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Calculation of Ambient ($H^*(10)$) and Personal ($H_p(10)$) Dose Equivalent from a ^{252}Cf Neutron Source

RJ Traub

March 2010



Pacific Northwest
NATIONAL LABORATORY

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RJ Traub

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Prepared for
the U.S. Department of Energy
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Pacific Northwest National Laboratory
Richland, Washington 99352

Executive Summary

The neutron emission rate from radioisotope neutron sources such as ^{252}Cf sources can be calibrated by the National Institute of Standards and Technology (NIST) by the manganous sulfite bath method. This calibration method does not compute the dose or dose equivalent rate from the source. Because there is no accepted transfer standard for neutron dose measurements, secondary calibration facilities are responsible for determining their own neutron dose factors.

This report describes a neutron source and irradiation apparatus in use at the Pacific Northwest National Laboratory Calibration Facility. The neutron source is a SR-Cf-3000 design ^{252}Cf neutron source. The neutron source is contained in an aluminum transfer capsule that is used to transport the neutron source between its storage location and its irradiation location. During irradiations, the source is located in a transfer tube assembly that consists of two concentric aluminum tubes. When moderated neutrons are desired, the transfer tube assembly is surrounded by a sphere that is filled with D_2O as a moderating medium.

Ambient dose equivalent ($H^*(10)$) and Personal dose equivalent ($H_p(10)$) dose rates and dose conversion factors were calculated for moderated and unmoderated neutron spectra based on the data provided in ICRP Publication 74. The neutron fluence-to-dose-equivalent conversion factors calculated for this report are summarized and compared to published values in Table 47. The calculated coefficients for the unmoderated ^{252}Cf spectra agree very well with published reference values, within about 2%. The calculated coefficients for the D_2O moderated ^{252}Cf spectra, however, differ from published reference values by about 22%. The PNNL coefficients are higher than the published values which could be interpreted to mean that the PNNL D_2O moderated spectrum is harder, i.e. higher average energy, than the spectrum published by the ISO (2000), which formed the basis for the published coefficients. The D_2O moderating sphere in use at PNNL contains less D_2O moderator than did the D_2O moderating sphere that was used to calculate the ISO spectrum and this is the likely reason for much of the spectral differences.

The exact location of the ^{252}Cf activity in the source encapsulation is unknown. Preliminary measurements, not described in this report, indicate that the activity may be offset from the location that has been assumed in the past. Corrections for the offset are being proposed and will be the subject of another report.

This report was written in a calculation package format to help meet various Quality Assurance requirements.

Acknowledgments

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CALCULATION COVER SHEET

SHEET 1 OF 246

CALCULATION NO:

PNNL-19273 Rev.0

TITLE:

Neutron Fluence, dose equivalent, personal dose equivalent, and ambient dose equivalent calculations for the SR-Cf-3000 neutron source in the PNNL Low Scatter Room

PURPOSE AND OBJECTIVE:

The purpose of this calculation is to calculate the neutron dose factors for the Sr-Cf-3000 neutron source that is located in the 318 low scatter room (LSR). The dose factors were based on the dose conversion factors published in ICRP-21 Appendix 6, and the Ambient dose equivalent ($H^*(10)$) and Personal dose equivalent ($H_p(10)$) dose factors published in ICRP Publication 74.

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CALCULATION REVIEW CHECKLIST

CALC NO.: PNNL-19273, REV 0

REVISION NO.: 0

SHEET NO.: 2 OF 218

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6. Criteria are suitable and properly referenced to task specific documents.	X			↓	
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8. Calc method identified and appropriate for the design activity.	X				
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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

equator can range from 0.92 cm to 2.80 cm above the equator of the sphere.

The result of the offset from the center of the moderating sphere is that the moderated neutron fluence and dose rates appear to be highly asymmetrical with respect to the midplane (equator) of the D₂O moderating sphere. Previously, the moderated neutron fluence and dose rates were assumed to be symmetric about the midplane (equator) of the D₂O moderating sphere.

This calculation package presents fluence rates and ambient dose equivalent and personal dose equivalent rates from the Sr-Cf-3000 neutron source in the 318 low scatter room for moderated and unmoderated neutrons.

CALCULATION SHEET

PROJECT NO.:	CALC No.:	REVISION NO.:	SHEET NO.:
	<u>PNNL-19273</u>	<u>0</u>	<u>5/246</u>
SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵² Cf NEUTRON SOURCE IN 318 LOW SCATTER ROOM			
PREPARED BY: <u>R.J. TRAUB</u>	DATE: <u>02/8/10</u>	REVIEWED BY: <u>R.J. MCCONN</u>	DATE: <u>03/21/10</u>

1.0 INTRODUCTION

The Monte Carlo N-Particle (MCNP), version 5.14, radiation transport code, developed at Los Alamos National Laboratory (X-5 Monte Carlo Team 2003) was used to perform the calculations described in this report. The neutron fluence was used to assess the influence of the source encapsulation. All calculated neutron fluences were binned into 53 energy groups. The binning structure was the 52-group structure used in ISO-8529 that was extended down to 10^{-11} MeV from 0.414×10^{-7} MeV to maintain consistency with previous work (Hertel and McDonald 1991).

The fluences were converted into dose equivalent rates using the dose factors of ICRP Publication 21 (ICRP 1973) and the ICRP Publication 74 (ICRP 1996) ($H_p(10)$ and $H^*(10)$). The application of the dose factors was performed using functions built into MCNP that used log-log interpolation of the published dose conversion factors. The factors from ICRP Publication 21 (ICRP 1973) were included to show consistency with previous calculations.

2.0 Geometry and Materials

The geometry is based on the geometry that exists in the Low Scatter Room of the 318 Building. When not in use, radiation sources are housed in a shielded location. The sources are transported from the shielded location to the irradiation location by means of a pneumatic transfer system. Two types of neutron irradiations are possible, moderated and unmoderated neutrons.

In the case of unmoderated neutron irradiations, the ²⁵²Cf source material is encased in a primary and secondary sealed encapsulation. The secondary encapsulation is encased in an aluminum transfer capsule that is designed to function with a pneumatic transfer system. The radiation source transfer capsule assembly is located in the irradiation position of the pneumatic transfer system which consists of two concentric tubes, base plate, and a spring to dampen the force associated with the source landing in the irradiation position. Radiation detectors are then positioned at selected distances from the ²⁵²Cf source for calibration irradiations.

In the case of moderated neutron irradiations, a 15-cm radius D₂O filled, stainless steel sphere with a 0.0508-cm thick cadmium outer layer is positioned around the transfer tubing. A second moderating sphere without a 0.05-cm (0.02-inch) thick cadmium layer is available at the 318 low scatter room but was not modeled for these calculations.

The intent of the design of the irradiation facility is that the center of the D₂O filled moderating sphere should be collocated with the center of the ²⁵²Cf radiation source. For that reason, the midplane (equator) of the D₂O moderating sphere is a reference position for the irradiations in that irradiations are planned so that approximately one-half of the sensitive volume of a radiation detector or dosimeter is located above the equator of the moderating sphere and one-half of the sensitive volume is located below the equator of the moderating sphere.

During the evolution of these calculations, it was determined that when the SR-Cf-3000 source is in its irradiation location the ²⁵²Cf activity is not located at the center of the D₂O moderating sphere but could

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be located above the equator of the sphere at a distance ranging from 0.9 cm above the equator of the sphere to 2.8 cm above the equator of the sphere.

Three geometries were investigated for this report. The first geometry, labeled "lower," places all of the activity 0.9 cm above the equator of the D₂O moderating sphere and is thought to be the most likely true geometry. The second geometry, labeled "middle," places all the ²⁵²Cf activity in the void region between the upper and lower frits of the primary encapsulation. The last geometry, labeled "upper," places all the activity 2.8 cm above the equator of the D₂O moderating sphere.

This section describes the evolution of the MCNP input files for the source encapsulation, the pneumatic transfer capsule and tubing, and the D₂O moderating sphere. This discussion, along with copies of the source drawings in Appendix A and the MCNP input file stubs in Appendix B are intended to allow future modelers to modify the MCNP input files without difficulty. This also documents what is known about the source encapsulation.

The initial hope was that the ²⁵²Cf source material would be located in a small, well defined region. It turns out that the exact location of the ²⁵²Cf activity isn't really known. The volume in which the ²⁵²Cf activity could be located is about 0.75 +/- 0.02 inches long. There is the possibility that some unknown fraction of the activity could be imbedded into one of the frits, most likely the upper frit. Some other unknown fraction of the ²⁵²Cf activity could be loose and be drifting from end to end of the void volume.

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Source encapsulation

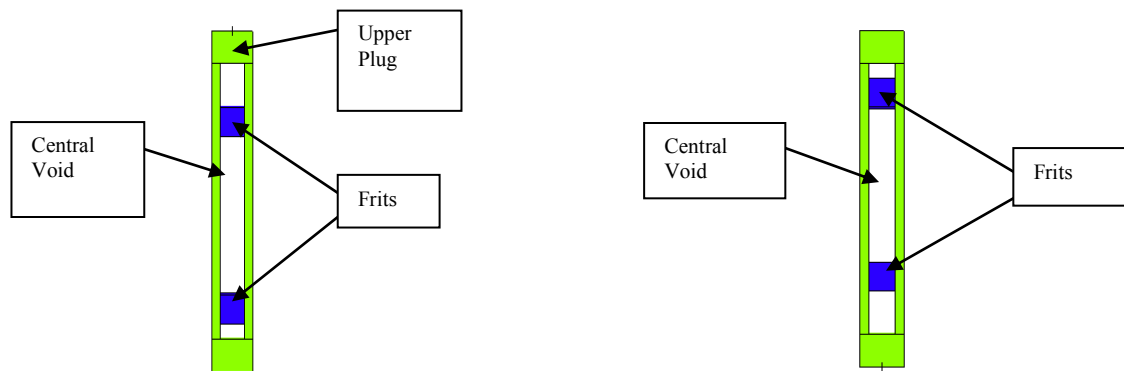


Figure 1.a. The primary encapsulation of the Sr-Cf-3000 source. *Sr3000_Primary.mcnp.inp*

Figure 1.b. The primary encapsulation in the inverted geometry. *Sr3000_Primary_flip.mcnp.inp*.

The SR-Cf-3000 source is a double encapsulated source. The primary encapsulation is a platinum-rhodium alloy that is 90% platinum, by weight. The primary encapsulation is contained in a secondary encapsulation that was specified in the engineering drawings as either 304L or Zircaloy-2. For these calculations, the authors assumed that the secondary encapsulation material was Zircaloy-2 to maintain consistency with previous work (Hertel and McDonald).

The dimensions of the primary encapsulation were obtained from DWG M-12541-CP-338E. A cross sectional view of the primary encapsulation is shown in Figure 1.a. (Note: the italicized part of the figure name is the name of the MCNP input file that is being shown.) The reference drawing clearly shows a shoulder in the capsule body interior for the placement of the bottom frit which results in the small void region at the lower part of Figure 1.a. The drawing shows the upper frit at the opposite end of the primary capsule body and in contact with the upper plug. Other drawings of the same series source show a void region at both ends of the primary encapsulation. An email from {LK Felker (Appendix C)} stated that the circumferential scribes noted in the Primary Capsule drawing describe the upper and lower boundaries of the source volume. According to the drawing, the scribes are 0.755 inches apart which implies that the source volume is 0.755 inches (1.9177 cm) long. However, the drawing also indicates that shoulder is milled into the inner wall of the primary encapsulation to serve as a stop when pushing the lower frit into position. The tolerances for the frit are such that the length of the frit can range from 0.130 inch to 0.140 inch. If the 0.140 inch length is used then the void between the two frits is 0.74 inches apart. This latter number is what was used for the model.

Also according to Mr. Felker, the ²⁵²Cf is introduced to the primary encapsulation as an oxalate precipitate and the lower frit serves as a filter for the material. The upper, second frit is then pressed in with a tool that places the bottom of the frit at the top scribe mark in this configuration. The oxalate is

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then fired to convert the oxalate to an oxide. The end plugs are then inserted and welded into place. During this process it is possible that some of the ²⁵²Cf oxide was bound to the lower frit material. For example, the oxalate precipitate could have been embedded in the frit during the filtration process and became immobilized during the firing process.

Appendix B contains the MCNP cell and surface descriptions for the primary encapsulation. The **pz** type surfaces are the distances from the top end, in agreement with DWG M-12541-CP-338E. When the primary is placed in the secondary, the initial bottom frit end is placed up toward the threaded end of the secondary encapsulation as shown in Figure 1.b. In the MCNP implementation of the primary encapsulation, the inversion of the primary encapsulation is accomplished by reversing the signs of the **pz** surfaces both in the surface definition section and the cell definition section.

The distribution of the source material in the void region is unknown. It could range from a single mass somewhere in the source volume to a uniform distribution throughout the entire volume. At the end of the transfer operation from the storage location to the irradiation location in the Low Scatter Room (LSR) the operators hear an audible “knock” as the transport capsule reaches the irradiation position and comes to an abrupt stop. Based on this observation, it seems plausible that most of the unbound source material has been shaken to the bottom of the source void region.

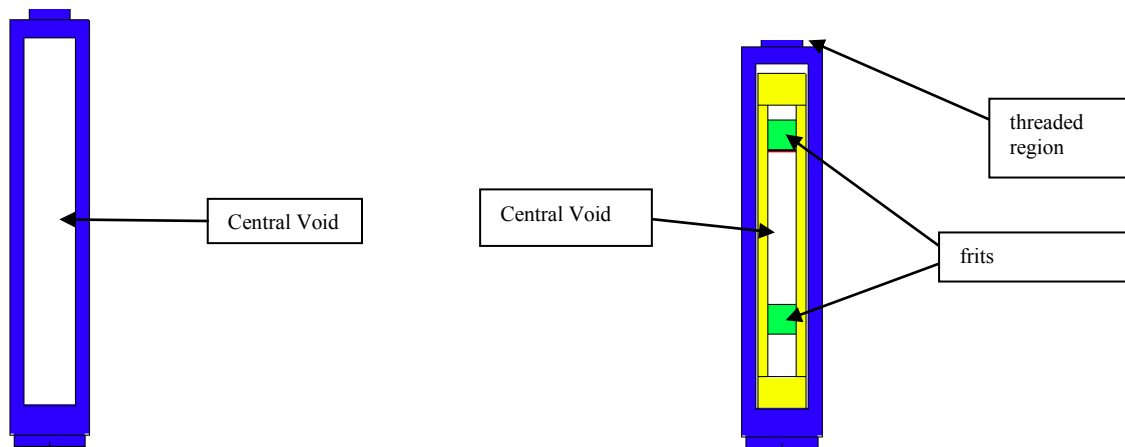


Figure 2.a. The secondary encapsulation.
Sr3000_Secondary.mcnp.inp

Figure 2.b. The secondary encapsulation with
the primary encapsulation.
Sr3000_SourceAssembly.mcnp.inp

The inverted primary encapsulation is then placed in a secondary encapsulation. A cross sectional view of the secondary encapsulation is shown in Figure 2.a. Figure 2.b is a cross sectional view of the the secondary encapsulation with the primary encapsulation. The primary encapsulation is somewhat shorter than the interior length of the secondary encapsulation. The top of the secondary encapsulation is threaded. The threaded region is screwed into the cap of the aluminum transfer capsule.

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The three possible locations for ^{252}Cf activity can be seen in Figure 2.b. If the ^{252}Cf oxide was entrained in the frit then some activity could be at the lower region of the upper frit. If the ^{252}Cf oxide is a loose powder it could be located at the top of the lower frit. Finally, if the ^{252}Cf oxide, which by now is likely a Cm oxide, is a powder it could be a very fine powder, due to the fractures caused by alpha emissions, and could be suspended in the void region. The three possibilities are not mutually exclusive.

Pneumatic Transfer System

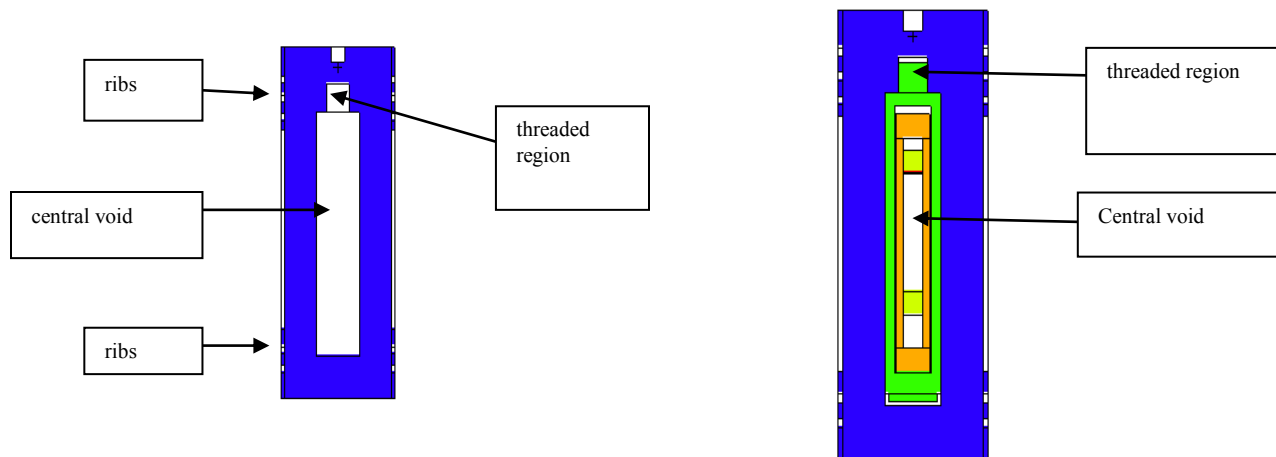


Figure 3.a. The pneumatic transfer capsule.
Sr3000_TransferCapsule.mcnp.inp

Figure 3.b. The Sr-Cf-3000 transfer capsule assembly.
Sr3000_TransferCapsuleAssembly.mcnp.inp

The source encapsulation is encased in an aluminum transfer enclosure, called a transfer capsule. This item is used by the pneumatic transfer system to transfer the source from the source storage location to the irradiation location. The transfer capsule provides a uniform interface between the pneumatic system and the source encapsulation.

The dimensions of the transfer capsule were obtained from something labeled "Figure 2." A cross sectional view of the transfer capsule is shown in Figure 3.a. The threaded region noted in the figure is tapped into the screw-on cover of the transfer capsule.

Figure 3.b shows a cross sectional view of the transfer capsule with the primary and secondary encapsulations (transfer capsule assembly). The threaded portion of the secondary encapsulation is screwed into the tapped hole of the transfer capsule. The secondary encapsulation is shorter than the cavity in the transfer capsule so there is an air gap under the secondary encapsulation.

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The source is transferred between its storage location and its irradiation position using a pneumatic transfer system. The part of the transfer system included in the modeling was the metal tubing located at the irradiation position. The dimensions of the transfer tube assembly were obtained from measurements of the actual assembly. A cross sectional view of the transfer tube assembly is shown in Figure 4.a. Figure 4.b shows a cross sectional view of the transfer tube assembly with the loaded transfer capsule in place. For this figure, 4.953 was added to the value of the **pz** surfaces of the transfer capsule assembly. This process lowers the transfer capsule assembly so that the lower surface of the transfer capsule assembly is at the upper surface of the spring. The spring was modeled as a solid mass of A228 spring steel at a reduced density of 1.123 g.cm⁻³.

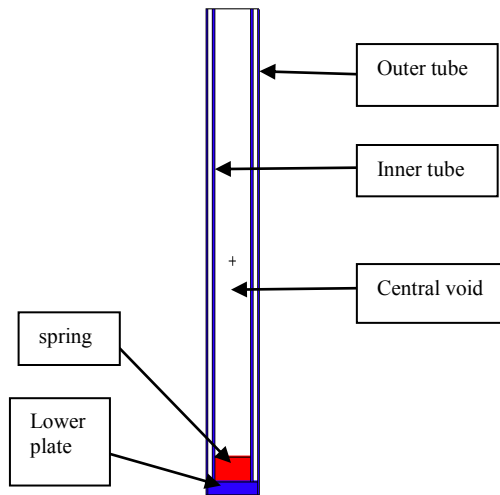


Figure 4.a Transfer Tube
LSR_TransferTubeAssembly.mcnp.inp

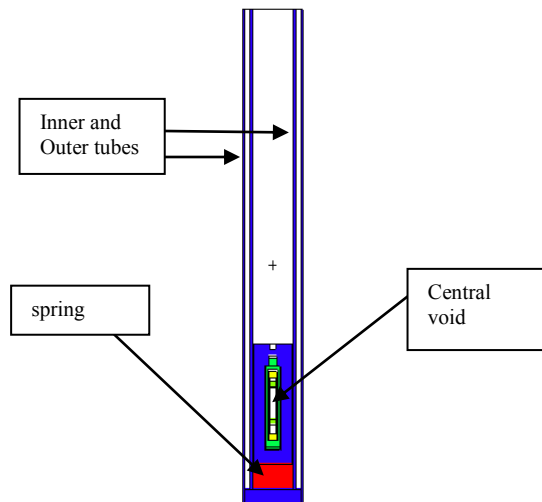


Figure 4.b TransferTube Assembly
SR3000_TransferTubeAssembly.mcnp.inp

D₂O Moderating Sphere

To moderate the neutrons, the neutron source is surrounded by a 30-cm (I.D.) stainless steel sphere that contains D₂O as a moderator. The sphere is made up of two hemispheres welded together with the seam running from pole to pole such that the sphere can be positioned without the seam being in the direct path between the source and artifacts being exposed. The MCNP5 model is based on DWG. SK-3-27847. This sphere is surrounded by a 0.0508 cm thick layer of Cd to remove the thermal neutrons from the beam. Again, two hemispheres make up the sphere, but in this case, the seam is at the equator and as such forms a slightly thicker region along the direct axis of the source and artifacts being exposed. This seam was not included in the MCNP model. Figure 5.a shows a cross sectional view of the D₂O moderating sphere. The outer shell consists of a 0.03 inch (0.0762 cm) layer of 304L steel and an outer 0.02 inch (0.508 cm) layer of cadmium. Figure 5.b shows the transfer assembly in the moderating sphere as built. The small “+” in the two figures is the location of the center of the sphere. The “+” is difficult to see in Figure 5.b but is located near the top of the lower plug of the primary encapsulation. The central void region of the primary encapsulation ranges from 0.364 inches (0.92456 cm) above the center of the

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The source was last calibrated at NIST on 3/3/03 and the neutron emission rate was $4.85\text{E}+09 \text{ n s}^{-1}$.

Table 1 shows a summary of the calculations for the MCNP material definition of the source material. The calculations are based on a mass assay date of 27-Feb-1995. The chemistry of the progeny radioelement Cm is not certain, but the assumption was that the product would be Cm_2O_3 . As seen in the table, the elemental composition underwent a significant change from being mostly californium to being mostly curium.

Calculations were performed with Sources4 (Wilson et al 1999; Shores 2000) to determine if the (α , n) reactions with oxygen in the source material or the in growth of curium isotopes that undergo spontaneous fission might influence the neutron spectrum. The data shown in Table 1 was used as input to Sources4. The results of the calculations, indicate that the total (α , n) neutron production would be very small compared to the ²⁵²Cf neutron production. Indeed, even the neutron production from Cm is much less than the neutron production from ²⁵²Cf even though the mass of Cm greatly exceeds the mass of ²⁵²Cf. The greatest influence on the neutron spectrum would be that, due to its relative long half-life, ²⁵⁰Cf has increased in importance and is responsible for about 1% of the neutrons emitted by the neutron source.

To maintain consistency with previous work (Hertel and McDonald 1990) the SDEF card was set to represent the ²⁵²Cf fission spectra as a Maxwellian distribution ($kT = 1.42 \text{ MeV}$).

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The majority of the tallies were ring detectors (f5 tallies) located on the surface of a reference sphere of either 50-cm radius or 100-cm radius. The tally rings were located on the equator of the reference sphere and at 10° increments of latitude. The polar tallies (latitude ±90°) were collected with point detectors (f5 tallies) also located on the surface of the reference spheres.

Point detector tallies were used to estimate the neutron fluence and dose equivalent rates at the face of a phantom, as would be used during irradiations of dosimeters. For these calculations, the plane is perpendicular to a horizontal line that passes through the center of the dose plane ($Z=X=0.0$) and the center of the reference sphere. The dose locations are at the center of the dose plane and 5- and 10-cm. above and below the center point (Z direction) and 5 and 10 cm to the right and left of the center point (X direction). Due to axial symmetry, only the X -positive data are shown.

5.0 RESULTS

Fluence Calculations

Calculations of the neutron emission rate from the transfer capsule assembly (see Figure 3.b) indicate that there is a small amount of neutron multiplication due mainly to (n, xn) type reactions. In the present calculations, the multiplication was only about 1.0003, which is negligible. The calculations also indicate that virtually all neutrons that are emitted in the assembly will escape from the assembly. The neutron source was calibrated at NIST in the assembly. The figures of this section will show the average neutron fluence from the transfer capsule assembly which is $1.544 \times 10^{+5}$ n.cm².s⁻¹ at 50 cm from the center of the reference sphere and $3.858 \times 10^{+4}$ n.cm².s⁻¹ at 100 cm

Figure 7 shows the moderated and unmoderated neutron fluence at the surface of the 50-cm radius reference sphere for the situation when the ²⁵²Cf activity is located on the surface of the upper frit. The plot on the left side is of the moderated fluence (ASIS) and the unmoderated fluence (TUBE) is shown on the right. The center of the plot represents the center of the reference sphere and the top of the plot represents the north pole (or where the polar angle with respect to the center of axis “z” axis is zero). The large spikes at the top and bottom of the moderated plot are due to the voids in the moderating sphere, as shown in Figure 5.

Figure 7 shows that, when comparing the neutron fluence above and below the equator, the neutron fluence curve of the TUBE geometry is more symmetrical than the ASIS geometry. This difference is because the asymmetry of the TUBE geometry is mainly due to asymmetric distances from the center of the source activity whereas the asymmetry of the ASIS geometry is affected by the moderating sphere and the distance that the neutrons must traverse through the D₂O moderator.

Figures 8 and 9 are similar to Figure 7 except that in Figure 8 the ²⁵²Cf activity was assumed to be in the void region between the two frits and for Figure 9 the ²⁵²Cf activity was assumed to be located on the lower frit. Put together, these figures show that the symmetry of the neutron fluence is affected by the

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location of the ²⁵²Cf activity in the source capsule. Furthermore, the presence of the D₂O moderating sphere enhances the asymmetry that is seen.

Because the center of the ²⁵²Cf source is not collocated with the center of the D₂O moderating sphere when the source is at the irradiation location in the upright position, the neutrons measured above the equator of the reference sphere have been moderated to a different extent than those neutrons that are measured below the equator. Therefore, the neutron spectrum was calculated to determine the extent to which the spectra differ. Lethergy plots of the neutron spectra on the equator of the reference sphere compared to the spectra 10° above the equator and 10° below the equator of the reference sphere are shown as Figures 10, 11 and 12. The three figures show the plots for the three source locations; upper frit, void between the frits, and lower frit.

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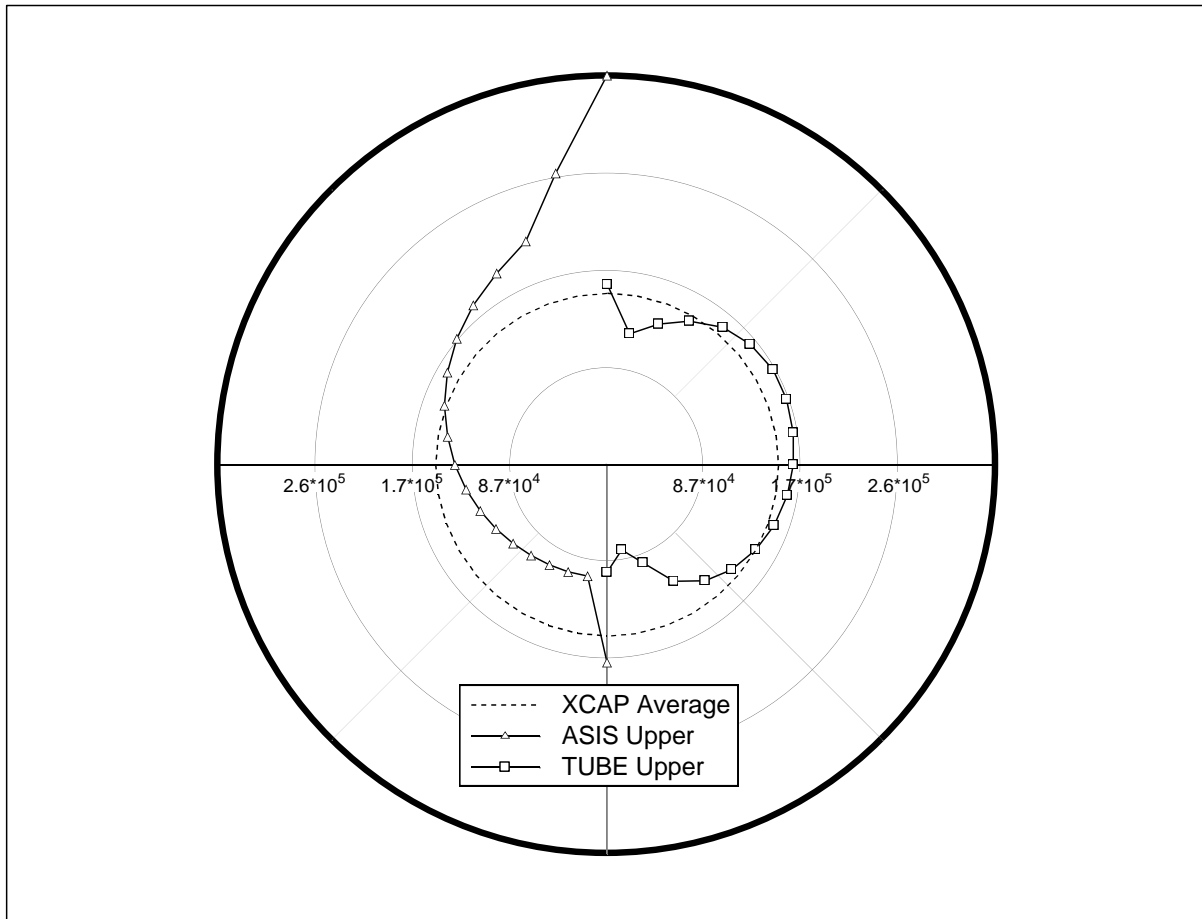


Figure 6. Neutron fluence ($\text{n}\cdot\text{cm}^{-2}\cdot\text{s}^{-1}$) at 50 cm from the ^{252}Cf source. The horizontal line represents the equator of the reference sphere. The dashed line, labeled XCAP average represents the average neutron fluence at 50 cm from the transfer capsule assembly. The plot on the left side represents the neutron fluence at 50 cm when the source encapsulation is in the D_2O moderating sphere. The plot on the right side represents the neutron fluence at 50 cm when the source encapsulation is in the transfer tube assembly. The ^{252}Cf activity is assumed to be in the upper frit of the source encapsulation.

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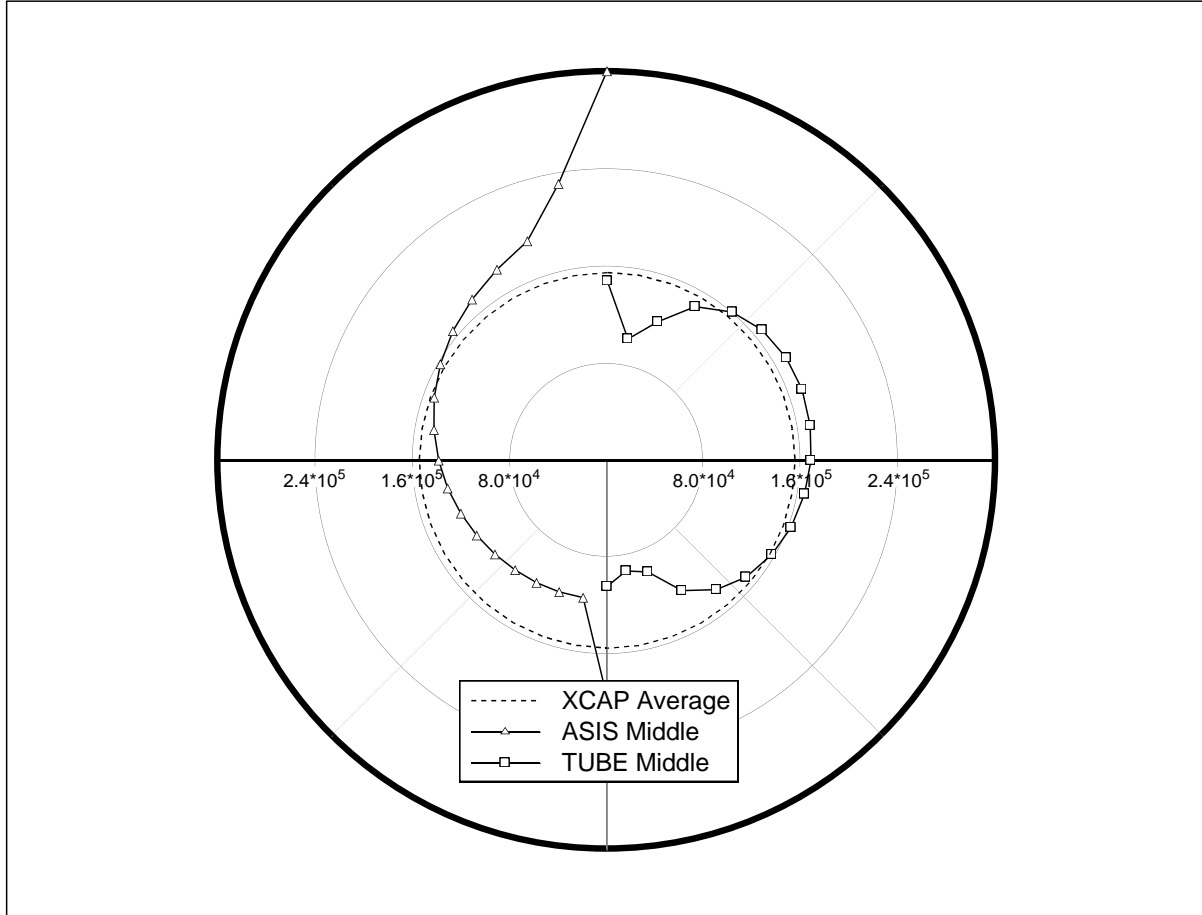


Figure 7 . Neutron fluence (n.cm⁻².s⁻¹) at 50 cm from the ²⁵²Cf source. The horizontal line represents the equator of the reference sphere. The dashed line, labeled XCAP average, represents the average neutron fluence at 50 cm from the transfer capsule assembly. The plot on the left side represents the neutron fluence at 50 cm when the source encapsulation is in the D₂O moderating sphere. The plot on the right side represents the neutron fluence at 50 cm when the source encapsulation is in the transfer tube assembly. The ²⁵²Cf activity is assumed to be in the void between the frits of the source encapsulation.

