5SPHERE19.75 6SPHERE19.95 7SPHERE580.0 8SPHERE581.0 GEOMETRY sector1sec1 -3 sector2sec2 -43 sector3sec3 -54 sector4sec4 -65 sector5sec5 -76 sector6sec6 -87 Boundaryvacuum+8 MIX NLIB=ENDFB6R7 \$Aluminium(0.2%Fe -56,ignoreSi,Cu) mat1w -p1.223130270.998 260560.002 \$Steel(Cr18.5%,Fe -5670.4%,N i11.1%) mat2w -p7.824240000.185 260560.704 280000.111 \$Air mat3w -p0.001280160.2307 70140.7693 ASSIGN-M 132231425360 ASSIGN-MC 1yellow \$AluminiumSphere 2sky \$air \$steel 3gray Oorange \$void EGS pegslib=egsAl.dat \$electrontransportenabledinthefollowingsectors: esectors=234 ECut=0.3\$killelectrontranportforE<0.3MeV WALK -ENERGY photonregion2to40.299 SOURCE npart=5000000 increment1. p=1e=1a=1

defineposition=1point0.0.0. defineangle=1isotropic defineenergy=1neutron bin1.00e -010.0000e+001.12e -01 0.0000e+001.26e -018.4667e -031.41e -01 3.2078e-031.59e -011.3347e -021.78e -01 1.2373e-022.00e -018.6500e -032.24e -01 1.5593e-022.52e -011.2494e -022.83e -01 1.3988e-023.17e -011.5797e -023.56e -01 1.5289e-024.00e -011.3567e -024.49e -01 1.5602e-025.04e -011.7710e -025.66e -01 1.7159e-026.35e -011.8103e -027.13e -01 1.8575e-028.00e -011.9821e -028.78e -01 1.8093e-029 .64e-011.7351e -021.058e+00 1.7029e-021.162e+001.5965e -021.275e+00 1.4584e-021.40e+001.3317e -021.542e+00 1.2404e-021.698e+001.1572e -021.871e+00 1.0800e-022.061e+009.5885e -032.27e+00 8.9913e-032.500e+001.0250e -022.704e+00 1.5245e-022.924e+0 06.2689e -033.162e+00 5.1440e-033.419e+005.1821e -033.699e+00 4.6545e-034.000e+004.3103e -034.165e+00 3.7343e-034.337e+003.6391e -034.516e+00 3.3128e-034.703e+003.3134e -034.897e+00 3.0738e-035.099e+002.7431e -035.310e+00 2.3868e-035.529e+002. 3026e-035.757e+00 2.2924e-035.995e+002.0672e -036.242e+00 2.2438e-036.50e+002.0343e -036.765e+00 1.8109e-037.041e+001.6829e -037.327e+00 1.7667e-037.627e+001.8508e -037.938e+00 1.6192e-038.261e+001.6006e -038.598e+00 1.7823e-038.949e+001.9307e -039.314e+00 2.0393e-039.693e+002.0028e -031.009e+01 2.1120e-031.050e+012.5331e -031.082e+01 2.7884e-031.114e+013.0059e -031.148e+01 3.6600e-031.183e+014.8200e -031.218e+01 6.1784e-031.255e+018.2955e -031.277e+01 1.0778e-021.300e+011.5808e -02 1.324e+01 2.9208e-021.348e+016.5208e -021.372e+01 1.4536e-011.397e+012.9968e -011.422e+01 5.1160e-011.447e+016.5481e -011.474e+01 7.3692e-011.500e+015.5556e -011.527e+01 3.2133e-011.554e+011.3621e -011.583e+01 5.1071e-021.611e+011.4721e -021.64 e+01 \$***TALLYCARDS*** Detector number=bcd1 boundarycounts564227327.1 BinEnergy=neutron 0.0971220.101090.105210.1095 0.113970.118620.123470.1285 0.133750.139210.144890.1508 0.156960.163360.170030.17697 0.184190.1 91710.199530.20767 0.216150.224970.234150.24371 0.253650.2640.274780.28599 0.297660.309810.322450.33561 0.349310.363570.37840.39385 0.409920.426650.444060.46218 0.481050.500680.521110.54238 0.564510.587550.611530.63648 0.662460.689 50.717630.74692 0.77740.809130.842150.87652 0.912290.949520.988271.0286 1.07061.11431.15981.2071 1.25631.30761.3611.41651.4743 1.53451.59711.66231.7301 1.80081.87421.95072.0303 2.11322.19942.28922.3826

2.47992.58112.68642.796 2.91013.02893.15253.2812 3.41513.55453.69953.8505 4.00764.17124.34144.5186 4.7034.89495.09475.3026 5.5195.74435.97876.2227 6.47666.7417.01617.3024 7.60047.91068.23348.5694 8.91929.28329.66210.056 10.46710.89411.33911.801 12.28312. 78413.30613.849 14.41415.00215.61516.252 16.91517.60518.32419.07219.85 number=bcd2 boundary564227327.1 BinEnergy=photon 3.0E -014.0E -015.0E -016.0E -01 -019.0E -011.0 7.0E -018.0E E+00 1.10E+001.20E+001.30E+001.40E+00 1.50E+001.60E+001.70E+001.80E+00 1.90E+002.00E+002.10E+002.20E+00 2.30E+002.40E+002.50E+002.60E+00 2.70E+002.80E+002.90E +003.10E+00 3.20E+003.30E+003.40E+003.50E+00 3.60E+003.70E+003.80E+003.90E+00 4.00E+004.10E+004.20E+004.30E+00 4.40E+004.50E+004.60E+004.70E+00 +005.00E+005.10E+00 4.80E+004.90E 5.20E+005.30E+005.40E+005.50E+00 5.60E+005.70E+005.80E+005.90E+00 6.00E+006.20E+006.40E+006.60E+00 6.80E+007.00E+007.20E+007.40E+00 7.60 E+007.80E+008.00E+008.20E+00 8.40E+008.60E+008.80E+009.00E+00 9.20E+009.40E+009.60E+009.80E+00 1.00E+011.04E+011.08E+011.12E+01 1.16E+011.20E+011.24E+011 .28E+01 1.32E+011.36E+011.40E+011.44E+01 1.48E+011.52E+011.56E+011.60E+01 1.64E+011.68E+011.72E+011.76E+01 1.80E+011.84E+011.88E+011.92E+01 1.96E+01 2.00E+01

END

AnalysisofOKTAVIANExperimentforSecondaryGamma \$LEAKAGEFROMALUMINIUM(40CMDIA)SPHERE3 \$COGinput/Photonsource BASIC photon elec tron cm MeV sec dnearON\$activate"dnear"option SURFACES 1SPHERE10.00 2SPHERE10.20 3SPHERE19.75 4SPHERE19.95 5SPHERE580.00 6SPHERE20.0 GEOMETRY sector1sec1 -1 sector2sec21 -2 sector3sec32 -3 sector4sec43 -4 sector5sec54 -6 sector6sec6 -56 Boundaryvacuum+5 MIX NLIB=ENDFB6R7 mat1w -p1.22130271.0 \$Aluminium -p7.9240000.185 mat2w 250550.013 260000.691 28000.0.111 ASSIGN-M\$sector#material# 1022 3142 5060 EGS pegslib=egsAl_g.dat \$electrontransportenabledinthefollowingsectors: esectors=234 ECut=0.300\$killelectrontranportforE<0.050MeV WALK-ENERGY photonregion2to40.3 SOURCE npart=100000 0 increment0.0862p=1e=1a=1 definePosition=1point0.0.0. defineAngle=1isotropic \$SI10.693110.0 defineenergy=1photon bin 6.00000E -012.961e -27.00000E -014.793e -2 8.00000E -019.615e -29.00000E -014.543e -2 1.00000E+004.082e -21.10000E+005.335e -2 1.20000E+006.609e -21.30000E+004.793e 1.40000E+003.476E -21.50000E+002.035E 1.60000E+001.733E -21.70000E+001.733E -2 -2 -2 1.80000E+001.557E -21.90000E+001.326E 2.00000E+001.257E -22.10000E+001.191E -2 -2 2.20000E+001.070E -22.30000E+001.014E 2.40000E+001.070E -22.50000E+001.129E -2 -2

-Rays<<AI -g>> -DSURFACETALLY(ENDF/B -VI)