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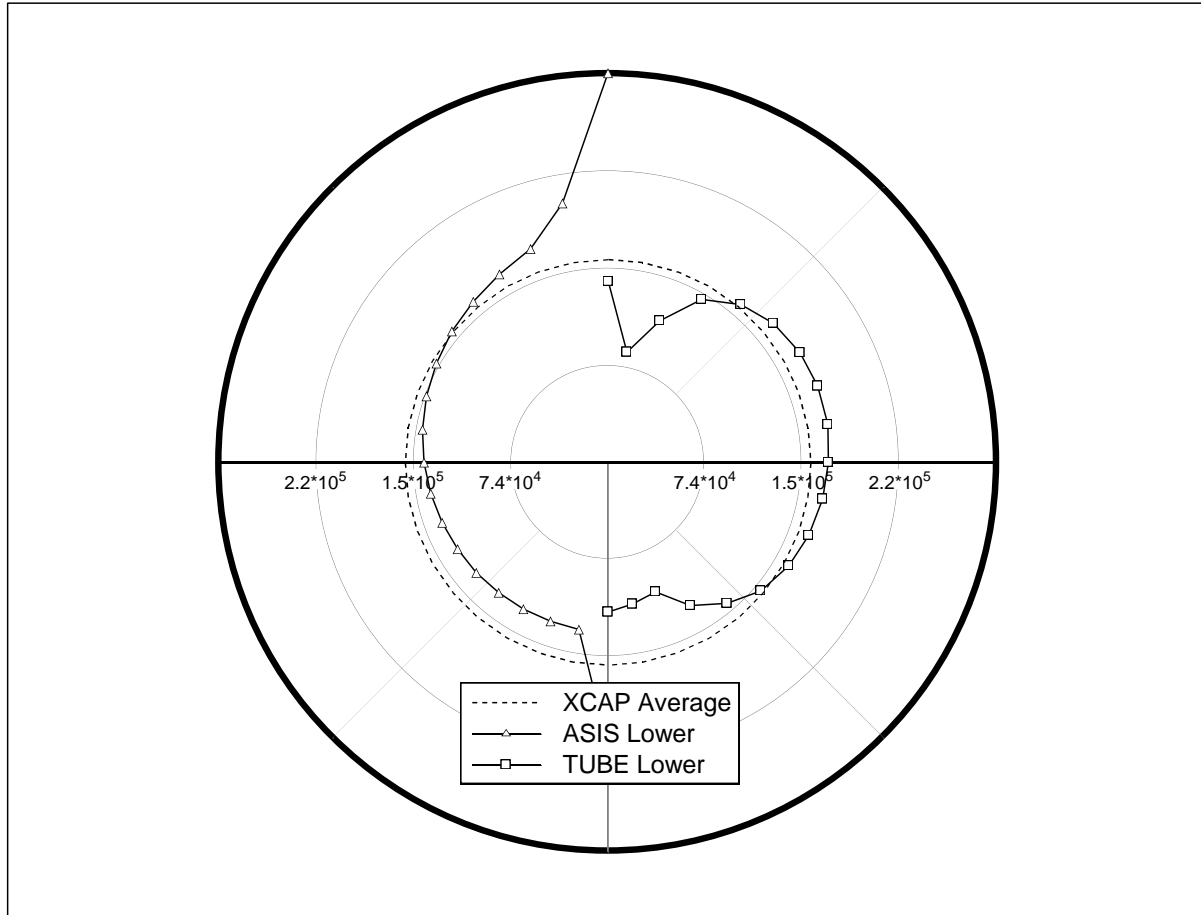


Figure 8 . Neutron fluence (n.cm⁻².s⁻¹) at 50 cm from the ²⁵²Cf source. The horizontal line represents the equator of the reference sphere. The dashed line, labeled XCAP average, represents the average neutron fluence at 50 cm from the transfer capsule assembly. The plot on the left side represents the neutron fluence at 50 cm when the source encapsulation is in the D₂O moderating sphere. The plot on the right side represents the neutron fluence at 50 cm when the source encapsulation is in the transfer tube assembly. The ²⁵²Cf activity is assumed to be in the lower frit of the source encapsulation.

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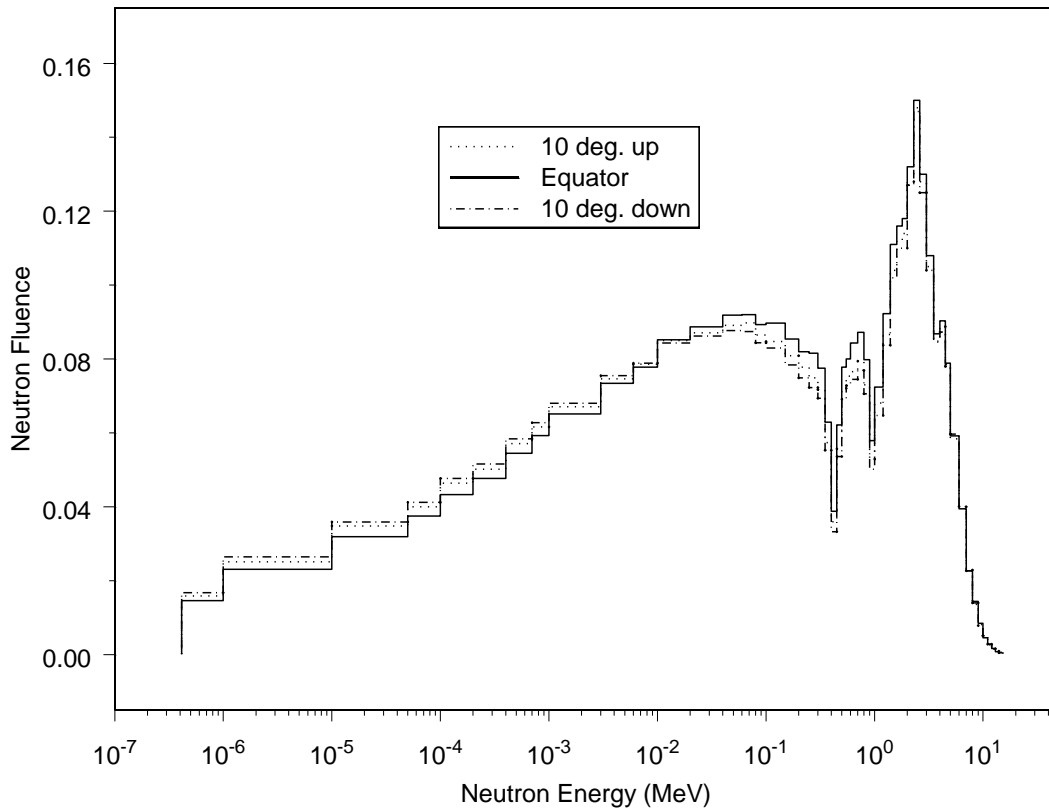


Figure 9. Neutron spectrum (lethargy plots) at 50 cm from the center of the D₂O moderating sphere. The three spectra were taken on the equator of the moderating sphere and 10° above the equator and 10° below the equator. The ^{252}Cf activity is assumed to be in the upper frit of the source encapsulation.

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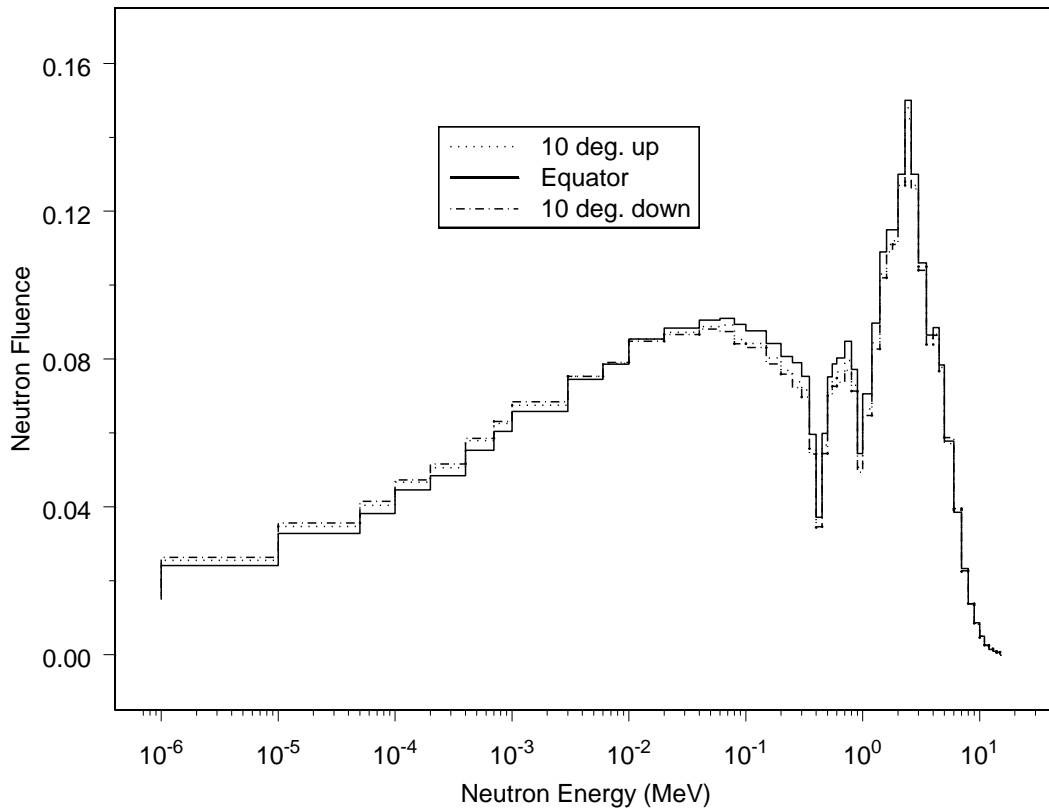


Figure 10. Neutron spectrum (lethargy plots) at 50 cm from the center of the D_2O moderating sphere. The three spectra were taken on the equator of the moderating sphere and 10° above the equator and 10° below the equator. The ^{252}Cf activity is assumed to be in the void between the frits of the source encapsulation.

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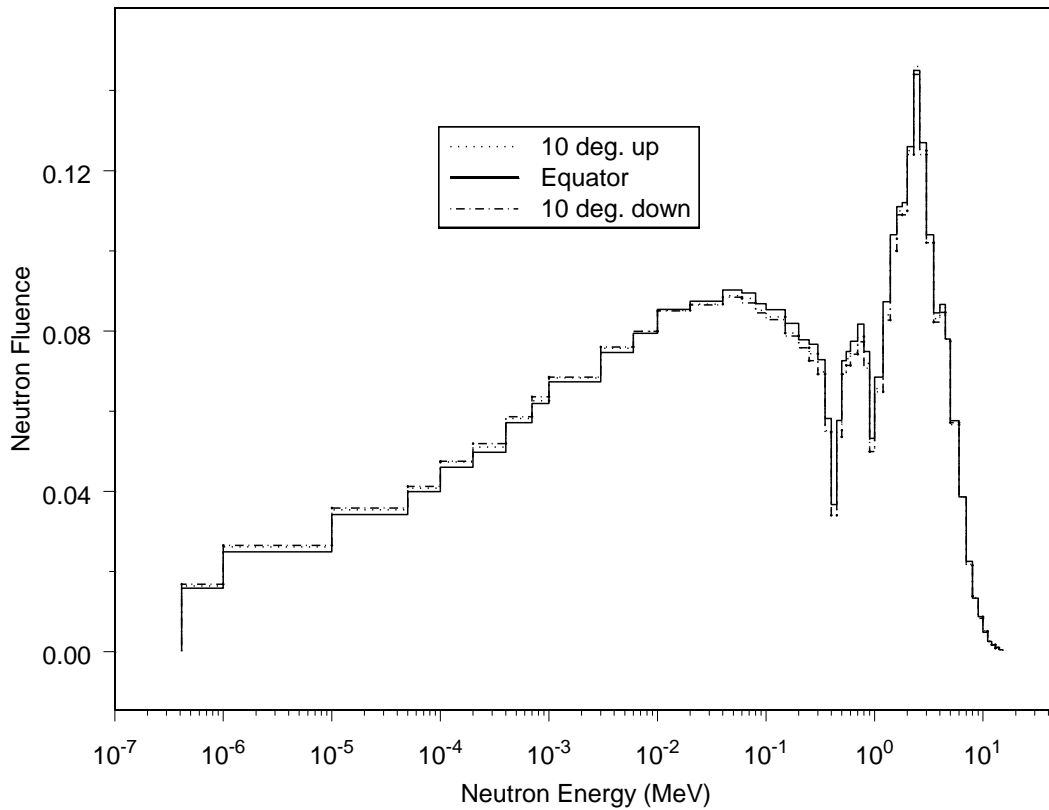


Figure 11. Neutron spectrum (lethargy plots) at 50 cm from the center of the D₂O moderating sphere. The three spectra were taken on the equator of the moderating sphere and 10° above the equator and 10° below the equator. The ^{252}Cf activity is assumed to be in the lower frit of the source encapsulation.

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PREPARED BY: <u>R.J. TRAUB</u>	DATE: <u>02/8/10</u>	REVIEWED BY: <u>R.J. MCCONN</u>	DATE: <u>03/21/10</u>

Dose Calculations

Neutron fluence rates, dose rates and dose factors on the surface of the 50-cm and 100-cm reference spheres at 10° increments above and below the equator of the reference spheres are listed in Tables 2 through Table 13. The tabulated data are for the moderated and unmoderated neutron geometries. Separate tables are provided for the three different source locations; upper frit, middle void region, and lower frit.

Neutron fluence rates on the surface of the flat dosimeter irradiation plane are listed in Tables 14 through Table 16. The tabulated data are for the moderated and unmoderated neutron geometries. Separate tables are provided for the three different source locations; upper frit, middle void region, and lower frit.

Neutron dose factors on the face of the flat phantom plane are listed in Tables 17 through Table 19 for the moderated geometry. Separate tables are provided for the three different source locations; upper frit, middle void region, and lower frit.

Neutron dose factors on the face of the flat phantom plane are listed in Tables 20 through Table 22 for the unmoderated geometry. Separate tables are provided for the three different source locations; upper frit, middle void region, and lower frit.

Neutron dose rates on the face of the flat phantom plane are listed in Tables 23 through Table 25 for the moderated geometry. Separate tables are provided for the three different source locations; upper frit, middle void region, and lower frit.

Neutron dose rates on the face of the flat phantom plane are listed in Tables 26 through Table 28 for the unmoderated geometry. Separate tables are provided for the three different source locations; upper frit, middle void region, and lower frit.

Neutron fluence rates, dose rates, and dose factors on the face of the flat phantom plane when the equator of the measurement sphere is 1 cm above the center of the reference sphere are listed in Tables 29 through Table 37. These tables are applicable to the situation where calibrations are made with the source encapsulation with an elevated measurement to account for the elevated source location. These tables are for only the unmoderated geometry.

Neutron fluence rates, dose rates, and dose factors on the face of the flat phantom plane when the equator of the measurement sphere is 1.864 cm above the center of the reference sphere are listed in Tables 38 through Table 46. These tables are applicable when the equator of the reference sphere is elevated to pass through the center of the center void region of the primary source encapsulation. These tables are for only the unmoderated geometry.

CALCULATION SHEET

PROJECT NO.:	CALC NO.:	REVISION NO.:	SHEET NO.:
	<u>PNNL-19273</u>	0	<u>23/246</u>
SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵² Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM			
PREPARED BY: <u>R.J. TRAUB</u>	DATE: <u>02/8/10</u>	REVIEWED BY: <u>R.J.McCONN</u>	DATE: <u>03/21/10</u>

Table 2. Neutron dose rate (rem.h⁻¹) at increments of 10° latitude above and below the equator of the reference sphere. The source encapsulation is in the upright configuration in the pneumatic transfer tube assembly. The activity is on the upper frit. The reference date is March 3, 2003. The emission rate is 4.85e9 n.s⁻¹.

Latitude	50 cm				100 cm			
	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 Rem.h ⁻¹	H _p (10) Rem.h ⁻¹	H*(10) Rem.h ⁻¹	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 Rem.h ⁻¹	H _p (10) Rem.h ⁻¹	H*(10) Rem.h ⁻¹
90	1.618E+05	19.316	23.229	22.348	3.770E+04	4.503	5.415	5.209
80	1.194E+05	14.349	17.196	16.542	2.780E+04	3.340	4.003	3.850
70	1.346E+05	16.037	19.292	18.560	3.164E+04	3.769	4.534	4.362
60	1.486E+05	17.582	21.205	20.402	3.486E+04	4.129	4.978	4.790
50	1.615E+05	18.999	22.968	22.099	3.834E+04	4.519	5.461	5.255
40	1.681E+05	19.688	23.837	22.936	4.027E+04	4.724	5.718	5.502
30	1.717E+05	20.053	24.304	23.386	4.170E+04	4.871	5.902	5.679
20	1.715E+05	19.985	24.240	23.325	4.209E+04	4.910	5.955	5.730
10	1.697E+05	19.769	23.984	23.078	4.209E+04	4.905	5.951	5.726
0	1.672E+05	19.467	23.617	22.725	4.194E+04	4.879	5.918	5.695
-10	1.642E+05	19.143	23.220	22.343	4.159E+04	4.846	5.878	5.656
-20	1.597E+05	18.607	22.564	21.712	4.087E+04	4.761	5.774	5.556
-30	1.540E+05	18.002	21.813	20.990	3.978E+04	4.647	5.631	5.419
-40	1.465E+05	17.176	20.784	19.998	3.819E+04	4.469	5.409	5.204
-50	1.365E+05	16.077	19.411	18.676	3.580E+04	4.218	5.094	4.901
-60	1.209E+05	14.354	17.277	16.622	3.204E+04	3.794	4.568	4.395
-70	9.403E+04	11.273	13.501	12.987	2.511E+04	3.007	3.603	3.466
-80	7.777E+04	9.425	11.253	10.825	2.045E+04	2.474	2.955	2.842
-90	9.668E+04	11.698	13.988	13.456	2.513E+04	3.044	3.638	3.499

CALCULATION SHEET

PROJECT NO.:

CALC NO.:

REVISION NO.: 0

SHEET NO.: 24/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

Table 3. Neutron dose factors (pSv.cm²) at increments of 10° latitude above and below the equator of the reference sphere. The source encapsulation is in the upright configuration in the pneumatic transfer tube assembly. The activity is on the upper frit. The reference date is March 3, 2003. The emission rate is 4.85e9 n.s⁻¹.

Latitude	50 cm				100 cm			
	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 pSv.cm ²	H _p (10) pSv.cm ²	H*(10) pSv.cm ²	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 pSv.cm ²	H _p (10) pSv.cm ²	H*(10) pSv.cm ²
90	1.618E+05	331.6	398.7	383.6	3.770E+04	331.8	398.9	383.8
80	1.194E+05	333.7	399.9	384.7	2.780E+04	333.7	399.9	384.7
70	1.346E+05	330.9	398.1	383.0	3.164E+04	330.9	398.0	382.9
60	1.486E+05	328.6	396.3	381.3	3.486E+04	329.0	396.6	381.6
50	1.615E+05	326.8	395.1	380.2	3.834E+04	327.4	395.7	380.7
40	1.681E+05	325.4	394.0	379.1	4.027E+04	325.9	394.4	379.5
30	1.717E+05	324.5	393.3	378.4	4.170E+04	324.4	393.2	378.3
20	1.715E+05	323.8	392.7	377.9	4.209E+04	324.0	393.0	378.1
10	1.697E+05	323.6	392.6	377.8	4.209E+04	323.7	392.7	377.9
0	1.672E+05	323.4	392.3	377.5	4.194E+04	323.1	392.0	377.2
-10	1.642E+05	323.9	392.8	378.0	4.159E+04	323.6	392.6	377.7
-20	1.597E+05	323.7	392.6	377.8	4.087E+04	323.6	392.4	377.6
-30	1.540E+05	324.6	393.4	378.5	3.978E+04	324.5	393.2	378.3
-40	1.465E+05	325.6	394.0	379.1	3.819E+04	325.1	393.4	378.5
-50	1.365E+05	327.1	394.9	380.0	3.580E+04	327.2	395.2	380.2
-60	1.209E+05	329.7	396.8	381.7	3.204E+04	329.0	396.1	381.0
-70	9.403E+04	333.0	398.8	383.6	2.511E+04	332.6	398.5	383.3
-80	7.777E+04	336.6	401.9	386.6	2.045E+04	336.1	401.5	386.2
-90	9.668E+04	336.1	401.9	386.6	2.513E+04	336.4	402.0	386.7

CALCULATION SHEET

PROJECT NO.: _____ CALC NO.: _____ REVISION NO.: 0 SHEET NO.: 25/246
PNNL-19273
 SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM
 PREPARED BY: R.J. TRAUB DATE: 02/8/10 REVIEWED BY: R.J.McCONN DATE: 03/21/10

Table 4. Neutron dose rate (rem.h⁻¹) at increments of 10° latitude above and below the equator of the reference sphere. The source encapsulation is in the upright configuration in the pneumatic transfer tube assembly. The activity is in the void region between the frits. The reference date is March 3, 2003. The emission rate is 4.85e9 n.s⁻¹.

Latitude	50 cm				100 cm			
	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 Rem.h ⁻¹	H _p (10) Rem.h ⁻¹	H*(10) Rem.h ⁻¹	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 Rem.h ⁻¹	H _p (10) Rem.h ⁻¹	H*(10) Rem.h ⁻¹
90	1.471E+05	17.652	21.175	20.371	3.489E+04	4.192	5.027	4.836
80	1.010E+05	12.192	14.573	14.017	2.397E+04	2.898	3.464	3.332
70	1.211E+05	14.472	17.368	16.708	2.885E+04	3.452	4.142	3.984
60	1.453E+05	17.229	20.753	19.967	3.477E+04	4.129	4.972	4.783
50	1.591E+05	18.764	22.665	21.807	3.842E+04	4.530	5.471	5.264
40	1.661E+05	19.502	23.598	22.705	4.039E+04	4.747	5.742	5.525
30	1.693E+05	19.819	24.006	23.099	4.145E+04	4.860	5.885	5.663
20	1.700E+05	19.855	24.068	23.159	4.197E+04	4.905	5.945	5.721
10	1.689E+05	19.727	23.920	23.017	4.206E+04	4.907	5.950	5.725
0	1.671E+05	19.490	23.639	22.746	4.188E+04	4.885	5.924	5.700
-10	1.641E+05	19.167	23.244	22.366	4.148E+04	4.838	5.867	5.645
-20	1.604E+05	18.760	22.736	21.878	4.076E+04	4.762	5.772	5.554
-30	1.557E+05	18.221	22.069	21.235	3.976E+04	4.656	5.639	5.426
-40	1.489E+05	17.488	21.154	20.354	3.826E+04	4.492	5.434	5.228
-50	1.389E+05	16.388	19.782	19.033	3.591E+04	4.232	5.109	4.916
-60	1.233E+05	14.644	17.623	16.954	3.200E+04	3.802	4.576	4.402
-70	9.755E+04	11.679	14.000	13.467	2.546E+04	3.049	3.655	3.516
-80	9.216E+04	11.106	13.305	12.799	2.380E+04	2.868	3.436	3.306
-90	1.035E+05	12.485	14.949	14.381	2.649E+04	3.201	3.830	3.684

CALCULATION SHEET

PROJECT NO.:

CALC NO.:

REVISION NO.: 0

SHEET NO.: 26/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

Table 5. Neutron dose factors (pSv.cm²) at increments of 10° latitude above and below the equator of the reference sphere. The source encapsulation is in the upright configuration in the pneumatic transfer tube assembly. The activity is in the void region between the frits. The reference date is March 3, 2003. The emission rate is 4.85e9 n.s⁻¹.

Latitude	50 cm				100 cm			
	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 pSv.cm ²	H _p (10) pSv.cm ²	H*(10) pSv.cm ²	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 pSv.cm ²	H _p (10) pSv.cm ²	H*(10) pSv.cm ²
90	1.471E+05	333.4	400.0	384.8	3.489E+04	333.8	400.2	385.0
80	1.010E+05	335.3	400.8	385.5	2.397E+04	335.8	401.4	386.1
70	1.211E+05	332.0	398.5	383.3	2.885E+04	332.3	398.7	383.6
60	1.453E+05	329.4	396.8	381.8	3.477E+04	329.9	397.2	382.2
50	1.591E+05	327.5	395.6	380.6	3.842E+04	327.5	395.5	380.6
40	1.661E+05	326.1	394.6	379.7	4.039E+04	326.4	394.9	379.9
30	1.693E+05	325.2	393.9	379.0	4.145E+04	325.7	394.4	379.5
20	1.700E+05	324.3	393.2	378.3	4.197E+04	324.6	393.5	378.6
10	1.689E+05	324.3	393.3	378.4	4.206E+04	324.0	392.9	378.1
0	1.671E+05	324.0	392.9	378.1	4.188E+04	323.9	392.9	378.0
-10	1.641E+05	324.4	393.4	378.5	4.148E+04	324.0	392.9	378.0
-20	1.604E+05	324.8	393.7	378.8	4.076E+04	324.6	393.4	378.5
-30	1.557E+05	325.1	393.8	378.9	3.976E+04	325.3	394.0	379.1
-40	1.489E+05	326.2	394.6	379.6	3.826E+04	326.1	394.5	379.6
-50	1.389E+05	327.8	395.7	380.7	3.591E+04	327.4	395.3	380.3
-60	1.233E+05	329.9	397.0	381.9	3.200E+04	330.0	397.2	382.1
-70	9.755E+04	332.6	398.7	383.5	2.546E+04	332.6	398.8	383.6
-80	9.216E+04	334.7	401.0	385.8	2.380E+04	334.7	401.0	385.8
-90	1.035E+05	335.1	401.3	386.0	2.649E+04	335.6	401.6	386.3

CALCULATION SHEET

PROJECT NO.:

CALC NO.:

REVISION NO.: 0

SHEET NO.: 27/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

Table 6. Neutron dose rate (rem.h⁻¹) at increments of 10° latitude above and below the equator of the reference sphere. The source encapsulation is in the upright configuration in the pneumatic transfer tube assembly. The activity is on the lower frit. The reference date is March 3, 2003. The emission rate is 4.85e9 n.s⁻¹.

Latitude	50 cm				100 cm			
	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 Rem.h ⁻¹	H _p (10) Rem.h ⁻¹	H*(10) Rem.h ⁻¹	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 Rem.h ⁻¹	H _p (10) Rem.h ⁻¹	H*(10) Rem.h ⁻¹
90	1.373E+05	16.552	19.830	19.076	3.319E+04	3.999	4.790	4.608
80	8.500E+04	10.334	12.314	11.843	2.065E+04	2.506	2.987	2.873
70	1.145E+05	13.706	16.436	15.811	2.781E+04	3.327	3.991	3.839
60	1.426E+05	16.882	20.343	19.572	3.480E+04	4.124	4.969	4.780
50	1.566E+05	18.424	22.267	21.424	3.840E+04	4.521	5.464	5.257
40	1.640E+05	19.206	23.254	22.375	4.039E+04	4.734	5.731	5.514
30	1.678E+05	19.595	23.751	22.854	4.158E+04	4.849	5.877	5.655
20	1.694E+05	19.754	23.961	23.056	4.213E+04	4.910	5.956	5.731
10	1.693E+05	19.718	23.924	23.021	4.221E+04	4.919	5.968	5.743
0	1.673E+05	19.482	23.636	22.744	4.191E+04	4.877	5.918	5.694
-10	1.652E+05	19.255	23.359	22.477	4.149E+04	4.836	5.867	5.645
-20	1.622E+05	18.903	22.929	22.064	4.091E+04	4.767	5.782	5.564
-30	1.581E+05	18.483	22.400	21.554	3.998E+04	4.674	5.664	5.450
-40	1.517E+05	17.777	21.518	20.705	3.848E+04	4.504	5.452	5.246
-50	1.402E+05	16.516	19.952	19.196	3.563E+04	4.196	5.069	4.877
-60	1.255E+05	14.881	17.929	17.249	3.201E+04	3.790	4.567	4.394
-70	1.048E+05	12.500	15.024	14.454	2.665E+04	3.178	3.821	3.676
-80	1.093E+05	13.098	15.741	15.144	2.777E+04	3.325	3.996	3.845
-90	1.138E+05	13.661	16.393	15.771	2.872E+04	3.450	4.139	3.981

CALCULATION SHEET

PROJECT NO.:

CALC NO.:

REVISION NO.: 0

SHEET NO.: 28/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

Table 7. Neutron dose factors (pSv.cm²) at increments of 10° latitude above and below the equator of the reference sphere. The source encapsulation is in the upright configuration in the pneumatic transfer tube assembly. The activity is on the lower frit. The reference date is March 3, 2003. The emission rate is 4.85e9 n.s⁻¹.

Latitude	50 cm				100 cm			
	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 pSv.cm ²	H _p (10) pSv.cm ²	H*(10) pSv.cm ²	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 pSv.cm ²	H _p (10) pSv.cm ²	H*(10) pSv.cm ²
90	1.373E+05	334.9	401.2	385.9	3.319E+04	334.7	400.9	385.7
80	8.500E+04	337.7	402.4	387.0	2.065E+04	337.1	401.8	386.5
70	1.145E+05	332.5	398.7	383.5	2.781E+04	332.4	398.6	383.4
60	1.426E+05	328.8	396.3	381.2	3.480E+04	329.2	396.6	381.6
50	1.566E+05	326.8	395.0	380.1	3.840E+04	327.1	395.3	380.3
40	1.640E+05	325.3	393.9	379.0	4.039E+04	325.6	394.2	379.3
30	1.678E+05	324.4	393.2	378.3	4.158E+04	323.9	392.6	377.8
20	1.694E+05	323.8	392.8	378.0	4.213E+04	323.8	392.7	377.9
10	1.693E+05	323.4	392.4	377.6	4.221E+04	323.7	392.7	377.9
0	1.673E+05	323.6	392.6	377.7	4.191E+04	323.3	392.2	377.4
-10	1.652E+05	323.7	392.7	377.9	4.149E+04	323.8	392.8	378.0
-20	1.622E+05	323.6	392.6	377.7	4.091E+04	323.6	392.5	377.7
-30	1.581E+05	324.7	393.6	378.7	3.998E+04	324.7	393.5	378.7
-40	1.517E+05	325.5	394.0	379.1	3.848E+04	325.1	393.6	378.7
-50	1.402E+05	327.2	395.3	380.3	3.563E+04	327.1	395.2	380.2
-60	1.255E+05	329.5	397.0	381.9	3.201E+04	328.9	396.3	381.3
-70	1.048E+05	331.3	398.2	383.1	2.665E+04	331.3	398.3	383.2
-80	1.093E+05	332.8	400.0	384.8	2.777E+04	332.6	399.8	384.6
-90	1.138E+05	333.5	400.2	385.0	2.872E+04	333.8	400.3	385.1

CALCULATION SHEET

PROJECT NO.:

CALC NO.:

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

Table 8. Neutron dose rate (rem.h⁻¹) at increments of 10° latitude above and below the equator of the reference sphere. The ²⁵²Cf source is in the D₂O Moderating Sphere. The activity is on the upper frit. The reference date is March 3, 2003. The emission rate is 4.85e9 n.s⁻¹.

Latitude	50 cm				100 cm			
	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 Rem.h ⁻¹	H _p (10) Rem.h ⁻¹	H*(10) Rem.h ⁻¹	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 Rem.h ⁻¹	H _p (10) Rem.h ⁻¹	H*(10) Rem.h ⁻¹
90	3.496E+05	25.741	31.632	30.421	8.232E+04	6.026	7.400	7.116
80	2.659E+05	15.963	19.722	18.954	6.326E+04	3.827	4.719	4.535
70	2.136E+05	10.048	12.551	12.051	5.071E+04	2.381	2.969	2.851
60	1.984E+05	8.782	10.973	10.533	4.732E+04	2.089	2.607	2.502
50	1.871E+05	8.082	10.077	9.670	4.508E+04	1.943	2.420	2.322
40	1.763E+05	7.470	9.289	8.912	4.281E+04	1.813	2.255	2.164
30	1.658E+05	6.896	8.553	8.205	4.057E+04	1.693	2.099	2.014
20	1.555E+05	6.347	7.849	7.528	3.834E+04	1.573	1.946	1.866
10	1.456E+05	5.838	7.201	6.905	3.614E+04	1.456	1.797	1.723
0	1.368E+05	5.377	6.616	6.343	3.412E+04	1.355	1.668	1.600
-10	1.286E+05	4.966	6.096	5.843	3.225E+04	1.262	1.549	1.485
-20	1.214E+05	4.619	5.658	5.423	3.056E+04	1.179	1.445	1.385
-30	1.153E+05	4.331	5.297	5.076	2.909E+04	1.108	1.355	1.299
-40	1.103E+05	4.112	5.019	4.809	2.785E+04	1.054	1.287	1.233
-50	1.065E+05	3.949	4.814	4.612	2.693E+04	1.015	1.237	1.185
-60	1.039E+05	3.862	4.702	4.504	2.628E+04	0.992	1.208	1.157
-70	1.025E+05	3.861	4.692	4.495	2.591E+04	0.992	1.206	1.155
-80	1.016E+05	3.832	4.664	4.469	2.569E+04	0.985	1.198	1.148
-90	1.776E+05	13.050	15.688	15.076	4.535E+04	3.370	4.049	3.891

CALCULATION SHEET

PROJECT NO.: _____ CALC NO.: _____ REVISION NO.: 0 SHEET No.: 30/246
PNNL-19273
 SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM
 PREPARED BY: R.J. TRAUB DATE: 02/8/10 REVIEWED BY: R.J.McCONN DATE: 03/21/10

Table 9. Neutron dose factors (pSv.cm²) at increments of 10° latitude above and below the equator of the reference sphere. The ²⁵²Cf source is in the D₂O Moderating Sphere. The activity is on the upper frit. The reference date is March 3, 2003. The emission rate is 4.85e9 n.s⁻¹.

Latitude	50 cm				100 cm			
	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 pSv.cm ²	H _p (10) pSv.cm ²	H*(10) pSv.cm ²	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 pSv.cm ²	H _p (10) pSv.cm ²	H*(10) pSv.cm ²
90	3.496E+05	204.5	251.3	241.7	8.232E+04	203.3	249.7	240.1
80	2.659E+05	166.8	206.1	198.0	6.326E+04	168.0	207.2	199.1
70	2.136E+05	130.7	163.2	156.7	5.071E+04	130.4	162.7	156.2
60	1.984E+05	123.0	153.6	147.5	4.732E+04	122.6	153.0	146.9
50	1.871E+05	120.0	149.6	143.6	4.508E+04	119.7	149.1	143.1
40	1.763E+05	117.7	146.4	140.4	4.281E+04	117.7	146.3	140.4
30	1.658E+05	115.5	143.3	137.5	4.057E+04	115.9	143.7	137.9
20	1.555E+05	113.4	140.2	134.5	3.834E+04	113.9	141.0	135.2
10	1.456E+05	111.4	137.4	131.7	3.614E+04	111.9	138.1	132.5
0	1.368E+05	109.2	134.4	128.8	3.412E+04	110.3	135.8	130.2
-10	1.286E+05	107.3	131.7	126.2	3.225E+04	108.7	133.5	127.9
-20	1.214E+05	105.7	129.5	124.1	3.056E+04	107.2	131.3	125.9
-30	1.153E+05	104.3	127.6	122.3	2.909E+04	105.8	129.4	124.0
-40	1.103E+05	103.6	126.4	121.1	2.785E+04	105.1	128.4	123.0
-50	1.065E+05	103.0	125.6	120.3	2.693E+04	104.7	127.6	122.3
-60	1.039E+05	103.3	125.7	120.5	2.628E+04	104.9	127.7	122.3
-70	1.025E+05	104.7	127.2	121.9	2.591E+04	106.4	129.2	123.8
-80	1.016E+05	104.8	127.6	122.2	2.569E+04	106.5	129.5	124.1
-90	1.776E+05	204.1	245.3	235.8	4.535E+04	206.4	248.0	238.3

CALCULATION SHEET

PROJECT NO.:	CALC NO.:	REVISION NO.:	SHEET No.:
	<u>PNNL-19273</u>	0	<u>31/246</u>
SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵² Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM			
PREPARED BY: <u>R.J. TRAUB</u>	DATE: <u>02/8/10</u>	REVIEWED BY: <u>R.J.McCONN</u>	DATE: <u>03/21/10</u>

Table 10. Neutron dose rate (rem.h⁻¹) at increments of 10° latitude above and below the equator of the reference sphere. The ²⁵²Cf source is in the D₂O Moderating Sphere. The activity is in the void between frits. The reference date is March 3, 2003. The emission rate is 4.85e9 n.s⁻¹.

Latitude	50 cm				100 cm			
	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 Rem.h ⁻¹	H _p (10) Rem.h ⁻¹	H*(10) Rem.h ⁻¹	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 Rem.h ⁻¹	H _p (10) Rem.h ⁻¹	H*(10) Rem.h ⁻¹
90	3.191E+05	23.477	28.747	27.643	7.616E+04	5.588	6.834	6.571
80	2.302E+05	13.004	16.043	15.413	5.507E+04	3.129	3.850	3.699
70	1.913E+05	8.632	10.751	10.319	4.584E+04	2.069	2.572	2.468
60	1.806E+05	7.804	9.713	9.320	4.350E+04	1.876	2.330	2.236
50	1.724E+05	7.279	9.042	8.675	4.184E+04	1.763	2.188	2.099
40	1.650E+05	6.833	8.470	8.124	4.025E+04	1.668	2.067	1.982
30	1.578E+05	6.426	7.949	7.623	3.870E+04	1.582	1.957	1.877
20	1.508E+05	6.045	7.462	7.155	3.718E+04	1.499	1.850	1.774
10	1.442E+05	5.701	7.023	6.734	3.569E+04	1.420	1.749	1.677
0	1.382E+05	5.385	6.624	6.350	3.430E+04	1.347	1.657	1.589
-10	1.327E+05	5.095	6.256	5.997	3.304E+04	1.283	1.576	1.511
-20	1.276E+05	4.854	5.953	5.706	3.191E+04	1.227	1.505	1.443
-30	1.234E+05	4.655	5.704	5.466	3.091E+04	1.180	1.445	1.385
-40	1.200E+05	4.500	5.509	5.279	3.008E+04	1.144	1.400	1.341
-50	1.174E+05	4.399	5.381	5.157	2.945E+04	1.118	1.367	1.310
-60	1.158E+05	4.359	5.327	5.104	2.903E+04	1.109	1.353	1.297
-70	1.149E+05	4.382	5.350	5.127	2.885E+04	1.113	1.357	1.300
-80	1.144E+05	4.376	5.347	5.125	2.875E+04	1.110	1.354	1.298
-90	1.944E+05	14.027	16.897	16.238	4.901E+04	3.564	4.289	4.122

CALCULATION SHEET

PROJECT NO.:	CALC NO.:	REVISION NO.:	SHEET NO.:
	<u>PNNL-19273</u>	0	<u>32/246</u>
SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵² Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM			
PREPARED BY: <u>R.J. TRAUB</u>	DATE: <u>02/8/10</u>	REVIEWED BY: <u>R.J.McCONN</u>	DATE: <u>03/21/10</u>

Table 11. Neutron dose factors (pSv.cm²) at increments of 10° latitude above and below the equator of the reference sphere. The ²⁵²Cf source is in the D₂O Moderating Sphere. The activity is in the void between frits. The reference date is March 3, 2003. The emission rate is 4.85e9 n.s⁻¹.

Latitude	50 cm				100 cm			
	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 pSv.cm ²	H _p (10) pSv.cm ²	H _s (10) pSv.cm ²	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 pSv.cm ²	H _p (10) pSv.cm ²	H _s (10) pSv.cm ²
90	3.191E+05	204.3	250.2	240.6	7.616E+04	203.8	249.3	239.7
80	2.302E+05	156.9	193.6	186.0	5.507E+04	157.8	194.2	186.6
70	1.913E+05	125.3	156.1	149.8	4.584E+04	125.3	155.8	149.6
60	1.806E+05	120.0	149.4	143.4	4.350E+04	119.8	148.8	142.8
50	1.724E+05	117.3	145.7	139.8	4.184E+04	117.1	145.2	139.3
40	1.650E+05	115.0	142.6	136.8	4.025E+04	115.1	142.6	136.8
30	1.578E+05	113.1	140.0	134.2	3.870E+04	113.5	140.4	134.7
20	1.508E+05	111.4	137.5	131.8	3.718E+04	112.0	138.3	132.6
10	1.442E+05	109.8	135.2	129.7	3.569E+04	110.5	136.2	130.5
0	1.382E+05	108.3	133.2	127.7	3.430E+04	109.1	134.2	128.6
-10	1.327E+05	106.7	131.0	125.6	3.304E+04	107.9	132.5	127.0
-20	1.276E+05	105.7	129.6	124.2	3.191E+04	106.9	131.0	125.6
-30	1.234E+05	104.8	128.4	123.1	3.091E+04	106.0	129.8	124.4
-40	1.200E+05	104.2	127.5	122.2	3.008E+04	105.7	129.3	123.9
-50	1.174E+05	104.1	127.3	122.0	2.945E+04	105.5	128.9	123.5
-60	1.158E+05	104.6	127.8	122.5	2.903E+04	106.1	129.5	124.1
-70	1.149E+05	105.9	129.3	123.9	2.885E+04	107.1	130.6	125.2
-80	1.144E+05	106.2	129.8	124.4	2.875E+04	107.2	130.8	125.4
-90	1.944E+05	200.4	241.4	232.0	4.901E+04	202.0	243.1	233.6

CALCULATION SHEET

PROJECT NO.:	CALC NO.:	REVISION NO.:	SHEET No.: <u>33/246</u>
	<u>PNNL-19273</u>		
SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵² Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM			
PREPARED BY: <u>R.J. TRAUB</u>	DATE: <u>02/8/10</u>	REVIEWED BY: <u>R.J.McCONN</u>	DATE: <u>03/21/10</u>

Table 12. Neutron dose rate (rem.h⁻¹) at increments of 10° latitude above and below the equator of the reference sphere. The ²⁵²Cf source is in the D₂O Moderating Sphere. The activity is on the lower frit. The reference date is March 3, 2003. The emission rate is 4.85e9 n.s⁻¹.

Latitude	50 cm				100 cm			
	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 Rem.h ⁻¹	H _p (10) Rem.h ⁻¹	H*(10) Rem.h ⁻¹	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 Rem.h ⁻¹	H _p (10) Rem.h ⁻¹	H*(10) Rem.h ⁻¹
90	2.955E+05	21.795	26.613	25.590	7.142E+04	5.265	6.422	6.174
80	1.998E+05	10.528	12.972	12.459	4.825E+04	2.541	3.124	3.000
70	1.726E+05	7.483	9.290	8.915	4.180E+04	1.811	2.245	2.154
60	1.650E+05	6.886	8.537	8.189	4.014E+04	1.675	2.073	1.989
50	1.594E+05	6.510	8.060	7.731	3.899E+04	1.593	1.971	1.890
40	1.548E+05	6.221	7.693	7.378	3.799E+04	1.530	1.891	1.813
30	1.505E+05	5.982	7.386	7.083	3.705E+04	1.475	1.821	1.746
20	1.467E+05	5.752	7.095	6.802	3.617E+04	1.427	1.759	1.687
10	1.431E+05	5.559	6.846	6.563	3.536E+04	1.382	1.702	1.631
0	1.398E+05	5.379	6.619	6.345	3.462E+04	1.339	1.648	1.580
-10	1.368E+05	5.223	6.422	6.156	3.396E+04	1.301	1.600	1.534
-20	1.342E+05	5.096	6.263	6.004	3.335E+04	1.273	1.564	1.499
-30	1.320E+05	4.997	6.136	5.881	3.285E+04	1.250	1.535	1.471
-40	1.306E+05	4.931	6.052	5.800	3.247E+04	1.237	1.518	1.455
-50	1.292E+05	4.876	5.984	5.735	3.215E+04	1.224	1.501	1.439
-60	1.287E+05	4.895	6.005	5.755	3.200E+04	1.227	1.503	1.441
-70	1.284E+05	4.907	6.020	5.771	3.193E+04	1.233	1.511	1.448
-80	1.289E+05	4.982	6.112	5.859	3.206E+04	1.249	1.530	1.467
-90	2.158E+05	15.422	18.630	17.905	5.374E+04	3.863	4.662	4.480

CALCULATION SHEET

PROJECT NO.:	CALC NO.:	REVISION NO.:	SHEET NO.:
	<u>PNNL-19273</u>	0	34/246
SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵² Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM			
PREPARED BY: <u>R.J. TRAUB</u>	DATE: <u>02/8/10</u>	REVIEWED BY: <u>R.J.McCONN</u>	DATE: <u>03/21/10</u>

Table 13. Neutron dose factors (pSv.cm²) at increments of 10° latitude above and below the equator of the reference sphere. The ²⁵²Cf source is in the D₂O Moderating Sphere. The activity is on the lower frit. The reference date is March 3, 2003. The emission rate is 4.85e9 n.s⁻¹.

Latitude	50 cm				100 cm			
	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 pSv.cm ²	H _p (10) pSv.cm ²	H*(10) pSv.cm ²	Fluence (cm ⁻² .s ⁻¹)	ICRP-21 pSv.cm ²	H _p (10) pSv.cm ²	H*(10) pSv.cm ²
90	2.955E+05	204.9	250.2	240.6	7.142E+04	204.8	249.7	240.1
80	1.998E+05	146.3	180.3	173.2	4.825E+04	146.3	179.8	172.7
70	1.726E+05	120.4	149.5	143.5	4.180E+04	120.3	149.2	143.1
60	1.650E+05	115.9	143.7	137.9	4.014E+04	115.9	143.5	137.6
50	1.594E+05	113.5	140.5	134.7	3.899E+04	113.5	140.4	134.7
40	1.548E+05	111.7	138.1	132.4	3.799E+04	111.9	138.2	132.6
30	1.505E+05	110.4	136.3	130.7	3.705E+04	110.6	136.5	130.9
20	1.467E+05	109.0	134.4	128.8	3.617E+04	109.6	135.1	129.5
10	1.431E+05	107.9	132.9	127.4	3.536E+04	108.5	133.7	128.1
0	1.398E+05	106.9	131.5	126.0	3.462E+04	107.4	132.2	126.7
-10	1.368E+05	106.1	130.4	125.0	3.396E+04	106.4	130.9	125.4
-20	1.342E+05	105.5	129.7	124.3	3.335E+04	106.0	130.3	124.9
-30	1.320E+05	105.1	129.1	123.7	3.285E+04	105.7	129.8	124.4
-40	1.306E+05	104.9	128.7	123.3	3.247E+04	105.8	129.8	124.4
-50	1.292E+05	104.8	128.7	123.3	3.215E+04	105.8	129.7	124.3
-60	1.287E+05	105.6	129.6	124.2	3.200E+04	106.5	130.5	125.1
-70	1.284E+05	106.1	130.2	124.8	3.193E+04	107.3	131.4	126.0
-80	1.289E+05	107.3	131.7	126.2	3.206E+04	108.2	132.6	127.1
-90	2.158E+05	198.5	239.8	230.4	5.374E+04	199.7	241.0	231.6

CALCULATION SHEET

PROJECT NO.: _____ CALC No.: _____ REVISION No.: 0 SHEET No.: 51/246
PNNL-19273
 SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM
 PREPARED BY: R.J. TRAUB DATE: 02/8/10 REVIEWED BY: R.J.McCONN DATE: 03/21/10

Table 30. Neutron dose factors at the surface of a 10-cm × 10-cm rectangle 50 cm and 100 cm from the center of the reference sphere. The ²⁵²Cf source is in the pneumatic transfer tube assembly. The dose rectangle has been elevated 1 cm. relative to the equator of the reference sphere. The activity is on the upper frit. The reference date is March 3, 2003. The emission rate is 4.85e9 n.s⁻¹.

Z position (cm)	50 cm from center of the reference sphere			100 cm from center of the reference sphere		
	horizontal position (cm)			horizontal position (cm)		
	0	5	10	0	5	10
ICRP-21 Appendix 6 (pSv.cm ²)						
11	323.5	323.5	323.5	323.5	323.5	323.5
6	323.4	323.4	323.4	323.5	323.5	323.5
1	323.4	323.4	323.4	323.5	323.5	323.5
-4	323.4	323.4	323.4	323.4	323.4	323.4
-9	323.5	323.5	323.5	323.4	323.4	323.4
Personal Dose Equivalent Hp(10) (pSv.cm ²)						
11	392.5	392.4	392.4	392.4	392.4	392.4
6	392.4	392.4	392.4	392.4	392.4	392.4
1	392.4	392.4	392.4	392.4	392.4	392.4
-4	392.4	392.4	392.4	392.4	392.4	392.4
-9	392.4	392.4	392.4	392.4	392.4	392.4
Ambient Dose Equivalent H*(10) (pSv.cm ²)						
11	377.6	377.6	377.6	377.6	377.6	377.6
6	377.6	377.6	377.6	377.6	377.6	377.6
1	377.6	377.6	377.6	377.6	377.6	377.6
-4	377.6	377.6	377.6	377.6	377.6	377.6
-9	377.6	377.6	377.6	377.6	377.6	377.6
Dose Factor	Maximum	Minimum	Ratio	Maximum	Minimum	Ratio
10-cm Range						
ICRP-21	323.5	323.4	1.000	323.5	323.4	1.000
Hp(10)	392.5	392.4	1.000	392.4	392.4	1.000
H*(10)	377.6	377.6	1.000	377.6	377.6	1.000
5-cm Range						
ICRP-21	323.4	323.4	1.000	323.5	323.4	1.000
Hp(10)	392.4	392.4	1.000	392.4	392.4	1.000
H*(10)	377.6	377.6	1.000	377.6	377.6	1.000

CALCULATION SHEET

PROJECT NO.:	CALC No.:	REVISION No.:	SHEET No.:
	<u>PNNL-19273</u>	0	<u>68/246</u>
SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵² Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM			
PREPARED BY: <u>R.J. TRAUB</u>	DATE: <u>02/8/10</u>	REVIEWED BY: <u>R.J.MCCONN</u>	DATE: <u>03/21/10</u>

The data show that when the D₂O moderating sphere is present the dose rates are highly asymmetric across the face of the dose plane. The highest dose rate is at the upper center and the lowest dose rate is at the lower edges. At 50 cm from the center of the D₂O moderating sphere, the ratio of the maximum to minimum dose rate is 1.18 and at 100 cm 1.08.

The neutron fluence-to-dose-equivalent conversion factors calculated for this report are summarized and compared to published values in Table 47. The calculated coefficients for the unmoderated ²⁵²Cf spectra agree very well with published reference values, within about 2%. The calculated coefficients for the D₂O moderated ²⁵²Cf spectra, however, differ from published reference values by about 22%. The PNNL coefficients are higher than the published values which could be interpreted to mean that the PNNL D₂O moderated spectrum is harder, i.e. higher average energy, than the spectrum published by the ISO (2000), which formed the basis for the published coefficients. Figure 13 shows the ISO and PNNL spectra for D₂O moderated ²⁵²Cf neutrons. This figure clearly shows that the moderated portion of the ISO spectra tends to lower energy than does the PNNL spectra.

The cause of the discrepancy in the D₂O moderated spectra is likely due to enhanced void region that surrounds the ²⁵²Cf source in the PNNL D₂O moderating sphere (see Figures 5.a and 5.b). The description of the source and D₂O moderating sphere, described in ISO 8529-1:2000(E), had a small void region. Because neutrons are not moderated in a void or metals, the PNNL D₂O moderating geometry would be expected to result in higher energy neutrons than would the ISO geometry.

Table 47. Comparison of neutron fluence-to-dose-equivalent conversion factors published by international agencies and those prepared for this report.

Quantity	Calibration Field			
	ISO spectra		PNNL spectra	
	Bare	D ₂ O Moderated	Bare	D ₂ O Moderated
Ambient dose equivalent, H*(10)	385 ^a	105 ^a	378 ^c	128 ^c
Personal dose equivalent, H _p (10)	400 ^b	110 ^b	392 ^c	133 ^c

- a. ISO 8529-1:2000(E), IAEA (2001)
 b. IAEA (2001)
 c. Average of Upper Frit, Middle Void, and Lower Frit source locations

CALCULATION SHEET

PROJECT NO.:

CALC No.:

REVISION NO.: 0

SHEET NO.: 69/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

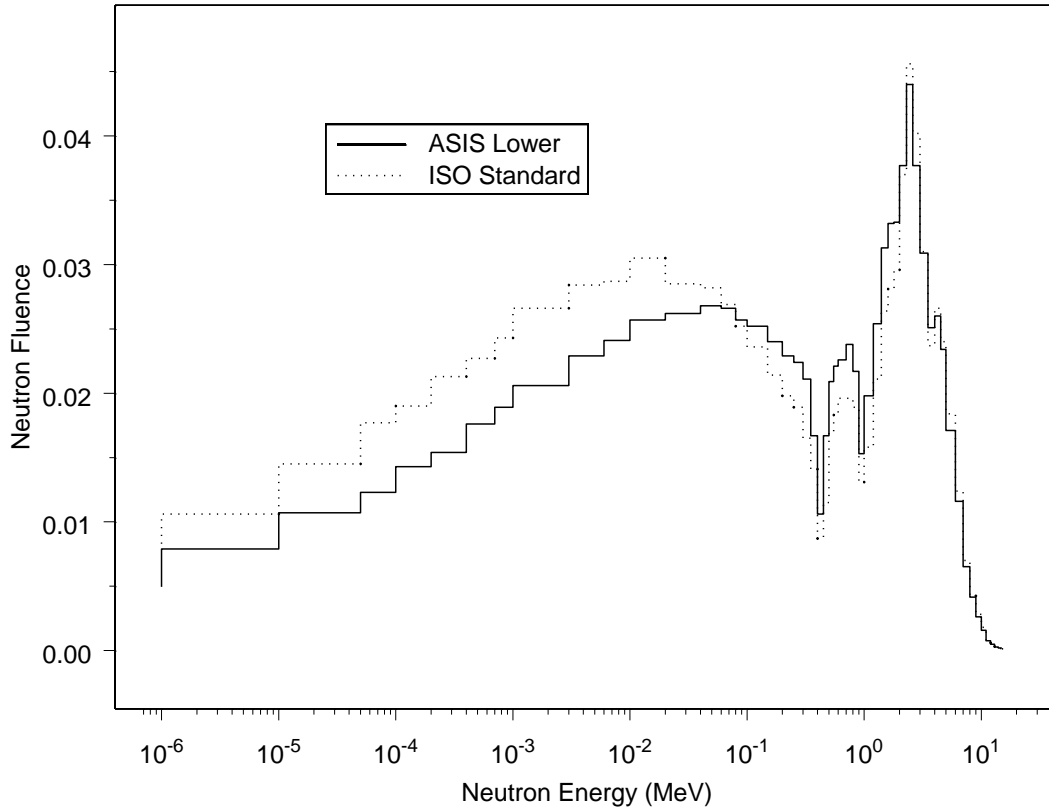


Figure 12. Neutron spectrum (lethargy plots) at 50 cm from the center of the D₂O moderating sphere. The ASIS spectrum represents the spectrum on the equator of the D₂O moderating sphere. The ²⁵²Cf activity is assumed to be in the lower frit of the source encapsulation. The ISO standard spectrum was obtained from ISO 8529-1:2000(E)

CALCULATION SHEET

PROJECT NO.:

CALC NO.:

REVISION NO.: 0

SHEET NO.: 75/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. MCCONN

DATE: 03/21/10

426	pz	-3.130000	\$ Cf Activity - top
427	pz	-3.149600	\$ Lower Frit - Top
428	pz	-3.505200	\$ Lower Frit - Bottom
429	pz	-3.683000	\$ Primary Capsule Lower End Plug - Top
430	pz	-4.076700	\$ Bottom of Primary Capsule

c

c Data cards

sdef

c

c Dry Air, rho=1.205E-3 g/cc, ICRU-37

m2	6000	-1.24E-04	\$ Carbon
	7014	-7.55E-01	\$ Nitrogen
	8016	-2.32E-01	\$ Oxygen
	18000	-1.28E-02	\$ Argon

c

c Zircaloy-2: 98.250 wt % zirconium, 1.45 wt % tin, 0.100 wt % chromium, 0.135 wt % iron, 0.055 wt % nickel, 0.01 wt % hafnium, 6.56 g/cc

c Standard Composition Library, ORNL, for SCALE Calculations

m3	40000	-9.825E-01	\$ Zirconium
	50000	-1.450E-02	\$ Tin
	24000	-1.000E-03	\$ Chromium
	26000	-1.350E-03	\$ Iron
	28000	-5.500E-04	\$ Nickel
	72000	-1.000E-04	\$ Hafnium

c

c Platinum, Sintered (rho=10.725)

m4	78000	-1.00
----	-------	-------

c

c 90% Platinum, 10% Rhodium Mixture, rho= 19.970 g/cc, <http://www.azom.com/details.asp?ArticleID=2273>

m5	78000	-0.9
	45103	-0.1

c

c

c Cf-252 source composition for SR-Cf-3000 Hanford Source

c Ref: see calculation package

m6	98249	-0.006141
	98250	-0.006543
	98251	-0.004022
	98252	-0.002888
	96245	-0.000992
	96246	-0.041218
	96247	-0.000251
	96248	-0.621612
	08016	-0.088141

CALCULATION SHEET

PROJECT NO.:

CALC NO.:

REVISION NO.: 0

SHEET NO.: 77/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

```
c ===== Primary Encapsulation =====
c
c
c Primary Capsule Body Surfaces
420 cz 0.163576          $ Primary Capsule - Inner Radius
421 cz 0.276860          $ Primary Capsule - Outer Radius
c
422 pz 0.000000          $ Primary Capsule - Top
423 pz 0.393700          $ Primary Capsule Top End Plug - bottom
424 pz 0.9144            $ Upper Frit - Top
425 pz 1.27              $ Upper Frit - bottom
426 pz 3.130000          $ Cf Activity - top
427 pz 3.149600          $ Lower Frit - Top
428 pz 3.505200          $ Lower Frit - Bottom
429 pz 3.683000          $ Primary Capsule Lower End Plug - Top
430 pz 4.076700          $ Bottom of Primary Capsule
c
c Data cards
sdef
c
c Dry Air, rho=1.205E-3 g/cc, ICRU-37
m2 6000 -1.24E-04 $ Carbon
    7014 -7.55E-01 $ Nitrogen
    8016 -2.32E-01 $ Oxygen
    18000 -1.28E-02 $ Argon
c
c Zircaloy-2: 98.250 wt % zirconium, 1.45 wt % tin, 0.100 wt % chromium,0.135 wt % iron, 0.055 wt % nickel, 0.01 wt %
hafnium, 6.56 g/cc
c Standard Composition Library, ORNL, for SCALE Calculations
m3 40000 -9.825E-01 $ Zirconium
    50000 -1.450E-02 $ Tin
    24000 -1.000E-03 $ Chromium
    26000 -1.350E-03 $ Iron
    28000 -5.500E-04 $ Nickel
    72000 -1.000E-04 $ Hafnium
c
c Platinum, Sintered (rho=10.725)
m4 78000 -1.00
c
c 90% Platinum, 10% Rhodium Mixture, rho= 19.970 g/cc, http://www.azom.com/details.asp?ArticleID=2273
m5 78000 -0.9
    45103 -0.1
c
c
```


CALCULATION SHEET

PROJECT NO.:

CALC NO.:

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SHEET NO.: 79/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. MCCONN

DATE: 03/21/10

400	cz	0.245110	\$ Threaded Top Radius
401	cz	0.469900	\$ Secondary Main Body Radius - Outer
402	cz	0.297180	\$ Secondary Main Body Radius - Inner
403	cz	0.411480	\$ Indentation Radius
	c		
404	pz	5.33400	\$ Top of Threaded cap
405	pz	4.85140	\$ Bottom of Cap Cut-Out
406	pz	4.64820	\$ Void Region for primary - Top
407	pz	0.45720	\$ Top of Secondary Cap plug
408	pz	0.12700	\$ Top of Indentation
409	pz	0.00000	\$ Bottom of Indentation

c
c

c Dry Air, rho=1.205E-3 g/cc, ICRU-37

m2	6000	-1.24E-04	\$ Carbon
	7014	-7.55E-01	\$ Nitrogen
	8016	-2.32E-01	\$ Oxygen
	18000	-1.28E-02	\$ Argon

c

c Zircaloy-2: 98.250 wt % zirconium, 1.45 wt % tin, 0.100 wt % chromium, 0.135 wt % iron, 0.055 wt % nickel, 0.01 wt % hafnium, 6.56 g/cc

c Standard Composition Library, ORNL, for SCALE Calculations

m3	40000	-9.825E-01	\$ Zirconium
	50000	-1.450E-02	\$ Tin
	24000	-1.000E-03	\$ Chromium
	26000	-1.350E-03	\$ Iron
	28000	-5.500E-04	\$ Nickel
	72000	-1.000E-04	\$ Hafnium

c

sdef

Sr3000_SourceAssembly.mcnp.inp

This contains both the primary and Secondary Encapsulation

c
c
c
c

c | SR-CF-3000 Cf-252 Source Capsule |
c | DWG M-12541-CP-338E |
c
c
c ===== Primary Encapsulation =====

CALCULATION SHEET

PROJECT NO.:

CALC NO.:

REVISION NO.: 0

SHEET NO.: 80/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. MCCONN

DATE: 03/21/10

```
c
c The Source is flipped upside down to be like whats in secondary Capsule
c because the bottom of the primary encapsulation is at the top of the
c secondary encapsulation. The source was flipped by reversing the sign
c of the surface definitions and the signs of the surfaces in the cell definitions
c
420 5 -19.970      -421 420 423 -429          imp:n=1 $ Tube wall
422 5 -19.970      -421 422 -423          imp:n=1 $ Top End Plug
424 2 -1.205e-3    -420 423 -424          imp:n=1 $ Upper Void
426 4 -10.725      -420 424 -425          imp:n=1 $ Upper Frit
427 2 -1.205e-3    -420 425 -426          imp:n=1 $ Middle Void
428 6 -5.5         -420 426 -427          imp:n=1 $ Californium Source Volume
430 4 -10.725      -420 427 -428          imp:n=1 $ Lower Frit
432 2 -1.205E-3    -420 428 -429          imp:n=1 $ Lower Void
436 5 -19.970      -421 429 -430          imp:n=1 $ Lower End Plug
c
c
c ===== Secondary Encapsulation =====
c
404 3 -6.56        -400 -404 405          imp:n=1 $ Upper Threaded Section
402 3 -6.56        -401 -405 408 (402:406:-407) imp:n=1 $ Main Zircaloy Body
400 3 -6.56        -403 -408 409          imp:n=1 $ Bottom Indentation
c
410 2 -1.205e-3    -402 -406 407 (421:-422:430) imp:n=1 $ primary capsule Region
c
c *****
999 0 (400:404:-405) (401:405:-408) (403:408:-409) imp:n=0
c
c
c *****
c |                Surface Definition Section                |
c -----
c
c *****
c |                SR-CF-3000 Cf-252 Source Capsule            |
c |                DWG M-12541-CP-338E                        |
c
c ===== Inner Encapsulation =====
c
420 cz 0.163576          $ Primary Capsule - Inner Radius
421 cz 0.276860          $ Primary Capsule - Outer Radius
c
422 pz 0.457200          $ Primary Capsule - Top
```

CALCULATION SHEET

PROJECT NO.:

CALC NO.:

REVISION NO.: 0

SHEET NO.: 81/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. MCCONN

DATE: 03/21/10

423	pz	0.850900	\$ Primary Capsule Top End Plug - bottom
424	pz	1.371600	\$ Upper Frit - Top
425	pz	1.727200	\$ Upper Frit - bottom
426	pz	3.587200	\$ Cf Activity - top
427	pz	3.606800	\$ Lower Frit - Top
428	pz	3.962400	\$ Lower Frit - Bottom
429	pz	4.140200	\$ Primary Capsule Lower End Plug - Top
430	pz	4.533900	\$ Bottom of Primary Capsule

c
 ===== Secondary Encapsulation =====
 c

400	cz	0.245110	\$ Threaded Top Radius
401	cz	0.469900	\$ Secondary Main Body Radius - Outer
402	cz	0.297180	\$ Secondary Main Body Radius - Inner
403	cz	0.411480	\$ Indentation Radius
404	pz	5.33400	\$ Top of Threaded cap
405	pz	4.85140	\$ Bottom of Cap Cut-Out
406	pz	4.64820	\$ Void Region for primary - Top
407	pz	0.45720	\$ Top of Secondary Cap plug
408	pz	0.12700	\$ Top of Indentation
409	pz	0.00000	\$ Bottom of Indentation

c
 c
 c ***** End Surface Definitions *****

c *****
 c | Data Card Section |
 c |
 c =====

c
 c Dry Air, rho=1.205E-3 g/cc, ICRU-37
 m2 6000 -1.24E-04 \$ Carbon
 7014 -7.55E-01 \$ Nitrogen
 8016 -2.32E-01 \$ Oxygen
 18000 -1.28E-02 \$ Argon

c
 c Zircaloy-2: 98.250 wt % zirconium, 1.45 wt % tin, 0.100 wt % chromium, 0.135 wt % iron, 0.055 wt % nickel, 0.01 wt % hafnium, 6.56 g/cc

c Standard Composition Library, ORNL, for SCALE Calculations
 m3 40000 -9.825E-01 \$ Zirconium
 50000 -1.450E-02 \$ Tin
 24000 -1.000E-03 \$ Chromium
 26000 -1.350E-03 \$ Iron

CALCULATION SHEET

PROJECT NO.:

CALC NO.:

REVISION NO.: 0

SHEET NO.: 83/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

(358:-359:-357)

(360:362:-363)

(361:363:-364)

imp:n=1 \$ Body of Capsule

```

c
342 1 -2.745 -340 341 -342 344 imp:n=1 $ Rib #1
343 2 -1.205e-3 -340 341 -344 345 imp:n=1 $ Air Gap #1
344 1 -2.745 -340 341 -345 346 imp:n=1 $ Rib #2
345 2 -1.205e-3 -340 341 -346 347 imp:n=1 $ Air Gap #2
346 1 -2.745 -340 341 -347 348 imp:n=1 $ Rib #3
347 2 -1.205e-3 -340 341 -348 349 imp:n=1 $ Air Gap #3
348 1 -2.745 -340 341 -349 350 imp:n=1 $ Rib #4
349 2 -1.205e-3 -340 341 -350 351 imp:n=1 $ Air Gap #4
350 1 -2.745 -340 341 -351 352 imp:n=1 $ Rib #5
351 2 -1.205e-3 -340 341 -352 353 imp:n=1 $ Air Gap #5
352 1 -2.745 -340 341 -353 354 imp:n=1 $ Rib #6
353 2 -1.205e-3 -340 341 -354 355 imp:n=1 $ Air Gap #6
354 1 -2.745 -340 341 -355 356 imp:n=1 $ Rib #7

```

```

c
c Interior Region for Source Capsule
355 0 -360 -362 363 imp:n=1 $ Threaded Hole
356 2 -1.205e-3 -361 -363 364 imp:n=1 $ Capsule Body

```

```

c
999 0 (342:340:-356) imp:n=0 $ Great Void
c -----

```

c Surfaces

```

c
c *****
c | Transfer (Rabbit) Capsule |
c | DWG Figure 2 |
c

```

```

340 cz 1.2573 $ Outer
341 cz 1.1811 $ Inner
c
342 pz 0.396240 $ Screw Cap - Top surface
343 pz 0.0 $ Main Body - Top surface
344 pz -0.18542
345 pz -0.32512
346 pz -0.56642
347 pz -0.70612
348 pz -0.94742
349 pz -1.08712
350 pz -1.27
351 pz -5.2705
352 pz -5.63118

```

CALCULATION SHEET

PROJECT NO.:

CALC NO.:

REVISION NO.: 0

SHEET NO.: 84/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

353 pz -5.77088
354 pz -6.01218
355 pz -6.15188
356 pz -6.6675
c
357 pz 0.07874 \$ Bottom of Slot
358 px 0.15875
359 px -0.15876
c
360 cz 0.245110 \$ Threaded Top Radius
361 cz 0.474980 \$ Body Radius
c
362 pz -0.345440 \$ Top of Threaded hole
363 pz -0.904240 \$ Bottom of Threaded Hole
364 pz -5.819140 \$ Bottom of Body Cavity
c
c
365 c/y 0.4445 -0.63627 0.1190625 \$ Drilled Hole
c
c
c

c Data Cards

c Materials

c 6061-T6 Aluminum Alloy, Used Average Values of Materials Defined in ASTM Standard B308/B 308M - 02, rho=2.745 g/cc from CRC and NIST Listed Densities

ml 13027 -9.492E-01 \$ Aluminum
14000 -6.132E-03 \$ Silicon
26000 -1.422E-02 \$ Iron
29000 -6.359E-03 \$ Copper
25055 -2.999E-03 \$ Manganese
12000 -8.844E-03 \$ Magnesium
24000 -3.689E-03 \$ Chromium
30000 -5.950E-03 \$ Zinc
22000 -2.613E-03 \$ Titanium

c

c Dry Air, rho=1.205E-3 g/cc, ICRU-37

m2 6000 -1.24E-04 \$ Carbon
7014 -7.55E-01 \$ Nitrogen
8016 -2.32E-01 \$ Oxygen
18000 -1.28E-02 \$ Argon

c

sdef

c

CALCULATION SHEET

PROJECT NO.:

CALC NO.:

REVISION NO.: 0

SHEET No.: 86/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

```
c | SR-CF-3000 Cf-252 Source Capsule |
c | DWG M-12541-CP-338E |
c
c ===== Primary Encapsulation =====
c
c The Source is flipped upside down to be like whats in secondary Capsule
c because the bottom of the primary encapsulation is at the top of the
c secondary encapsulation. The source was flipped by reversing the sign
c of the surface definitions and the signs of the surfaces in the cell definitions
c
420 5 -19.970 -421 420 423 -429 imp:n=1 $ Tube wall
422 5 -19.970 -421 422 -423 imp:n=1 $ Top End Plug
424 2 -1.205e-3 -420 423 -424 imp:n=1 $ Upper Void
426 4 -10.725 -420 424 -425 imp:n=1 $ Upper Frit
427 2 -1.205e-3 -420 425 -426 imp:n=1 $ Middle Void
428 6 -5.5 -420 426 -427 imp:n=1 $ Californium Source Volume
430 4 -10.725 -420 427 -428 imp:n=1 $ Lower Frit
432 2 -1.205E-3 -420 428 -429 imp:n=1 $ Lower Void
436 5 -19.970 -421 429 -430 imp:n=1 $ Lower End Plug
```

```
c
c ===== Secondary Encapsulation =====
c
404 3 -6.56 -400 -404 405 imp:n=1 $ Upper Threaded Section
402 3 -6.56 -401 -405 408 (402:406:-407) imp:n=1 $ Main Zircaloy Body
400 3 -6.56 -403 -408 409 imp:n=1 $ Bottom Indentation
c
410 2 -1.205e-3 -402 -406 407 (421:-422:430) imp:n=1 $ primary capsule Region
c
c
999 0 (342:340:-356) imp:n=0 $ Great Void
c -----
```

Surfaces

```
c *****
c | Transfer (Rabbit) Capsule |
c | DWG Figure 2 |
c
340 cz 1.2573 $ Outer
341 cz 1.1811 $ Inner
c
342 pz 0.396240 $ Screw Cap - Top surface
343 pz 0.0 $ Main Body - Top surface
344 pz -0.18542
```


CALCULATION SHEET

PROJECT NO.:

CALC NO.:

REVISION NO.: 0

SHEET NO.: 88/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

430 pz -1.221740 \$ Bottom of Primary Capsule

c

c

c

===== Secondary Encapsulation =====

400 cz 0.245110 \$ Threaded Top Radius

401 cz 0.469900 \$ Secondary Main Body Radius - Outer

402 cz 0.297180 \$ Secondary Main Body Radius - Inner

403 cz 0.411480 \$ Indentation Radius

c

404 pz -0.421640 \$ Top of Threaded cap

405 pz -0.904240 \$ Bottom of Cap Cut-Out

406 pz -1.107440 \$ Void Region for primary - Top

407 pz -5.298440 \$ Top of Secondary Cap plug

408 pz -5.628640 \$ Top of Indentation

409 pz -5.755640 \$ Bottom of Indentation

c

c

c

c Data Cards

c Materials

c 6061-T6 Aluminum Alloy, Used Average Values of Materials Defined in ASTM Standard B308/B 308M - 02, rho=2.745 g/cc from CRC and NIST Listed Densities

m1 13027 -9.492E-01 \$ Aluminum

14000 -6.132E-03 \$ Silicon

26000 -1.422E-02 \$ Iron

29000 -6.359E-03 \$ Copper

25055 -2.999E-03 \$ Manganese

12000 -8.844E-03 \$ Magnesium

24000 -3.689E-03 \$ Chromium

30000 -5.950E-03 \$ Zinc

22000 -2.613E-03 \$ Titanium

c

c Dry Air, rho=1.205E-3 g/cc, ICRU-37

m2 6000 -1.24E-04 \$ Carbon

7014 -7.55E-01 \$ Nitrogen

8016 -2.32E-01 \$ Oxygen

18000 -1.28E-02 \$ Argon

c

c Zircaloy-2: 98.250 wt % zirconium, 1.45 wt % tin, 0.100 wt % chromium, 0.135 wt % iron, 0.055 wt % nickel, 0.01 wt % hafnium, 6.56 g/cc

c Standard Composition Library, ORNL, for SCALE Calculations

m3 40000 -9.825E-01 \$ Zirconium

50000 -1.450E-02 \$ Tin

24000 -1.000E-03 \$ Chromium

CALCULATION SHEET

PROJECT NO.:

CALC NO.:

REVISION NO.: 0

SHEET No.: 90/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. MCCONN

DATE: 03/21/10

```

324 2 -1.205E-3 -323 -325 329                               imp:n=1 $ Air inside Transfer Tube
c
330 10 -1.123 -329 330 -323                               imp:n=1 $ Spring Assembly
c
999 0 (325:-324:320) imp:n=0                               $ The Great void

```

```

c *****
c |                Transfer Tubing                |
c |                DWG ??????                    |
c
320 cz 1.905                                           $ Outer Guide Tube Outer Radius
321 cz 1.778                                           $ Outer Guide Tube Inner Radius
322 cz 1.42875                                         $ Inner Guide Tube Outer Radius
323 cz 1.27                                             $ Inner Guide Tube Inner Radius
324 pz -3.9624                                         $ Base of Guide Tube Assembly
325 pz 25                                              $ Top of Guide Tube Assembly
c Spring
329 pz -1.7145                                         $ Top of Spring Assembly
330 pz -3.2004                                         $ Top of Rabbit Tube Assembly Base; bottom of Spring
c
345 cz 1.2573                                         $ Outer Edges of Grooves
360 pz 5.32924                                         $ Top of Cap
c

```

```

c Data Cards
c Materials
c 6061-T6 Aluminum Alloy, Used Average Values of Materials Defined in ASTM Standard B308/B 308M - 02, rho=2.745 g/cc from
CRC and NIST Listed Densities
ml 13027 -9.492E-01 $ Aluminum
   14000 -6.132E-03 $ Silicon
   26000 -1.422E-02 $ Iron
   29000 -6.359E-03 $ Copper
   25055 -2.999E-03 $ Manganese
   12000 -8.844E-03 $ Magnesium
   24000 -3.689E-03 $ Chromium
   30000 -5.950E-03 $ Zinc
   22000 -2.613E-03 $ Titanium
c
c Dry Air, rho=1.205E-3 g/cc, ICRU-37
m2 6000 -1.24E-04 $ Carbon
   7014 -7.55E-01 $ Nitrogen
   8016 -2.32E-01 $ Oxygen
   18000 -1.28E-02 $ Argon
c
c

```

CALCULATION SHEET

PROJECT NO.:

CALC NO.:

REVISION NO.: 0

SHEET No.: 91/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

c Spring Steel ASTM A228 / A228M - 07 + ICRU-37 Dry Air, rho=1.123

m10 6000 -8.49E-3
25055 -4.50E-3
15031 -2.50E-4
16000 -3.00E-4
14000 -2.00E-3
26000 -9.84E-1
7014 -6.92E-4
8016 -2.13E-4
18000 -1.17E-5

c
sdef

Sr3000_TransferTubeAssembly.mcnp.inp

This is the transfer tube assembly

```
c
c *****
c |                Transfer Tubing                |
c |                DWG ??????                    |
c
320 1 -2.745      -320 321 -325 324                imp:n=1 $ Outer Al Guide Tube
321 1 -2.745      -321 324 -330                    imp:n=1 $ Al Guide Assembly Base
322 1 -2.745      -322 323 -325 330                imp:n=1 $ Inner Al Guide Tube
323 2 -1.205E-3   -321 322 -325 330                imp:n=1 $ Air Between Inner and Outer Guide Tubes
c
324 2 -1.205E-3   -323 -325 329 (342:340:-356)     imp:n=1 $ Air inside Transfer Tube
c
330 10 -1.123     -329 330 -323                    imp:n=1 $ Spring Assembly
c
c *****
c |                Transfer (Rabbit) Capsule       |
c |                DWG Figure 2                   |
c
340 2 -1.205e-3   -342 357 -358 359 -341          imp:n=1 $ Slot
c
341 1 -2.745      -341 -342 356                    (358:-359:-357)
                    (360:362:-363)
                    (361:363:-364)                imp:n=1 $ Body of Capsule
c
342 1 -2.745      -340 341 -342 344                imp:n=1 $ Rib #1
```

CALCULATION SHEET

PROJECT NO.:

CALC NO.:

REVISION NO.: 0

SHEET NO.: 92/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

343	2	-1.205e-3	-340	341	-344	345	imp:n=1	\$ Air Gap #1
344	1	-2.745	-340	341	-345	346	imp:n=1	\$ Rib #2
345	2	-1.205e-3	-340	341	-346	347	imp:n=1	\$ Air Gap #2
346	1	-2.745	-340	341	-347	348	imp:n=1	\$ Rib #3
347	2	-1.205e-3	-340	341	-348	349	imp:n=1	\$ Air Gap #3
348	1	-2.745	-340	341	-349	350	imp:n=1	\$ Rib #4
349	2	-1.205e-3	-340	341	-350	351	imp:n=1	\$ Air Gap #4
350	1	-2.745	-340	341	-351	352	imp:n=1	\$ Rib #5
351	2	-1.205e-3	-340	341	-352	353	imp:n=1	\$ Air Gap #5
352	1	-2.745	-340	341	-353	354	imp:n=1	\$ Rib #6
353	2	-1.205e-3	-340	341	-354	355	imp:n=1	\$ Air Gap #6
354	1	-2.745	-340	341	-355	356	imp:n=1	\$ Rib #7

c

Interior Region for Source Capsule

355	0		-360		-362	363		
				(400:404:-405)			imp:n=1	\$ Threaded Hole
356	2	-1.205e-3	-361		-363	364		
				(401:405:-408)	(403:408:-409)		imp:n=1	\$ Capsule Body

c

c

c

c

SR-CF-3000 Cf-252 Source Capsule

c

DWG M-12541-CP-338E

c

c

===== Primary Encapsulation =====

c

c

The Source is flipped upside down to be like whats in secondary Capsule

c

because the bottom of the primary encapsulation is at the top of the

c

secondary encapsulation. The source was flipped by reversing the sign

c

of the surface definitions and the signs of the surfaces in the cell definitions

c

420	5	-19.970	-421	420	423	-429	imp:n=1	\$ Tube wall
422	5	-19.970	-421	422	-423		imp:n=1	\$ Top End Plug
424	2	-1.205e-3	-420	423	-424		imp:n=1	\$ Upper Void
426	4	-10.725	-420	424	-425		imp:n=1	\$ Upper Frit
427	2	-1.205e-3	-420	425	-426		imp:n=1	\$ Middle Void
428	6	-5.5	-420	426	-427		imp:n=1	\$ Californium Source Volume
430	4	-10.725	-420	427	-428		imp:n=1	\$ Lower Frit
432	2	-1.205E-3	-420	428	-429		imp:n=1	\$ Lower Void
436	5	-19.970	-421	429	-430		imp:n=1	\$ Lower End Plug

c

c

c

===== Secondary Encapsulation =====

c

404	3	-6.56	-400	-404	405		imp:n=1	\$ Upper Threaded Section
-----	---	-------	------	------	-----	--	---------	---------------------------

CALCULATION SHEET

PROJECT NO.:

CALC NO.:

REVISION NO.: 0

SHEET NO.: 93/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. MCCONN

DATE: 03/21/10

```

402 3 -6.56      -401 -405 408 (402:406:-407)      imp:n=1 $ Main Zircaloy Body
400 3 -6.56      -403 -408 409                      imp:n=1 $ Bottom Indentation
c
410 2 -1.205e-3 -402 -406 407 (421:-422:430)      imp:n=1 $ primary capsule Region
c
c
999 0          (325:-324:320) imp:n=0              $ The Great void

c *****
c |                Surface Definition Section      |
c |-----|
c
c
c *****
c |                Transfer Assembly Tubing        |
c |                DWG ???????                     |
c
320  cz      1.905                                $ Outer Guide Tube Outer Radius
321  cz      1.778                                $ Outer Guide Tube Inner Radius
322  cz      1.42875                              $ Inner Guide Tube Outer Radius
323  cz      1.27                                  $ Inner Guide Tube Inner Radius
324  pz     -3.9624                              $ Base of Guide Tube Assembly
325  pz      25                                    $ Top of Guide Tube Assembly
c Spring
329  pz     -1.7145                              $ Top of Spring Assembly
330  pz     -3.2004                              $ Top of Rabbit Tube Assembly Base; bottom of Spring
c
c *****
c |                Transfer (Rabbit) Capsule        |
c |                DWG Figure 2                    |
c
340  cz      1.2573                                $ Outer
341  cz      1.1811                                $ Inner
c
342  pz      5.349240                              $ Screw Cap - Top surface
343  pz      4.953000                              $ Main Body - Top surface
344  pz      4.767580
345  pz      4.627880
346  pz      4.386580
347  pz      4.246880
348  pz      4.005580
349  pz      3.865880
350  pz      3.683000
351  pz     -0.317500
    
```


CALCULATION SHEET

PROJECT NO.:

CALC NO.:

REVISION NO.: 0

SHEET NO.: 95/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. MCCONN

DATE: 03/21/10

```
403 cz 0.411480 $ Indentation Radius
c
404 pz 4.531360 $ Top of Threaded cap
405 pz 4.048760 $ Bottom of Cap Cut-Out
406 pz 3.845560 $ Void Region for primary - Top
407 pz -0.345440 $ Top of Secondary Cap plug
408 pz -0.675640 $ Top of Indentation
409 pz -0.802640 $ Bottom of Indentation
c
c ***** End Surface Definitions *****
c *****
c | Data Card Section |
c | |
c =====
c
c Data Cards
c Materials
c 6061-T6 Aluminum Alloy, Used Average Values of Materials Defined in ASTM Standard B308/B 308M - 02, rho=2.745 g/cc from
CRC and NIST Listed Densities
m1 13027 -9.492E-01 $ Aluminum
14000 -6.132E-03 $ Silicon
26000 -1.422E-02 $ Iron
29000 -6.359E-03 $ Copper
25055 -2.999E-03 $ Manganese
12000 -8.844E-03 $ Magnesium
24000 -3.689E-03 $ Chromium
30000 -5.950E-03 $ Zinc
22000 -2.613E-03 $ Titanium
c
c Dry Air, rho=1.205E-3 g/cc, ICRU-37
m2 6000 -1.24E-04 $ Carbon
7014 -7.55E-01 $ Nitrogen
8016 -2.32E-01 $ Oxygen
18000 -1.28E-02 $ Argon
c
c
c Zircaloy-2: 98.250 wt % zirconium, 1.45 wt % tin, 0.100 wt % chromium, 0.135 wt % iron, 0.055 wt % nickel, 0.01 wt %
hafnium, 6.56 g/cc
c Standard Composition Library, ORNL, for SCALE Calculations
m3 40000 -9.825E-01 $ Zirconium
50000 -1.450E-02 $ Tin
24000 -1.000E-03 $ Chromium
26000 -1.350E-03 $ Iron
28000 -5.500E-04 $ Nickel
```

CALCULATION SHEET

PROJECT NO.:

CALC NO.:

REVISION NO.: 0

SHEET NO.: 96/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

72000 -1.000E-04 \$ Hafnium

c

c

c Platinum, Sintered (rho=10.725)

m4 78000 -1.00

c

c 90% Platinum, 10% Rhodium Mixture, rho= 19.970 g/cc, <http://www.azom.com/details.asp?ArticleID=2273>

m5 78000 -0.9

45103 -0.1

c

c

c Cf-252 source composition for SR-Cf-3000 Hanford Source

c Ref: see calculation package

m6 98249 -0.006141

98250 -0.006543

98251 -0.004022

98252 -0.002888

96245 -0.000992

96246 -0.041218

96247 -0.000251

96248 -0.621612

08016 -0.088141

c

c

c Spring Steel ASTM A228 / A228M - 07 + ICRU-37 Dry Air, rho=1.123

m10 6000 -8.49E-3

25055 -4.50E-3

15031 -2.50E-4

16000 -3.00E-4

14000 -2.00E-3

26000 -9.84E-1

7014 -6.92E-4

8016 -2.13E-4

18000 -1.17E-5

c

sdef

LSR_D2O_Sphere.mcnp.inp

This is the D2O Moderating Sphere with a Cd cover

c

CALCULATION SHEET

PROJECT NO.:

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SHEET No.: 97/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

```

c D2O Moderating Sphere
c
c
c ===== D2O Moderating Sphere with Cd Cover =====
c
300 7 -8.65          $ Cd
    -300 301        $ Cd Cover
    (300:-301:303:-310)
    (300:-301:305:310)
    imp:n=1
c
301 9 -8.03          $ SS 304L
    -301 302        $ Steel Shell
    (301:-302:303:-310)
    (301:-302:305:310)
    imp:n=1
c
302 8 -1.104        $ D2O
    -302            $ Inside sphere
    (303:-308)
    (305:308)
    imp:n=1
c
303 9 -8.03          $ SS 304L
    -303 304 307 -300 $ Upper Void Region Tube
    imp:n=1
c
304 2 -1.205e-3     $ Air
    -304 307 -300   $ Upper Void
    imp:n=1
c
305 9 -8.03          $ SS 304L
    -305 306 -307 -300 $ Lower Void
    imp:n=1
c
306 2 -1.205e-3     $ Air
    -306 -307 -300   $ Lower Void
    imp:n=1
c
307 9 -8.03          $ SS 304L
    -303 305 -307 308 $ Base Plate
    imp:n=1
c
999 0 300          imp:n=0 $ The Great Void
c -----

```


CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

100/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

imp:n=1

c
305

9 -8.03 \$ SS 304L
-305 306 -307 -300 \$ Lower Void
imp:n=1

c
306

2 -1.205e-3 \$ Air
-306 -307 -300 \$ Lower Void
imp:n=1

c
307

9 -8.03 \$ SS 304L
-303 305 -307 308 \$ Base Plate
imp:n=1

c
c

c
c

| Transfer Tubing |
| DWG ?????? |

c
c

320 1 -2.745 -320 321 -325 324 imp:n=1 \$ Outer Al Guide Tube
321 1 -2.745 -321 324 -330 imp:n=1 \$ Al Guide Assembly Base
322 1 -2.745 -322 323 -325 330 imp:n=1 \$ Inner Al Guide Tube
323 2 -1.205E-3 -321 322 -325 330 imp:n=1 \$ Air Between Inner and Outer Guide Tubes

c
c

324 2 -1.205E-3 -323 -325 329 (342:340:-356) imp:n=1 \$ Air inside Transfer Tube

c
c

330 10 -1.123 -329 330 -323 imp:n=1 \$ Spring Assembly

c
c

c
c

| Transfer (Rabbit) Capsule |
| DWG Figure 2 |

c
c

340 2 -1.205e-3 -342 357 -358 359 -341 imp:n=1 \$ Slot

c
c

341 1 -2.745 -341 -342 356
(358:-359:-357)
(360:362:-363)
(361:363:-364) imp:n=1 \$ Body of Capsule

c
c

342 1 -2.745 -340 341 -342 344 imp:n=1 \$ Rib #1
343 2 -1.205e-3 -340 341 -344 345 imp:n=1 \$ Air Gap #1
344 1 -2.745 -340 341 -345 346 imp:n=1 \$ Rib #2
345 2 -1.205e-3 -340 341 -346 347 imp:n=1 \$ Air Gap #2
346 1 -2.745 -340 341 -347 348 imp:n=1 \$ Rib #3

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

101/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

347	2	-1.205e-3	-340 341 -348 349	imp:n=1	\$ Air Gap #3
348	1	-2.745	-340 341 -349 350	imp:n=1	\$ Rib #4
349	2	-1.205e-3	-340 341 -350 351	imp:n=1	\$ Air Gap #4
350	1	-2.745	-340 341 -351 352	imp:n=1	\$ Rib #5
351	2	-1.205e-3	-340 341 -352 353	imp:n=1	\$ Air Gap #5
352	1	-2.745	-340 341 -353 354	imp:n=1	\$ Rib #6
353	2	-1.205e-3	-340 341 -354 355	imp:n=1	\$ Air Gap #6
354	1	-2.745	-340 341 -355 356	imp:n=1	\$ Rib #7

c

Interior Region for Source Capsule

355	0		-360 -362 363		
			(400:404:-405)	imp:n=1	\$ Threaded Hole
356	2	-1.205e-3	-361 -363 364		
			(401:405:-408) (403:408:-409)	imp:n=1	\$ Capsule Body

c

c

c

c

| SR-CF-3000 Cf-252 Source Capsule |

c

| DWG M-12541-CP-338E |

c

c

===== Primary Encapsulation =====

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

420	5	-19.970	-421 420 423 -429	imp:n=1	\$ Tube wall
422	5	-19.970	-421 422 -423	imp:n=1	\$ Top End Plug
424	2	-1.205e-3	-420 423 -424	imp:n=1	\$ Upper Void
426	4	-10.725	-420 424 -425	imp:n=1	\$ Upper Frit
427	2	-1.205e-3	-420 425 -426	imp:n=1	\$ Middle Void
428	6	-5.5	-420 426 -427	imp:n=1	\$ Californium Source Volume
430	4	-10.725	-420 427 -428	imp:n=1	\$ Lower Frit
432	2	-1.205E-3	-420 428 -429	imp:n=1	\$ Lower Void
436	5	-19.970	-421 429 -430	imp:n=1	\$ Lower End Plug

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

c

===== Secondary Encapsulation =====

404	3	-6.56	-400 -404 405	imp:n=1	\$ Upper Threaded Section
402	3	-6.56	-401 -405 408 (402:406:-407)	imp:n=1	\$ Main Zircaloy Body
400	3	-6.56	-403 -408 409	imp:n=1	\$ Bottom Indentation

c

c

c

c

c

c

c

c

c

c

c

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

102/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

410 2 -1.205e-3 -402 -406 407 (421:-422:430) imp:n=1 \$ primary capsule Region

c
c

999 0 (325:-324:320) 300 imp:n=0 \$ The Great void

c *****

c | Surface Definition Section |

c |-----|

c *****

c | D2O Moderating Sphere with Cd Cover |

c | DWG: |

c |

c |

300 so 15.1257 \$ Outer Surface - Cd layer
301 so 15.0749 \$ Outer Surface - Steel layer
302 so 14.9987 \$ Inner Surface - Steel layer

c
303 cz 2.00025 \$ Outer Radius - Upper Void
304 cz 1.94437 \$ Inner Radius - Upper Void
305 cz 0.635
306 cz 0.5842

c
307 pz -3.9624
308 pz -4.2545
309 pz -15.875
310 pz 0 \$ Ambiguity plane

c

c

c *****

c | Transfer Assembly Tubing |

c | DWG ?????? |

c |

320 cz 1.905 \$ Outer Guide Tube Outer Radius
321 cz 1.778 \$ Outer Guide Tube Inner Radius
322 cz 1.42875 \$ Inner Guide Tube Outer Radius
323 cz 1.27 \$ Inner Guide Tube Inner Radius
324 pz -3.9624 \$ Base of Guide Tube Assembly
325 pz 25 \$ Top of Guide Tube Assembly
c Spring
329 pz -1.7145 \$ Top of Spring Assembly
330 pz -3.2004 \$ Top of Rabbit Tube Assembly Base; bottom of Spring

c

CALCULATION SHEET

PROJECT No.:	CALC No.:	REVISION No.: <u>0</u>	SHEET No.:
	<u>PNNL-19273</u>		<u>103/246</u>
SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵² Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM			
PREPARED BY: <u>R.J. TRAUB</u>	DATE: <u>02/8/10</u>	REVIEWED BY: <u>R.J.McCONN</u>	DATE: <u>03/21/10</u>

```

c
c *****
c |                               Transfer (Rabbit) Capsule                               |
c |                               DWG Figure 2                                         |
c
340 cz    1.2573                    $ Outer
341 cz    1.1811                    $ Inner
c
342 pz    5.349240                  $ Screw Cap - Top surface
343 pz    4.953000                  $ Main Body - Top surface
344 pz    4.767580
345 pz    4.627880
346 pz    4.386580
347 pz    4.246880
348 pz    4.005580
349 pz    3.865880
350 pz    3.683000
351 pz    -0.317500
352 pz    -0.678180
353 pz    -0.817880
354 pz    -1.059180
355 pz    -1.198880
356 pz    -1.714500
c
357 pz    5.031740                    $ Bottom of Slot
358 px    0.15875
359 px    -0.15876
c
360 cz    0.245110                    $ Threaded Top Radius
361 cz    0.474980                    $ Body Radius
c
362 pz    4.607560                    $ Top of Threaded hole
363 pz    4.048760                    $ Bottom of Threaded Hole
364 pz    -0.866140                    $ Bottom of Body Cavity
c
c
365 c/y  0.4445 -0.63627 0.1190625    $ Drilled Hole
c
c *****
c |                               SR-CF-3000 Cf-252 Source Capsule                               |
c |                               DWG M-12541-CP-338E                                         |
c
c ===== Inner Encapsulation =====

```


CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

105/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

12000 -8.844E-03 \$ Magnesium
24000 -3.689E-03 \$ Chromium
30000 -5.950E-03 \$ Zinc
22000 -2.613E-03 \$ Titanium

c

c Dry Air, rho=1.205E-3 g/cc, ICRU-37

m2 6000 -1.24E-04 \$ Carbon
7014 -7.55E-01 \$ Nitrogen
8016 -2.32E-01 \$ Oxygen
18000 -1.28E-02 \$ Argon

c

c

c Zircaloy-2: 98.250 wt % zirconium, 1.45 wt % tin, 0.100 wt % chromium, 0.135 wt % iron, 0.055 wt % nickel, 0.01 wt % hafnium, 6.56 g/cc

c Standard Composition Library, ORNL, for SCALE Calculations

m3 40000 -9.825E-01 \$ Zirconium
50000 -1.450E-02 \$ Tin
24000 -1.000E-03 \$ Chromium
26000 -1.350E-03 \$ Iron
28000 -5.500E-04 \$ Nickel
72000 -1.000E-04 \$ Hafnium

c

c

c Platinum, Sintered (rho=10.725)

m4 78000 -1.00

c

c 90% Platinum, 10% Rhodium Mixture, rho= 19.970 g/cc, <http://www.azom.com/details.asp?ArticleID=2273>

m5 78000 -0.9
45103 -0.1

c

c

c Cf-252 source composition for SR-Cf-3000 Hanford Source

c Ref: see calculation package

m6 98249 -0.006141
98250 -0.006543
98251 -0.004022
98252 -0.002888
96245 -0.000992
96246 -0.041218
96247 -0.000251
96248 -0.621612
08016 -0.088141

c

c

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

106/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

c Cadmium, 8.65 g/cc, NIST, <http://physics.nist.gov/cgi-bin/Star/compos.pl?matno=048>
m7 48000 -1.0 \$ Cadmium

c
c

c Deuterium Oxide (Heavy Water), rho=1.1044, <http://www.coleparmer.com/catalog/Msds/95555.htm>

m8 1002 0.667
8016 0.333

mt8 hwtr.01t

c
c

c 304L and 304 Stainless Steel, Specification from AKSTEEL composition using average %s, rho=8.03 g/cc

c http://www.aksteel.com/pdf/markets_products/stainless/austenitic/304_304L_Data_Sheet.pdf

m9 6000 -6.54296E-05 \$ Carbon
25055 -0.019941613 \$ Manganese
15031 -0.000252967 \$ Phosphorus
16000 -0.000174592 \$ Sulfur
14000 -0.003822966 \$ Silicon
24000 -0.179300472 \$ Chromium
28000 -0.106523721 \$ Nickel
7014 -0.000254211 \$ Nitrogen
26000 -0.689664029 \$ Iron

c
c

c Spring Steel ASTM A228 / A228M - 07 + ICRU-37 Dry Air, rho=1.123

m10 6000 -8.49E-3
25055 -4.50E-3
15031 -2.50E-4
16000 -3.00E-4
14000 -2.00E-3
26000 -9.84E-1
7014 -6.92E-4
8016 -2.13E-4
18000 -1.17E-5

c
sdef

CALCULATION SHEET

PROJECT NO.:

CALC No.:

REVISION No.: 0

SHEET NO.:

107/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

Appendix B.

Engineering Drawings

CALCULATION SHEET

PROJECT NO.:

CALC No.:

REVISION No.: 0

SHEET NO.:

110/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

Appendix C

MCNP Input and Output File Example

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

111/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

Example input file: LSR.OBJ_MV_CF3000_ASIS_TG01.inp

This is the Low Scatter Room compatible version of the 318 neutron sources

c

c This input file has cell and surface numbering that is compatible with
c the LLNL cells and surfaces of the PNNL Low Scatter Room.

c

c

c Tally Group 01

c Ring Detectors 50 cm from the center of the D20 moderating sphere.

c Note: Moderating sphere might not be present.

c

c F5, F15, F25 - ICRP-21 Dose Factors

c F35, F45, F55 - ICRP-74 Hp(10) factors

c F65, F75, F85 - ICRP-74 H*(10) factors

c

c

c Objects

c

c

c *****

c | D20 Moderating Sphere with Cd Cover |

c | DWG: |

c

300 7 -8.65 \$ Cd
-300 301 \$ Cd Cover
(300:-301:303:-310)
(300:-301:305:310)
imp:n=1

c

301 9 -8.03 \$ SS 304L
-301 302 \$ Steel Shell
(301:-302:303:-310)
(301:-302:305:310)
imp:n=1

c

302 8 -1.104 \$ D20
-302 \$ Inside sphere
(303:-308)
(305:308)

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-300 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

imp:n=1

c
303 9 -8.03 \$ SS 304L
-303 304 307 -300 \$ Upper Void Region Tube
imp:n=1

c
304 2 -1.205e-3 \$ Air
-304 307 -300 320 \$ Upper Void (Source goes here)
imp:n=1

c
305 9 -8.03 \$ SS 304L
-305 306 -307 -300 \$ Lower Void
imp:n=1

c
306 2 -1.205e-3 \$ Air
-306 -307 -300 \$ Lower Void
imp:n=1

c
307 9 -8.03 \$ SS 304L
-303 305 -307 308 \$ Base Plate
imp:n=1

c
c
c *****

c | Transfer Tubing |
c | DWG ??????? |

c
320 1 -2.745 -320 321 -325 324 imp:n=1 \$ Outer Al Guide Tube
321 1 -2.745 -321 324 -330 imp:n=1 \$ Al Guide Assembly Base
322 1 -2.745 -322 323 -325 330 imp:n=1 \$ Inner Al Guide Tube
323 2 -1.205E-3 -321 322 -325 330 imp:n=1 \$ Air Between Inner and Outer Guide Tubes
c
324 2 -1.205E-3 -323 -325 329 (342:340:-356) imp:n=1 \$ Air inside Transfer Tube
c
330 10 -1.123 -329 330 -323 imp:n=1 \$ Spring Assembly
c

c
c *****

c | Transfer (Rabbit) Capsule |
c | DWG Figure 2 |

c
340 2 -1.205e-3 -342 357 -358 359 -341 imp:n=1 \$ Slot
c
341 1 -2.745 -341 -342 356

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SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵² Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM			
PREPARED BY: <u>R.J. TRAUB</u>	DATE: <u>02/8/10</u>	REVIEWED BY: <u>R.J.McCONN</u>	DATE: <u>03/21/10</u>

```

(358:-359:-357)
(360:362:-363)
(361:363:-364)          imp:n=1  $ Body of Capsule

c
342 1 -2.745          -340 341 -342 344          imp:n=1  $ Rib #1
343 2 -1.205e-3      -340 341 -344 345          imp:n=1  $ Air Gap #1
344 1 -2.745          -340 341 -345 346          imp:n=1  $ Rib #2
345 2 -1.205e-3      -340 341 -346 347          imp:n=1  $ Air Gap #2
346 1 -2.745          -340 341 -347 348          imp:n=1  $ Rib #3
347 2 -1.205e-3      -340 341 -348 349          imp:n=1  $ Air Gap #3
348 1 -2.745          -340 341 -349 350          imp:n=1  $ Rib #4
349 2 -1.205e-3      -340 341 -350 351          imp:n=1  $ Air Gap #4
350 1 -2.745          -340 341 -351 352          imp:n=1  $ Rib #5
351 2 -1.205e-3      -340 341 -352 353          imp:n=1  $ Air Gap #5
352 1 -2.745          -340 341 -353 354          imp:n=1  $ Rib #6
353 2 -1.205e-3      -340 341 -354 355          imp:n=1  $ Air Gap #6
354 1 -2.745          -340 341 -355 356          imp:n=1  $ Rib #7

c
c Interior Region for Source Capsule
355 0                -360          -362 363
                (400:404:-405)  imp:n=1  $ Threaded Hole
356 2 -1.205e-3      -361          -363 364
                (401:405:-408) (403:408:-409) imp:n=1  $ Capsule Body

c
c
c *****
c |                SR-CF-3000 Cf-252 Source Capsule                |
c |                DWG M-12541-CP-338E                            |
c
c ===== Primary Encapsulation =====
c
c The Source is flipped upside down to be like whats in secondary Capsule
c because the bottom of the primary encapsulation is at the top of the
c secondary encapsulation. The source was flipped by reversing the sign
c of the surface definitions and the signs of the surfaces in the cell definitions
c
420 5 -19.970        -421 420 423 -429          imp:n=1  $ Tube wall
422 5 -19.970        -421 422 -423          imp:n=1  $ Top End Plug
424 2 -1.205e-3      -420 423 -424          imp:n=1  $ Upper Void
426 4 -10.725        -420 424 -425          imp:n=1  $ Upper Frit
427 6 -5.5           -420 425 -426          imp:n=1  $ Californium Source Volume
428 2 -1.205e-3      -420 426 -427          imp:n=1  $ Void Region
430 4 -10.725        -420 427 -428          imp:n=1  $ Lower Frit
432 2 -1.205E-3      -420 428 -429          imp:n=1  $ Lower Void
    
```