2.80000E+007.761E -32.90000E+008.188E -3 3.0000E+008.188E -33.30000E+007.761E -3 3.40000E+007.356E -33.70000E+006.973E -3 3.60000E+007.356E -33.70000E+005.028E -4 4.00000E+005.624E -34.30000E+005.338E -3 4.20000E+005.624E -34.30000E+005.938E -3 4.40000E+005.627E -34.70000E+004.082E -3 5.00000E+003.476E -35.10000E+003.295E -3 5.00000E+003.476E -35.10000E+003.295E -3 5.00000E+003.476E -35.10000E+003.667E -3 5.00000E+003.869E -35.50000E+002.806E -3 5.60000E+003.869E -35.50000E+002.806E -3 6.00000E+002.806E -36.30000E+002.806E -3 6.00000E+002.960E -36.10000E+002.806E -3 6.00000E+002.980E -36.70000E+002.806E -3 6.00000E+002.980E -36.70000E+002.806E -3 6.00000E+002.980E -37.70000E+001.328E -3 7.0000E+001.326E -37.70000E+001.326E -3 7.0000E+001.326E -37.70000E+001.326E -3 7.0000E+001.326E -37.70000E+001.326E -3 8.0000E+001.326E -37.70000E+001.326E -3 8.0000E+001.326E -37.70000E+001.326E -3 7.80000E+001.326E -37.70000E+001.326E -3 8.0000E+001.326E -37.70000E+001.326E -3 8.0000E+001.326E -37.70000E+001.326E -3 8.0000E+001.326E -37.90000E+001.326E -3 8.0000E+001.326E -37.9000E+001.326E -3 8.0000E+001.326E -37.9000E+001.326E -3 8.0000E+001.326E -37.9000E+001.326E -3 8.0000E+001.326E -37.9000E+001.326E -3 8.0000E+001.326E -37.9000E+001.326E -3 8.0000E+001.326E -37.9000E+005.628E -49 9.0000E+001.326E -49.1000E+005.628E -49 9.0000E+005.628E -49	2.60000E+001.014E -22.70000E+008.638E	-3
3.0000E+008.638E -33.1000E+008.638E -33.20000E+007.356E -33.30000E+007.356E -33.70000E+007.356E -33.70000E+005.628E -33.80000E+005.628E -33.30000E+005.628E -34.30000E+005.938E -34.20000E+005.628E -34.50000E+005.938E -34.40000E+005.628E -34.50000E+005.938E -34.40000E+005.628E -34.50000E+003.295E -35.50000E+003.476E -35.50000E+003.295E -35.20000E+003.476E -35.50000E+003.667E -35.50000E+003.869E -35.50000E+003.667E -35.50000E+003.869E -35.50000E+002.960E -35.80000E+002.806E -35.70000E+002.960E -36.30000E+002.960E -36.40000E+002.659E -36.50000E+002.806E -36.60000E+002.659E -36.50000E+002.806E -36.60000E+002.521E -36.90000E+002.521E -36.90000E+002.521E -36.90000E+002.521E -36.90000E+002.521E -37.70000E+001.326E -37.70000E+001.326E -37.80000E+001.326E -37.70000E+001.326E -37.80000E+001.326E -37.70000E+001.326E -37.80000E+001.326E -37.90000E+001.326E -37.90000E+005.057E -49.30000E+005.057E -49.90000E+005.057E -49.90000E+005.050E+00 -00.50E+005.05E+00 -00.50E+	2.80000E+007.761E -32.90000E+008.188E	-3
3.2000E+008.188E -33.3000E+007.761E -3 3.40000E+007.356E -33.50000E+005.628E -3 3.60000E+005.628E -33.30000E+005.628E -3 4.0000E+005.628E -34.10000E+005.938E -3 4.40000E+005.628E -34.30000E+005.938E -3 4.40000E+005.628E -34.70000E+005.938E -3 4.60000E+005.057E -34.70000E+004.082E -3 5.0000E+003.476E -35.10000E+003.667E -3 5.0000E+003.476E -35.10000E+003.667E -3 5.0000E+003.89E -35.50000E+003.667E -3 5.0000E+003.89E -35.50000E+003.667E -3 5.0000E+003.89E -35.50000E+002.806E -3 6.00000E+002.960E -36.10000E+002.960E -3 6.40000E+002.960E -36.50000E+002.806E -3 6.40000E+002.960E -36.50000E+002.806E -3 6.40000E+002.960E -36.50000E+002.806E -3 6.40000E+002.960E -36.50000E+002.806E -3 6.40000E+002.989E -37.50000E+001.2821E -3 7.0000E+001.326E -37.30000E+001.2821E -3 7.0000E+001.326E -37.70000E+001.326E -3 7.80000E+001.326E -37.70000E+001.326E -3 8.0000E+001.326E -37.70000E+001.326E -3 8.0000E+001.326E -37.70000E+001.326E -3 8.0000E+001.326E -37.70000E+001.257E -3 8.0000E+001.326E -37.70000E+001.257E -3 8.0000E+001.326E -38.10000E+001.257E -4 9.0000E+005.638E -49 .10000E+005.638E -4 9.20000E+005.538E -49.30000E+005.638E -4 9.20000E+005.5628 -49 .10000E+005.628E -4 9.80000E+002.965E -49.30000E+002.86E -4 9.80000E+002.55E -49.30000E+002.86E -4 9.20000E+002.55E -49.30000E+002.86E -4 9.20000E+002.55E -49.30000E+002.86E -4 9.20000E+002.55E -49.30000E+002.86E -4 9.20000E+002.55E -49.30000E+002.86E -4 9.20000E+002.55E -49.30000E+002.86E -4 9.20000E+002.55E -49.30000E+002.80E -4 9.20000E+002.55E -49.90000E+002.80E -4 9.20E+003.30E+003.90E+00 1.90E+002.00E+005.40E+004.30E+00 1.90E+002.00E+005.40E+004.30E+00 1.90E+002.00E+005.40E+005.50E+00 5.00E+00.30E+005.40E+003.90E+00 5.00E+007.80E+005.80E+009.80E+00 9.20E+009.40E+005.80E+009.80E+00 9.20E+0	3.00000E+008.638E -33.10000E+008.638E	-3
3.40000E+007.356E -33.50000E+007.356E -3 3.60000E+007.356E -33.70000E+005.973E -3 3.80000E+005.628E -34.10000E+005.335E -3 4.00000E+005.628E -34.30000E+005.938E -3 4.00000E+005.628E -34.30000E+003.938E -3 4.60000E+003.476E -34.50000E+003.295E -3 5.00000E+003.476E -35.10000E+003.667E -3 5.00000E+003.869E -35.50000E+003.667E -3 5.00000E+003.869E -35.50000E+002.806E -3 5.60000E+002.806E -35.50000E+002.806E -3 5.60000E+002.806E -36.50000E+002.806E -3 6.00000E+002.806E -36.50000E+002.806E -3 6.00000E+002.806E -36.50000E+002.806E -3 6.00000E+002.806E -36.50000E+002.806E -3 6.00000E+002.802E -36.50000E+002.802E -3 6.00000E+001.326E -37.70000E+001.326E -3 7.00000E+001.326E -37.70000E+001.326E -3 7.80000E+001.326E -37.70000E+001.326E -3 7.80000E+001.326E -37.90000E+001.326E -3 8.00000E+001.326E -37.90000E+001.257E -3 8.00000E+001.326E -37.90000E+001.257E -3 8.00000E+001.326E -37.90000E+001.268E -4 8.00000E+001.326E -49.10000E+005.628E -4 9.00000E+005.338E -48.90000E+005.628E -4 9.00000E+005.628E -49 .10000E+005.628E -4 9.00000E+005.628E -49 .10000E+005.628E -4 9.00000E+005.628E -49 .10000E+005.628E -4 9.00000E+005.628E -49.10000E+005.628E -4 9.00000E+005.628E -49.10000E+005.628E -4 9.00000E+005.628E -49.10000E+005.628E -4 9.00000E+005.938E -48.90000E+005.628E -4 9.00000E+005.628E -49.10000E+005.628E -4 9.00000E+005.628E -49.10000E+005.628E -4 9.00000E+005.628E -49.10000E+005.628E -4 9.00000E+005.628E -49.10000E+005.628E -4 9.00000E+005.628E -49.10000E+005.628E -4 9.00000E+005.628E -49.10000E+005.628E -4 9.00000E+005.02E+005.00E+005.00E+00 1.00E+01 .00E+001.30E+001.40E+00 1.00E+01 .00E+001.30E+002.00E+00 3.00E+001.20E+005.00E+003.00E+00 3.00E+001.20E+005.00E+005.00E+00 5.00E+00.30E+005.00E+00 5.00E+00.570E+005.80E+00,30E+00 5.00E+	3.20000E+008.188E -33.30000E+007.761E	-3
3.60000E+007.356E -33.70000E+006.973E - 3.80000E+005.264E -33.90000E+005.358E - 4.20000E+005.628E -34.30000E+005.938E - 4.40000E+005.057E -34.70000E+004.082E - 4.80000E+003.476E -35.10000E+003.295E - 5.00000E+003.476E -35.30000E+003.667E - 5.20000E+004.082E -35.30000E+003.667E - 5.20000E+003.869E -35.50000E+003.667E - 5.80000E+002.806E -35.70000E+002.806E - 5.80000E+002.806E -36.10000E+002.960E - 6.20000E+002.960E -36.10000E+002.960E - 6.40000E+002.960E -36.50000E+002.806E - 6.40000E+002.960E -36.50000E+002.806E - 7.20000E+002.980E -36.50000E+002.521E - 6.60000E+002.980E -37.30000E+002.521E - 7.0000E+002.389E -37.10000E+001.326E - 7.40000E+001.326E -37.30000E+001.326E - 7.40000E+001.326E -37.0000E+001.326E - 7.80000E+001.326E -37.0000E+001.326E - 8.00000E+001.326E -37.0000E+001.326E - 7.80000E+001.326E -37.0000E+001.326E - 8.00000E+001.326E -37.0000E+001.326E - 7.80000E+001.326E -37.0000E+001.326E - 7.80000E+001.326E -37.0000E+001.326E - 8.00000E+001.326E -37.0000E+001.326E - 7.80000E+001.326E -37.0000E+001.326E - 8.00000E+001.326E -37.0000E+001.326E - 8.00000E+001.326E -37.0000E+001.326E - 7.80000E+001.326E -37.90000E+001.326E - 8.00000E+001.326E -37.90000E+001.326E - 8.00000E+001.326E -37.90000E+001.326E - 8.00000E+001.326E -37.90000E+001.326E - 8.00000E+001.326E -37.90000E+001.326E - 8.00000E+001.326E -49.90000E+005.638E -4 8.00000E+005.628E -49 .10000E+005.638E -4 8.00000E+004.306E -49.50000E+003.667E -4 9.20000E+004.306E -49.70000E+003.667E -4 9.20000E+004.306E -49.70000E+003.667E -4 9.20000E+004.306E -49.70000E+003.667E -4 9.20000E+004.306E -49.70000E+003.667E -4 9.20000E+002.90E+003.10E+00 1.90E+002.00E+002.50E+00 3.00E+001.60E+001.70 E+003.30E+00 3.00E+001.60E+001.70 E+003.30E+00 3.00E+003.30E+003.40E+003.50E+00 3.00E+003.30E+003.40E+003.50E+00 3.00E+003.30E+005.40E+005.50E+00 5.00E+00.50E+005.80E+005.90E+00 5.00E+005.70E+005.80E+005.90E+00 5.00E+005.70E+005.80E+005.90E+00 5.00E+005.70E+005.80E+005.90E+00 5.00E+00.50E+005.80E+005.90E+00 5.00E+00.50E+00	3.40000E+007.356E -33.50000E+007.356E	-3
3.80000E+006.264E -33.90000E+005.628E -34.0000E+005.335E -34.10000E+005.335E -34.0000E+005.938E -34.00000E+005.057E -34.70000E+004.082E -34.00000E+003.476E -34.90000E+003.295E -35.0000E+003.476E -35.10000E+003.667E -5.20000E+003.898E -35.50000E+003.667E -5.20000E+003.898E -35.50000E+003.667E -5.60000E+003.898E -35.50000E+002.806E -35.90000E+002.806E -35.90000E+002.806E -35.90000E+002.960E -36.10000E+002.960E -36.10000E+002.806E -36.0000E+002.969E -36.50000E+002.806E -37.70000E+002.806E -37.20000E+002.521E -36.90000E+002.521E -36.90000E+002.521E -36.90000E+002.521E -36.90000E+002.521E -37.30000E+001.326E -37.70000E+001.326E -37.90000E+001.326E -37.90000E+005.628E -48.90000E+005.628E -49 .10000E+005.628E -49 .30000E+005.628E -40 .30000E+002.806E -40 .300E+002.806E -40 .300E+003.30E+002.806E -40 .300E+003.30	3.60000E+007.356E -33.70000E+006.973E	-3
4 .0000E+005.335E -34.1000E+005.335E -3 4.20000E+005.628E -34.3000E+005.938E -3 4.60000E+005.057E -34.70000E+003.697E -3 4.80000E+003.476E -34.9000E+003.295E -3 5.0000E+003.476E -35.1000E+003.667E -3 5.0000E+003.889E -35.50000E+003.667E -3 5.60000E+003.295E -35.70000E+002.806E -3 5.80000E+002.806E -35.9000E+002.806E -3 6.0000E+002.960E -36.10000E+002.960E -3 6.20000E+002.960E -36.30000E+002.521E -3 6.60000E+002.59E -36.50000E+002.521E -3 6.60000E+002.389E -37.50000E+002.521E -3 7.0000E+001.326E -37.30000E+001.326E -3 7.80000E+001.326E -37.50000E+001.326E -3 7.80000E+001.326E -37.70000E+001.326E -3 8.0000E+001.326E -37.70000E+001.326E -3 8.0000E+001.326E -37.90000E+001.326E -3 8.0000E+001.326E -3 9.0000E+002.659E -49.90000E+005.628E -4 9.0000E+002.659E -49.90000E+005.628E -4 9.0000E+002.659E -49.90000E+005.628E -4 9.0000E+002.659E -49.90000E+005.628E -4 9.0000E+002.659E -49.90000E+003.667E -4 9.0000E+002.90E -49.70000E+003.667E -4 9.0000E+002.90E -49.70000E+003.90E+00 1.0E+001.0E+001.70 E+001.30E+00 3.0E -014.0E -015.0E -016.0E -01 7.0E+003.30E+003.30E+003.30E+00 3.0E+003.30E+003.40E+003.50E+00 3.0E+003.30E+003.40E+003.50E+00 3.0E+003.30E+003.40E+003.50E+00 3.0E+003.30E+005.90E+00 6.00E+004.50E+004.60E+004.30E+00 6.00E+004.50E+004.60E+004.30E+00 6.00E+004.02E+004.60E+004.80E+00 8.40E+004.60E+008.80E+009.80E+00 9.20E+009.40E+009.60E+009.80E+00 9.20E+009.40E+009.60E+009.80E+	3.80000E+006.264E -33.90000E+005.628E	-3
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4.0000E+003.476E -34.9000E+003.293E - 5.0000E+003.476E -35.10000E+003.667E - 5.20000E+003.295E -35.50000E+003.667E - 5.60000E+003.295E -35.70000E+002.960E - 5.80000E+002.960E -36.10000E+002.960E - 6.20000E+002.960E -36.30000E+002.806E - 6.40000E+002.659E -36.50000E+002.521E - 6.60000E+002.389E -37.10000E+002.521E - 6.80000E+002.389E -37.10000E+001.929E - 7.20000E+001.326E -37.70000E+001.326E - 7.40000E+001.326E -37.70000E+001.326E - 7.40000E+001.326E -37.90000E+001.326E - 7.80000E+001.326E -37.90000E+001.326E - 8.0000E+001.326E -37.90000E+001.326E - 8.0000E+001.326E -37.90000E+001.326E - 8.0000E+001.326E -37.90000E+001.326E - 8.80000E+001.326E -37.90000E+001.326E - 8.0000E+001.326 -37.90000E+001.326E - 8.0000E+002.938E -48.90000E+005.938E - 4.80000E+005.938E -48.90000E+005.628E - 9.20000E+005.628E -49 .10000E+005.628E - 9.20000E+005.628E -49 .10000E+005.628E - 9.80000E+002.960E -49.70000E+002.806E - 4.0000E+001 - DETECTOR numbe r=bcd2 boundary564227327.1 BinEnergy=photon 3.0E -014.0E -015.0E -016.0E -01 7.0E -018.0E -019.0E -011.0E+00 1.10E+001.20E+001.30E+001.40E+00 1.0000E+01 DETECTOR numbe r=bcd2 boundary564227327.1 BinEnergy=photon 3.0E -014.0E -015.0E -016.0E -01 7.0E -018.0E -019.0E -011.0E+00 1.00E+00 2.70E+002.80E+002.90E+003.10E+00 3.0E +002.00E+002.10E+002.20E+00 3.0E +003.70 E+003.80E+003.90E+00 3.00E+004.90E+005.00E+003.90E+00 3.00E+004.90E+005.00E+003.90E+00 3.00E+004.90E+005.00E+005.90E+00 5.00E+004.90E+005.00E+005.90E+00 5.00E+004.90E+005.00E+005.90E+00 5.00E+004.90E+005.00E+005.90E+00 6.80E+007.80E+008.80E+005.90E+00 8.40E+004.60E+008.80E+009.80E+00 8.40E+004.60E+008.80E+009.80E+00 8.40E+004.60E+008.80E+009.80E+00 8.40E+007.80E+008.80E+009.80	4.00000E+003.037E -34.70000E+004.002E	-0
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5.20000E+004.082E -35.30000E+004.082E -35.50000E+003.667E -35.50000E+002.806E -35.90000E+002.806E -35.90000E+002.806E -36.70000E+002.806E -36.70000E+002.806E -36.70000E+002.806E -36.70000E+002.808E -36.70000E+002.521E -36.90000E+002.521E -36.90000E+002.521E -36.90000E+002.521E -37.700000E+001.326E -37.70000E+001.326E -37.70000E+001.326E -37.70000E+001.326E -37.90000E+001.326E -37.90000E+001.326E -37.90000E+001.326E -37.90000E+001.326E -37.90000E+001.326E -38.10000E+001.326E -38.80000E+001.326E -38.30000E+005.628E -48.80000E+005.628E -49 .10000E+005.628E -49 .10000E+005.628E -49.70000E+005.628E -49.70000E+002.806E -40.70 E+001.80E+00 1.90E+001.20E+001.30E+001.40E+00 1.50E+001.30E+001.30E+001.40E+00 1.50E+001.30E+001.30E+001.40E+00 1.50E+001.30E+001.30E+001.40E+00 1.50E+001.30E+001.40E+00 1.50E+002.80E+003.80E+003.90E+00 3.20E+003.30E+003.40E+003.50E+00 3.20E+003.30E+003.30E+003.90E+00 3.20E+003.30E+003.90E+00 4.40E+004.50E+004.30E+00 3.90E+00 4.40E+004.50E+004.50E+004.30E+00 3.90E+00 4.40E+004.50E+004.50E+00 5.50E+00 5.60E+00 5.60E+00 5.60E+00 5.70E+005.80E+003.90E+00 5.00E+00 5.00	5. 00000E+003.476E -35. 10000E+003.667E	-3
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LEAKAGEFROMALUMINIUM(40CMDIA)SPHERE3