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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-300 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

```
436 5 -19.970    -421 429 -430          imp:n=1 $ Lower End Plug
c
c
c ===== Secondary Encapsulation =====
c
404 3 -6.56      -400 -404 405          imp:n=1 $ Upper Threaded Section
402 3 -6.56      -401 -405 408 (402:406:-407)  imp:n=1 $ Main Zircaloy Body
400 3 -6.56      -403 -408 409          imp:n=1 $ Bottom Indentation
c
410 2 -1.205e-3  -402 -406 407 (421:-422:430)  imp:n=1 $ primary capsule Region
c
c
500 0 (325:-324:320) 300    -999          imp:n=1
999 0          999          imp:n=0

c *****
c |                Surface Definition Section                |
c |-----|
c
c *****
c |                D2O Moderating Sphere with Cd Cover        |
c |                DWG:                                        |
c
c
300 so 15.1257          $ Outer Surface - Cd layer
301 so 15.0749          $ Outer Surface - Steel layer
302 so 14.9987          $ Inner Surface - Steel layer
c
303 cz 2.00025          $ Outer Radius - Upper Void
304 cz 1.94437          $ Inner Radius - Upper Void
305 cz 0.635
306 cz 0.5842
c
307 pz -3.9624
308 pz -4.2545
309 pz -15.875
310 pz 0                $ Ambiguity plane
c
c
c *****
c |                Transfer Assembly Tubing                    |
```

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DATE: 03/21/10

c			DWG ????????		
c					
320	cz	1.905			\$ Outer Guide Tube Outer Radius
321	cz	1.778			\$ Outer Guide Tube Inner Radius
322	cz	1.42875			\$ Inner Guide Tube Outer Radius
323	cz	1.27			\$ Inner Guide Tube Inner Radius
324	pz	-3.9624			\$ Base of Guide Tube Assembly
325	pz	25			\$ Top of Guide Tube Assembly
c	Spring				
329	pz	-1.7145			\$ Top of Spring Assembly
330	pz	-3.2004			\$ Top of Rabbit Tube Assembly Base; bottom of Spring
c					
c					
c			*****		
c			Transfer (Rabbit) Capsule		
c			DWG Figure 2		
c					
340	cz	1.2573			\$ Outer
341	cz	1.1811			\$ Inner
c					
342	pz	5.349240			\$ Screw Cap - Top surface
343	pz	4.953000			\$ Main Body - Top surface
344	pz	4.767580			
345	pz	4.627880			
346	pz	4.386580			
347	pz	4.246880			
348	pz	4.005580			
349	pz	3.865880			
350	pz	3.683000			
351	pz	-0.317500			
352	pz	-0.678180			
353	pz	-0.817880			
354	pz	-1.059180			
355	pz	-1.198880			
356	pz	-1.714500			
c					
357	pz	5.031740			\$ Bottom of Slot
358	px	0.15875			
359	px	-0.15876			
c					
360	cz	0.245110			\$ Threaded Top Radius
361	cz	0.474980			\$ Body Radius
c					
362	pz	4.607560			\$ Top of Threaded hole

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PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

c Data Cards
c
c
c DATA CARDS
c Materials
c 6061-T6 Aluminum Alloy, Used Average Values of Materials Defined in ASTM Standard B308/B 308M - 02, rho=2.745 g/cc from CRC and NIST Listed Densities
m1 13027 -9.492E-01 \$ Aluminum
14000 -6.132E-03 \$ Silicon
26000 -1.422E-02 \$ Iron
29000 -6.359E-03 \$ Copper
25055 -2.999E-03 \$ Manganese
12000 -8.844E-03 \$ Magnesium
24000 -3.689E-03 \$ Chromium
30000 -5.950E-03 \$ Zinc
22000 -2.613E-03 \$ Titanium
c
c Dry Air, rho=1.205E-3 g/cc, ICRU-37
m2 6000 -1.24E-04 \$ Carbon
7014 -7.55E-01 \$ Nitrogen
8016 -2.32E-01 \$ Oxygen
18000 -1.28E-02 \$ Argon
c
c Zircaloy-2: 98.250 wt % zirconium, 1.45 wt % tin, 0.100 wt % chromium, 0.135 wt % iron, 0.055 wt % nickel, 0.01 wt % hafnium, 6.56 g/cc
c Standard Composition Library, ORNL, for SCALE Calculations
m3 40000 -9.825E-01 \$ Zirconium
50000 -1.450E-02 \$ Tin
24000 -1.000E-03 \$ Chromium
26000 -1.350E-03 \$ Iron
28000 -5.500E-04 \$ Nickel
72000 -1.000E-04 \$ Hafnium
c
c Platinum, Sintered (rho=10.725)
m4 78000 -1.00
c
c 90% Platinum, 10% Rhodium Mixture, rho= 19.970 g/cc, <http://www.azom.com/details.asp?ArticleID=2273>
m5 78000 -0.9
45103 -0.1
c
c
c Cf-252 source composition for SR-Cf-3000 Hanford Source
c Ref: see calculation package
m6 98249 -0.006141

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PREPARED BY: R.J. TRAUB

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98250 -0.006543
98251 -0.004022
98252 -0.002888
96245 -0.000992
96246 -0.041218
96247 -0.000251
96248 -0.621612
08016 -0.088141

c

c

c Cadmium, 8.65 g/cc, NIST, <http://physics.nist.gov/cgi-bin/Star/compos.pl?matno=048>

m7 48000 -1.0 \$ Cadmium

c

c Deuterium Oxide (Heavy Water), rho=1.1044, <http://www.coleparmer.com/catalog/Msds/95555.htm>

m8 1002 0.667

8016 0.333

mt8 hwtr.01t

c

c

c 304L and 304 Stainless Steel, Specification from AKSTEEL composition using average %s, rho=8.03 g/cc

c http://www.aksteel.com/pdf/markets_products/stainless/austenitic/304_304L_Data_Sheet.pdf

m9 6000 -6.54296E-05 \$ Carbon
25055 -0.019941613 \$ Manganese
15031 -0.000252967 \$ Phosphorus
16000 -0.000174592 \$ Sulfur
14000 -0.003822966 \$ Silicon
24000 -0.179300472 \$ Chromium
28000 -0.106523721 \$ Nickel
7014 -0.000254211 \$ Nitrogen
26000 -0.689664029 \$ Iron

c

c Spring Steel ASTM A228 / A228M - 07 + ICRU-37 Dry Air, rho=1.123

m10 6000 -8.49E-3
25055 -4.50E-3
15031 -2.50E-4
16000 -3.00E-4
14000 -2.00E-3
26000 -9.84E-1
7014 -6.92E-4
8016 -2.13E-4
18000 -1.17E-5

c

c

c Source Specification

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sdef CEL=427 POS=0 0 0.924 RAD=d2 EXT=d3 ERG=d1 WGT=1 PAR=1 AXS=0 0 1
spl -2 1.42 \$ Maxwell fission Spectrum for Cf252
si2 0.163957 \$ Radius of Source Well
si3 0.029465 \$ Extent of Source Well

c

c

c Tally Group 01

c

FC5 Point Detector at 90 Degrees

F5:n 0.000 0.000 50.000 10.000

FC15 Point Detector at -90 Degrees

F15:n 0.000 0.000 -50.000 10.000

FC25 50 cm Tally Ring

F25z:n	50.000000	1.000000	0
	49.240388	8.682409	0
	46.984631	17.101007	0
	43.301270	25.000000	0
	38.302222	32.139380	0
	32.139380	38.302222	0
	25.000000	43.301270	0
	17.101007	46.984631	0
	8.682409	49.240388	0
	0.000000	50.000000	0
	-8.682409	49.240388	0
	-17.101007	46.984631	0
	-25.000000	43.301270	0
	-32.139380	38.302222	0
	-38.302222	32.139380	0
	-43.301270	25.000000	0
	-46.984631	17.101007	0
	-49.240388	8.682409	0
	-50.000000	1.000000	0

c

FC35 Point Detector at 90 Degrees

F35:n 0.000 0.000 50.000 10.000

FC45 Point Detector at -90 Degrees

F45:n 0.000 0.000 -50.000 10.000

FC55 50 cm Tally Ring

F55z:n	50.000000	1.000000	0
	49.240388	8.682409	0
	46.984631	17.101007	0
	43.301270	25.000000	0
	38.302222	32.139380	0
	32.139380	38.302222	0

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

25.000000	43.301270	0
17.101007	46.984631	0
8.682409	49.240388	0
0.000000	50.000000	0
-8.682409	49.240388	0
-17.101007	46.984631	0
-25.000000	43.301270	0
-32.139380	38.302222	0
-38.302222	32.139380	0
-43.301270	25.000000	0
-46.984631	17.101007	0
-49.240388	8.682409	0
-50.000000	1.000000	0

c

FC65 Point Detector at 90 Degrees

F65:n 0.000 0.000 50.000 10.000

FC75 Point Detector at -90 Degrees

F75:n 0.000 0.000 -50.000 10.000

FC85 50 cm Tally Ring

F85z:n	50.000000	1.000000	0
	49.240388	8.682409	0
	46.984631	17.101007	0
	43.301270	25.000000	0
	38.302222	32.139380	0
	32.139380	38.302222	0
	25.000000	43.301270	0
	17.101007	46.984631	0
	8.682409	49.240388	0
	0.000000	50.000000	0
	-8.682409	49.240388	0
	-17.101007	46.984631	0
	-25.000000	43.301270	0
	-32.139380	38.302222	0
	-38.302222	32.139380	0
	-43.301270	25.000000	0
	-46.984631	17.101007	0
	-49.240388	8.682409	0
	-50.000000	1.000000	0

c

c

ICRP-21 Appendix 6 dose conversion factors (neutrons)

c Dose Equivalent (pSv-cm2)

de5	2.50E-08	1.00E-07	1.00E-06	1.00E-05	1.00E-04	1.00E-03	1.00E-02	1.00E-01
	5.00E-01	1.00E+00	2.00E+00	5.00E+00	1.00E+01	2.00E+01	5.00E+01	1.00E+02

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PNNL-19273

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DATE: 03/21/10

	2.00E+02	5.00E+02	1.00E+03	2.00E+03	3.00E+03				
df5	10.68	11.57	12.63	12.08	11.57	10.29	9.92	57.87	
	198.41	326.80	396.83	408.50	408.50	427.35	455.37	496.03	
	544.66	771.60	1262.63	1736.11	1984.13				

c
c

c ICRP-21 Appendix 6 dose conversion factors (neutrons)

c Dose Equivalent (pSv-cm2)

de15	2.50E-08	1.00E-07	1.00E-06	1.00E-05	1.00E-04	1.00E-03	1.00E-02	1.00E-01	
	5.00E-01	1.00E+00	2.00E+00	5.00E+00	1.00E+01	2.00E+01	5.00E+01	1.00E+02	
	2.00E+02	5.00E+02	1.00E+03	2.00E+03	3.00E+03				
df15	10.68	11.57	12.63	12.08	11.57	10.29	9.92	57.87	
	198.41	326.80	396.83	408.50	408.50	427.35	455.37	496.03	
	544.66	771.60	1262.63	1736.11	1984.13				

c
c

c ICRP-21 Appendix 6 dose conversion factors (neutrons)

c Dose Equivalent (pSv-cm2)

de25	2.50E-08	1.00E-07	1.00E-06	1.00E-05	1.00E-04	1.00E-03	1.00E-02	1.00E-01	
	5.00E-01	1.00E+00	2.00E+00	5.00E+00	1.00E+01	2.00E+01	5.00E+01	1.00E+02	
	2.00E+02	5.00E+02	1.00E+03	2.00E+03	3.00E+03				
df25	10.68	11.57	12.63	12.08	11.57	10.29	9.92	57.87	
	198.41	326.80	396.83	408.50	408.50	427.35	455.37	496.03	
	544.66	771.60	1262.63	1736.11	1984.13				

c
c

c ICRP-74 Table A.42 H(p,slab) (10,0deg)

c Personal dose equivalent (pSv-cm^2)

de35	1.00E-09	1.00E-08	2.53E-08	1.00E-07	2.00E-07	5.00E-07	1.00E-06	2.00E-06	
	5.00E-06	1.00E-05	2.00E-05	5.00E-05	1.00E-04	2.00E-04	5.00E-04	1.00E-03	
	2.00E-03	5.00E-03	1.00E-02	2.00E-02	3.00E-02	5.00E-02	7.00E-02	1.00E-01	
	1.50E-01	2.00E-01	3.00E-01	5.00E-01	7.00E-01	9.00E-01	1.00E+00	1.20E+00	
	2.00E+00	3.00E+00	4.00E+00	5.00E+00	6.00E+00	7.00E+00	8.00E+00	9.00E+00	
	1.00E+01	1.20E+01	1.40E+01	1.50E+01	1.60E+01	1.80E+01	2.00E+01		
df35	8.19	9.97	11.4	12.6	13.5	14.2	14.4	14.3	
	13.8	13.2	12.4	11.2	10.3	9.84	9.34	8.78	
	8.72	9.36	11.2	17.1	24.9	39.0	59.0	90.6	
	139	180	246	335	386	414	422	433	
	442	431	422	420	423	432	445	461	
	480	517	550	564	576	595	600		

c
c

c ICRP-74 Table A.42 H(p,slab) (10,0deg)

c Personal dose equivalent (pSv-cm^2)

CALCULATION SHEET

PROJECT No.:

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

de45	1.00E-09	1.00E-08	2.53E-08	1.00E-07	2.00E-07	5.00E-07	1.00E-06	2.00E-06
	5.00E-06	1.00E-05	2.00E-05	5.00E-05	1.00E-04	2.00E-04	5.00E-04	1.00E-03
	2.00E-03	5.00E-03	1.00E-02	2.00E-02	3.00E-02	5.00E-02	7.00E-02	1.00E-01
	1.50E-01	2.00E-01	3.00E-01	5.00E-01	7.00E-01	9.00E-01	1.00E+00	1.20E+00
	2.00E+00	3.00E+00	4.00E+00	5.00E+00	6.00E+00	7.00E+00	8.00E+00	9.00E+00
	1.00E+01	1.20E+01	1.40E+01	1.50E+01	1.60E+01	1.80E+01	2.00E+01	
df45	8.19	9.97	11.4	12.6	13.5	14.2	14.4	14.3
	13.8	13.2	12.4	11.2	10.3	9.84	9.34	8.78
	8.72	9.36	11.2	17.1	24.9	39.0	59.0	90.6
	139	180	246	335	386	414	422	433
	442	431	422	420	423	432	445	461
	480	517	550	564	576	595	600	

c
c

c ICRP-74 Table A.42 H(p,slab) (10,0deg)

c Personal dose equivalent (pSv-cm²)

de55	1.00E-09	1.00E-08	2.53E-08	1.00E-07	2.00E-07	5.00E-07	1.00E-06	2.00E-06
	5.00E-06	1.00E-05	2.00E-05	5.00E-05	1.00E-04	2.00E-04	5.00E-04	1.00E-03
	2.00E-03	5.00E-03	1.00E-02	2.00E-02	3.00E-02	5.00E-02	7.00E-02	1.00E-01
	1.50E-01	2.00E-01	3.00E-01	5.00E-01	7.00E-01	9.00E-01	1.00E+00	1.20E+00
	2.00E+00	3.00E+00	4.00E+00	5.00E+00	6.00E+00	7.00E+00	8.00E+00	9.00E+00
	1.00E+01	1.20E+01	1.40E+01	1.50E+01	1.60E+01	1.80E+01	2.00E+01	
df55	8.19	9.97	11.4	12.6	13.5	14.2	14.4	14.3
	13.8	13.2	12.4	11.2	10.3	9.84	9.34	8.78
	8.72	9.36	11.2	17.1	24.9	39.0	59.0	90.6
	139	180	246	335	386	414	422	433
	442	431	422	420	423	432	445	461
	480	517	550	564	576	595	600	

c
c

c ICRP-74 Table A.42 H*(10) Ambient dose equivalent (pSv-cm²)

de65	1.00E-09	1.00E-08	2.53E-08	1.00E-07	2.00E-07	5.00E-07	1.00E-06	2.00E-06
	5.00E-06	1.00E-05	2.00E-05	5.00E-05	1.00E-04	2.00E-04	5.00E-04	1.00E-03
	2.00E-03	5.00E-03	1.00E-02	2.00E-02	3.00E-02	5.00E-02	7.00E-02	1.00E-01
	1.50E-01	2.00E-01	3.00E-01	5.00E-01	7.00E-01	9.00E-01	1.00E+00	1.20E+00
	2.00E+00	3.00E+00	4.00E+00	5.00E+00	6.00E+00	7.00E+00	8.00E+00	9.00E+00
	1.00E+01	1.20E+01	1.40E+01	1.50E+01	1.60E+01	1.80E+01	2.00E+01	3.00E+01
	5.00E+01	7.50E+01	1.00E+02	1.25E+02	1.50E+02	1.75E+02	2.01E+02	
df65	6.60	9.00	10.6	12.9	13.5	13.6	13.3	12.9
	12.0	11.3	10.6	9.90	9.40	8.90	8.30	7.90
	7.70	8.00	10.5	16.6	23.7	41.1	60.0	88.0
	132	170	233	322	375	400	416	425
	420	412	408	405	400	405	409	420

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

123/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

440	480	520	540	555	570	600	515
400	330	285	260	245	250	260	

c
c
c
c
c

ICRP-74 Table A.42 H*(10) Ambient dose equivalent (pSv-cm²)

de75	1.00E-09	1.00E-08	2.53E-08	1.00E-07	2.00E-07	5.00E-07	1.00E-06	2.00E-06
	5.00E-06	1.00E-05	2.00E-05	5.00E-05	1.00E-04	2.00E-04	5.00E-04	1.00E-03
	2.00E-03	5.00E-03	1.00E-02	2.00E-02	3.00E-02	5.00E-02	7.00E-02	1.00E-01
	1.50E-01	2.00E-01	3.00E-01	5.00E-01	7.00E-01	9.00E-01	1.00E+00	1.20E+00
	2.00E+00	3.00E+00	4.00E+00	5.00E+00	6.00E+00	7.00E+00	8.00E+00	9.00E+00
	1.00E+01	1.20E+01	1.40E+01	1.50E+01	1.60E+01	1.80E+01	2.00E+01	3.00E+01
	5.00E+01	7.50E+01	1.00E+02	1.25E+02	1.50E+02	1.75E+02	2.01E+02	
df75	6.60	9.00	10.6	12.9	13.5	13.6	13.3	12.9
	12.0	11.3	10.6	9.90	9.40	8.90	8.30	7.90
	7.70	8.00	10.5	16.6	23.7	41.1	60.0	88.0
	132	170	233	322	375	400	416	425
	420	412	408	405	400	405	409	420
	440	480	520	540	555	570	600	515
	400	330	285	260	245	250	260	

c
c
c
c
c

ICRP-74 Table A.42 H*(10) Ambient dose equivalent (pSv-cm²)

de85	1.00E-09	1.00E-08	2.53E-08	1.00E-07	2.00E-07	5.00E-07	1.00E-06	2.00E-06
	5.00E-06	1.00E-05	2.00E-05	5.00E-05	1.00E-04	2.00E-04	5.00E-04	1.00E-03
	2.00E-03	5.00E-03	1.00E-02	2.00E-02	3.00E-02	5.00E-02	7.00E-02	1.00E-01
	1.50E-01	2.00E-01	3.00E-01	5.00E-01	7.00E-01	9.00E-01	1.00E+00	1.20E+00
	2.00E+00	3.00E+00	4.00E+00	5.00E+00	6.00E+00	7.00E+00	8.00E+00	9.00E+00
	1.00E+01	1.20E+01	1.40E+01	1.50E+01	1.60E+01	1.80E+01	2.00E+01	3.00E+01
	5.00E+01	7.50E+01	1.00E+02	1.25E+02	1.50E+02	1.75E+02	2.01E+02	
df85	6.60	9.00	10.6	12.9	13.5	13.6	13.3	12.9
	12.0	11.3	10.6	9.90	9.40	8.90	8.30	7.90
	7.70	8.00	10.5	16.6	23.7	41.1	60.0	88.0
	132	170	233	322	375	400	416	425
	420	412	408	405	400	405	409	420
	440	480	520	540	555	570	600	515
	400	330	285	260	245	250	260	

c
c
mode n
c

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

124/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

c
NPS 1e6
prdmp j j 1 2
c

c Follow on
c Rev1: Move the upper frit to the top of the primary source encapsulation

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SHEET No.:

126/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-300 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

25-		(300:-301:303:-310)		
26-		(300:-301:305:310)		
27-		imp:n=1		
28-	c			
29-	301	9 -8.03	\$ SS 304L	
30-		-301 302	\$ Steel Shell	
31-		(301:-302:303:-310)		
32-		(301:-302:305:310)		
33-		imp:n=1		
34-	c			
35-	302	8 -1.104	\$ D2O	
36-		-302	\$ Inside sphere	
37-		(303:-308)		
38-		(305:308)		
39-		imp:n=1		
40-	c			
41-	303	9 -8.03	\$ SS 304L	
42-		-303 304 307 -300	\$ Upper Void Region Tube	
43-		imp:n=1		
44-	c			
45-	304	2 -1.205e-3	\$ Air	
46-		-304 307 -300 320	\$ Upper Void (Source goes here)	
47-		imp:n=1		
48-	c			
49-	305	9 -8.03	\$ SS 304L	
50-		-305 306 -307 -300	\$ Lower Void	
51-		imp:n=1		
52-	c			
53-	306	2 -1.205e-3	\$ Air	
54-		-306 -307 -300	\$ Lower Void	
55-		imp:n=1		
56-	c			
57-	307	9 -8.03	\$ SS 304L	
58-		-303 305 -307 308	\$ Base Plate	
59-		imp:n=1		
60-	c			
61-	c			
62-	c	*****		
63-	c	Transfer Tubing		
64-	c	DWG ????????		
65-	c			
66-	320	1 -2.745 -320 321 -325 324		imp:n=1 \$ O
67-	321	1 -2.745 -321 324 -330		imp:n=1 \$ A
68-	322	1 -2.745 -322 323 -325 330		imp:n=1 \$ I
69-	323	2 -1.205E-3 -321 322 -325 330		imp:n=1 \$ A
70-	c			
71-	324	2 -1.205E-3 -323 -325 329 (342:340:-356)		imp:n=1 \$ Air i
72-	c			
73-	330	10 -1.123 -329 330 -323		imp:n=1 \$ S
74-	c			

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SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

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DATE: 03/21/10

```

75- c
76- c *****
77- c | Transfer (Rabbit) Capsule |
78- c | DWG Figure 2 |
79- c
80- 340 2 -1.205e-3 -342 357 -358 359 -341 imp:n=1 $ Slot
81- c
82- 341 1 -2.745 -341 -342 356
83- (358:-359:-357)
84- (360:362:-363)
85- (361:363:-364) imp:n=1 $ Body of Capsule
86- c
87- 342 1 -2.745 -340 341 -342 344 imp:n=1 $ Rib #1
88- 343 2 -1.205e-3 -340 341 -344 345 imp:n=1 $ Air Gap #1
89- 344 1 -2.745 -340 341 -345 346 imp:n=1 $ Rib #2
90- 345 2 -1.205e-3 -340 341 -346 347 imp:n=1 $ Air Gap #2
91- 346 1 -2.745 -340 341 -347 348 imp:n=1 $ Rib #3
92- 347 2 -1.205e-3 -340 341 -348 349 imp:n=1 $ Air Gap #3
93- 348 1 -2.745 -340 341 -349 350 imp:n=1 $ Rib #4
94- 349 2 -1.205e-3 -340 341 -350 351 imp:n=1 $ Air Gap #4
95- 350 1 -2.745 -340 341 -351 352 imp:n=1 $ Rib #5
96- 351 2 -1.205e-3 -340 341 -352 353 imp:n=1 $ Air Gap #5
97- 352 1 -2.745 -340 341 -353 354 imp:n=1 $ Rib #6
98- 353 2 -1.205e-3 -340 341 -354 355 imp:n=1 $ Air Gap #6
99- 354 1 -2.745 -340 341 -355 356 imp:n=1 $ Rib #7
100- c
101- c Interior Region for Source Capsule
102- 355 0 -360 -362 363
103- (400:404:-405) imp:n=1 $ Threaded Hole
104- 356 2 -1.205e-3 -361 -363 364
105- (401:405:-408) (403:408:-409) imp:n=1 $ Capsule Body
106- c
107- c
108- c *****
109- c | SR-CF-3000 Cf-252 Source Capsule |
110- c | DWG M-12541-CP-338E |
111- c
112- c ===== Primary Encapsulation =====
113- c
114- c The Source is flipped upside down to be like whats in secondary Capsule
115- c because the bottom of the primary encapsulation is at the top of the
116- c secondary encapsulation. The source was flipped by reversing the sign
117- c of the surface definitions and the signs of the surfaces in the cell defini
118- c
119- 420 5 -19.970 -421 420 423 -429 imp:n=1 $ Tube wall
120- 422 5 -19.970 -421 422 -423 imp:n=1 $ Top End Plug
121- 424 2 -1.205e-3 -420 423 -424 imp:n=1 $ Upper Void
122- 426 4 -10.725 -420 424 -425 imp:n=1 $ Upper Frit
123- 427 6 -0.086 -420 425 -427 imp:n=1 $ Californium Sour
124- c 428 2 -1.205e-3 -420 425 -426 imp:n=1 $ Void Reg
    
```

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

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REVIEWED BY: R.J. McCONN

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```

125- 430 4 -10.725 -420 427 -428 imp:n=1 $ Lower Frit
126- 432 2 -1.205E-3 -420 428 -429 imp:n=1 $ Lower Void
127- 436 5 -19.970 -421 429 -430 imp:n=1 $ Lower End Plug
128- c
129- c
130- c ===== Secondary Encapsulation =====
131- c
132- 404 3 -6.56 -400 -404 405 imp:n=1 $ Upper Threaded S
133- 402 3 -6.56 -401 -405 408 (402:406:-407) imp:n=1 $ Main Zircaloy Bo
134- 400 3 -6.56 -403 -408 409 imp:n=1 $ Bottom Indentati
135- c
136- 410 2 -1.205e-3 -402 -406 407 (421:-422:430) imp:n=1 $ primary capsule
137- c
138- c
139- c
140- 500 0 (325:-324:320) 300 -999 imp:n=1
141- 999 0 999 imp:n=0
142-
143- c *****
144- c | Surface Definition Section |
145- c |-----|
146- c
147- c
148- c *****
149- c | D2O Moderating Sphere with Cd Cover |
150- c | DWG: |
151- c
152- c
153- 300 so 15.1257 $ Outer Surface - Cd layer
154- 301 so 15.0749 $ Outer Surface - Steel layer
155- 302 so 14.9987 $ Inner Surface - Steel layer
156- c
157- 303 cz 2.00025 $ Outer Radius - Upper Void
158- 304 cz 1.94437 $ Inner Radius - Upper Void
159- 305 cz 0.635
160- 306 cz 0.5842
161- c
162- 307 pz -3.9624
163- 308 pz -4.2545
164- 309 pz -15.875
165- 310 pz 0 $ Ambiguity plane
166- c
167- c
168- c *****
169- c | Transfer Assembly Tubing |
170- c | DWG ?????? |
171- c
172- 320 cz 1.905 $ Outer Guide Tub
173- 321 cz 1.778 $ Outer Guide Tub
174- 322 cz 1.42875 $ Inner Guide Tub
    
```

CALCULATION SHEET

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PNNL-19273

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175-	323	cz	1.27		\$ Inner Guide Tub
176-	324	pz	-3.9624		\$ Base of Guide T
177-	325	pz	25		\$ Top of Guide Tu
178-		c	Spring		
179-	329	pz	-1.7145		\$ Top of Spring A
180-	330	pz	-3.2004		\$ Top of Rabbit T
181-		c			
182-		c			
183-		c			
184-		c		Transfer (Rabbit) Capsule	
185-		c		DWG Figure 2	
186-		c			
187-	340	cz	1.2573		\$ Outer
188-	341	cz	1.1811		\$ Inner
189-		c			
190-	342	pz	5.349240		\$ Screw Cap - Top surface
191-	343	pz	4.953000		\$ Main Body - Top surface
192-	344	pz	4.767580		
193-	345	pz	4.627880		
194-	346	pz	4.386580		
195-	347	pz	4.246880		
196-	348	pz	4.005580		
197-	349	pz	3.865880		
198-	350	pz	3.683000		
199-	351	pz	-0.317500		
200-	352	pz	-0.678180		
201-	353	pz	-0.817880		
202-	354	pz	-1.059180		
203-	355	pz	-1.198880		
204-	356	pz	-1.714500		
205-		c			
206-	357	pz	5.031740		\$ Bottom of Slot
207-	358	px	0.15875		
208-	359	px	-0.15876		
209-		c			
210-	360	cz	0.245110		\$ Threaded Top Radius
211-	361	cz	0.474980		\$ Body Radius
212-		c			
213-	362	pz	4.607560		\$ Top of Threaded hole
214-	363	pz	4.048760		\$ Bottom of Threaded Hole
215-	364	pz	-0.866140		\$ Bottom of Body Cavity
216-		c			
217-		c			
218-	365	c/y	0.4445 -0.63627 0.1190625		\$ Drilled Hole
219-		c			
220-		c			
221-		c			
222-		c		SR-CF-3000 Cf-252 Source Capsule	
223-		c		DWG M-12541-CP-338E	
224-		c			

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PNNL-19273

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PREPARED BY: R.J. TRAUB

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REVIEWED BY: R.J.McCONN

DATE: 03/21/10

```

225- c ===== Inner Encapsulation =====
226- c
227- 420 cz 0.163576 $ Primary Capsule
228- 421 cz 0.276860 $ Primary Capsule
229- c
230- 422 pz -0.345440 $ Primary Capsule
231- 423 pz 0.048260 $ Primary Capsule
232- 424 pz 0.568960 $ Upper Frit - To
233- 425 pz 0.924560 $ Upper Frit - bo
234- 426 pz 2.774695 $ Cf Activity Lin
235- 427 pz 2.804160 $ Lower Frit - To
236- 428 pz 3.159760 $ Lower Frit - Bo
237- 429 pz 3.337560 $ Primary Capsule
238- 430 pz 3.731260 $ Bottom of Prima
239- c
240- c ===== Secondary Encapsulation =====
241- c
242- 400 cz 0.245110 $ Threaded Top Ra
243- 401 cz 0.469900 $ Secondary Main
244- 402 cz 0.297180 $ Secondary Main
245- 403 cz 0.411480 $ Identation Radi
246- c
247- 404 pz 4.531360 $ Top of Threade
248- 405 pz 4.048760 $ Bottom of Cap
249- 406 pz 3.845560 $ Void Region fo
250- 407 pz -0.345440 $ Top of Seconda
251- 408 pz -0.675640 $ Top of Indenta
252- 409 pz -0.802640 $ Bottom of Iden
253- c
254- c ***** End Surface Definitions *****
255- 999 so 500
256- c
257-
258- c Data Cards
259- c
260- c
261- c DATA CARDS
262- c Materials
263- c 6061-T6 Aluminum Alloy, Used Average Values of Materials Defined in ASTM Stand
264- ml 13027 -9.492E-01 $ Aluminum
265- 14000 -6.132E-03 $ Silicon
266- 26000 -1.422E-02 $ Iron
267- 29000 -6.359E-03 $ Copper
268- 25055 -2.999E-03 $ Manganese
269- 12000 -8.844E-03 $ Magnesium
270- 24000 -3.689E-03 $ Chromium
271- 30000 -5.950E-03 $ Zinc
272- 22000 -2.613E-03 $ Titanium
273- c
274- c Dry Air, rho=1.205E-3 g/cc, ICRU-37
    
```

CALCULATION SHEET

PROJECT No.:

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SHEET No.:

131/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

275-	m2	6000	-1.24E-04	\$ Carbon
276-		7014	-7.55E-01	\$ Nitrogen
277-		8016	-2.32E-01	\$ Oxygen
278-		18000	-1.28E-02	\$ Argon
279-	c			
280-	c	Zircaloy-2: 98.250 wt % zirconium, 1.45 wt % tin, 0.100 wt % chromium, 0.135 wt		
281-	c	Standard Composition Library, ORNL, for SCALE Calculations		
282-	m3	40000	-9.825E-01	\$ Zirconium
283-		50000	-1.450E-02	\$ Tin
284-		24000	-1.000E-03	\$ Chromium
285-		26000	-1.350E-03	\$ Iron
286-		28000	-5.500E-04	\$ Nickel
287-		72000	-1.000E-04	\$ Hafnium
288-	c			
289-	c	Platinum, Sintered (rho=10.725)		
290-	m4	78000	-1.00	
291-	c			
292-	c	90% Platinum, 10% Rhodium Mixture, rho= 19.970 g/cc, http://www.azom.com/detai		
293-	m5	78000	-0.9	
294-		45103	-0.1	
295-	c			
296-	c			
297-	c	Cf-252 source composition for SR-Cf-3000 Hanford Source		
298-	c	Ref: see calculation package		
299-	m6	98249	-0.006141	
300-		98250	-0.006543	
301-		98251	-0.004022	
302-		98252	-0.002888	
303-		96245	-0.000992	
304-		96246	-0.041218	
305-		96247	-0.000251	
306-		96248	-0.621612	
307-		08016	-0.088141	
308-	c			
309-	c			
310-	c	Cadmium, 8.65 g/cc, NIST, http://physics.nist.gov/cgi-bin/Star/compos.pl?matno		
311-	m7	48000	-1.0	\$ Cadmium
312-	c			
313-	c	Deuterium Oxide (Heavy Water), rho=1.1044, http://www.coleparmer.com/catalog/M		
314-	m8	1002	0.667	
315-		8016	0.333	
316-	mt8	hwtr.01t		
317-	c			
318-	c			
319-	c	304L and 304 Stainless Steel, Specification from AKSTEEL composition using ave		
320-	c	http://www.aksteel.com/pdf/markets_products/stainless/austenitic/304_304L_Data		
321-	m9	6000	-6.54296E-05	\$ Carbon
322-		25055	-0.019941613	\$ Manganese
323-		15031	-0.000252967	\$ Phosphorus
324-		16000	-0.000174592	\$ Sulfur

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PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

```
325-      14000  -0.003822966  $ Silicon
326-      24000  -0.179300472  $ Chromium
327-      28000  -0.106523721  $ Nickel
328-       7014  -0.000254211  $ Nitrogen
329-      26000  -0.689664029  $ Iron
330-      c
331-      c Spring Steel ASTM A228 / A228M - 07 + ICRU-37 Dry Air, rho=1.123
332-      ml0    6000   -8.49E-3
333-      25055  -4.50E-3
334-      15031  -2.50E-4
335-      16000  -3.00E-4
336-      14000  -2.00E-3
337-      26000  -9.84E-1
338-      7014   -6.92E-4
339-      8016   -2.13E-4
340-      18000  -1.17E-5
341-      c
342-      c
343-      c Source Specification
344-      sdef CEL=427 POS=0 0 2.774 RAD=d2 EXT=d3 ERG=d1 WGT=1 PAR=1 AXS=0 0 1
345-      sp1    -2 1.42          $ Maxwell fission Spectrum for Cf252
346-      si2     0.163957        $ Radius of Source Well
347-      si3     1.88           $ Extent of Source Well
348-      c
349-      c
350-      c Tally Group 01
351-      c
352-      FC5 Point Detector at 90 Degrees
353-      F5:n 0.000 0.000 50.000 10.000
354-      FC15 Point Detector at -90 Degrees
355-      F15:n 0.000 0.000 -50.000 10.000
356-      FC25 50 cm Tally Ring
357-      F25z:n 50.000000      1.000000      0
358-      49.240388      8.682409      0
359-      46.984631      17.101007      0
360-      43.301270      25.000000      0
361-      38.302222      32.139380      0
362-      32.139380      38.302222      0
363-      25.000000      43.301270      0
364-      17.101007      46.984631      0
365-      8.682409       49.240388      0
366-      0.000000       50.000000      0
367-      -8.682409      49.240388      0
368-      -17.101007     46.984631      0
369-      -25.000000     43.301270      0
370-      -32.139380     38.302222      0
371-      -38.302222     32.139380      0
372-      -43.301270     25.000000      0
373-      -46.984631     17.101007      0
374-      -49.240388     8.682409      0
```

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375-	-50.000000	1.000000	0
376-	c		
377-	FC35 Point Detector at 90 Degrees		
378-	F35:n 0.000 0.000 50.000 10.000		
379-	FC45 Point Detector at -90 Degrees		
380-	F45:n 0.000 0.000 -50.000 10.000		
381-	FC55 50 cm Tally Ring		
382-	F55z:n 50.000000	1.000000	0
383-	49.240388	8.682409	0
384-	46.984631	17.101007	0
385-	43.301270	25.000000	0
386-	38.302222	32.139380	0
387-	32.139380	38.302222	0
388-	25.000000	43.301270	0
389-	17.101007	46.984631	0
390-	8.682409	49.240388	0
391-	0.000000	50.000000	0
392-	-8.682409	49.240388	0
393-	-17.101007	46.984631	0
394-	-25.000000	43.301270	0
395-	-32.139380	38.302222	0
396-	-38.302222	32.139380	0
397-	-43.301270	25.000000	0
398-	-46.984631	17.101007	0
399-	-49.240388	8.682409	0
400-	-50.000000	1.000000	0
401-	c		
402-	FC65 Point Detector at 90 Degrees		
403-	F65:n 0.000 0.000 50.000 10.000		
404-	FC75 Point Detector at -90 Degrees		
405-	F75:n 0.000 0.000 -50.000 10.000		
406-	FC85 50 cm Tally Ring		
407-	F85z:n 50.000000	1.000000	0
408-	49.240388	8.682409	0
409-	46.984631	17.101007	0
410-	43.301270	25.000000	0
411-	38.302222	32.139380	0
412-	32.139380	38.302222	0
413-	25.000000	43.301270	0
414-	17.101007	46.984631	0
415-	8.682409	49.240388	0
416-	0.000000	50.000000	0
417-	-8.682409	49.240388	0
418-	-17.101007	46.984631	0
419-	-25.000000	43.301270	0
420-	-32.139380	38.302222	0
421-	-38.302222	32.139380	0
422-	-43.301270	25.000000	0
423-	-46.984631	17.101007	0
424-	-49.240388	8.682409	0

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425-		-50.000000	1.000000	0					
426-	c								
427-	c								
428-	c	ICRP-21 Appendix 6 dose conversion factors (neutrons)							
429-	c	Dose Equivalent (pSv-cm2)							
430-	de5	2.50E-08	1.00E-07	1.00E-06	1.00E-05	1.00E-04	1.00E-03	1.00E-02	1.00E-01
431-		5.00E-01	1.00E+00	2.00E+00	5.00E+00	1.00E+01	2.00E+01	5.00E+01	1.00E+02
432-		2.00E+02	5.00E+02	1.00E+03	2.00E+03	3.00E+03			
433-	df5	10.68	11.57	12.63	12.08	11.57	10.29	9.92	57.87
434-		198.41	326.80	396.83	408.50	408.50	427.35	455.37	496.03
435-		544.66	771.60	1262.63	1736.11	1984.13			
436-	c								
437-	c								
438-	c	ICRP-21 Appendix 6 dose conversion factors (neutrons)							
439-	c	Dose Equivalent (pSv-cm2)							
440-	de15	2.50E-08	1.00E-07	1.00E-06	1.00E-05	1.00E-04	1.00E-03	1.00E-02	1.00E-01
441-		5.00E-01	1.00E+00	2.00E+00	5.00E+00	1.00E+01	2.00E+01	5.00E+01	1.00E+02
442-		2.00E+02	5.00E+02	1.00E+03	2.00E+03	3.00E+03			
443-	df15	10.68	11.57	12.63	12.08	11.57	10.29	9.92	57.87
444-		198.41	326.80	396.83	408.50	408.50	427.35	455.37	496.03
445-		544.66	771.60	1262.63	1736.11	1984.13			
446-	c								
447-	c								
448-	c	ICRP-21 Appendix 6 dose conversion factors (neutrons)							
449-	c	Dose Equivalent (pSv-cm2)							
450-	de25	2.50E-08	1.00E-07	1.00E-06	1.00E-05	1.00E-04	1.00E-03	1.00E-02	1.00E-01
451-		5.00E-01	1.00E+00	2.00E+00	5.00E+00	1.00E+01	2.00E+01	5.00E+01	1.00E+02
452-		2.00E+02	5.00E+02	1.00E+03	2.00E+03	3.00E+03			
453-	df25	10.68	11.57	12.63	12.08	11.57	10.29	9.92	57.87
454-		198.41	326.80	396.83	408.50	408.50	427.35	455.37	496.03
455-		544.66	771.60	1262.63	1736.11	1984.13			
456-	c								
457-	c								
458-	c	ICRP-74 Table A.42 H(p,slab) (10,0deg)							
459-	c	Personal dose equivalent (pSv-cm^2)							
460-	de35	1.00E-09	1.00E-08	2.53E-08	1.00E-07	2.00E-07	5.00E-07	1.00E-06	2.00E-06
461-		5.00E-06	1.00E-05	2.00E-05	5.00E-05	1.00E-04	2.00E-04	5.00E-04	1.00E-03
462-		2.00E-03	5.00E-03	1.00E-02	2.00E-02	3.00E-02	5.00E-02	7.00E-02	1.00E-01
463-		1.50E-01	2.00E-01	3.00E-01	5.00E-01	7.00E-01	9.00E-01	1.00E+00	1.20E+00
464-		2.00E+00	3.00E+00	4.00E+00	5.00E+00	6.00E+00	7.00E+00	8.00E+00	9.00E+00
465-		1.00E+01	1.20E+01	1.40E+01	1.50E+01	1.60E+01	1.80E+01	2.00E+01	
466-	df35	8.19	9.97	11.4	12.6	13.5	14.2	14.4	14.3
467-		13.8	13.2	12.4	11.2	10.3	9.84	9.34	8.78
468-		8.72	9.36	11.2	17.1	24.9	39.0	59.0	90.6
469-		139	180	246	335	386	414	422	433
470-		442	431	422	420	423	432	445	461
471-		480	517	550	564	576	595	600	
472-	c								
473-	c								
474-	c	ICRP-74 Table A.42 H(p,slab) (10,0deg)							

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475-	c	Personal dose equivalent (pSv-cm ²)							
476-	de45	1.00E-09	1.00E-08	2.53E-08	1.00E-07	2.00E-07	5.00E-07	1.00E-06	2.00E-06
477-		5.00E-06	1.00E-05	2.00E-05	5.00E-05	1.00E-04	2.00E-04	5.00E-04	1.00E-03
478-		2.00E-03	5.00E-03	1.00E-02	2.00E-02	3.00E-02	5.00E-02	7.00E-02	1.00E-01
479-		1.50E-01	2.00E-01	3.00E-01	5.00E-01	7.00E-01	9.00E-01	1.00E+00	1.20E+00
480-		2.00E+00	3.00E+00	4.00E+00	5.00E+00	6.00E+00	7.00E+00	8.00E+00	9.00E+00
481-		1.00E+01	1.20E+01	1.40E+01	1.50E+01	1.60E+01	1.80E+01	2.00E+01	
482-	df45	8.19	9.97	11.4	12.6	13.5	14.2	14.4	14.3
483-		13.8	13.2	12.4	11.2	10.3	9.84	9.34	8.78
484-		8.72	9.36	11.2	17.1	24.9	39.0	59.0	90.6
485-		139	180	246	335	386	414	422	433
486-		442	431	422	420	423	432	445	461
487-		480	517	550	564	576	595	600	
488-	c								
489-	c								
490-	c	ICRP-74 Table A.42 H(p,slab) (10,0deg)							
491-	c	Personal dose equivalent (pSv-cm ²)							
492-	de55	1.00E-09	1.00E-08	2.53E-08	1.00E-07	2.00E-07	5.00E-07	1.00E-06	2.00E-06
493-		5.00E-06	1.00E-05	2.00E-05	5.00E-05	1.00E-04	2.00E-04	5.00E-04	1.00E-03
494-		2.00E-03	5.00E-03	1.00E-02	2.00E-02	3.00E-02	5.00E-02	7.00E-02	1.00E-01
495-		1.50E-01	2.00E-01	3.00E-01	5.00E-01	7.00E-01	9.00E-01	1.00E+00	1.20E+00
496-		2.00E+00	3.00E+00	4.00E+00	5.00E+00	6.00E+00	7.00E+00	8.00E+00	9.00E+00
497-		1.00E+01	1.20E+01	1.40E+01	1.50E+01	1.60E+01	1.80E+01	2.00E+01	
498-	df55	8.19	9.97	11.4	12.6	13.5	14.2	14.4	14.3
499-		13.8	13.2	12.4	11.2	10.3	9.84	9.34	8.78
500-		8.72	9.36	11.2	17.1	24.9	39.0	59.0	90.6
501-		139	180	246	335	386	414	422	433
502-		442	431	422	420	423	432	445	461
503-		480	517	550	564	576	595	600	
504-	c								
505-	c								
506-	c								
507-	c	ICRP-74 Table A.42 H*(10) Ambient dose equivalent (pSv-cm ²)							
508-	de65	1.00E-09	1.00E-08	2.53E-08	1.00E-07	2.00E-07	5.00E-07	1.00E-06	2.00E-06
509-		5.00E-06	1.00E-05	2.00E-05	5.00E-05	1.00E-04	2.00E-04	5.00E-04	1.00E-03
510-		2.00E-03	5.00E-03	1.00E-02	2.00E-02	3.00E-02	5.00E-02	7.00E-02	1.00E-01
511-		1.50E-01	2.00E-01	3.00E-01	5.00E-01	7.00E-01	9.00E-01	1.00E+00	1.20E+00
512-		2.00E+00	3.00E+00	4.00E+00	5.00E+00	6.00E+00	7.00E+00	8.00E+00	9.00E+00
513-		1.00E+01	1.20E+01	1.40E+01	1.50E+01	1.60E+01	1.80E+01	2.00E+01	3.00E+01
514-		5.00E+01	7.50E+01	1.00E+02	1.25E+02	1.50E+02	1.75E+02	2.01E+02	
515-	df65	6.60	9.00	10.6	12.9	13.5	13.6	13.3	12.9
516-		12.0	11.3	10.6	9.90	9.40	8.90	8.30	7.90
517-		7.70	8.00	10.5	16.6	23.7	41.1	60.0	88.0
518-		132	170	233	322	375	400	416	425
519-		420	412	408	405	400	405	409	420
520-		440	480	520	540	555	570	600	515
521-		400	330	285	260	245	250	260	
522-	c								
523-	c								
524-	c								

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PREPARED BY: R.J. TRAUB

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525-      c
526-      c ICRP-74 Table A.42 H*(10) Ambient dose equivalent (pSv-cm^2)
527- de75  1.00E-09 1.00E-08 2.53E-08 1.00E-07 2.00E-07 5.00E-07 1.00E-06 2.00E-06
528-      5.00E-06 1.00E-05 2.00E-05 5.00E-05 1.00E-04 2.00E-04 5.00E-04 1.00E-03
529-      2.00E-03 5.00E-03 1.00E-02 2.00E-02 3.00E-02 5.00E-02 7.00E-02 1.00E-01
530-      1.50E-01 2.00E-01 3.00E-01 5.00E-01 7.00E-01 9.00E-01 1.00E+00 1.20E+00
531-      2.00E+00 3.00E+00 4.00E+00 5.00E+00 6.00E+00 7.00E+00 8.00E+00 9.00E+00
532-      1.00E+01 1.20E+01 1.40E+01 1.50E+01 1.60E+01 1.80E+01 2.00E+01 3.00E+01
533-      5.00E+01 7.50E+01 1.00E+02 1.25E+02 1.50E+02 1.75E+02 2.01E+02
534- df75  6.60 9.00 10.6 12.9 13.5 13.6 13.3 12.9
535-      12.0 11.3 10.6 9.90 9.40 8.90 8.30 7.90
536-      7.70 8.00 10.5 16.6 23.7 41.1 60.0 88.0
537-      132 170 233 322 375 400 416 425
538-      420 412 408 405 400 405 409 420
539-      440 480 520 540 555 570 600 515
540-      400 330 285 260 245 250 260
541-      c
542-      c
543-      c
544-      c
545-      c ICRP-74 Table A.42 H*(10) Ambient dose equivalent (pSv-cm^2)
546- de85  1.00E-09 1.00E-08 2.53E-08 1.00E-07 2.00E-07 5.00E-07 1.00E-06 2.00E-06
547-      5.00E-06 1.00E-05 2.00E-05 5.00E-05 1.00E-04 2.00E-04 5.00E-04 1.00E-03
548-      2.00E-03 5.00E-03 1.00E-02 2.00E-02 3.00E-02 5.00E-02 7.00E-02 1.00E-01
549-      1.50E-01 2.00E-01 3.00E-01 5.00E-01 7.00E-01 9.00E-01 1.00E+00 1.20E+00
550-      2.00E+00 3.00E+00 4.00E+00 5.00E+00 6.00E+00 7.00E+00 8.00E+00 9.00E+00
551-      1.00E+01 1.20E+01 1.40E+01 1.50E+01 1.60E+01 1.80E+01 2.00E+01 3.00E+01
552-      5.00E+01 7.50E+01 1.00E+02 1.25E+02 1.50E+02 1.75E+02 2.01E+02
553- df85  6.60 9.00 10.6 12.9 13.5 13.6 13.3 12.9
554-      12.0 11.3 10.6 9.90 9.40 8.90 8.30 7.90
555-      7.70 8.00 10.5 16.6 23.7 41.1 60.0 88.0
556-      132 170 233 322 375 400 416 425
557-      420 412 408 405 400 405 409 420
558-      440 480 520 540 555 570 600 515
559-      400 330 285 260 245 250 260
560-      c
561-      c
562- mode n
563-      c
564-      c
565- NPS 1e6
566- prdmp j j 1 2
567-      c
568-

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surface 307 and surface 324 are the same. 324 will be deleted.

surface 329 and surface 356 are the same. 356 will be deleted.

surface 360 and surface 400 are the same. 400 will be deleted.

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surface 363 and surface 405 are the same. 405 will be deleted.

surface 422 and surface 407 are the same. 407 will be deleted.

comment. 5 surfaces were deleted for being the same as others.

warning. 3 materials had unnormalized fractions. print table 40.
1cells

print table 60

cell	mat	atom density	gram density	volume	mass	pieces	neutron importance
1	300	7	4.63393E-02	8.65000E+00	1.44855E+02	1.25300E+03	1 1.0000E+00
2	301	9	8.77621E-02	8.03000E+00	2.15451E+02	1.73007E+03	1 1.0000E+00
3	302	8s	9.96795E-02	1.10400E+00	1.38787E+04	1.53221E+04	1 1.0000E+00
4	303	9	8.77621E-02	8.03000E+00	1.31288E+01	1.05424E+02	1 1.0000E+00
5	304	2	4.98942E-05	1.20500E-03	9.02944E+00	1.08805E-02	1 1.0000E+00
6	305	9	8.77621E-02	8.03000E+00	2.16971E+00	1.74228E+01	1 1.0000E+00
7	306	2	4.98942E-05	1.20500E-03	1.19632E+01	1.44156E-02	1 1.0000E+00
8	307	9	8.77621E-02	8.03000E+00	3.30153E+00	2.65113E+01	1 1.0000E+00
9	320	1	6.01502E-02	2.74500E+00	4.25588E+01	1.16824E+02	1 1.0000E+00
10	321	1	6.01502E-02	2.74500E+00	7.56778E+00	2.07735E+01	1 1.0000E+00
11	322	1	6.01502E-02	2.74500E+00	3.79561E+01	1.04189E+02	1 1.0000E+00
12	323	2	4.98942E-05	1.20500E-03	9.92217E+01	1.19562E-01	1 1.0000E+00
13	324	2	4.98942E-05	1.20500E-03	1.00284E+02	1.20842E-01	1 1.0000E+00
14	330	10	1.25460E-02	1.12300E+00	7.52917E+00	8.45525E+00	1 1.0000E+00
15	340	2	4.98942E-05	1.20500E-03	0.00000E+00	0.00000E+00	0 1.0000E+00
16	341	1	6.01502E-02	2.74500E+00	0.00000E+00	0.00000E+00	0 1.0000E+00
17	342	1	6.01502E-02	2.74500E+00	3.39531E-01	9.32012E-01	1 1.0000E+00
18	343	2	4.98942E-05	1.20500E-03	8.15467E-02	9.82637E-05	1 1.0000E+00
19	344	1	6.01502E-02	2.74500E+00	1.40853E-01	3.86642E-01	1 1.0000E+00
20	345	2	4.98942E-05	1.20500E-03	8.15467E-02	9.82637E-05	1 1.0000E+00
21	346	1	6.01502E-02	2.74500E+00	1.40853E-01	3.86642E-01	1 1.0000E+00
22	347	2	4.98942E-05	1.20500E-03	8.15467E-02	9.82637E-05	1 1.0000E+00
23	348	1	6.01502E-02	2.74500E+00	1.06752E-01	2.93034E-01	1 1.0000E+00
24	349	2	4.98942E-05	1.20500E-03	2.33520E+00	2.81392E-03	1 1.0000E+00
25	350	1	6.01502E-02	2.74500E+00	2.10539E-01	5.77929E-01	1 1.0000E+00
26	351	2	4.98942E-05	1.20500E-03	8.15467E-02	9.82637E-05	1 1.0000E+00
27	352	1	6.01502E-02	2.74500E+00	1.40853E-01	3.86642E-01	1 1.0000E+00
28	353	2	4.98942E-05	1.20500E-03	8.15467E-02	9.82637E-05	1 1.0000E+00
29	354	1	6.01502E-02	2.74500E+00	3.00981E-01	8.26194E-01	1 1.0000E+00
30	355	0	0.00000E+00	0.00000E+00	1.43823E-02	0.00000E+00	1 1.0000E+00
31	356	2	4.98942E-05	1.20500E-03	1.38707E-01	1.67142E-04	1 1.0000E+00
32	420	5	6.71684E-02	1.99700E+01	5.15590E-01	1.02963E+01	1 1.0000E+00
33	422	5	6.71684E-02	1.99700E+01	9.48060E-02	1.89328E+00	1 1.0000E+00
34	424	2	4.98942E-05	1.20500E-03	4.37700E-02	5.27429E-05	1 1.0000E+00
35	426	4	3.31076E-02	1.07250E+01	2.98917E-02	3.20589E-01	1 1.0000E+00
36	427	6	5.54742E-04	8.60000E-02	1.57999E-01	1.35879E-02	1 1.0000E+00
37	430	4	3.31076E-02	1.07250E+01	2.98917E-02	3.20589E-01	1 1.0000E+00

CALCULATION SHEET

PROJECT No.:

CALC No.:

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SHEET No.:

138/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

38	432	2	4.98942E-05	1.20500E-03	1.49459E-02	1.80098E-05	1	1.0000E+00
39	436	5	6.71684E-02	1.99700E+01	9.48060E-02	1.89328E+00	1	1.0000E+00
40	404	3	4.32406E-02	6.56000E+00	9.10876E-02	5.97535E-01	1	1.0000E+00
41	402	3	4.32406E-02	6.56000E+00	2.11443E+00	1.38707E+01	1	1.0000E+00
42	400	3	4.32406E-02	6.56000E+00	6.75540E-02	4.43154E-01	1	1.0000E+00
43	410	2	4.98942E-05	1.20500E-03	1.81104E-01	2.18230E-04	1	1.0000E+00
44	500	0	0.00000E+00	0.00000E+00	5.23584E+08	0.00000E+00	0	1.0000E+00
45	999	0	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0	0.0000E+00

total 5.23599E+08 1.87385E+04

warning. surface 309 is not used for anything.

warning. surface 343 is not used for anything.

warning. surface 365 is not used for anything.

warning. surface 426 is not used for anything.

minimum source weight = 1.0000E+00 maximum source weight = 1.0000E+00

* Random Number Generator = 1 *
* Random Number Seed = 19073486328125 *
* Random Number Multiplier = 19073486328125 *
* Random Number Adder = 0 *
* Random Number Bits Used = 48 *
* Random Number Stride = 152917 *

5 warning messages so far.

1cross-section tables

print table 100

table length

tables from file endf66a

1002.66c	5770	1-h-2 at 293.6K from endf-vi.6 njoy99.50	mat 128	07/13/01
6000.66c	44688	6-c-0 at 293.6K from endf-vi.6 njoy99.50	mat 600	07/13/01
15031.66c	24697	15-p-31 at 293.6K from endf-vi.6 njoy99.50	mat1525	07/24/01

tables from file actia

7014.62c	67462	7-n-14 at 293.6K from endf-vi.8 njoy99.50	mat 725	12/05/01
8016.62c	170541	8-o-16 at 293.6K from endf-vi.8 njoy99.50	mat 825	12/05/01
12000.62c	44838	12-mg-0 at 293.6K from endf/b-vi.8 njoy99.50	mat1200	12/06/01
13027.62c	75363	13-al-27 at 293.6K from endf-vi.8 njoy99.50	mat1325	12/17/01
16000.62c	68665	16-s-0 at 293.6K from endf/b-vi.8 njoy99.50	mat1600	12/06/01
22000.62c	54128	22-ti-0 at 293.6K from endf/b-vi.8 njoy99.50	mat2200	12/06/01

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PREPARED BY: R.J. TRAUB

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DATE: 03/21/10

25055.62c	134565	25-mn-55 at 293.6K from endf/b-vi.8 njoy99.50	mat2525	02/11/02
		tables from file endf60		
14000.60c	51392	14-si-nat from endf/b-vi	mat1400	11/25/93
72000.60c	57062	72-hf-nat from endf-vi	mat7200	11/27/93
		tables from file rmccsa		
18000.35c	2182	endl85	(18)	11/01/85
		temperature = 0.0000E+00 adjusted to 2.5300E-08		
78000.35c	7619	endl85	(78)	11/01/85
		temperature = 0.0000E+00 adjusted to 2.5300E-08		
		tables from file rmccs		
24000.50c	89104	njoy	(1324)	79/06/21.
26000.55c	84136	njoy	(260)	10/21/82
28000.50c	82267	njoy	(1328)	79/06/21.
29000.50c	22473	njoy	(1329)	02/05/80
48000.51c	4772	njoy	(1281)	03/10/80
		tables from file endl92		
30000.42c	152923	ENDL library name: nd920609 LANL/XTM modified: 951222		911219
		temperature = 2.5860E-08 adjusted to 2.5300E-08		
50000.42c	141628	ENDL library name: nd920609 LANL/XTM modified: 951222		911219
		temperature = 2.5860E-08 adjusted to 2.5300E-08		
		tables from file endf66b		
40000.66c	98524	40-zr-0 at 293.6K from endf-vi.1 njoy99.50	mat4000	07/24/01
45103.66c	85877	45-rh-103 at 293.6K from endf-vi.0 njoy99.50	mat4525	08/08/01
		probability tables used from 1.5000E-03 to 4.0400E-02 mev.		
		tables from file endf66c		
96245.66c	31729	96-cm-245 at 293.6K from endf-vi.2 njoy99.50 prompt nu	mat9640	08/30/01
		probability tables used from 6.0500E-05 to 1.0000E-02 mev.		
warning. nubar of		96246.66c may be either prompt or total.		
96246.66c	33296	96-cm-246 at 293.6K from endf-vi.2 njoy99.50	mat9643	06/18/02
warning. nubar of		96247.66c may be either prompt or total.		
96247.66c	44733	96-cm-247 at 293.6K from endf-vi.2 njoy99.50	mat9646	08/30/01
		probability tables used from 6.1700E-05 to 1.0000E-02 mev.		
warning. nubar of		96248.66c may be either prompt or total.		
96248.66c	86149	96-cm-248 at 293.6K from endf-vi.0 njoy99.50	mat9649	08/30/01
		probability tables used from 2.4000E-03 to 1.0000E-02 mev.		

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. MCCONN

DATE: 03/21/10

98249.66c 60446 98-cf-249 at 293.6K from endf-vi.0 (MOD) njoy99.50.prompt nu mat9852 10/23/01
 probability tables used from 7.0000E-05 to 3.0000E-02 mev.

warning. nubar of 98250.66c may be either prompt or total.
 98250.66c 49309 98-cf-250 at 293.6K from endf-vi.2 njoy99.50 mat9855 08/28/01
 probability tables used from 2.8610E-04 to 1.0000E-02 mev.

98251.66c 45963 98-cf-251 at 293.6K from endf-vi.2 njoy99.50 prompt nu mat9858 08/28/01
 probability tables used from 1.6390E-04 to 1.0000E-02 mev.

warning. nubar of 98252.66c may be either prompt or total.
 98252.66c 52848 98-cf-252 at 293.6K from endf-vi.2 njoy99.50 mat9861 08/28/01
 probability tables used from 3.6650E-04 to 1.0000E-02 mev.

tables from file tmccs

hwtr.01t 10193 deuterium in heavy water at 300 degrees kelvin 1002 0 010/22/85

total 1985342

warning. neutron energy cutoff is below some cross-section tables.

comment. 4 cross sections modified by free gas thermal treatment.

 dump no. 1 on file mcnp.tpe nps = 0 coll = 0 ctm = 0.00 nrn = 0

11 warning messages so far.

1problem summary

run terminated when 1000000 particle histories were done.

+ 09/29/09 02:54:14
 This is the Low Scatter Room compatible version of the 318 neutron sources probid = 09/29/09 01:59:53

neutron creation	tracks	weight (per source particle)	energy	neutron loss	tracks	weight (per source particle)	energy
source	1000000	1.0000E+00	2.1286E+00	escape	921576	9.1258E-01	5.9307E-01
				energy cutoff	0	0.	0.
				time cutoff	0	0.	0.
weight window	0	0.	0.	weight window	0	0.	0.
cell importance	0	0.	0.	cell importance	0	0.	0.
weight cutoff	0	8.8481E-04	1.7018E-08	weight cutoff	81994	9.1174E-04	1.7913E-08
e or t importance	0	0.	0.	e or t importance	0	0.	0.
dxtran	0	0.	0.	dxtran	0	0.	0.
forced collisions	0	0.	0.	forced collisions	0	0.	0.
exp. transform	0	0.	0.	exp. transform	0	0.	0.
upscattering	0	0.	7.4760E-09	downscattering	0	0.	1.4989E+00
photonuclear	0	0.	0.	capture	0	9.0896E-02	2.4027E-02
(n,xn)	6767	6.6288E-03	9.0072E-03	loss to (n,xn)	3381	3.3119E-03	2.2025E-02

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PROJECT No.:

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SHEET No.:

141/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. MCCONN

DATE: 03/21/10

prompt fission	244	2.4260E-04	5.4895E-04	loss to fission	60	5.9636E-05	1.5925E-04
delayed fission	0	0.	0.				
total	1007011	1.0078E+00	2.1382E+00	total	1007011	1.0078E+00	2.1382E+00

number of neutrons banked	3570	average time of (shakes)	cutoffs
neutron tracks per source particle	1.0070E+00	escape	tco 1.0000E+33
neutron collisions per source particle	1.2357E+01	capture	eco 0.0000E+00
total neutron collisions	12357143	capture or escape	wc1 -5.0000E-01
net multiplication	1.0035E+00 0.0001	any termination	wc2 -2.5000E-01

computer time so far in this run	53.55 minutes	maximum number ever in bank	5
computer time in mcrun	53.23 minutes	bank overflows to backup file	0
source particles per minute	1.8785E+04		
random numbers generated	710969452	most random numbers used was	12050 in history 898994

range of sampled source weights = 1.0000E+00 to 1.0000E+00

source efficiency = 0.4980 in cell 427
lneutron activity in each cell

print table 126

cell	tracks entering	population	collisions	collisions * weight (per history)	number weighted energy	flux weighted energy	average track weight (relative)	average track mfp (cm)	
1	300	1000159	989357	107146	1.0215E-01	3.3335E-03	5.0140E-01	9.8487E-01	3.3602E+00
2	301	1049455	989676	99856	9.7859E-02	8.3235E-04	4.3394E-01	9.8298E-01	1.9430E+00
3	302	1418153	998863	11480236	1.1375E+01	1.1389E-03	5.2063E-01	9.9177E-01	3.1598E+00
4	303	1639698	980188	72258	7.1485E-02	7.0966E-03	1.1290E+00	9.9382E-01	3.1195E+00
5	304	1627939	980769	24	2.3751E-05	7.2884E-03	1.1449E+00	9.9392E-01	7.5839E+03
6	305	53848	26135	4532	4.4522E-03	1.3537E-03	5.9630E-01	9.8768E-01	2.4017E+00
7	306	28403	23921	12	1.1964E-05	1.3755E-03	6.0101E-01	9.8811E-01	5.4241E+03
8	307	57279	49216	13946	1.3644E-02	2.5338E-03	6.8290E-01	9.8689E-01	2.6776E+00
9	320	1625223	986051	67682	6.7369E-02	7.5769E-03	1.1672E+00	9.9408E-01	6.6070E+00
10	321	66119	57398	11283	1.1201E-02	3.0260E-03	7.4780E-01	9.8967E-01	7.3137E+00
11	322	1445726	989636	72521	7.2243E-02	1.0526E-02	1.3381E+00	9.9501E-01	6.4210E+00
12	323	1527113	986687	149	1.4772E-04	8.7931E-03	1.2514E+00	9.9459E-01	7.9174E+03
13	324	1313372	977974	70	6.8384E-05	3.9280E-03	9.0266E-01	9.9267E-01	6.6648E+03
14	330	63243	57471	5332	5.2481E-03	4.3701E-03	9.2521E-01	9.9150E-01	2.5612E+01
15	340	11433	11278	1	9.9431E-07	7.8657E-03	1.1965E+00	9.9442E-01	7.7521E+03
16	341	1203435	1000603	248224	2.4752E-01	3.0949E-02	1.6798E+00	9.9680E-01	5.9778E+00
17	342	33556	30669	898	8.9404E-04	7.2471E-03	1.1229E+00	9.9428E-01	6.6384E+00
18	343	14677	14320	0	0.0000E+00	9.6078E-03	1.2356E+00	9.9490E-01	7.9250E+03
19	344	23081	22239	498	4.9576E-04	9.6403E-03	1.2629E+00	9.9475E-01	6.4442E+00
20	345	18107	17714	0	0.0000E+00	1.0094E-02	1.3021E+00	9.9506E-01	8.1379E+03
21	346	29039	28071	565	5.6311E-04	1.1804E-02	1.3638E+00	9.9499E-01	6.3237E+00
22	347	23141	22686	1	1.0000E-06	1.4606E-02	1.4245E+00	9.9537E-01	8.5328E+03
23	348	31309	30459	560	5.5758E-04	1.5579E-02	1.4440E+00	9.9551E-01	6.2459E+00
24	349	1006538	857026	15	1.4884E-05	2.8107E-02	1.6371E+00	9.9670E-01	9.2006E+03
25	350	37478	35556	879	8.7546E-04	1.0277E-02	1.2968E+00	9.9444E-01	6.3430E+00
26	351	17045	16601	0	0.0000E+00	8.5832E-03	1.2328E+00	9.9427E-01	7.9325E+03

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PROJECT No.:

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142/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

27	352	21663	20812	478	4.7588E-04	8.4057E-03	1.2094E+00	9.9407E-01	6.5375E+00
28	353	13791	13437	1	9.9764E-07	8.1154E-03	1.1556E+00	9.9399E-01	7.6194E+03
29	354	30070	27559	858	8.5314E-04	6.2376E-03	1.0718E+00	9.9309E-01	6.7760E+00
30	355	3350	3315	0	0.0000E+00	1.3700E-02	1.3804E+00	9.9511E-01	0.0000E+00
31	356	1105337	989022	2	1.9646E-06	4.7623E-02	1.7877E+00	9.9715E-01	9.6438E+03
32	420	1061918	993421	84243	8.3972E-02	3.0694E-01	2.0024E+00	9.9826E-01	2.4307E+00
33	422	11657	11465	1874	1.8410E-03	3.1178E-02	1.5492E+00	9.9157E-01	2.2754E+00
34	424	11264	10926	0	0.0000E+00	6.4792E-02	1.7351E+00	9.9487E-01	9.5427E+03
35	426	39417	38759	1651	1.6433E-03	2.4350E-01	1.9621E+00	9.9774E-01	4.9324E+00
36	427	1026750	1000256	510	5.0974E-04	6.4858E-01	2.0853E+00	9.9948E-01	4.3861E+02
37	430	39528	38867	1650	1.6449E-03	2.3092E-01	1.9736E+00	9.9787E-01	4.9278E+00
38	432	9612	9426	0	0.0000E+00	1.0947E-01	1.8429E+00	9.9580E-01	9.8361E+03
39	436	18101	17821	2633	2.5993E-03	5.7088E-02	1.7098E+00	9.9396E-01	2.3291E+00
40	404	6627	6541	644	6.4155E-04	1.5301E-02	1.4684E+00	9.9513E-01	3.9716E+00
41	402	1104685	1000491	75466	7.5246E-02	1.0246E-01	1.8989E+00	9.9770E-01	4.2906E+00
42	400	10297	10087	441	4.3837E-04	1.3887E-02	1.3327E+00	9.9431E-01	3.9027E+00
43	410	1080178	996311	4	3.9784E-06	1.5227E-01	1.9458E+00	9.9774E-01	1.0087E+04
44	500	925927	921601	0	0.0000E+00	5.9258E-03	6.4743E-01	9.9021E-01	0.0000E+00
total		21884741	17290681	12357143	1.2242E+01				

ltally 5 nps = 1000000
 + Point Detector at 90 Degrees
 tally type 5 particle flux at a point detector.
 tally for neutrons

this tally is modified by a dose function.

detector located at x,y,z = 0.00000E+00 0.00000E+00 5.00000E+01
 1.34463E-02 0.0011

detector located at x,y,z = 0.00000E+00 0.00000E+00 5.00000E+01
 uncollided neutron flux
 7.19548E-03 0.0003

detector score diagnostics	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
times average score				
1.00000E-01	1303316	0.33078	8.57372E-06	0.13032
1.00000E+00	2575610	0.98446	5.11513E-05	0.90784
2.00000E+00	49830	0.99711	4.24428E-06	0.97235
5.00000E+00	8010	0.99914	1.45218E-06	0.99443
1.00000E+01	726	0.99933	3.04393E-07	0.99905
1.00000E+02	53	0.99934	4.92191E-08	0.99980
1.00000E+03	0	0.99934	0.00000E+00	0.99980
1.00000E+38	0	0.99934	0.00000E+00	0.99980
1st 200 histories	2599	1.00000	1.31175E-08	1.00000

average tally per history = 6.57882E-05 largest score = 2.20380E-03
 (largest score)/(average tally) = 3.34984E+01 nps of largest score = 756939

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

score contributions by cell					
cell	misses	hits	tally per history	weight per hit	
1	300	13409	12551	4.68272E-07	3.73095E-05
2	301	56525	43160	1.51484E-06	3.50982E-05
3	302	9179280	2300955	3.04873E-05	1.32499E-05
4	303	16222	55975	7.24353E-07	1.29407E-05
5	304	4	20	3.84804E-10	1.92402E-05
6	305	2983	1542	1.12596E-08	7.30196E-06
7	306	9	3	2.15814E-11	7.19379E-06
8	307	2402	11516	1.16749E-07	1.01380E-05
9	320	12429	55244	1.01140E-06	1.83078E-05
10	321	4015	7264	6.78538E-08	9.34111E-06