CMCNPinput

c***Cellcards*** 3 -0.0012 -3 1 22 -7.824 -43 -1.223 -54 31 42 -7.824 -65 53 -0.0012 -76 607 c***Surfacecards*** 3so10.0 4so10.2 5so19.75 6so19.95 7so580.0 c***Materialcards*** cAluminium(0.2%Fe -56,ignoreSi,Cu) m113027.60c -0.99826056.60c -0.002 cSteel(Cr18.5%,Fe -5670.4%,Ni11.1%) m224000.50c -0.18526056.60c -0.70428000.50c -0.111 cAir m38016.60C0.208 7014.60C0.792 c ***Datacards*** modenpe imp:n111110 imp:p111110 imp:e111110 sdefpos=0.0.0.cel=1erg=d1 c***Energybinforsource neutron*** si1h1.000e -11.120e -11.260e -11.410e -11.590e -1 1.780e -12.000e -12.240e -12.520e -12.830e -1 -13.560e -14.000e -14.490e -15.040e -1 3.170e 5.660e -16.350e -17.130e -18.000e -18.780e -1 -11.058e+01.162e+01.275e+01.400e+0 9.640e 1.542e+01.698e+01.871e+02.061e+02.270e +02.500e+02.704e+02.924e+03.162e+03.419e+0 3.699e+04.000e+04.165e+04.337e+04.516e+0 4.703e+04.897e+05.099e+05.310e+05.529e+0 5.757e+05.995e+06.242e+06.500e+06.765e+0 7.041e+07.327e+07.627e+07.938e+08.261e+0 8.598e+08.949e+09.314e+09.693e+01.009e+1 1.050e+11.082e+11.114e+11.148e+11.183e+1 1.218e+11.255e+11.277e+11.300e+11.324e+1 1.348e+11.372e+11.397e+11.422e+11.447e+1 1.474e+11.500e+11.527e+11.554e+11.583e+1 1.611e+11.640e+1 c***Sourcedistribution*** sp10.000e -40.000e -00.000e -01.270e -45.774e -5 2.536e -42.722e -42.076e -44.366e -43.873e -4 4.756e -46.161e -46.727e -46.648e -48.581e -4 1.098e -31.184e -31.412e -3 1.616e-31.546e -3 1.556e -31.631e -31.771e -31.804e -31.823e -3 1.891e -31.935e -32.002e -32.052e -32.004e -3 2.068e -32.091e -33.354e -31.492e -31.322e -3 -31.401e -37.112e -46.423e -46.514e -4 1.451e -46.428e -46.209e -45.788e -45.227e -4 6.195e -45.456e -45.106e -45.789e -45.391 e-4 5.250e -44.813e -45.300e -45.756e -45.230e -4 4.998e -46.256e -47.047e -47.729e -47.951e -4 5.394e -48.106e -48.923e -41.022e -31.281e -3 8.659e -32.286e -31.825e -32.479e -33.794e -3 1.687e -31.565e -23.634e -27.492e -21.279e -1 7.010e -11.916e -11.500e -18.676e -23.950e -2 1.768e 1.430e -24.269e -3 c***Tallycards** fc21Neutroncurrentthroughtheoutersurface f21:n7

c***Energy bin*** e210.0971220.101090.105210.1095 0.113970.118620.123470.1285 0.133750.139210.144890.1508 0.156960.163360.170030.17697 0.184190.191710.199530.20767 0.216150.224970.234150.24371 0.253650.2640.274780.28599 0.297660.309810 .322450.33561 0.349310.363570.37840.39385 0.409920.426650.444060.46218 0.481050.500680.521110.54238 0.564510.587550.611530.63648 0.662460. 68950.717630.74692 0.77740.809130.842150.87652 0.912290.949520.988271.0286 1.07061.11431.15981.2071 1.25631.30761.3611.41651.4743 1.53451.59711.66231.7301 1.80081.87421.95072.0303 22.19942.28922.3826 2.113 2.47992.58112.68642.796 2.91013.02893.15253.2812 3.41513.55453.69953.8505 4.00764.17124.34144.5186 4.7034.89495.09475.3026 5.5195.74435.97876.2227 6.47666.7417.0161 7.3024 7.60047.91068.23348.5694 8.91929.28329.66210.056 10.46710.89411.33911.801 12.28312.78413.30613.849 14.41415.00215.61516.252 16.91517.60518.32419.07219.85 fc32Photoncurrentthroughtheo utersurface f32:p7 fm324227327.1\$4*Pi*R7 fq32et c***Energybin*** e320.356i6.019i10.024i20 t328.81e6t С phys:n20.00 phys:p20.000 phys:e20.00 0001011 c***Cutoffcard*** ccut:n1.0e161.0e -30.01 cut:n1.0e60.0 -0.5 -0.250 cut:p1.0e60.299 -0.5 -0.250 cut:e1.0e60.3 -0.5 -0.250 c***Neutronhistory*** nps5000000 print

```
AnalysisofOKTAVIANExperimentforSecondaryGamma
                                                     -Rays<<Al -g>>
CMNCPinput
cJAERI -Data/Code98 -024p.174Fig.A -17
10
           -1
22
      -7.901
                -2
31
      -1.222
                -3
42
      -7.903
                -4
50
        4
              -5
605
1so10.00
2so10.20
3so19.75
4so19.95
5so580.00
modepe
imp:p111110
imp:e111110
sdeferg=d1wgt=0.0862
si10.693i10.0
sp10.000e+02.961e -34 .793e-39.615e -34.543e -34.082e -35.335e -36.609e -3
4.793e
         -33.476e -32.035e -31.733e -31.733e -31.557e -31.326e -31.257e -3
1.191e
         -31.070e -31.014e -31.070e -31.129e -31.014e -38.638e -47.761e -4
         -48.638e -48.638e -48.188e -47.761 e-47.356e -47.356e -47.356e -4
8.188e
6.973e
         -46.264e -45.628e -45.335e -45.335e -45.628e -45.938e -46.264e -4
         -45.057e -44.082e -43.476e -43.295e -43.476e -43.667e -44.082e -4
5.938e
4.082e
         -43.869e -43.667e -43.295e -42.960e -42.806e -42.806e -4 2.960e-4
2.960e
         -42.960e -42.806e -42.659e -42.521e -42.389e -42.389e -42.521e -4
2.521e
         -42.389e -41.929e -41.642e -41.476e -41.399e -41.326e -41.326e -4
         -41.326e -41.326e -41.326e -41.257e -41.070e -49.113e -58.188e -5
1.326e
6.973e
         -56.609e -56.264e -55.938e -55.938e -55.628e -55.628e -55.335e -5
5.057e
         -54.306e -53.667e -52.960e -52.659e -52.659e -52.806e -5
С
m113027.1
m224000.
           -0.18525055. -0.01326000. -0.691
28000.
          -0.111
С
fc32 -----photonspectrum
                        -----
f32:p5
fm324227327.1$4*pi*580*580
fq32et
e320.356i6.019i10.0
t326.91e6t
С
phys:p20.000
phys:e20.000001011
cut:p1e60.299
               -0.5 -0.250
cut:e1e60.3
               -0.5 -0.250
nps1000000
ctme1000000
prdmp1000000100000011
lost1010
print
```

3. FNSliquidoxygen(1989)SBE3.006

fns-tof/lo2slab -tofJ \$COGinput	ENDL	-3.2'94	-08-18
BASIC neutron MeV cm			
SURFACES 1PLAN EZ -28.0 2PLANEZ -27.5 4PLANEZ -0.5 5PLANEZ -25.90 6PLANEZ -25.90 6PLANEZ -25.20 8PLANEZ -25.20 8PLANEZ -24.80 10PLANEZ -24.00 12PLANEZ -3.20 11PLANEZ -3.20 12PLANEZ -4.0 13PLANEZ -70.0 14CYLZ35.0 15CYLZ34.7 16CYL Z30.8 17CYLZ30.0 18CYLZ29.8 19CYLZ23.25 20CYLZ15.0 21SPHERE136.146 22SPHERE102.822 24SPHERE102.822 25SPHERE102.822 25SPHERE102.822 25SPHERE102.822 26SPHERE102.822 25SPHERE102.822 26SPHERE102.822 27SPHERE102.822 27SPHERE102.822 28SPHERE102.822 29CYLZ4.977 30CYL4.985012001 31CYL5.012012001 32CYL5.074012001 33CYL5.212012001 34SPHERE1000.0	TR0.0.134.146 TR0.0.134.096 TR0.0.134.096 TTR0.011 TTR0.0.77. TTR0.0.77. TR0.0.77.672 TR0.0.77.672 TR0.0.77.672 TR0.0.77.672 TR0.0.77.672 TR0.0.77.672 TR0.0.77.672 TR0.0.77.672 TR0.0.77.672 TR0.0.77.672 TR0.0.77.672 TR0.0.0.77.672 TR0.0.0.148.79 TR0.0.0.298.01 TR0.0.0.298.01 TR0.0.0.477.49 TR0.0.0.676.23 \$W0	05.7227 05.6727 7227 72 29.7227 29.6727 730688.2148\$R 630 64 810534.0526\$R 070289.8328\$R orld	otation 12.0212\$Rotation otation otation
GEOMETRY	10.04		
Sector isec i	OR+13 -2+14	-34	
\$********** **sourc	evacuumregior	1:AIR***********	****
sector3sec3	-14+13 -1 OR -27+1 -20		
\$*****************mate	erialregion*****	*****	
\$sus316	0		
sector4sec4	+1 -3 -14+20 OR+4 -2 -14+ OR+3 -4 -14+	-19 -15	
sector5sec5	+27 -28 -20 OR+21 -22 -1	Q	
sector6sec6	+9 -11 -17+20 OR+12 -10 -1 OR+11 -12 -1	7+20 7+18	
sector7sec7	+25 -26 -20 OR+23 -24 -2	0	
\$vacuum	011723 -24 -2		
sector8sec8	+3 -5 -15+20		
	OR+6 -4 -15+	19	
sector9sec9	UR+5 -6 -15+ +28 -5 -20	16	

OR+22+ 6-19 sector10sec10+7 -9 -17+20 OR+10 -8 -17+20 sector11sec11+26+7 -20 OR+24 -8 -20 \$ ----al sector12sec12+5 -7 -16 OR+8 -6 -16 OR+7 -8 -16+17 \$ ----o sector13sec13+11 -12 -18 OR -25 -11 -20 OR -23+12 -20 \$****** *detectorvacuumregion****** sector14sec14+2 -34 -29 OR+2 -34 -30 OR+2 -34 -31 OR+2 -34 -32 OR+2 -34 -33 sector15sec15+2 -34+29+30+31+32+33 BOUNDARYVACUUM+34 \$GeometryPictureviews -100. -54 -28.5100 -54 -28.5100100 -100. -54 -10100 -54 -10100100 -1 picturecssectorcolor -28.5 picturecssectorcolor -10 picturecssector50.0 -80.50050 -50050 picturecsmaterialcolor -100. -54 -28.5100 -54 -28.5100100 -28.5 pictur ecsmaterialcolor -100. -54 -10.100 -54 -10100100 -10 , picturecsmaterialcolor50.0 -80.50050 -50050 picturecsmaterialcolor40.0 -70.40040 -40040 MIX NLIB=ENDFB6R7 \$air mat1#1.17868E -0370140.7886 680160.21134 \$sus316:Cr=1.6787 -2,Mn55=1.3420 -3,Fe -6.0507-2,Ni=7.3429 -3 mat2#7.89844240500.00848240520.16360 240530.01855240540.00462 250550.01561260540.04152 260560.64547260 570.01478 260580.00197280580.05830 280600.02229280610.00097 280620.00307280640.00078 mat3#2.7130271.0 \$o mat4#1.140780161.0 ASSIGN-M\$sector#material 102031 425 26272 8090100110 12313414015 -1 ASSIGN-MC 1sky \$air 2gray \$iron/steel 3lavender\$aluminium 4blue \$oxygen SOURCE npart=2000000 increment1.p=1e=1a=1 defineposition=1point0.0. -44.0 defineangle=1

```
0.0.1.
isotropic
IMP -1.0.0010.3420.0010.4381.1.1.
```

defineenergy=1neutron

bin 0.00.0 0.0408672.6124E -020.046308 3.4481E-020.0524743.3150E -020.059461 2.6938E-020.0673783.0194E -020.076349 2.5607E-020.0 865152.7734E -020.098035 2.8991E-020.111092.9141E -020.12588 2.6302E-020.142642.9641E -020.16163 2.8005E-020.183153.0887E -020.20754 3.0245E-020.235173.2826E -020.26649 3.2751E-020.301973.4530E -020.34217 3.3660E-020.387743.4872E -020.43936 3.4850E-020.497863.5502E -020.56415 3.5145E-020.639273.5064E -020.72438 3.3990E-020.820843.1826E -020.93013 3.0023E-021.0542.7451E -021.1943 2.5196E-021.35332.2862E -021.5335 2.0E-021.7377 \$modified,wasp=9.6E -03E=1.7377 1.8147E-021.8498 1.7170E -021.9691 1.5955E-022.09611.4685E -022.2313 1.3976E-022.37521.3360E -022.5284 1.3154E-022.69141.2994E -022.865 1.3420E-023.04981.0371E -023.2465 8.5640E-033.45597.2864E -033.6787 6.4825E-033.9165.7965E -034.1686 5.3054E-034.43744.571 3E-034.7236 4.3260E-035.02823.6910E -035.3525 3.3215E-035.69782.7708E -036.0652 2.5777E-036.45642.6035E -036.8728 2.1745E-037.31611.9697E -037.7879 1.8256E-038.29022.0836E -038.8249 2.1067E-039.394 2.1E-039.9999 \$modified,wasp=5.11E -04E =9.9999 2.0071E-0310.1572.0076E -0310.317 1.9948E-0310.482.3648E -0310.645 2.6038E-0310.8122.5727E -0310.983 2.8794E-0311.1563.3077E -0311.331 3.2699E-0311.513.9627E -0311.691 6.1168E-0311.8756.1150E -0312.062 6.3421E-0312.2521.2160E -0212.445 1.2157E-0212.6411.2154E -0212.84 2.5910E-0213.0422.8279E -0213.248 2.8545E-0213.4561.1398E -0113.668 1.6320E-0113.8831.6242E -0114.102 4.4862E-0114.3248.0814E -0114.55 8.1148E-0114.7797.0288E -0115.012 3.7148E-0115.2483.7138E -0115.488 3.5695E-0115.7324.0391E -0315.98 4.0705E-0316.2310.0000E+0016.487 DETECTOR \$Test:pointdetectoralignedwithbeamaxistheta=0.0degree \$(others --//fluxesat5ptdts(th=0.0,12.2,24.9,41.8,66.8deg) \$f5:n0.00703.0000 1 \$148.79730688.21481 \$298.01630642.02121 \$477.49810534.05261 \$676.23070289.83281 number=pt1 Point0.00.0703. BinEner gy=neutron 4.0867 -024.6308 -02 5.2474 -025.9461 -026.7378 -027.6349 -028.6515 -02 -021.1109 -011.2588 -011.4264 -011.6163 -01 9.8035 1.8315 -012.0754 -012.3517 -012.6649 -013.0197 -01

-013.8774 -014.3936 -014.9786 -015.6415 -01 3.4217 6 3927 -017.2438 -018.2084 -019.3013 -011.0540+00 1.1943+001.3533+001.5335+001.7377+001.8498+00 1.9691+002.0961+002.2313+002.3752+002.5284+00 2.6914+002.8650+003.0498+003.2465+003. 4559+00 3.6787+003.9160+004.1686+004.4374+004.7236+00 5.0282+005.3525+005.6978+006.0652+006.4564+00 6.8728+007.3161+007.7879+008.2902+008.8249+00 9.3940+009.9999+001.0157+011.0317+011.0480+01 0645+011.0812+011.0983+011.1156+011.1331+01 1. 1.1510+011.1691+011.1875+011.2062+011.2252+01 1.2445+011.2641+011.2840+011.3042+011.3248+01 1.3456+011.3668+011.3883+011.4102+011.4324+01 1.4550+011.4779+ 011.5012+011.5248+011.5488+01 1.5732+011.5980+011.6231+011.6487+01 number=pt2 Point148.79730.0688.2148 BinEnergy=neutron 4.0867 -024.6308 -02 -025.9461 -026.7378 -027.6349 -028.6515 -02 5.2474 9.8035 -021.1109 -011.2588 -011.4264 -011.6163 -01 -012.0754 -012.3517 -012.6649 -013.0197 -01 1.8315 3.4217 -013.8774 -014.3936 -014.9786 -015.6415 -01 -017.2438 -018.2084 -019.3013 -011.0540+00 6.3927 1.1943+00 1.3533+001.5335+001.7377+001.8498+00 1.9691+002.0961+002.2313+002.3752+002.5284+00 2.6914+002.8650+003.0498+003.2465+003.4559+00 3.6787+003.9160+004.1686+004.4374+004.7236+00 978+006.0652+006.4564+00 5.0282+005.3525+005.6 6.8728+007.3161+007.7879+008.2902+008.8249+00 9.3940+009.9999+001.0157+011.0317+011.0480+01 1.0645+011.0812+011.0983+011.1156+011.1331+01 1.1510+011.1691+011.1875+011.2062+0 11.2252+01 1.2445+011.2641+011.2840+011.3042+011.3248+01 1.3456+011.3668+011.3883+011.4102+011.4324+01 1.4550+011.4779+011.5012+011.5248+011.5488+01 1.5732+011.5980+011.6231+011.6487+01 number=pt3 Point298.01630.0642.0212 BinEnergy=neutron -024.6308 -02 4.0867 -025.9461 -026.7378 -027.6349 -028.6515 -02 5.2474 -021.1109 -011.2588 -011.4264 -011.6163 -01 9.8035 1.8315 -012.0754 -012 .3517-012.6649 -013.0197 -01 -013.8774 -014.3936 -014.9786 -015.6415 -01 3.4217 6.3927 -017.2438 -018.2084 -019.3013 -011.0540+00 1.1943+001.3533+001.5335+001.7377+001.8498+00 1.9691+002.0961+002.2313+002.3752 +002.5284+00 2.6914+002.8650+003.0498+003.2465+003.4559+00 3.6787+003.9160+004.1686+004.4374+004.7236+00 5.0282+005.3525+005.6978+006.0652+006.4564+00 6.8728+007.3161+007.7879+008.2902+008.8249+00 9.3940+009.9999+001.0157+011.0317+011.0480+01 1.0645+011.0812+011.0983+011.1156+011.1331+01 1.1510+011.1691+011.1875+011.2062+011.2252+01 1.2445+011.2641+011.2840+011.3042+011.3248+01 1.3456+01 1.3668+011.3883+011.4102+011.4324+01 1.4550+011.4779+011.5012+011.5248+011.5488+01 1.5732+011.5980+011.6231+011.6487+01 number=pt4 Point477.49810.0534.0526 BinEnergy=neutron 4.0867 -024 .6308-02 5.2474 -025.9461 -026.7378 -027.6349 -028.6515 -02 9.8035 -021.1109 -011.2588 -011.4264 -011.6163 -01 1.8315 -012.0754 -012.3517 -012.6649 -013.0197 -01 3.4217 -013.8774 -014.3936 -014.9786 -015.6415 -01