11	322	5004	67511	1.70212E-06	2.52125E-05
12	323	4	145	3.12295E-09	2.15376E-05
13	324	0	70	4.22546E-09	6.03638E-05
14	330	1050	4276	4.66490E-08	1.09095E-05
15	340	0	1	3.88434E-11	3.88434E-05
16	341	19189	229028	5.11746E-06	2.23442E-05
17	342	0	898	5.50246E-08	6.12746E-05
19	344	0	498	2.54392E-08	5.10827E-05
21	346	1	564	2.66475E-08	4.72473E-05
22	347	0	1	4.26574E-11	4.26574E-05
23	348	0	560	2.37766E-08	4.24582E-05
24	349	0	15	2.70660E-10	1.80440E-05
25	350	138	741	7.97257E-09	1.07592E-05
27	352	80	398	4.05598E-09	1.01909E-05
28	353	0	1	2.46027E-11	2.46027E-05
29	354	220	638	6.25395E-09	9.80243E-06
31	356	0	2	1.75551E-11	8.77755E-06
32	420	16774	67089	1.35876E-06	2.02531E-05
33	422	809	1007	9.70467E-09	9.63721E-06
35	426	280	1368	1.94955E-08	1.42511E-05
36	427	108	1000401	2.11397E-05	2.11312E-05
37	430	42	1606	1.21045E-07	7.53708E-05
39	436	29	2541	2.34787E-07	9.23993E-05
40	404	0	644	5.28630E-08	8.20855E-05
41	402	3843	71622	1.42362E-06	1.98768E-05
42	400	155	286	2.52428E-09	8.82617E-06
43	410	1	3	8.03408E-11	2.67803E-05
total	9335005	3940144	6.57882E-05	1.66969E-05	

score misses	
russian roulette on pd	0
psc=0.	301395
russian roulette in transmission	9032986
underflow in transmission	624
hit a zero-importance cell	0
energy cutoff	0

CALCULATION SHEET

PROJECT No.:	CALC No.:	REVISION No.:	SHEET No.:
	<u>PNNL-19273</u>	0	<u>144/246</u>
SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵² CF NEUTRON SOURCE IN 318LOW SCATTER ROOM			
PREPARED BY: <u>R.J. TRAUB</u>	DATE: <u>02/8/10</u>	REVIEWED BY: <u>R.J.McCONN</u>	DATE: <u>03/21/10</u>

=====

results of 10 statistical checks for the estimated answer for the tally fluctuation chart (tfc) bin of tally 5

tfc bin behavior	--mean-- behavior	-----relative error----- value decrease decrease rate	----variance of the variance---- value decrease decrease rate	--figure of merit-- value behavior	-pdf- slope		
desired	random	<0.05 yes	1/sqrt(nps) yes	<0.10 yes	1/nps	constant random	>3.00
observed	random	0.00 yes	yes yes	0.00 yes	yes yes	constant random	10.00
passed?	yes	yes yes	yes yes	yes yes	yes yes	yes yes	yes

=====

this tally meets the statistical criteria used to form confidence intervals: check the tally fluctuation chart to verify. the results in other bins associated with this tally may not meet these statistical criteria.

----- estimated confidence intervals: -----

estimated asymmetric confidence interval(1,2,3 sigma): 1.3432E-02 to 1.3461E-02; 1.3417E-02 to 1.3476E-02; 1.3403E-02 to 1.3490E-02
 estimated symmetric confidence interval(1,2,3 sigma): 1.3432E-02 to 1.3461E-02; 1.3417E-02 to 1.3476E-02; 1.3403E-02 to 1.3490E-02

lanalysis of the results in the tally fluctuation chart bin (tfc) for tally 5 with nps = 1000000 print table 160

normed average tally per history = 1.34463E-02	unnormed average tally per history = 1.34463E-02
estimated tally relative error = 0.0011	estimated variance of the variance = 0.0001
relative error from zero tallies = 0.0000	relative error from nonzero scores = 0.0011
number of nonzero history tallies = 999993	efficiency for the nonzero tallies = 1.0000
history number of largest tally = 680971	largest unnormalized history tally = 5.27688E-01
(largest tally)/(average tally) = 3.92440E+01	(largest tally)/(avg nonzero tally) = 3.92437E+01
(confidence interval shift)/mean = 0.0000	shifted confidence interval center = 1.34464E-02

if the largest history score sampled so far were to occur on the next history, the tfc bin quantities would change as follows:

estimated quantities	value at nps	value at nps+1	value(nps+1)/value(nps)-1.
mean	1.34463E-02	1.34469E-02	0.000038
relative error	1.08685E-03	1.08748E-03	0.000580
variance of the variance	8.65543E-05	8.78662E-05	0.015158
shifted center	1.34464E-02	1.34464E-02	0.000000
figure of merit	1.59030E+04	1.58846E+04	-0.001158

the estimated slope of the 200 largest tallies starting at 2.54238E-01 appears to be decreasing at least exponentially. the large score tail of the empirical history score probability density function appears to have no unsampled regions.

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

145/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. MCCONN

DATE: 03/21/10

fom = (histories/minute)*(f(x) signal-to-noise ratio)**2 = (1.879E+04)*(9.201E-01)**2 = (1.879E+04)*(8.466E-01) = 1.590E+04

ltally 15 nps = 1000000
 + Point Detector at -90 Degrees
 tally type 5 particle flux at a point detector.
 tally for neutrons

this tally is modified by a dose function.

detector located at x,y,z = 0.00000E+00 0.00000E+00-5.00000E+01
 8.03378E-03 0.0012

detector located at x,y,z = 0.00000E+00 0.00000E+00-5.00000E+01
 uncollided neutron flux
 4.99227E-03 0.0003

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	1085594	0.32233	4.35681E-06	0.10867
1.00000E+00	2175049	0.96813	2.90228E-05	0.83258
2.00000E+00	88358	0.99437	4.68521E-06	0.94944
5.00000E+00	15024	0.99883	1.62370E-06	0.98994
1.00000E+01	1199	0.99918	3.15741E-07	0.99782
1.00000E+02	144	0.99923	7.93767E-08	0.99980
1.00000E+03	0	0.99923	0.00000E+00	0.99980
1.00000E+38	0	0.99923	0.00000E+00	0.99980
1st 200 histories	2606	1.00000	8.15061E-09	1.00000

average tally per history = 4.00918E-05 largest score = 2.14806E-03
 (largest score)/(average tally) = 5.35787E+01 nps of largest score = 527552

score contributions by cell					
cell	misses	hits	tally per history	weight per hit	
1 300	16389	9571	3.08259E-07	3.22076E-05	
2 301	64573	35112	1.05676E-06	3.00969E-05	
3 302	9459460	2020775	2.02919E-05	1.00416E-05	
4 303	65658	6539	3.32784E-08	5.08922E-06	
5 304	21	3	1.20363E-11	4.01209E-06	
6 305	638	3887	1.08076E-07	2.78045E-05	
7 306	0	12	6.54048E-10	5.45040E-05	
8 307	10681	3237	2.93872E-08	9.07854E-06	
9 320	56726	10947	5.19213E-08	4.74297E-06	
10 321	6406	4873	1.00247E-07	2.05720E-05	
11 322	62647	9868	4.77700E-08	4.84090E-06	
12 323	123	26	1.05439E-10	4.05536E-06	
13 324	51	19	9.48928E-11	4.99436E-06	
14 330	3021	2305	6.72846E-08	2.91907E-05	
15 340	1	0	0.00000E+00	0.00000E+00	
16 341	134012	114205	1.28128E-06	1.12192E-05	

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

146/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

17	342	859	39	1.56476E-10	4.01220E-06
19	344	469	29	1.16400E-10	4.01379E-06
21	346	525	40	1.63286E-10	4.08214E-06
22	347	1	0	0.00000E+00	0.00000E+00
23	348	506	54	2.27569E-10	4.21424E-06
24	349	13	2	8.01864E-12	4.00932E-06
25	350	582	297	1.69263E-09	5.69909E-06
27	352	317	161	9.06826E-10	5.63246E-06
28	353	0	1	5.54737E-12	5.54737E-06
29	354	590	268	2.00772E-09	7.49150E-06
31	356	0	2	3.34852E-11	1.67426E-05
32	420	17013	66850	8.95651E-07	1.33979E-05
33	422	16	1800	1.15153E-07	6.39736E-05
35	426	33	1615	8.32809E-08	5.15671E-05
36	427	1005	999504	1.45805E-05	1.45877E-05
37	430	271	1377	1.29950E-08	9.43721E-06
39	436	1069	1501	9.89398E-09	6.59159E-06
40	404	194	450	2.87074E-09	6.37943E-06
41	402	3303	72162	9.90180E-07	1.37216E-05
42	400	1	440	1.89036E-08	4.29626E-05
43	410	1	3	4.75814E-11	1.58605E-05
	total	9907175	3367974	4.00918E-05	1.19038E-05

score misses

russian roulette on pd	0
psc=0.	301313
russian roulette in transmission	9605245
underflow in transmission	617
hit a zero-importance cell	0
energy cutoff	0

results of 10 statistical checks for the estimated answer for the tally fluctuation chart (tfc) bin of tally 15

tfc bin behavior	--mean-- behavior	-----relative value	error decrease	-----decrease rate	----variance of the value	variance decrease	----decrease rate	--figure of merit-- value	behavior	-pdf-slope
desired	random	<0.05	yes	1/sqrt(nps)	<0.10	yes	1/nps	constant	random	>3.00
observed	random	0.00	yes	yes	0.00	yes	yes	constant	random	10.00
passed?	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

this tally meets the statistical criteria used to form confidence intervals: check the tally fluctuation chart to verify. the results in other bins associated with this tally may not meet these statistical criteria.

----- estimated confidence intervals: -----

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PROJECT NO.:

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REVISION NO.: 0

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

estimated asymmetric confidence interval(1,2,3 sigma): 8.0241E-03 to 8.0435E-03; 8.0144E-03 to 8.0533E-03; 8.0047E-03 to 8.0630E-03
 estimated symmetric confidence interval(1,2,3 sigma): 8.0241E-03 to 8.0435E-03; 8.0143E-03 to 8.0532E-03; 8.0046E-03 to 8.0629E-03

lanalysis of the results in the tally fluctuation chart bin (tfc) for tally 15 with nps = 1000000 print table 160

normed average tally per history = 8.03378E-03	unnormed average tally per history = 8.03378E-03
estimated tally relative error = 0.0012	estimated variance of the variance = 0.0001
relative error from zero tallies = 0.0000	relative error from nonzero scores = 0.0012
number of nonzero history tallies = 999694	efficiency for the nonzero tallies = 0.9997
history number of largest tally = 77153	largest unnormalized history tally = 5.43972E-01
(largest tally)/(average tally) = 6.77106E+01	(largest tally)/(avg nonzero tally) = 6.76899E+01
(confidence interval shift)/mean = 0.0000	shifted confidence interval center = 8.03382E-03

if the largest history score sampled so far were to occur on the next history, the tfc bin quantities would change as follows:

estimated quantities	value at nps	value at nps+1	value (nps+1)/value (nps) -1.
mean	8.03378E-03	8.03432E-03	0.000067
relative error	1.20989E-03	1.21165E-03	0.001451
variance of the variance	1.47690E-04	1.55974E-04	0.056095
shifted center	8.03382E-03	8.03382E-03	0.000000
figure of merit	1.28329E+04	1.27957E+04	-0.002896

the estimated slope of the 200 largest tallies starting at 1.84177E-01 appears to be decreasing at least exponentially.
 the large score tail of the empirical history score probability density function appears to have no unsampled regions.

fom = (histories/minute)*(f(x) signal-to-noise ratio)**2 = (1.879E+04)*(8.265E-01)**2 = (1.879E+04)*(6.831E-01) = 1.283E+04

ltally 25 nps = 1000000
 + 50 cm Tally Ring
 tally type 5 particle flux at a ring detector.
 tally for neutrons

this tally is modified by a dose function.

detector symmetric about z-axis located at z = 5.00000E+01 with radius = 1.00000E+00
 1.32991E-02 0.0013

detector symmetric about z-axis located at z = 5.00000E+01 with radius = 1.00000E+00
 uncollided neutron flux
 7.01139E-03 0.0007

detector score diagnostics		cumulative	tally	cumulative
times average score	transmissions	fraction of	per	fraction of
		transmissions	history	total tally

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

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148/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

1.00000E-01	1291242	0.34256	8.45887E-06	0.12927
1.00000E+00	2386370	0.97566	4.72019E-05	0.85064
2.00000E+00	72586	0.99491	6.35937E-06	0.94783
5.00000E+00	15178	0.99894	2.71048E-06	0.98925
1.00000E+01	1223	0.99926	5.23673E-07	0.99725
1.00000E+02	177	0.99931	1.66881E-07	0.99980
1.00000E+03	0	0.99931	0.00000E+00	0.99980
1.00000E+38	0	0.99931	0.00000E+00	0.99980
1st 200 histories	2601	1.00000	1.28455E-08	1.00000

average tally per history = 6.54340E-05 largest score = 4.20558E-03
 (largest score)/(average tally) = 6.42722E+01 nps of largest score = 199661

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	13487	12473	4.66377E-07	3.73909E-05
2 301	56968	42717	1.51931E-06	3.55670E-05
3 302	9290599	2189636	3.06441E-05	1.39951E-05
4 303	24551	47646	7.84987E-07	1.64754E-05
5 304	6	18	3.51918E-10	1.95510E-05
6 305	3344	1181	8.89028E-09	7.52776E-06
7 306	8	4	2.61905E-11	6.54762E-06
8 307	4543	9375	1.08901E-07	1.16161E-05
9 320	15404	52269	1.14299E-06	2.18675E-05
10 321	5206	6073	6.40287E-08	1.05432E-05
11 322	19367	53148	1.52778E-06	2.87458E-05
12 323	22	127	3.18919E-09	2.51117E-05
13 324	0	70	4.06473E-09	5.80676E-05
14 330	1276	4050	4.76311E-08	1.17608E-05
15 340	0	1	6.86104E-11	6.86104E-05
16 341	32347	215870	5.10292E-06	2.36389E-05
17 342	0	898	5.53273E-08	6.16116E-05
19 344	0	498	2.47982E-08	4.97956E-05
21 346	3	562	2.70876E-08	4.81986E-05
22 347	0	1	2.26801E-11	2.26801E-05
23 348	0	560	2.37523E-08	4.24148E-05
24 349	0	15	2.62810E-10	1.75207E-05
25 350	107	772	9.25106E-09	1.19832E-05
27 352	67	411	4.55121E-09	1.10735E-05
28 353	0	1	1.58642E-11	1.58642E-05
29 354	191	667	7.12164E-09	1.06771E-05
31 356	1	1	8.20152E-12	8.20152E-06
32 420	20329	63534	1.41047E-06	2.22002E-05
33 422	895	921	9.88740E-09	1.07355E-05
35 426	404	1244	1.84294E-08	1.48146E-05
36 427	6975	993534	2.05898E-05	2.07238E-05
37 430	42	1606	1.16106E-07	7.22953E-05
39 436	27	2543	2.33243E-07	9.17194E-05
40 404	0	644	5.08236E-08	7.89187E-05
41 402	9402	66063	1.42502E-06	2.15706E-05

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

149/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

42	400	200	241	2.23839E-09	9.28794E-06
43	410	1	3	5.11824E-11	1.70608E-05
	total	9505772	3769377	6.54340E-05	1.73594E-05

score misses

russian roulette on pd	0
psc=0.	304031
russian roulette in transmission	9201160
underflow in transmission	581
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = 4.92404E+01 with radius = 8.68241E+00
7.44776E-03 0.0017

detector symmetric about z-axis located at z = 4.92404E+01 with radius = 8.68241E+00
uncollided neutron flux
2.52976E-03 0.0010

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	1720273	0.43303	8.16081E-06	0.17199
1.00000E+00	2118422	0.96629	2.90124E-05	0.78343
2.00000E+00	106574	0.99311	6.80419E-06	0.92683
5.00000E+00	23342	0.99899	2.97146E-06	0.98946
1.00000E+01	1246	0.99930	3.79683E-07	0.99746
1.00000E+02	173	0.99935	1.11014E-07	0.99980
1.00000E+03	0	0.99935	0.00000E+00	0.99980
1.00000E+38	0	0.99935	0.00000E+00	0.99980
1st 200 histories	2598	1.00000	9.62699E-09	1.00000

average tally per history = 4.74492E-05 largest score = 1.97666E-03
(largest score)/(average tally) = 4.16584E+01 nps of largest score = 550896

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	12420	13540	4.67005E-07	3.44908E-05
2 301	52704	46981	1.51135E-06	3.21693E-05
3 302	8706855	2773380	3.22834E-05	1.16405E-05
4 303	44576	27621	6.88551E-07	2.49285E-05
5 304	13	11	3.81610E-10	3.46918E-05
6 305	4347	178	8.45253E-10	4.74861E-06
7 306	12	0	0.00000E+00	0.00000E+00
8 307	12139	1779	1.14305E-08	6.42525E-06
9 320	38168	29505	8.04482E-07	2.72660E-05
10 321	9859	1420	7.71699E-09	5.43450E-06
11 322	33153	39362	9.61166E-07	2.44186E-05
12 323	77	72	1.57888E-09	2.19289E-05
13 324	5	65	2.91954E-09	4.49161E-05

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

150/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

14	330	4357	969	5.20832E-09	5.37494E-06
15	340	0	1	4.75135E-12	4.75135E-06
16	341	113497	134720	2.07771E-06	1.54224E-05
17	342	182	716	2.29278E-08	3.20220E-05
19	344	124	374	1.05116E-08	2.81060E-05
21	346	150	415	9.95967E-09	2.39992E-05
22	347	0	1	4.85628E-12	4.85628E-06
23	348	160	400	9.45255E-09	2.36314E-05
24	349	10	5	1.16441E-10	2.32881E-05
25	350	642	237	1.82238E-09	7.68936E-06
27	352	340	138	9.85368E-10	7.14035E-06
28	353	0	1	3.20328E-11	3.20328E-05
29	354	653	205	1.36477E-09	6.65741E-06
31	356	1	1	4.74363E-12	4.74363E-06
32	420	36149	47714	6.46080E-07	1.35407E-05
33	422	1423	393	2.03987E-09	5.19050E-06
35	426	1056	592	3.41242E-09	5.76422E-06
36	427	199387	801122	7.12418E-06	8.89275E-06
37	430	189	1459	5.48410E-08	3.75881E-05
39	436	179	2391	1.17260E-07	4.90423E-05
40	404	19	625	2.90976E-08	4.65561E-05
41	402	29329	46136	5.90833E-07	1.28063E-05
42	400	344	97	4.72217E-10	4.86821E-06
43	410	2	2	1.93592E-11	9.67962E-06
	total	9302521	3972628	4.74492E-05	1.19440E-05

score misses

russian roulette on pd	0
psc=0.	301985
russian roulette in transmission	8999901
underflow in transmission	635
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = 4.69846E+01 with radius = 1.71010E+01
4.94389E-03 0.0019

detector symmetric about z-axis located at z = 4.69846E+01 with radius = 1.71010E+01
uncollided neutron flux
9.55756E-04 0.0012

detector score diagnostics

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	1867164	0.46696	7.35773E-06	0.18664
1.00000E+00	1984569	0.96328	2.28747E-05	0.76688
2.00000E+00	117782	0.99274	6.24433E-06	0.92527
5.00000E+00	25393	0.99909	2.64005E-06	0.99224
1.00000E+01	944	0.99932	2.35446E-07	0.99821
1.00000E+02	107	0.99935	6.32631E-08	0.99982

CALCULATION SHEET

PROJECT NO.:

CALC NO.:

REVISION NO.: 0

SHEET NO.:

151/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

1.00000E+03	0	0.99935	0.00000E+00	0.99982
1.00000E+38	0	0.99935	0.00000E+00	0.99982
1st 200 histories	2603	1.00000	7.28092E-09	1.00000

average tally per history = 3.94228E-05 largest score = 1.83157E-03
 (largest score)/(average tally) = 4.64597E+01 nps of largest score = 352653

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	11463	14497	4.59201E-07	3.16756E-05
2 301	49216	50469	1.49354E-06	2.95932E-05
3 302	8297607	3182628	3.22507E-05	1.01334E-05
4 303	46555	25642	4.27392E-07	1.66676E-05
5 304	17	7	1.81041E-10	2.58630E-05
6 305	4467	58	2.30202E-10	3.96901E-06
7 306	12	0	0.00000E+00	0.00000E+00
8 307	13459	459	1.79948E-09	3.92044E-06
9 320	40367	27306	5.22272E-07	1.91266E-05
10 321	10695	584	2.30159E-09	3.94109E-06
11 322	40304	32211	5.77088E-07	1.79159E-05
12 323	87	62	1.05201E-09	1.69679E-05
13 324	8	62	1.95558E-09	3.15416E-05
14 330	4911	415	1.64248E-09	3.95779E-06
15 340	0	1	6.01351E-12	6.01351E-06
16 341	153086	95131	6.65627E-07	6.99695E-06
17 342	279	619	8.83159E-09	1.42675E-05
19 344	185	313	3.43578E-09	1.09769E-05
21 346	184	381	4.09896E-09	1.07584E-05
22 347	0	1	4.54121E-12	4.54121E-06
23 348	214	346	3.09129E-09	8.93437E-06
24 349	14	1	3.94552E-12	3.94552E-06
25 350	769	110	4.47893E-10	4.07176E-06
27 352	441	37	1.46854E-10	3.96903E-06
28 353	0	1	4.90701E-12	4.90701E-06
29 354	782	76	3.04692E-10	4.00910E-06
31 356	1	1	3.94299E-12	3.94299E-06
32 420	56417	27446	2.16421E-07	7.88535E-06
33 422	1625	191	8.01953E-10	4.19871E-06
35 426	1363	285	1.16640E-09	4.09263E-06
36 427	492102	508407	2.55356E-06	5.02267E-06
37 430	635	1013	1.50148E-08	1.48221E-05
39 436	899	1671	2.92272E-08	1.74908E-05
40 404	150	494	7.40100E-09	1.49818E-05
41 402	47872	27593	1.73665E-07	6.29380E-06
42 400	397	44	1.76571E-10	4.01297E-06
43 410	4	0	0.00000E+00	0.00000E+00
total	9276587	3998562	3.94228E-05	9.85924E-06

score misses

russian roulette on pd

0

CALCULATION SHEET

PROJECT No.:

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

psc=0. 300713
 russian roulette in transmission 8975226
 underflow in transmission 648
 hit a zero-importance cell 0
 energy cutoff 0

detector symmetric about z-axis located at z = 4.33013E+01 with radius = 2.50000E+01
 4.46957E-03 0.0018

detector symmetric about z-axis located at z = 4.33013E+01 with radius = 2.50000E+01
 uncollided neutron flux
 8.13599E-04 0.0013

detector score diagnostics		cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
times average score	transmissions			
1.00000E-01	1946029	0.47047	7.24272E-06	0.19446
1.00000E+00	2057005	0.96777	2.25232E-05	0.79919
2.00000E+00	111454	0.99472	5.50420E-06	0.94697
5.00000E+00	18663	0.99923	1.80239E-06	0.99537
1.00000E+01	535	0.99936	1.25800E-07	0.99875
1.00000E+02	67	0.99937	3.95938E-08	0.99981
1.00000E+03	0	0.99937	0.00000E+00	0.99981
1.00000E+38	0	0.99937	0.00000E+00	0.99981
1st 200 histories	2595	1.00000	7.13533E-09	1.00000

average tally per history = 3.72450E-05 largest score = 1.47543E-03
 (largest score)/(average tally) = 3.96141E+01 nps of largest score = 98438

score contributions by cell					
cell	misses	hits	tally per history	weight per hit	
1	300	10572	15388	4.56209E-07	2.96470E-05
2	301	46263	53422	1.47242E-06	2.75621E-05
3	302	8095576	3384659	3.13161E-05	9.25237E-06
4	303	48280	23917	2.84603E-07	1.18996E-05
5	304	17	7	4.92977E-11	7.04253E-06
6	305	4477	48	1.78617E-10	3.72119E-06
7	306	12	0	0.00000E+00	0.00000E+00
8	307	13565	353	1.30442E-09	3.69524E-06
9	320	42134	25539	3.66943E-07	1.43680E-05
10	321	10764	515	1.92301E-09	3.73400E-06
11	322	43118	29397	4.04653E-07	1.37651E-05
12	323	89	60	9.16397E-10	1.52733E-05
13	324	12	58	1.52248E-09	2.62496E-05
14	330	5025	301	1.14946E-09	3.81882E-06
15	340	0	1	3.72436E-12	3.72436E-06
16	341	164349	83868	4.59000E-07	5.47289E-06
17	342	346	552	5.14515E-09	9.32093E-06
19	344	197	301	2.43807E-09	8.09991E-06
21	346	210	355	2.61240E-09	7.35887E-06

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PROJECT No.:

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

22	347	0	1	4.02132E-12	4.02132E-06
23	348	253	307	2.04453E-09	6.65969E-06
24	349	13	2	7.43850E-12	3.71925E-06
25	350	791	88	3.29370E-10	3.74284E-06
27	352	436	42	1.56340E-10	3.72237E-06
28	353	0	1	4.17780E-12	4.17780E-06
29	354	784	74	2.77146E-10	3.74522E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	59287	24576	1.63198E-07	6.64053E-06
33	422	1645	171	6.42474E-10	3.75716E-06
35	426	1385	263	1.02133E-09	3.88339E-06
36	427	534837	465672	2.15260E-06	4.62257E-06
37	430	832	816	7.96010E-09	9.75503E-06
39	436	1178	1392	1.27240E-08	9.14079E-06
40	404	223	421	3.30396E-09	7.84789E-06
41	402	51726	23739	1.23397E-07	5.19807E-06
42	400	399	42	1.59840E-10	3.80571E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	9138801	4136348	3.72450E-05	9.00432E-06

score misses

russian roulette on pd	0
psc=0.	300657
russian roulette in transmission	8837447
underflow in transmission	697
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = 3.83022E+01 with radius = 3.21394E+01
4.16922E-03 0.0017

detector symmetric about z-axis located at z = 3.83022E+01 with radius = 3.21394E+01
uncollided neutron flux
7.42600E-04 0.0013

detector score diagnostics		cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
times average score	transmissions			
1.00000E-01	2016521	0.47219	7.16850E-06	0.20168
1.00000E+00	2136106	0.97239	2.23966E-05	0.83180
2.00000E+00	102873	0.99647	4.76946E-06	0.96599
5.00000E+00	12065	0.99930	1.09499E-06	0.99679
1.00000E+01	341	0.99938	7.84809E-08	0.99900
1.00000E+02	51	0.99939	2.90923E-08	0.99982
1.00000E+03	0	0.99939	0.00000E+00	0.99982
1.00000E+38	0	0.99939	0.00000E+00	0.99982
1st 200 histories	2597	1.00000	6.36943E-09	1.00000

average tally per history = 3.55435E-05 largest score = 2.31279E-03
(largest score)/(average tally) = 6.50692E+01 nps of largest score = 840639

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PROJECT No.:

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

score contributions by cell					
cell	misses	hits	tally per history	weight per hit	
1	300	9943	16017	4.44898E-07	2.77766E-05
2	301	43567	56118	1.44775E-06	2.57983E-05
3	302	7929900	3550335	3.02967E-05	8.53349E-06
4	303	49633	22564	2.02157E-07	8.95925E-06
5	304	18	6	4.57166E-11	7.61943E-06
6	305	4474	51	1.83279E-10	3.59371E-06
7	306	12	0	0.00000E+00	0.00000E+00
8	307	13520	398	1.40723E-09	3.53575E-06
9	320	43449	24224	2.70965E-07	1.11858E-05
10	321	10774	505	1.80093E-09	3.56620E-06
11	322	45028	27487	2.92222E-07	1.06313E-05
12	323	91	58	6.99274E-10	1.20564E-05
13	324	16	54	1.13911E-09	2.10946E-05
14	330	5018	308	1.10582E-09	3.59034E-06
15	340	1	0	0.00000E+00	0.00000E+00
16	341	170145	78072	3.68651E-07	4.72194E-06
17	342	388	510	3.47978E-09	6.82309E-06
19	344	211	287	1.63943E-09	5.71232E-06
21	346	263	302	1.75305E-09	5.80480E-06
22	347	0	1	6.49816E-12	6.49816E-06
23	348	268	292	1.53761E-09	5.26580E-06
24	349	11	4	1.42194E-11	3.55484E-06
25	350	797	82	2.97410E-10	3.62695E-06
27	352	440	38	1.35188E-10	3.55758E-06
28	353	1	0	0.00000E+00	0.00000E+00
29	354	780	78	2.77252E-10	3.55451E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	60758	23105	1.32433E-07	5.73180E-06
33	422	1661	155	5.97551E-10	3.85517E-06
35	426	1404	244	8.78768E-10	3.60151E-06
36	427	555431	445078	1.95603E-06	4.39481E-06
37	430	973	675	5.58006E-09	8.26675E-06
39	436	1453	1117	6.25721E-09	5.60180E-06
40	404	299	345	1.56491E-09	4.53598E-06
41	402	53458	22007	1.01160E-07	4.59673E-06
42	400	404	37	1.31713E-10	3.55981E-06
43	410	4	0	0.00000E+00	0.00000E+00
total	9004595	4270554	3.55435E-05	8.32293E-06	

score misses	
russian roulette on pd	0
psc=0.	299686
russian roulette in transmission	8704212
underflow in transmission	697
hit a zero-importance cell	0
energy cutoff	0

CALCULATION SHEET

PROJECT No.:

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. MCCONN

DATE: 03/21/10

detector symmetric about z-axis located at z = 3.21394E+01 with radius = 3.83022E+01
3.91367E-03 0.0016

detector symmetric about z-axis located at z = 3.21394E+01 with radius = 3.83022E+01
uncollided neutron flux
6.86060E-04 0.0014

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	2088479	0.47548	7.09216E-06	0.20866
1.00000E+00	2199767	0.97630	2.20246E-05	0.85666
2.00000E+00	92912	0.99746	4.05067E-06	0.97584
5.00000E+00	8231	0.99933	7.12206E-07	0.99679
1.00000E+01	283	0.99940	6.31219E-08	0.99865
1.00000E+02	62	0.99941	3.53047E-08	0.99969
1.00000E+03	1	0.99941	4.29122E-09	0.99981
1.00000E+38	0	0.99941	0.00000E+00	0.99981
1st 200 histories	2591	1.00000	6.29558E-09	1.00000

average tally per history = 3.39886E-05 largest score = 4.29122E-03
(largest score)/(average tally) = 1.26255E+02 nps of largest score = 677577

score contributions by cell					
cell	misses	hits	tally per history	weight per hit	
1	300	9358	16602	4.33507E-07	2.61117E-05
2	301	41212	58473	1.40863E-06	2.40902E-05
3	302	7785238	3694997	2.92515E-05	7.91652E-06
4	303	51223	20974	1.43863E-07	6.85911E-06
5	304	19	5	3.04618E-11	6.09237E-06
6	305	4473	52	1.76703E-10	3.39814E-06
7	306	12	0	0.00000E+00	0.00000E+00
8	307	13504	414	1.39317E-09	3.36515E-06
9	320	44533	23140	2.00409E-07	8.66074E-06
10	321	10720	559	1.90814E-09	3.41349E-06
11	322	46324	26191	2.19260E-07	8.37157E-06
12	323	96	53	4.72518E-10	8.91544E-06
13	324	16	54	7.70926E-10	1.42764E-05
14	330	5004	322	1.09446E-09	3.39893E-06
15	340	1	0	0.00000E+00	0.00000E+00
16	341	173724	74493	3.12733E-07	4.19816E-06
17	342	439	459	2.27944E-09	4.96610E-06
19	344	258	240	1.22701E-09	5.11256E-06
21	346	298	267	1.25820E-09	4.71236E-06
22	347	0	1	4.87335E-12	4.87335E-06
23	348	315	245	1.16045E-09	4.73655E-06
24	349	14	1	3.39140E-12	3.39140E-06
25	350	784	95	3.23532E-10	3.40560E-06
27	352	435	43	1.61159E-10	3.74788E-06
28	353	1	0	0.00000E+00	0.00000E+00

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PROJECT No.:

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

29	354	804	54	1.92156E-10	3.55844E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	62342	21521	1.11187E-07	5.16645E-06
33	422	1660	156	5.53920E-10	3.55077E-06
35	426	1411	237	8.27226E-10	3.49040E-06
36	427	569997	430512	1.80101E-06	4.18342E-06
37	430	1093	555	3.13539E-09	5.64935E-06
39	436	1735	835	3.38908E-09	4.05878E-06
40	404	381	263	9.71658E-10	3.69452E-06
41	402	54982	20483	8.50518E-08	4.15231E-06
42	400	411	30	1.02680E-10	3.42265E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	8882823	4392326	3.39886E-05	7.73818E-06

score misses

russian roulette on pd	0
psc=0.	299386
russian roulette in transmission	8582778
underflow in transmission	659
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = 2.50000E+01 with radius = 4.33013E+01