.3927-017.2438 -018.2084 -019.3013 -011.0540+00 6 1.1943+001.3533+001.5335+001.7377+001.8498+00 1.9691+002.0961+002.2313+002.3752+002.5284+00 2.6914+002.8650+003.0498+003.2465+003.4559+00 3.6787+003.9160 +004.1686+004.4374+004.7236+00 5.0282+005.3525+005.6978+006.0652+006.4564+00 6.8728+007.3161+007.7879+008.2902+008.8249+00 9.3940+009.9999+001.0157+011.0317+011.0480+01 1.0645+011.0812+011.0983+01 1.1156+011.1331+01 1.1510+011.1691+011.1875+011.2062+011.2252+01 1.2445+011.2641+011.2840+011.3042+011.3248+01 1.3456+011.3668+011.3883+011.4102+011.4324+01 1.4550+011.4779+011.5012+011.5248+011.548 8+01 1.5732+011.5980+011.6231+011.6487+01 number=pt5 Point676.23070.0289.8328 BinEnergy=neutron -024.6308 -02 4.0867 5.2474 -025.9461 -026.7378 -027.6349 -028.6515 -02 9.8035 -021.1109 -011. 2588-011.4264 -011.6163 -01 1.8315 -012.0754 -012.3517 -012.6649 -013.0197 -01 -013.8774 -014.3936 -014.9786 -015.6415 -01 3.4217 6.3927 -017.2438 -018.2084 -019.3013 -011.0540+00 1.1943+001.3533+001.5335+001.7377+ 001.8498+00 1.9691+002.0961+002.2313+002.3752+002.5284+00 2.6914+002.8650+003.0498+003.2465+003.4559+00 3.6787+003.9160+004.1686+004.4374+004.7236+00 5.0282+005.3525+005.6978+006.0652+006.4564+00 6.8728+007.3161+007.7879+008.2902+008.8249+00 9.3940+009.9999+001.0157+011.0317+011.0480+01 1.0645+011.0812+011.0983+011.1156+011.1331+01 1.1510+011.1691+011.1875+011.2062+011.2252+01 1.2445+011 .2641+011.2840+011.3042+011.3248+01 1.3456+011.3668+011.3883+011.4102+011.4324+01 1.4550+011.4779+011.5012+011.5248+011.5488+01 1.5732+011.5980+011.6231+011.6487+01

END

fns-tof/lo2slab -tofJENDL -3.2'94 -08-18 CMCNPinput c*cellcard* 10 -13:+13 -2+14:+34:+2 -34+29+30+31+32+33 20 -21 -2 -19 c ----sus316 428.5979 -2+1 -3 -14+20:+4 -2 -14+19:+3 -4 -14+15 528.5979 -2+27 -28 -20:+21 -22 -19 628.5979 -2+9 -11 -17+20:+12 -10 -17+20:+11 -12 -17+18 728.5 979-2+25 -26 -20:+23 -24 -20 c ----vacuum

 80+3
 -5 -15+20:+6
 -4 -15+19:+5
 -6 -15+16

 90+28
 -5 -20:+22+6
 -19

 100+7
 -9 -17+20:+10
 -8 -17+20

 110+26+7
 -20:
 +24
 -8 -20

 c ----al[changeddensityfrom+3.6244E -3*e24atoms/ccto -2.7g/cc] 123 -2.7+5 -7 -16:+8 -6 -16:+7 -8 -16+17 с ----о 1344.2947 -2+11 -12 -18: -25 -11 -20: -23+12 -20 c*******detectorvacuu mregion****** 140+2 -34 -29:+2 -34 -30:+2 -34 -31:+2 -34 -32:+2 -34 -33 c -----thefollowingisablankdelimeter c*surfacecard* 1pz -28.0 2pz0.0 -27.5 3pz -0.5 4pz -25.90 5pz -2.10 6pz -25.20 7pz 8 pz -2.80 9pz -24.80 10pz -3.20 -24.0 11pz 12pz -4.0 -70.0 13pz с -----35.0 14cz 15cz34.7 16cz30.8 17cz30.0 18cz29.8 19cz23.25 20cz15.0 c ----test -----21 sz134.146136.146 22sz134.096136.146 23sz -105.7227102.8227 24sz -105.6727102.8227 25sz77.7227102.8227 26sz77.6727 102.8227 -129.7227102.8227 27sz -129.6727102.8227 28sz c21pz -0.05 c22pz -0.10 -0.10 -105.7227102.8227 sz -105.6727102.8227 -24.05 c23sz c24 -24.05 c25pz c26pz -24.10 -129.7227102.8227 c27sz

-129.6727102.8227

c28sz

С -----29cz4.977 301cz4.985 312cz5.012 323cz5.074 334cz5.212 34so1000.0 c -----thefollowingisablankdelimeter moden c*transformationcards* c*rotationaboutthe yaxisbytheta* *tr100012.290102.290090 77.89012.2+1 *tr200024.990114.990090 65.19024.9+1 *tr3 00041.890131.890090 48.29041.8+1 *tr400066.890156.890090 23.29066.8+1 c*cellparametercards * imp:n0111111 1111111 * c*sourcespecificationcards c*src1=pointisotropicoption* c*sdirdirc.biasing -heightreductionconsidered* c*si(eng.)andsp(prob.)takenfrombetofsourcecharac c*modifiedprobaforEnery=1.7377,9.9999MeV* CCC*** ***** sdeferg=d1pos=00 -44.0vec=001dir=d2wgt=1.0 sb2 -314.0 si14.0867 -024.6308 -02 5.2474 -025.9461 -026.7378 -027.6349 -028.6515 -02 -021.1109 -011.2588 -011.4264 -011.6163 -01 9.8035 -012.0754 -012.3517 -012.6649 -013.0197 -01 1.8315 -013.8774 -014.3936 -014.9786 -015.6415 -01 3.4217 -017.2438 -018.2084 -019.3013 -011.0540+00 6.3927 1.1943+001.3533+001.5335+001.7377+001.8498+00 1.9691+002.0961+002.2313+002.3752+002.5284+00 2.6914+002.8650+003.0498+003.2465+003.4559+00 3.6787+003.9160+004.1686+004.4374+004.7236+00 5.0282+005.3525+005.6978+006.0652+006.4564+00 6.8728+007. 3161+007.7879+008.2902+008.8249+00 9.3940+009.9999+001.0157+011.0317+011.0480+01 1.0645+011.0812+011.0983+011.1156+011.1331+01 1.1510+011.1691+011.1875+011.2062+011.2252+01 1.2445+011.2641+011.2840+ 011.3042+011.3248+01 1.3456+011.3668+011.3883+011.4102+011.4324+01 1.4550+011.4779+011.5012+011.5248+011.5488+01 1.5732+011.5980+011.6231+011.6487+01 -04 sp101.4214 -042.3162 -042.1327 -042.7087 -042.6032 -04 2.1261 3.1949 -043.7848 -044.3099 -044.4082 -045.6289 -04 -047.5334 -048.3566 -041.0281 -031.1620 -03 6.0267 -031.5339 -031.8001 -032.0387 -032.3534 -03 1 3881 2.6401 -032.9843 -033.2787 -033.4783 -033 .7189-03 -034.0062 -034.1197 -034.084 -032.0343 -03 3.8514 2.0484 -032.0263 -031.9854 -032.0112 -032.0467 -03 -032.2558 -032.4800 -032.0399 -031.7933 -03 2.1441 1.6234 -031.5383 -031.4642 -031.4261 -031.3083 -03 1.31 77-031.1970 -031.1469 -031.0180 -031.0084 -03 1.0841 -039.6395 -049.2930 -049.1702 -041.1141 -03

```
-031.2724 -033.1532 -043.2121 -043.2516 -04
1.1989
3.9020
       -044.3484 -044.3993 -044.9814 -045.7884 -04
5.8531
        -047.1724 -04 1.1255-031.1435 -031.2050 -03
        -032.3827 -032.4186 -035.2339 -035.8254 -03
2.3468
5.9374
        -032.4164 -023.5089 -023.5570 -029.9593 -02
1.8264
        -011.8583 -011.6377 -018.7669 -028.9130 -02
8.7095 -021.0017 -031.0217 -030
c
c*materialspecificationcards*
c -----iron(fe) -----
  ---air
С
m17014.60c3.8810 -58016.6 0c1.0400 -5
c ---sus316:Cr=1.6787 -2,Mn55=1.3420 -3,Fe -6.0507-2,Ni=7.3429 -3
m224050.60c7.2940 -424052.60c1.4066 -224053.60c1.5948 -3
24054.60c3.9701 -4
25055.60c1.3420
                -3
26054.60c3.5699
                -326056.60c5.5497 -226057.60c1.270 6-3
26058.60c1.6942
               -4
28058.60c5.0130
               -328060.60c1.9165 -328061.60c8.2975 -5
               -428064.60c6.6820 -5
28062.60c2.6361
c ---al
cm313027.60c3.6244 -3wrongdensity!
m313027.60c1.0
с ---о
m48016.60c4.2947 -2
cdrxs
c*tallyspecificationcards*
fc5 --//fluxesat5ptdts(th=0.0,12.2,24.9,41.8,66.8deg)
f5:n0.00703.0
                    0001
148.79730688.21481
298.01630642.02121
477.49810534.05261
676.23070289.83281
dd0.5100
e04.0867 -024.6308 -02
5. 2474-025.9461 -026.7378 -027.6349 -028.6515 -02
9.8035 -021.1109 -011.2588 -011.4264 -011.6163 -01
1.8315 -012.0754 -012.3517 -012.6649 -013.0197 -01
        -013.8774 -014.3936 -014.9786 -015.6415 -01
3.4217
       -017.2438 -018.2084 -019.3013 -011.0540+00
6.3927
1.1943+001.3533+001.5335+001.7377+001.8498+00
1.9691+002.0961+002.2313+002.3752+002.5284+00
2.6914+002.8650+003.0498+003.2465+003.4559+00
                              .4374+004.7236+00
3.6787+003.9160+004.1686+004
5.0282+005.3525+005.6978+006.0652+006.4564+00
6.8728+007.3161+007.7879+008.2902+008.8249+00
9.3940+009.9999+001.0157+011.0317+011.0480+01
1.0645+011.0812+011.0983+011.1156+011.1331
                                            +01
1.1510+011.1691+011.1875+011.2062+011.2252+01
1.2445+011.2641+011.2840+011.3042+011.3248+01
1.3456+011.3668+011.3883+011.4102+011.4324+01
1.4550+011.4779+011.5012+011.5248+011.5488+01
1.5732 +011.5980+011.6231+011.6487+01
fa0ef
c*problemcutoffcards*
-02 -10 -0.01
cut:n04.0000
nps2000000
cctme180
prdmp1000001000000
lost1010
print
```

4.0th ers

LEAKAGEFROMALUMINIUM(40CMDIA)SPHERE3 \$COGinput/PureAluminiumsphere BASIC neutron photon cm MeV sec SURFACES 1SPHERE10.0 2SPHERE10.2 3SPHERE19.75 4SPHERE19.95 **5SPHERE580.0** 6SPH ERE581.0 GEOMETRY sector1sec1 -1 sector2sec2 -4+1 sector3sec3 -5+4 sector4sec4 -6+5 Boundaryvacuum+6 MIX NLIB=ENDFB6R7 \$PureAluminium mat1w -p1.223130271.0 ASSIGN-M 10213040 ASSIGN-MC 1yellow \$AluminiumSphere 2sky \$air 3gray \$steel Oorange \$void WALK -ENERGY photonregion2to40.299 SOURCE npart=5000000 increment1.p=1e=1a=1 defineposition=1point0.0.0. defineangle=1isotropic defineenergy=1neutron 1.00e-01 bin 0.0000e+001.12e -010.0000e+001.26e -01 8.4667e-031.41e -013.2078e -031.59e -01 1.3347e-021.78e -011.2373e -022.00e -01 8.6500e-032.24e -011.5593e -022.52e -01 1.2494e-022.83e -011.3988e -023.17e -01 1.5797e-023.56e -011.5289e -024.00e -01 1.3567e-024.49e -011.5602e -025.04e -01 1.7710e-025.66e -011.7159e -026.35e -01 1.8103e-027.13e -011.8575e -028.00e -01 1.9821e-028.78e -011.8093e -029.64e -01 1.7351e-021.06e+001.7029e -021.16e+00 1.5965e-021.28e+001.4584e -021.40e+00 1.3317e-021.54e+001.2404e -021.7 0e+00 1.1572e-021.87e+001.0800e -022.06e+00 9.5885e-032.27e+008.9913e -032.50e+00 1.0250e-022.70e+001.5245e -022.92e+00 6.2689e-033.16e+005.1440e -033.42e+00 5.1821e-033.70e+004.6545e -034.00e+00 4.3103e-034.17e+003.7343e -034.34e+00

-DSURFACETALLY(ENDF/B -VI)

3.6391e-034.52e+003.3128e -034.70e+00 3.3134e-034.90e+003.0738e -035.10e+00 2.7431e-035.31e+002.3868e -035.53e+00 2.3026e-035.76e+002.2924e -036.00e+00 2.0672e-036.24e+002.2438e -036.50e+00 2.0343e-036.77e+001.8109e -037.04e+00 1.6829e-037.33e+001.766 7e-037.63e+00 1.8508e-037.94e+001.6192e -038.26e+00 1.6006e-038.60e+001.7823e -038.95e+00 1.9307e-039.31e+002.0393e -039.69e+00 2.0028e-031.01e+012.1120e -031.05e+01 2.5331e-031.08e+012.7884e -031.11e+01 3.0059e-031.15e+013.6600e -031.18e+01 4.8200e-031.22e+016.1784e -031.26e+01 8.2955e-031.28e+011.0778e -021.30e+01 1.5808e-021.32e+012.9208e -021.35e+01 6.5208e-021.37e+011.4536e -011.40e+01 2.9968e-011.42e+015.1160e -011.45e+01 6.5481e-011.47e+017.3692e -011.50e+01 5.5556e-011.53e+ 013.2133e -011.55e+01 1.3621e-011.58e+015.1071e -021.61e+01 1.4721e-021.64e+01 Detector number=bcd1 boundarycounts344227327.1 BinEnergy=neutron 1.290e -31.670e -32.150e -3 -33.590e -34.64 0e-35.990e -37.740e -3 2.780e 1.000e -21.290e -21.670e -22.150e -22.780e -2 3.590e -24.640e -25.990e -27.740e -2 1.000e -11.060e -11.120e -11.190e -1 1.260e -11.340e -11.410e -11.500e -11.590e -1 1.680e -11.780e -11.890e -12.000e -12.120e -1 2.240e -12.520e -12.830e -13.170e -13.560e -1 4.000e -14.490e -15.040e -15.660e -16.350e -1 7.130e -18.000e -18.780e -19.640e -11.058e+0 1.162e+01 .275e+01.400e+01.542e+01.698e+0 1.871e+02.061e+02.270e+02.500e+02.704e+0 2.924e+03.162e+03.419e+03.699e+04.000e+0 4.165e+04.337e+04.516e+04.703e+04.897e+0 5.099e+05.310e+0 5.529e+05.757e+05.995e+0 6.242e+06.500e+06.765e+07.041e+07.327e+0 7.627e+07.938e+08.261e+08.598e+08.949e+0 9.314e+09.693e+01.009e+11.050e+11.082e+1 1.114e+11.148e+11.183e+11.218e+11.25 5e+1 1.277e+11.300e+11.324e+11.348e+11.372e+1 1.397e+11.422e+11.447e+11.474e+11.500e+1 1.527e+11.554e+11.583e+11.611e+11.640e+1 number=bcd2 boundary344227327.1 BinEnergy =photon 3.0E -014.0E -015.0E -016.0E -01 7.0E -018.0E -019.0E -011.0E+00 1.10E+001.20E+001.30E+001.40E+00 1.50E+001.60E+001.70E+001.80E+00 1.90E+002.00E+002.1 0E+002.20E+00 2.30E+002.40E+002.50E+002.60E+00 2.70E+002.80E+002.90E+003.10E+00 3.20E+003.30E+003.40E+003.50E+00 3.60E+003.70E+003.80E+003.90E+00 10E+004.20E+004.30E+00 4 00F+004 4.40E+004.50E+004.60E+004.70E+00 4.80E+004.90E+005.00E+005.10E+00 5.20E+005.30E+005.40E+005.50E+00 5.60E+005.70E+005.80E+005.90E+00 6.00E +006.20E+006.40E+006.60E+00 6.80E+007.00E+007.20E+007.40E+00 7.60E+007.80E+008.00E+008.20E+00

8.40E+008.60E+008.80E+009.00E+00 9.20E+009.40E+009.60E+009.80E +00 1.00E+011.04E+011.08E+011.12E+01 1.16E+011.20E+011.24E+011.28E+01 1.32E+011.36E+011.40E+011.44E+01 1.48E+011.52E+011.56E+011.60E+01 1.64E+011.6 8E+011.72E+011.76E+01 1.80E+011.84E+011.88E+011.92E+01 1.96E+012.00E+01

END

```
-DSURFACETALLY(ENDF/B -VI)
```

CMCNPinput/ Purealuminiumsphere c***Cellcards*** 10 -1 21 -1.223 -21 30 -32 403 c***Surfacecards*** 1so10.0 2so19.95 3so580.0 c***Materialcards*** cAluminium m113027.60c -1. c***Datacards*** modenp imp:n1110 imp:p1110 sdefpos=0 .0.0.erg=d1 c***Energybinforsourceneutron*** si1h1.000e -11.120e -11.260e -11.410e -11.590e -1 1.780e -12.000e -12.24 0e-12.520e -12.830e -1 -13.560e -14.000e -14.490e -15.040e -1 3.170e -16.350e -17.130e -18.000e -18.780e -1 5.660e -11.058e+01.162e+01. 275e+01.400e+0 9.640e 1.542e+01.698e+01.871e+02.061e+02.270e+0 2.500e+02.704e+02.924e+03.162e+03.419e+0 3.699e+04.000e+04.165e+04.337e+0 4.516e+0 4.703e+04.897e+05.099e+05.310e+05.529e+0 5.757e+05.995e+06.242e+06.500e+06.765e+0 7.041e+07.327e+07.627e+07.938e+08.261e+ 0 8.598e+08.949e+09.314e+09.693e+01.009e+1 1.050e+11.082e+11.114e+11.148e+11.183e+1 1.218e+11.255e+11.277e+11.300e+11.324e+1 1.348e+11.372e+11.397e+11.422e+11.447e+1 1.474e+11.500e+11.527e+11.554e+11.583e+1 1.611e+11.640e+1 c***Sourcedistribution*** sp10.000e -40.000e -00.000e -01.270e -45.774e -5 2.536e -42.722e -42.076e -44.366e -43.873e -4 4.756e -46.161e -46.727e -46.648e -48.581e -4 1.098e -31.184e -31.412e -31.616e -31.546e -3 -31.631e -31.771e -31.804e -31.823e -3 1.556e 1.891e -31.935e -32.0 02e-32.052e -32.004e -3 2.068e -32.091e -33.354e -31.492e -31.322e -3 1.451e -31.401e -37.112e -46.423e -46.514e -4 -46.428e -46.209e -45 .788e-45.227e -4 6.195e 5.250e -45.456e -45.106e -45.789e -45.391e -4 4.998e -44.813e -45.300e -45.756e -45.230e -4 5.394e -46.256e -47.047e -47.729e -47.951e -4 8.659e -48.106e -48.923e -41.022e -31.281e -3 -32.286e -31.825e -32.479e -33.794e -3 1.687e 7.010e -31.565e -23.634e -27.492e -21.279e -1 1.768e -11.916e -11.500e -18.676e -23.950e -2 1.430e -24.269e -3 c***Tallycards*** fc21Neutroncurrentthroughtheoutersurface f21:n3 c***Energybin*** e211.290e -31.670e -32.150e -3 2.780e -3 3.590e-34.640e -35.990e -37.740e -3 1.000e -21.290e -21.670e -22.150e -22.780e -2 3.590e -24.640e -25.990e -27.740e -2 1.000e -11.060e -11.12 0e-11.190e -1 -11.340e -11.410e -11.500e -11.590e -1 1.260e -11.780e -11.890e -12.000e -12.120e -1 1.680e -12.520e -12.830e -13.170e -13.560e -1 2.240e 4.000e -14.490e -15.040e -15.660e -16.350e -1

LEAKAGEFROMALUMINIUM(40CMDIA)SPHERE3

```
7.130e -18.000e -18.780e -19.640e -11.058e+0
1.162e+01.275e+01.400e+01.542e+01.698e+0
1.871e+02.061e+02.270e+02.500e+02.704e+0
2.924e+03.162e+03.419e+03.699e+04.000e+0
4.165e+04.337e+04.516e+04.703e+04.897e+0
5.099e+05.310e+05.529e+05.757e+05.995e+0
    .242e+06.500e+06.765e+07.041e+07.327e+0
6
7.627e+07.938e+08.261e+08.598e+08.949e+0
9.314e+09.693e+01.009e+11.050e+11.082e+1
1.114e+11.148 e+11.183e+11.218e+11.255e+1
1.277e+11.300e+11.324e+11.348e+11.372e+1
1.397e+11.422e+11.447e+11.474e+11.500e+1
1.527e+11.554e+11.583e+1
                             1.611e+11.640e+1
fc32Photonfluxthroughtheoutersurface
f32:p3
c***Energybin***
e320.356i6.019i10.024i20
С
cphys:n20.00
cphys:p20.000
c***Cutoffcard***
ccut:n1.0e60.0
                  -0.5 -0.250
ccut:p1.0e60.299 -0.5 -0.250
c***Neutronhistory***
nps5000000
cnps10000
print
```

LEAKAGEFROMIRON(40CMDIA)SPHERE3 \$COGInputPureIronsphere

BASIC neutron ph oton cm MeV sec SURFACES 1SPHERE10.0 2SPHERE10.2 **3SPHERE19.75** 4SPHERE19.95 **5SPHERE580.0** 6SPHERE581.0 GEOMETRY sector1sec1 -1 sector2sec2 -4+1 sector3sec3 -5+4 sector4sec4 -6+5 Boundaryvacuum+6 MIX NLIB=ENDFB6R 7 \$PureFe -56 mat1w -p7.8260561.0 ASSIGN-M 10213040 ASSIGN-MC 1yellow \$AluminiumSphere 2sky \$air \$steel 3gray Oorange \$void WALK -ENERGY photonregion2to40.299 SOURCE npart=5000000 increment1.p=1e=1 a=1 defineposition=1point0.0.0. defineangle=1isotropic defineenergy=1neutron bin 1.00E-01 0.0000E+001.12E -010.0000E+001.26E -01 8.4667E-031.41E -013.2078E -031.59E -01 1.3347E-021.78E -011.2373E -022.00E -01 8.6500E-032.24E -011. 5593E-022.52E -01 1.2494E-022.83E -011.3988E -023.17E -01 1.5797E-023.56E -011.5289E -024.00E -01 1.3567E-024.49E -011.5602E -025.04E -01 1.7710E-025.66E -011.7159E -026.35E -01 1.8103E-027.13E -011.8575E -028.00E -01 1.9821E-028.78E -011.8093E -029.64E -01 1.7351E-021.06E+001.7029E -021.16E+00 1.5965E-021.28E+001.4584E -021.40E+00 1.3317E-021.54E+001.2404E -021.70E+00 1.1572E-021.87E+001.0800E -022.06E+00 9.5885E-032.27E+008.9913E -032.50E+00 1.0250E-022.70E+001.5245E -022.92E+00 6.2689E-033.1 6E+005.1440E -033.42E+00 5.1821E-033.70E+004.6545E -034.00E+00 4.3103E-034.17E+003.7343E -034.34E+00

3.6391E-034.52E+003.3128E -034.70E+00 3.3134E-034.90E+003.0738E -035.10E+00 2.7431E-035.31E+002.3868E -035.53E+00 2.3026E-035.76E+002.2924E -036.00E+00 2.0672E-036.24E+002.2438E -036.50E+00 2.0343E-036.77E+001.8109E -037.04E+00 1.6829E-037.33E+001.7667E -037.63E+00 1.8508E-037.94E+001.6192E -038.26E+00 1.6006E-038.60E+001.7823E -038.95E+00 1.9307E-039.31E+002.0393E -039.69E+00 2.0028E-031.01E+012.1120E -031.05E+01 2.5331E-031.08E+012.7884E -031.11E+01 3.0059E-031.15E+013.6600E -031.18E+01 4.8200E-031.22E+016.1784E -031.26E+01 8.2955E-031.28E+011.0778E -021.30E+01 1.5808E-021.32E+012.9208E -021.35E+01 6.5208E-021.37E+011 .4536E-011.40E+01 2.9968E-011.42E+015.1160E -011.45E+01 6.5481E-011.47E+017.3692E -011.50E+01 5.5556E-011.53E+013.2133E -011.55E+01 1.3621E-011.58E+015.1071E -021.61E+01 1.4721E-021.64E+01 Detector number=bcd1 boundarycounts344227 327.1 BinEnergy=neutron 1.290e -31.670e -32.150e -3 -33.590e -34.640e -35.990e -37.740e -3 2.780e -21.290e -21.670e -22.150e -22.780e -2 1.000e 3.590e -24.640e -25.990e -27.740e -2 1.000e -11.060e -11.120e -11.190e -1 1.260e -11.340e -11.410e -11.500e -11.590e -1 -11.780e -11.890e -12.000e -12.120e -1 1.680e 2.240e -12.520e -12.830e -13.170e -13.560e -1 -14.490e -15.040e -1 5.660e-16.350e -1 4.000e -18.000e -18.780e -19.640e -11.058e+0 7 130e 1.162e+01.275e+01.400e+01.542e+01.698e+0 1.871e+02.061e+02.270e+02.500e+02.704e+0 2.924e+03.162e+03.419e+ 03.699e+04.000e+0 4.165e+04.337e+04.516e+04.703e+04.897e+0 5.099e+05.310e+05.529e+05.757e+05.995e+0 6.242e+06.500e+06.765e+07.041e+07.327e+0 7.627e+07.938e+08.261e+08.598e+0 8.949e+0 9.314e+09.693e+01.009e+11.050e+11.082e+1 1.114e+11.148e+11.183e+11.218e+11.255e+1 1.277e+11.300e+11.324e+11.348e+11.372e+1 1.397e+11.422e+11.447e+11.474e+11.500e+1 1. 527e+11.554e+11.583e+11.611e+11.640e+1 number=bcd2 boundary344227327.1 BinEnergy=photon -015.0E -016.0E -01 3.0E -014.0E -019.0E -011.0E+00 7.0E -018.0E 1.10E+001.20E+ 001.30E+001.40E+00 1.50E+001.60E+001.70E+001.80E+00 1.90E+002.00E+002.10E+002.20E+00 2.30E+002.40E+002.50E+002.60E+00 2.70E+002.80E+002.90E+003.10E+00 3.20E+0 03.30E+003.40E+003.50E+00 3.60E+003.70E+003.80E+003.90E+00 4.00E+004.10E+004.20E+004.30E+00 4.40E+004.50E+004.60E+004.70E+00 4.80E+004.90E+005.00E+005.10E+00 5.20E+005.30E+005.40E+005.50E+00 5.60E+005.70E+005.80E+005.90E+00 6.00E+006.20E+006.40E+006.60E+00 6.80E+007.00E+007.20E+007.40E+00 7.60E+007.80E+008.00E+00 8.20E+00

8.40E+008.60E+008.80E+009.00E+00 9.20E+009.40E+009.60E+009.80E+00 1.00E+011.04E+011.08E+011.12E+01 1.16E+011.20E+011.24E+011.28E+01 1.32E+011. 36E+011.40E+011.44E+01 1.48E+011.52E+011.56E+011.60E+01 1.64E+011.68E+011.72E+011.76E+01 1.80E+011.84E+011.88E+011.92E+01 1.96E+012.00E+01

END

CMCNPinputPureironsphere c***Cellcards*** 10 -1 21 -7.8 -21 30 -32 403 c***Surfacecards*** 1so10.0 2so19.95 3so580.0 c***Materialcards*** clron m126056.60c -1. c***Datacards*** modenp imp:n1110 imp:p1110 sdefpos=0.0.0.cel=1erg=d1 c***Energybinforsourceneutron*** si1h1.000e -11.120e -11.260e -11.410e -11.590e -1 1.780e -12.000e -12.240e -12.520e -12.830e -1 -13.560e -14.000e -14.490e -15.040e -1 3.170e e-16.350e -17.130e -18.000e -18.780e -1 5.660 -11.058e+01.162e+01.275e+01.400e+0 9.640e 1.542e+01.698e+01.871e+02.061e+02.270e+0 2.500e+02.7 04e+02.924e+03.162e+03.419e+0 3.699e+04.000e+04.165e+04.337e+04.516e+0 4.703e+04.897e+05.099e+05.310e+05.529e+0 5.757e+05.995e+06 .242e+06.500e+06.765e+0 7.041e+07.327e+07.627e+07.938e+08.261e+0 8.598e+08.949e+09.314e+09.693e+01.009e+1 1.050e+11.082e+11.114e+1 1.148e+11.183e+1 1.218e+11.255e+11.277e+11.300e+11.324e+1 1.348e+11.372e+11.397e+11.422e+11.447e+1 1.474e+11.500e+11.527e+11.554e +11.583e+1 1.611e+11.640e+1 c***Sourcedistribution*** sp10.000e -40.000e -00.000e -01.270e -45.774e -5 2.536e -42.722e -42.076e -44.366e -43.873e -4 4.756e -46.161e -46.727e -46.648e -48.581e -4 1.098e -31.184e -31.412e -31.616e -31.546e -3 1.556e -31.631e -31.771e -31.804e -31.823e -3 1.891e -31.935e -32.002e -32.052e -32.004e -3 2.068e -32.091e -33.354e -31.492e -31.322e -3 1.45 1e-31.401e -37.112e -46.423e -46.514e -4 6.195e -46.428e -46.209e -45.788e -45.227e -4 5.250e -45.456e -45.106e -45.789e -45.391e -4 4.998e -44. 813e-45.300e -45.756e -45.230e -4 5.394e -46.256e -47.047e -47.729e -47.951e -4 8.659e -48.106e -48.923e -41.022e -31.281e -3 -32.286e -3 1.825e-32.479e -33.794e -3 1.687e 7.010e -31.565e -23.634e -27.492e -21.279e -1 1.768e -11.916e -11.500e -18.676e -23.950e -2 1.430e -24.269e -3 c***Tallycards*** fc21Neutroncurrentthroughtheoutersurface f21:n3 c***Energybin*** e211.290e -31.670e -32.150e -3 2.780e -33.590e -34.640e -35.990e -37.740e -3 1.000e -21.290e -21.670e -22.150e -22.780e -2 3.590e -24.640e -25.990e -27.740e -2 1.000e -11.060e -11.120e -11.190e -1 -11.340e -11.410e -11.500e -11.590e -1 1.260e -11.780e -11.890e -12.000e -12.120e -1 1.680e -12.520e -12.830e -13.1 70e-13.560e -1 2.240e 4.000e -14.490e -15.040e -15.660e -16.350e -1

LEAKAGEFROMIRON(40CMDIA)SPHERE3

```
7.130e -18.000e -18.780e -19.640e -11.058e+0
1.162e+01.275e+01.400e+01.542e+01.698e+
                                                0
1.871e+02.061e+02.270e+02.500e+02.704e+0
2.924e+03.162e+03.419e+03.699e+04.000e+0
4.165e+04.337e+04.516e+04.703e+04.897e+0
5.099e+05.310e+05.529e+05.757e+05.995e+0
6.242e+06.500e+06.765e+07.041e+07.327e+0
7.627e+07.938e+08.261e+08.598e+08.949e+0
9.314e+09.693e+01.009e+11.050e+11.082e+1
1.114e+11.148e+11.183e+11.218e+11.255e+1
1.277e+11.300e+11.324e+11.348e+11.372e+1
   .397e+11.422e+11.447e+11.474e+11.500e+1
1
1.527e+11.554e+11.583e+11.611e+11.640e+1
fc32Photoncurrentthroughtheoutersurface
f32:p3
cfm324227327.1$4*Pi*R7
cfq32et
c***Energybin***
e320.356i6.019i10.024i20
ct328.81e6t
С
phys:n20.00
phys:p20.000
c***Cutoffcard***
cut:n1.0e60.0 -0.5 -0.250
cut:p1.0e60.299 -0.5 -0.250
c***Neutronhistory***
nps5000000
cnps10000
print
```

PureNisphereR=16cm,Sphericalmodel,ENDF/B -VI,Source -2/Isotropic \$COGinput \$ BASIC neutron photon SURFACES 1SPHERE2.50 2SPHERE10.00 3SPHERE16.00 \$addsphere4 4SPHERE17. 00 GEOMETRY sector1sec1 -1 sector2sec21 -2 sector3sec32 -3 sector4sec4+3 -4 BOUNDARYVACUUM+4 MIX \$Nickelwithimpurities(expressedasweightpercent). NLIB=ENDFB6R7 mat1280580.67144280600.26554280610.01169 5280640.00988 280620.0377 140000.0016250550.0015260560.0004 120000.0001290637e -05290653e -05 mat2#180160.208 70140.792 ASSIGN-MD\$sector#material#density 120.0012218.85318.85400 SOURCE npart= 3000000 INCREMENT1.P=1E=1 DEFINEPOSITION=1 POINT0.0.0. DEFINEENERGY=1NEUTRON BIN 1.2600E-01 1.1200E -016.5541E -06 6.5541E-04 1.4100E-012.2939E -03 1.5900E-01 2.6216E-03 1.7800E-013.9928E -03 2.0000E-01 1.0296E-02 2.2400E-011.196 8E-02 2.5200E-01 2.8300E-011.0906E -02 1.1850E-02 3.1700E-01 1.4629E-02 3.5600E-011.4091E -02 4.0000E-01 4.4900E-011.6339E -02 5.0400E-01 1.2735E-02 1.6221E-02 5.6600E-011.7565E -02 6.3500E-01 1.6536E-02 7.1300E-011.6936E -02 8.0000E-01 8.7800E-011.6490E -02 1.7598E-02 9.6400E-01 1.5481E-02 1.0580E+001.5717E -02 1.1620E+00 1.4557E-02 1.2750E+001.3338E -02 1.4000E+00 1.3095E-02 1.5420E+001.1253E -02 1.6980E+00 1.1312E-02 1.8710E+001.0349E -02 2.0610E+00 8.8415E-03 2.2700E+008.0550E -03 2.5000E+00 8.3761E-03 2.7040E+001.0585E -02 2.9240E+00 3.1620E+005.6850E -03 6.3286E-03 3.4190E+00 5.0775E-03 3.6990E+004.6849E -03 4.0000E+00 4.4279E-03 4.1650E+004.2779E -03 4.3370E+00 3.6906E-03 4.5160E+003.6801E -03 4.7030E+00 3.6637E-03 4.8970E+003.6336E -03 5.0990E+00 3.3079E-03 5.3100E+003.5877E -03 5.5290E+00 3.0103E-03 5.7570E+002.9408E -03 5.9950E+00 3.0824E-03 6.2420E+003.1080E -03 6.5000E+00 3.2377E-03 6.7650E+003.0522E -03 7.0410E+00 2.9520E-03 7.3270E+003.2109E -03 7.6270E+00 7.9380E+002.6518E -03 2.8320E-03 8.2610E+00 3.1650E-03 8.5980E+003.1211E -03 8.9490E+00 2.9828E-03 9.3140E+003.6074E -03 9.6930E+00 3.7018E-03 1.0089E+013.8754E -03 1.0500E+01

4 5793E-03	1 0817E+015 0132E -03	1 1143E+01
5 2859E-03	1 1479E+016 1353E -03	1 1825E+01
6 8621E-03	1 2182E+018 4810E -03	1 2549E+01
9.8180E-03	1.2775E+011.1627E -02	1.3005E+01
1.4255E-02	1.3239E+011.9066E -02	1.3477E+01
2.7396E-02	1.3720E+015.0001E -02	1.3967E+01
1.3141E-01	1.4218E+013.9515E -01	1.4474E+01
7.1112E-01	1.4735E+018.2254E -01	1.5000E+01
6.3109E-01	1.5270E+01 4.3880E-01	1.5545E+01
1.7250E-01	1.5825E+015.0801E -02	1.6110E+01
1.0493E-02	1.6399E+01	

DETECTOR

\$LeakageNeutronSpectrumonsurfaceofsphere3 number=bc1 Boundarycounts343217. BINENERGY=neutron 6.000E -057.740E -051.000E -041 .290E-041.670E -042.150E -04 -043.590E -044.640E -045.990E -047.740E -041.000E -03 2.780E 1.290E -031.670E -032.150E -032.780E -033.590E -034.640E -03 -037.740E -031.000E -021.290E -021.670E -022.150E -02 5.990E -022.780 E-023.159E -023.590E -024.081E -024.640E -02 -025.990E -026.809E -027.740E -028.798E -021.000E -01 2.445E 5.272E 1.120E -011.260E -011.410E -011.590E -011.780E -012.000E -01 2.240E -012.520E -012.830E -013.170E -013.560E -014.000E -01 4.490E -015.040E -015.660E -016.350E -017.130E -018.000E -01 -019.640E -011.058E+001.162E+001.275E+001.400E+00 8.780E 1.542E+001.698E+001.871E+002.061E+002.270E+002.500E+00 2.704E+002.924E+003.162E+003.419E+003.699E+00 4.000E+004.165E+004.337E+004.516E+004.703E+004.897E+00 5.099E+005.310E+005.529E+005.757E+005.995E+006.242E+00 6.500E+006.765E+007.041E+007.327E+007.627E+007.938E+00 8.261E+008.598E+008.949E+009.314E+009.693 E+001.009E+01 1.050E+011.082E+011.114E+011.148E+011.183E+011.218E+01 1.255E+011.277E+011.300E+011.324E+011.348E+011.372E+01 1.397E+011.422E+011.447E+011.474E+011.500E+011.527E+01 1.555E+011.583E+011.611E+01 1.640E+01 \$LeakageNeutronSpectrumonsurfaceofsphere3 number=bc2 Boundary343217. BINENERGY=photon -015.0E -016.0E 3.0E -014.0E -01 -019.0E -011.0E+00 7.0E -018.0E 1.10E+001.20E+00 1.30E+001.40E+00 1.50E+001.60E+001.70E+001.80E+00 1.90E+002.00E+002.10E+002.20E+00 2.30E+002.40E+002.50E+002.60E+00 2.70E+002.80E+002.90E+003.10E+00 3.20E+00 3.30E+003.40E+003.50E+00 3.60E+003.70E+003.80E+003.90E+00 4.00E+004.10E+004.20E+004.30E+00 4.40E+004.50E+004.60E+004.70E+00 4.80E+004.90E+005.00E+005.10E+00 5.20E+005.30E+005.40E+005.50E+00 5.60E+005.70E+005.80E+005.90E+00 6.00E+006.20E+006.40E+006.60E+00 6.80E+007.00E+007.20E+007.40E+00 7.60E+007.80E+008.00E+008 .20E+00 8.40E+008.60E+008.80E+009.00E+00 9.20E+009.40E+009.60E+009.80E+00 1.00E+011.04E+011.08E+011.12E+01 1.16E+011.20E+011.24E+011.28E+01 1.32E+011.36E+ 011.40E+011.44E+01 1.48E+011.52E+011.56E+011.60E+01 1.64E+011.68E+011.72E+011.76E+01

1.80E+011.84E+011.88E+011.92E+01

1.96E+012.00E+01

END

PureNisphereR=16 cm,Sphericalmodel,ENDF/B -VI,Source -2/Isotropic CMCNPinput -0.0012 -1imp:n=1 12 -8.851 -2imp:n=1 21 31 -8.852 -3imp:n=1 403imp:n=0 1so2.502so10.00 so16.00 3 modenp imp:p1110 sdeferg=d1pos=000 CSourcespectrum -2(fromsampleMCNPinput) SI1H -011.2600E -011.4100E -011.5900E -011.7800E -01 1.1200E -012.2400E -012.5200E -012.8300E -013.1700E -01 2.0000E -014.0 000E-014.4900E -015.0400E -015.6600E -01 3.5600E 6.3500E -017.1300E -018.0000E -018.7800E -019.6400E -01 1.0580E+001.1620E+001.2750E+001.4000E+001.5420E+00 1.6980E+001.8710E+002.0610E+002.2700E+002.5000E+00 3.1620E+003.4190E+003.6990E+00 2.7040E+002.9240E+00 4.0000E+004.1650E+004.3370E+004.5160E+004.7030E+00 4.8970E+005.0990E+005.3100E+005.5290E+005.7570E+00 5.9950E+006.2420E+006.5000E+006.7650E+007.0410E+00 7.3270E+007.6270E+007.9380E+ 008.2610E+008.5980E+00 8.9490E+009.3140E+009.6930E+001.0089E+011.0500E+01 1.0817E+011.1143E+011.1479E+011.1825E+011.2182E+01 1.2549E+011.2775E+011.3005E+011.3239E+011.3477E+01 1.3720E+011.3967E+011.4218E+011.447 4E+011.4735E+01 1.5000E+011.5270E+011.5545E+011.5825E+011.6110E+01 1.6399E+01 SP1 0.0000E+009.1757E -089.8311E -064.1291E -054.9811E -05 8.7841E -052.4712E -043.3510E -043.6734E -043.7080E -04 -046.2002E -046. 2400E-048.9866E -041.0057E -03 5.7052E 1.2120E -031.2898E -031.4734E -031.3726E -031.4181E -03 -031.6345E -031.6449E -031.6672E -031.8595E -03 1.4552F -031.9570E -031.9663E -031.8479E -031.8526E -03 1.7555E -032.3287E -031.5062E -031.4611E -031.4217E -03 1.7087E 1.4101E -037.3061E -047.3579E -046.6062E -046.8818E -04 -047.3399E -046.9796E -047.8571E -046.8635E -04 7.1076E 6.9992E -047.6135E -048.0185E -048.5800E -048.4242E -04 -049.6325E -048.8076E -048.5653E -041.0666E -03 8.4426E -031.0887E -031.3672E -031.4659E -031.5928E -03 1.0955E -031.6343E -031.7761E -032.1228E -032.4498E -03 1.4517E 3.1125E -032.2189E -032.6742E -033.3357E -034.5377E -03 -031.2350E -023.2984E -021.0116E -011.85 60E-01 -011.7040E -011.2067E -014.8301E -021.4478E -02 6.6573E 2.1797E 3.0325F -03 CNickelwithimpurities(expressedasweightpercent). M128058.60C -0.6714428060.60C -0.2655428061.60C -0.01169 28062.60C -0.0377528064.60C -0.00988 14000 60C -0.001625055.60C -0.001526056.60C -0.0004 -0.000129063.60C -0.0000729065.60C -0.00003 12000.60C M28016.60C0.208 7014.60C0.792 fc1LeakageNeutronSpectrumontheSphereSurface f1:n3 e16.000E -057.7 40E-051.000E -041.290E -041.670E -042.150E -04 -043.590E -044.640E -045.990E -047.740E -041.000E -03 2.780E -031.670E -032.150E -032.780E -033.590E -034.640E -03 1.290E -037.740E -031.000E -021.290E -021.670E -022.150E -02 5.990E .445E-022.780E -023.159E -023.590E -024.081E -024.640E -02 -025.990E -026.809E -027.740E -028.798E -021.000E -01 2 5.272F -011.260E -011.410E -011.590E -011.780E -012.000E -01 1.120E -012.520E -012.830E -013.170E -013.560E -014.000E -01 2.240E -015.040E -015.660E -016.350E -017.130E -018.000E -01 4.490E 8.780E -019.640E -011.058E+001.162E+001.275E+001.400E+00

```
1.542E+001.698E+001.871E+002.061E+002.270E+002.500E+00
2.704E+002.924E+003.162E+003.419E+003.69
                                               9E+00
4.000E+004.165E+004.337E+004.516E+004.703E+004.897E+00
5.099E+005.310E+005.529E+005.757E+005.995E+006.242E+00
6.500E+006.765E+007.041E+007.327E+007.627E+007.938E+00
8.261E+008.598E+008.949E+009.314E+009.
                                             693E+001.009E+01
1.050E+011.082E+011.114E+011.148E+011.183E+011.218E+01
1.255E+011.277E+011.300E+011.324E+011.348E+011.372E+01
1.397E+011.422E+011.447E+011.474E+011.500E+011.527E+01
1.555E+011.583E+011.611E+01
                                 1.640E+01T
fc2photonfluxonspheresurface
f2:p3
c***Energybin***
e20.356i6.019i10.024i20
nps3000000
print
```