3.68024E-03 0.0016

detector symmetric about z-axis located at z = 2.50000E+01 with radius = 4.33013E+01
uncollided neutron flux
6.33563E-04 0.0014

detector score diagnostics		cumulative	tally	cumulative
times average score	transmissions	fraction of	per	fraction of
		transmissions	history	total tally
1.00000E-01	2155759	0.48105	6.99801E-06	0.21541
1.00000E+00	2230687	0.97881	2.13215E-05	0.87173
2.00000E+00	85509	0.99789	3.52064E-06	0.98010
5.00000E+00	6495	0.99934	5.47295E-07	0.99695
1.00000E+01	281	0.99940	5.89574E-08	0.99876
1.00000E+02	65	0.99942	3.34796E-08	0.99979
1.00000E+03	0	0.99942	0.00000E+00	0.99979
1.00000E+38	0	0.99942	0.00000E+00	0.99979
1st 200 histories	2602	1.00000	6.70269E-09	1.00000

average tally per history = 3.24866E-05 largest score = 1.45674E-03
(largest score)/(average tally) = 4.48415E+01 nps of largest score = 995627

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	8834	17126	4.18599E-07	2.44423E-05
2 301	39220	60465	1.36961E-06	2.26513E-05
3 302	7671988	3808247	2.81712E-05	7.39741E-06

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SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

4	303	53558	18639	9.95454E-08	5.34070E-06
5	304	15	9	3.52691E-11	3.91879E-06
6	305	4437	88	2.85680E-10	3.24637E-06
7	306	12	0	0.00000E+00	0.00000E+00
8	307	13408	510	1.67070E-09	3.27588E-06
9	320	46160	21513	1.50693E-07	7.00474E-06
10	321	10619	660	2.17752E-09	3.29927E-06
11	322	48152	24363	1.62309E-07	6.66210E-06
12	323	95	54	3.10323E-10	5.74673E-06
13	324	30	40	4.90888E-10	1.22722E-05
14	330	4998	328	1.07030E-09	3.26310E-06
15	340	1	0	0.00000E+00	0.00000E+00
16	341	177794	70423	2.68766E-07	3.81646E-06
17	342	469	429	1.65329E-09	3.85382E-06
19	344	314	184	7.11751E-10	3.86821E-06
21	346	331	234	9.07879E-10	3.87982E-06
22	347	0	1	3.24593E-12	3.24593E-06
23	348	345	215	8.44000E-10	3.92558E-06
24	349	11	4	1.29845E-11	3.24613E-06
25	350	796	83	2.73625E-10	3.29669E-06
27	352	431	47	1.57749E-10	3.35637E-06
28	353	1	0	0.00000E+00	0.00000E+00
29	354	788	70	2.27930E-10	3.25615E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	63670	20193	9.55608E-08	4.73237E-06
33	422	1658	158	5.60062E-10	3.54470E-06
35	426	1402	246	8.41761E-10	3.42179E-06
36	427	583781	416728	1.65850E-06	3.97980E-06
37	430	1202	446	2.18642E-09	4.90228E-06
39	436	1947	623	2.26811E-09	3.64062E-06
40	404	436	208	7.37229E-10	3.54437E-06
41	402	56445	19020	7.42380E-08	3.90315E-06
42	400	397	44	1.45500E-10	3.30682E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	8793751	4481398	3.24866E-05	7.24920E-06

score misses

russian roulette on pd	0
psc=0.	299797
russian roulette in transmission	8493301
underflow in transmission	653
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = 1.71010E+01 with radius = 4.69846E+01
3.46196E-03 0.0015

detector symmetric about z-axis located at z = 1.71010E+01 with radius = 4.69846E+01
uncollided neutron flux
5.85471E-04 0.0014

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

158/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	2210752	0.48787	6.86253E-06	0.22092
1.00000E+00	2229800	0.97995	2.03921E-05	0.87739
2.00000E+00	81665	0.99797	3.20899E-06	0.98069
5.00000E+00	6223	0.99935	5.06925E-07	0.99701
1.00000E+01	292	0.99941	5.89936E-08	0.99891
1.00000E+02	58	0.99943	2.75501E-08	0.99980
1.00000E+03	0	0.99943	0.00000E+00	0.99980
1.00000E+38	0	0.99943	0.00000E+00	0.99980
1st 200 histories	2605	1.00000	6.33726E-09	1.00000

average tally per history = 3.10634E-05 largest score = 1.79692E-03
 (largest score)/(average tally) = 5.78468E+01 nps of largest score = 78185

score contributions by cell				
cell	misses	hits	tally per history	weight per hit
1	300	8207	17753	4.12452E-07
2	301	37464	62221	1.34790E-06
3	302	7596909	3883326	2.70745E-05
4	303	56145	16052	6.88068E-08
5	304	14	10	4.68842E-11
6	305	4406	119	3.69739E-10
7	306	11	1	3.10571E-12
8	307	13278	640	2.01135E-09
9	320	48080	19593	1.12471E-07
10	321	10500	779	2.43986E-09
11	322	50299	22216	1.21723E-07
12	323	112	37	2.12558E-10
13	324	31	39	4.11030E-10
14	330	4912	414	1.30579E-09
15	340	0	1	3.10302E-12
16	341	182336	65881	2.33730E-07
17	342	587	311	1.02161E-09
19	344	341	157	5.12692E-10
21	346	367	198	6.88844E-10
22	347	1	0	0.00000E+00
23	348	383	177	6.28847E-10
24	349	14	1	3.10443E-12
25	350	775	104	3.28414E-10
27	352	421	57	1.78166E-10
28	353	0	1	3.10340E-12
29	354	769	89	2.76500E-10
31	356	2	0	0.00000E+00
32	420	65091	18772	8.17645E-08
33	422	1607	209	6.77761E-10
35	426	1384	264	8.67725E-10
36	427	597461	403048	1.52830E-06

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

159/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

37	430	1253	395	1.78617E-09	4.52195E-06
39	436	2140	430	1.46528E-09	3.40762E-06
40	404	496	148	4.69080E-10	3.16946E-06
41	402	57553	17912	6.59754E-08	3.68331E-06
42	400	401	40	1.29226E-10	3.23065E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	8743754	4531395	3.10634E-05	6.85515E-06

score misses

russian roulette on pd	0
psc=0.	298077
russian roulette in transmission	8445004
underflow in transmission	673
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = 8.68241E+00 with radius = 4.92404E+01
3.26526E-03 0.0016

detector symmetric about z-axis located at z = 8.68241E+00 with radius = 4.92404E+01
uncollided neutron flux
5.42413E-04 0.0015

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	2239538	0.49379	6.64025E-06	0.22364
1.00000E+00	2202754	0.97948	1.93043E-05	0.87382
2.00000E+00	83771	0.99795	3.15457E-06	0.98006
5.00000E+00	6323	0.99934	4.94907E-07	0.99673
1.00000E+01	321	0.99941	6.25000E-08	0.99883
1.00000E+02	63	0.99942	2.82800E-08	0.99979
1.00000E+03	0	0.99942	0.00000E+00	0.99979
1.00000E+38	0	0.99942	0.00000E+00	0.99979
1st 200 histories	2610	1.00000	6.31740E-09	1.00000

average tally per history = 2.96912E-05 largest score = 9.22088E-04
(largest score)/(average tally) = 3.10560E+01 nps of largest score = 425819

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	8023	17937	3.92938E-07	2.19066E-05
2 301	36325	63360	1.29534E-06	2.04442E-05
3 302	7571584	3908651	2.60033E-05	6.65275E-06
4 303	58680	13517	4.92073E-08	3.64040E-06
5 304	20	4	1.69785E-11	4.24461E-06
6 305	4318	207	6.21686E-10	3.00332E-06
7 306	12	0	0.00000E+00	0.00000E+00
8 307	13152	766	2.29619E-09	2.99764E-06
9 320	50596	17077	8.47043E-08	4.96014E-06

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

160/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

10	321	10232	1047	3.13188E-09	2.99129E-06
11	322	52671	19844	9.45121E-08	4.76275E-06
12	323	119	30	1.62043E-10	5.40143E-06
13	324	39	31	3.73458E-10	1.20470E-05
14	330	4854	472	1.41878E-09	3.00590E-06
15	340	1	0	0.00000E+00	0.00000E+00
16	341	185342	62875	2.10239E-07	3.34376E-06
17	342	700	198	5.98558E-10	3.02302E-06
19	344	390	108	3.36268E-10	3.11359E-06
21	346	423	142	4.29997E-10	3.02815E-06
22	347	1	0	0.00000E+00	0.00000E+00
23	348	423	137	4.20978E-10	3.07283E-06
24	349	12	3	8.89624E-12	2.96541E-06
25	350	758	121	3.66911E-10	3.03232E-06
27	352	430	48	1.43195E-10	2.98324E-06
28	353	1	0	0.00000E+00	0.00000E+00
29	354	753	105	3.11984E-10	2.97128E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	66063	17800	7.31333E-08	4.10861E-06
33	422	1601	215	6.55411E-10	3.04842E-06
35	426	1369	279	8.91169E-10	3.19415E-06
36	427	607925	392584	1.41368E-06	3.60096E-06
37	430	1338	310	1.14618E-09	3.69735E-06
39	436	2154	416	1.27769E-09	3.07136E-06
40	404	508	136	4.11709E-10	3.02727E-06
41	402	58541	16924	5.90243E-08	3.48761E-06
42	400	405	36	1.06757E-10	2.96546E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	8739769	4535380	2.96912E-05	6.54657E-06

score misses

russian roulette on pd	0
psc=0.	298348
russian roulette in transmission	8440627
underflow in transmission	794
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = 0.00000E+00 with radius = 5.00000E+01
3.08406E-03 0.0016

detector symmetric about z-axis located at z = 0.00000E+00 with radius = 5.00000E+01
uncollided neutron flux
5.01801E-04 0.0015

detector score diagnostics		cumulative	tally	cumulative
times average score	transmissions	fraction of	per	fraction of
		transmissions	history	total tally
1.00000E-01	2228068	0.49660	6.33970E-06	0.22272
1.00000E+00	2157685	0.97752	1.82190E-05	0.86277

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

161/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. MCCONN

DATE: 03/21/10

2.00000E+00	91004	0.99780	3.29187E-06	0.97841
5.00000E+00	6869	0.99933	5.17475E-07	0.99659
1.00000E+01	344	0.99941	6.38501E-08	0.99884
1.00000E+02	59	0.99942	2.71973E-08	0.99979
1.00000E+03	0	0.99942	0.00000E+00	0.99979
1.00000E+38	0	0.99942	0.00000E+00	0.99979
1st 200 histories	2603	1.00000	5.93692E-09	1.00000

average tally per history = 2.84650E-05 largest score = 1.58165E-03
 (largest score)/(average tally) = 5.55648E+01 nps of largest score = 221756

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	8074	17886	3.80588E-07	2.12785E-05
2 301	36124	63561	1.26282E-06	1.98679E-05
3 302	7596046	3884189	2.50096E-05	6.43883E-06
4 303	61186	11011	3.73233E-08	3.38964E-06
5 304	20	4	1.13834E-11	2.84586E-06
6 305	4102	423	1.22306E-09	2.89139E-06
7 306	10	2	5.69256E-12	2.84628E-06
8 307	13032	886	2.57716E-09	2.90876E-06
9 320	52631	15042	6.70996E-08	4.46082E-06
10 321	9994	1285	3.76018E-09	2.92621E-06
11 322	55009	17506	7.47177E-08	4.26812E-06
12 323	120	29	1.30262E-10	4.49181E-06
13 324	47	23	2.23179E-10	9.70343E-06
14 330	4705	621	1.82569E-09	2.93991E-06
15 340	1	0	0.00000E+00	0.00000E+00
16 341	188629	59588	1.90387E-07	3.19506E-06
17 342	752	146	4.20375E-10	2.87928E-06
19 344	421	77	2.20272E-10	2.86067E-06
21 346	451	114	3.33866E-10	2.92865E-06
22 347	1	0	0.00000E+00	0.00000E+00
23 348	450	110	3.17048E-10	2.88226E-06
24 349	9	6	1.70651E-11	2.84419E-06
25 350	716	163	4.65435E-10	2.85543E-06
27 352	402	76	2.35004E-10	3.09216E-06
28 353	0	1	2.84326E-12	2.84326E-06
29 354	708	150	4.45938E-10	2.97292E-06
31 356	2	0	0.00000E+00	0.00000E+00
32 420	66617	17246	6.80578E-08	3.94630E-06
33 422	1595	221	6.46298E-10	2.92443E-06
35 426	1351	297	9.76859E-10	3.28909E-06
36 427	621276	379233	1.30511E-06	3.44144E-06
37 430	1390	258	8.39020E-10	3.25202E-06
39 436	2226	344	1.00385E-09	2.91816E-06
40 404	552	92	2.63942E-10	2.86893E-06
41 402	59474	15991	5.31889E-08	3.32618E-06
42 400	391	50	1.42284E-10	2.84568E-06
43 410	3	1	2.84326E-12	2.84326E-06

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

162/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

total 8788517 4486632 2.84650E-05 6.34441E-06

score misses

russian roulette on pd	0
psc=0.	299079
russian roulette in transmission	8488657
underflow in transmission	781
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = -8.68241E+00 with radius = 4.92404E+01
2.91787E-03 0.0016

detector symmetric about z-axis located at z = -8.68241E+00 with radius = 4.92404E+01
uncollided neutron flux
4.67011E-04 0.0015

detector score diagnostics

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	2178244	0.49438	5.93815E-06	0.21757
1.00000E+00	2114300	0.97425	1.71421E-05	0.84564
2.00000E+00	102462	0.99751	3.54615E-06	0.97557
5.00000E+00	7939	0.99931	5.66968E-07	0.99635
1.00000E+01	356	0.99939	6.33344E-08	0.99867
1.00000E+02	74	0.99941	3.06255E-08	0.99979
1.00000E+03	0	0.99941	0.00000E+00	0.99979
1.00000E+38	0	0.99941	0.00000E+00	0.99979
1st 200 histories	2601	1.00000	5.77068E-09	1.00000

average tally per history = 2.72931E-05 largest score = 1.09283E-03
(largest score)/(average tally) = 4.00404E+01 nps of largest score = 90048

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	8650	17310	3.65675E-07	2.11251E-05
2 301	38032	61653	1.21189E-06	1.96567E-05
3 302	7657765	3822470	2.40476E-05	6.29111E-06
4 303	62537	9660	3.17976E-08	3.29168E-06
5 304	20	4	1.08968E-11	2.72419E-06
6 305	3724	801	2.46207E-09	3.07375E-06
7 306	8	4	1.09118E-11	2.72796E-06
8 307	12771	1147	3.19387E-09	2.78454E-06
9 320	54198	13475	5.35756E-08	3.97593E-06
10 321	9578	1701	4.72177E-09	2.77588E-06
11 322	56643	15872	6.08007E-08	3.83069E-06
12 323	128	21	9.50409E-11	4.52576E-06
13 324	55	15	1.94112E-10	1.29408E-05
14 330	4605	721	2.09332E-09	2.90336E-06
15 340	1	0	0.00000E+00	0.00000E+00

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

16	341	190294	57923	1.77291E-07	3.06080E-06
17	342	810	88	2.40857E-10	2.73702E-06
19	344	428	70	1.90867E-10	2.72667E-06
21	346	474	91	2.51685E-10	2.76577E-06
22	347	1	0	0.00000E+00	0.00000E+00
23	348	470	90	2.51443E-10	2.79381E-06
24	349	13	2	5.45380E-12	2.72690E-06
25	350	694	185	5.13622E-10	2.77633E-06
27	352	376	102	2.86344E-10	2.80729E-06
28	353	0	1	2.72603E-12	2.72603E-06
29	354	683	175	4.97128E-10	2.84073E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	66980	16883	6.44137E-08	3.81530E-06
33	422	1577	239	6.63960E-10	2.77807E-06
35	426	1346	302	1.03200E-09	3.41722E-06
36	427	631565	368944	1.21248E-06	3.28634E-06
37	430	1420	228	6.73502E-10	2.95396E-06
39	436	2306	264	7.48587E-10	2.83556E-06
40	404	581	63	1.72334E-10	2.73546E-06
41	402	60049	15416	4.91579E-08	3.18876E-06
42	400	385	56	1.55939E-10	2.78462E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	8869173	4405976	2.72931E-05	6.19457E-06

score misses

russian roulette on pd 0
 psc=0. 298856
 russian roulette in transmission 8569572
 underflow in transmission 745
 hit a zero-importance cell 0
 energy cutoff 0

detector symmetric about z-axis located at z = -1.71010E+01 with radius = 4.69846E+01
 2.78029E-03 0.0017

detector symmetric about z-axis located at z = -1.71010E+01 with radius = 4.69846E+01
 uncollided neutron flux
 4.38424E-04 0.0015

detector score diagnostics

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	2097045	0.48931	5.51730E-06	0.20987
1.00000E+00	2062262	0.97050	1.62004E-05	0.82610
2.00000E+00	114132	0.99713	3.83598E-06	0.97201
5.00000E+00	9207	0.99928	6.31742E-07	0.99604
1.00000E+01	423	0.99937	7.09698E-08	0.99874
1.00000E+02	75	0.99939	2.73345E-08	0.99978
1.00000E+03	0	0.99939	0.00000E+00	0.99978
1.00000E+38	0	0.99939	0.00000E+00	0.99978

CALCULATION SHEET

PROJECT No.:

CALC No.:

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164/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

1st 200 histories 2609 1.00000 5.69645E-09 1.00000

average tally per history = 2.62894E-05 largest score = 9.61596E-04
 (largest score)/(average tally) = 3.65773E+01 nps of largest score = 427168

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	9412	16548	3.52798E-07	2.13197E-05
2 301	40750	58935	1.17799E-06	1.99880E-05
3 302	7761573	3718662	2.31980E-05	6.23826E-06
4 303	63280	8917	2.93191E-08	3.28800E-06
5 304	20	4	1.05148E-11	2.62869E-06
6 305	3297	1228	4.51667E-09	3.67807E-06
7 306	9	3	2.95267E-11	9.84222E-06
8 307	12250	1668	4.52538E-09	2.71306E-06
9 320	55186	12487	4.38913E-08	3.51496E-06
10 321	8937	2342	6.52108E-09	2.78441E-06
11 322	57686	14829	5.01081E-08	3.37906E-06
12 323	129	20	6.07085E-11	3.03543E-06
13 324	59	11	9.19343E-11	8.35766E-06
14 330	4480	846	2.36794E-09	2.79899E-06
15 340	1	0	0.00000E+00	0.00000E+00
16 341	192083	56134	1.68321E-07	2.99855E-06
17 342	819	79	2.14908E-10	2.72036E-06
19 344	450	48	1.26228E-10	2.62975E-06
21 346	503	62	1.65399E-10	2.66773E-06
22 347	0	1	2.62721E-12	2.62721E-06
23 348	509	51	1.32630E-10	2.60060E-06
24 349	13	2	5.74422E-12	2.87211E-06
25 350	656	223	6.51186E-10	2.92012E-06
27 352	368	110	3.25502E-10	2.95911E-06
28 353	1	0	0.00000E+00	0.00000E+00
29 354	623	235	6.62604E-10	2.81959E-06
31 356	2	0	0.00000E+00	0.00000E+00
32 420	67586	16277	6.14102E-08	3.77282E-06
33 422	1558	258	7.29763E-10	2.82854E-06
35 426	1319	329	1.12506E-09	3.41964E-06
36 427	640841	359668	1.13682E-06	3.16076E-06
37 430	1445	203	5.61711E-10	2.76705E-06
39 436	2306	264	7.08762E-10	2.68470E-06
40 404	602	42	1.12504E-10	2.67866E-06
41 402	60273	15192	4.68912E-08	3.08657E-06
42 400	366	75	2.08028E-10	2.77371E-06
43 410	4	0	0.00000E+00	0.00000E+00
total	8989396	4285753	2.62894E-05	6.13414E-06

score misses

russian roulette on pd 0
 psc=0. 299593
 russian roulette in transmission 8689095

CALCULATION SHEET

PROJECT No.:

CALC No.:

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SHEET No.:

165/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

underflow in transmission 708
hit a zero-importance cell 0
energy cutoff 0

detector symmetric about z-axis located at z = -2.50000E+01 with radius = 4.33013E+01
2.66632E-03 0.0018

detector symmetric about z-axis located at z = -2.50000E+01 with radius = 4.33013E+01
uncollided neutron flux
4.13597E-04 0.0016

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	1999804	0.48353	5.09010E-06	0.20014
1.00000E+00	1992802	0.96536	1.52348E-05	0.79916
2.00000E+00	128536	0.99644	4.23724E-06	0.96576
5.00000E+00	11608	0.99925	7.59387E-07	0.99562
1.00000E+01	441	0.99936	7.40342E-08	0.99853
1.00000E+02	72	0.99937	2.95564E-08	0.99969
1.00000E+03	1	0.99937	2.99322E-09	0.99981
1.00000E+38	0	0.99937	0.00000E+00	0.99981
1st 200 histories	2594	1.00000	4.86017E-09	1.00000

average tally per history = 2.54330E-05 largest score = 2.99322E-03
(largest score)/(average tally) = 1.17690E+02 nps of largest score = 333516

score contributions by cell				
cell	misses	hits	tally per history	weight per hit
1 300	10477	15483	3.40224E-07	2.19741E-05
2 301	44117	55568	1.14455E-06	2.05973E-05
3 302	7898916	3581319	2.24637E-05	6.27245E-06
4 303	63613	8584	2.81030E-08	3.27388E-06
5 304	20	4	1.01709E-11	2.54272E-06
6 305	2733	1792	8.48170E-09	4.73309E-06
7 306	5	7	3.32583E-11	4.75119E-06
8 307	11626	2292	6.37621E-09	2.78194E-06
9 320	55768	11905	3.76171E-08	3.15977E-06
10 321	8294	2985	8.54837E-09	2.86378E-06
11 322	58496	14019	4.35566E-08	3.10697E-06
12 323	132	17	4.33094E-11	2.54761E-06
13 324	63	7	4.14731E-11	5.92473E-06
14 330	4275	1051	2.90585E-09	2.76484E-06
15 340	1	0	0.00000E+00	0.00000E+00
16 341	192637	55580	1.65031E-07	2.96925E-06
17 342	844	54	1.38638E-10	2.56737E-06
19 344	453	45	1.14591E-10	2.54646E-06
21 346	517	48	1.24058E-10	2.58454E-06
22 347	1	0	0.00000E+00	0.00000E+00
23 348	501	59	1.47803E-10	2.50514E-06

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PROJECT No.:

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

24	349	10	5	1.59667E-11	3.19333E-06
25	350	619	260	7.98046E-10	3.06941E-06
27	352	319	159	4.75631E-10	2.99139E-06
28	353	0	1	2.54470E-12	2.54470E-06
29	354	582	276	8.34951E-10	3.02518E-06
31	356	1	1	2.54295E-12	2.54295E-06
32	420	67523	16340	6.05108E-08	3.70323E-06
33	422	1540	276	7.58494E-10	2.74817E-06
35	426	1280	368	1.47230E-09	4.00081E-06
36	427	648747	351762	1.07143E-06	3.04590E-06
37	430	1475	173	4.48936E-10	2.59500E-06
39	436	2336	234	6.24781E-10	2.67001E-06
40	404	594	50	1.27214E-10	2.54428E-06
41	402	60424	15041	4.55105E-08	3.02576E-06
42	400	348	93	2.55042E-10	2.74238E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	9139291	4135858	2.54330E-05	6.14938E-06

score misses

russian roulette on pd	0
psc=0.	299390
russian roulette in transmission	8839189
underflow in transmission	712
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = -3.21394E+01 with radius = 3.83022E+01
2.57740E-03 0.0020

detector symmetric about z-axis located at z = -3.21394E+01 with radius = 3.83022E+01
uncollided neutron flux
3.97230E-04 0.0016

detector score diagnostics		cumulative	tally	cumulative
times average score	transmissions	fraction of	per	fraction of
		transmissions	history	total tally
1.00000E-01	1896398	0.47855	4.69525E-06	0.18992
1.00000E+00	1907406	0.95988	1.42770E-05	0.76743
2.00000E+00	138548	0.99484	4.51950E-06	0.95024
5.00000E+00	17158	0.99917	1.08713E-06	0.99421
1.00000E+01	583	0.99932	9.29633E-08	0.99797
1.00000E+02	112	0.99934	4.51620E-08	0.99980
1.00000E+03	0	0.99934	0.00000E+00	0.99980
1.00000E+38	0	0.99934	0.00000E+00	0.99980
1st 200 histories	2598	1.00000	4.90434E-09	1.00000

average tally per history = 2.47220E-05 largest score = 1.41452E-03
(largest score)/(average tally) = 5.72171E+01 nps of largest score = 111062

score contributions by cell

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PROJECT No.:

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

	cell	misses	hits	tally per history	weight per hit
1	300	11417	14543	3.31928E-07	2.28239E-05
2	301	47273	52412	1.11502E-06	2.12741E-05
3	302	8066023	3414212	2.18226E-05	6.39169E-06
4	303	63600	8597	2.83039E-08	3.29230E-06
5	304	20	4	9.89148E-12	2.47287E-06
6	305	2331	2194	1.24703E-08	5.68382E-06
7	306	5	7	1.25693E-10	1.79562E-05
8	307	10880	3038	9.04606E-09	2.97764E-06
9	320	56305	11368	3.45466E-08	3.03894E-06
10	321	7614	3665	1.16725E-08	3.18485E-06
11	322	58877	13638	4.13373E-08	3.03104E-06
12	323	126	23	5.75330E-11	2.50144E-06
13	324	69	1	2.47697E-12	2.47697E-06
14	330	4057	1269	3.85183E-09	3.03532E-06
15	340	1	0	0.00000E+00	0.00000E+00
16	341	192931	55286	1.66169E-07	3.00563E-06
17	342	858	40	9.90254E-11	2.47564E-06
19	344	470	28	7.16245E-11	2.55802E-06
21	346	521	44	1.08912E-10	2.47527E-06
22	347	1	0	0.00000E+00	0.00000E+00
23	348	508	52	1.29364E-10	2.48777E-06
24	349	10	5	1.26782E-11	2.53564E-06
25	350	577	302	1.00374E-09	3.32364E-06
27	352	321	157	5.00168E-10	3.18578E-06
28	353	1	0	0.00000E+00	0.00000E+00
29	354	551	307	1.08415E-09	3.53142E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	67063	16800	6.23909E-08	3.71375E-06
33	422	1406	410	1.18156E-09	2.88186E-06
35	426	1162	486	1.97261E-09	4.05886E-06
36	427	652407	348102	1.02870E-06	2.95517E-06
37	430	1488	160	4.03906E-10	2.52441E-06
39	436	2369	201	5.27534E-10	2.62455E-06
40	404	590	54	1.33645E-10	2.47490E-06
41	402	60183	15282	4.62179E-08	3.02433E-06
42	400	325	116	2.98554E-10	2.57374E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	9312346	3962803	2.47220E-05	6.23850E-06

score misses

russian roulette on pd 0
 psc=0. 299667
 russian roulette in transmission 9011987
 underflow in transmission 692
 hit a zero-importance cell 0
 energy cutoff 0

detector symmetric about z-axis located at z =-3.83022E+01 with radius = 3.21394E+01
 2.51972E-03 0.0021

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

detector symmetric about z-axis located at z = -3.83022E+01 with radius = 3.21394E+01
 uncollided neutron flux
 3.86350E-04 0.0016

detector score diagnostics		cumulative	tally	cumulative
times average score	transmissions	fraction of	per	fraction of
		transmissions	history	total tally
1.00000E-01	1796967	0.47571	4.35185E-06	0.17993
1.00000E+00	1805323	0.95363	1.33117E-05	0.73033
2.00000E+00	145692	0.99220	4.71457E-06	0.92526
5.00000E+00	25984	0.99908	1.64135E-06	0.99312
1.00000E+01	760	0.99928	1.16968E-07	0.99796
1.00000E+02	125	0.99931	4.40625E-08	0.99978
1.00000E+03	0	0.99931	0.00000E+00	0.99978
1.00000E+38	0	0.99931	0.00000E+00	0.99978
1st 200 histories	2600	1.00000	5.26357E-09	1.00000

average tally per history = 2.41857E-05 largest score = 9.68980E-04
 (largest score)/(average tally) = 4.00641E+01 nps of largest score = 336843

score contributions by cell				
cell	misses	hits	tally per history	weight per hit
1 300	12294	13666	3.25897E-07	2.38473E-05
2 301	50541	49144	1.09395E-06	2.22602E-05
3 302	8249336	3230899	2.13031E-05	6.59355E-06
4 303	63744	8453	2.87195E-08	3.39756E-06
5 304	21	3	7.26059E-12	2.42020E-06
6 305	1983	2542	1.97374E-08	7.76450E-06
7 306	4	8	8.98611E-11	1.12326E-05
8 307	10229	3689	1.30100E-08	3.52671E-06
9 320	56359	11314	3.51978E-08	3.11100E-06
10 321	7126	4153	1.55482E-08	3.74385E-06
11 322	58888	13627	4.29139E-08	3.14918E-06
12 323	130	19	4.81409E-11	2.53373E-06
13 324	69	1	2.42097E-12	2.42097E-06
14 330	3872	1454	5.48637E-09	3.77329E-06
15 340	1	0	0.00000E+00	0.00000E+00
16 341	192317	55900	1.73926E-07	3.11138E-06
17 342	850	48	1.16231E-10	2.42147E-06
19 344	467	31	7.65504E-11	2.46937E-06
21 346	526	39	9.65145E-11	2.47473E-06
22 347	1	0	0.00000E+00	0.00000E+00
23 348	517	43	1.27655E-10	2.96872E-06
24 349	11	4	1.12727E-11	2.81819E-06
25 350	545	334	1.29091E-09	3.86501E-06
27 352	307	171	5.99969E-10	3.50859E-06
28 353	0	1	2.87844E-12	2.87844E-06
29 354	531	327	1.30857E-09	4.00173E-06
31 356	2	0	0.00000E+00	0.00000E+00

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SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

32	420	66574	17289	6.72339E-08	3.88882E-06
33	422	1237	579	2.23700E-09	3.86356E-06
35	426	1055	593	2.73656E-09	4.61477E-06
36	427	653692	346817	1.00100E-06	2.88625E-06
37	430	1505	143	3.84756E-10	2.69060E-06
39	436	2383	187	4.99073E-10	2.66884E-06
40	404	610	34	8.42192E-11	2.47703E-06
41	402	59676	15789	4.98334E-08	3.15621E-06
42	400	291	150	4.71620E-10	3.14414E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	9497698	3777451	2.41857E-05	6.40266E-06

score misses

russian roulette on pd	0
psc=0.	299705
russian roulette in transmission	9197267
underflow in transmission	726
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = -4.33013E+01 with radius = 2.50000E+01
2.49639E-03 0.0023

detector symmetric about z-axis located at z = -4.33013E+01 with radius = 2.50000E+01
uncollided neutron flux
3.88343E-04 0.0016

detector score diagnostics		cumulative	tally	cumulative
times	average score	fraction of	per	fraction of
	transmissions	transmissions	history	total tally
1.00000E-01	1707076	0.47560	4.07727E-06	0.17095
1.00000E+00	1694166	0.94760	1.23670E-05	0.68946
2.00000E+00	147207	0.98861	4.75251E-06	0.88872
5.00000E+00	36682	0.99883	2.36756E-06	0.98798
1.00000E+01	1414	0.99922	2.10681E-07	0.99681
1.00000E+02	184	0.99928	7.11905E-08	0.99980
1.00000E+03	0	0.99928	0.00000E+00	0.99980
1.00000E+38	0	0.99928	0.00000E+00	0.99980
1st 200 histories	2599	1.00000	4.79179E-09	1.00000

average tally per history = 2.38510E-05 largest score = 2.28606E-03
(largest score)/(average tally) = 9.58474E+01 nps of largest score = 963000

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1	300	13230	12730	3.18472E-07
2	301	53742	45943	1.08216E-06
3	302	8445652	3034583	2.09252E-05
4	303	63548	8649	2.94419E-08
5	304	19	5	1.19367E-11

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

6	305	1741	2784	2.74531E-08	9.86104E-06
7	306	4	8	1.00338E-10	1.25422E-05
8	307	9671	4247	1.80257E-08	4.24433E-06
9	320	56251	11422	3.67824E-08	3.22031E-06
10	321	6594	4685	2.02778E-08	4.32825E-06
11	322	58480	14035	4.58173E-08	3.26450E-06
12	323	121	28	7.15686E-11	2.55602E-06
13	324	68	2	4.76974E-12	2.38487E-06
14	330	3749	1577	7.88631E-09	5.00083E-06
15	340	1	0	0.00000E+00	0.00000E+00
16	341	190839	57378	1.86302E-07	3.24692E-06
17	342	852	46	1.10235E-10	2.39642E-06
19	344	471	27	6.81865E-11	2.52543E-06
21	346	520	45	1.07796E-10	2.39546E-06
22	347	1	0	0.00000E+00	0.00000E+00
23	348	516	44	1.08098E-10	2.45678E-06
24	349	10	5	1.31794E-11	2.63589E-06
25	350	518	361	1.47345E-09	4.08158E-06
27	352	283	195	7.31658E-10	3.75209E-06
28	353	0	1	3.12971E-12	3.12971E-06
29	354	513	345	1.64283E-09	4.76182E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	66240	17623	7.56763E-08	4.29418E-06
33	422	1107	709	4.44689E-09	6.27205E-06
35	426	1009	639	4.39124E-09	6.87205E-06
36	427	646301	354208	1.00793E-06	2.84558E-06
37	430	1519	129	3.45975E-10	2.68198E-06
39	436	2392	178	4.35373E-10	2.44591E-06
40	404	587	57	1.36747E-10	2.39907E-06
41	402	58986	16479	5.47655E-08	3.32335E-06
42	400	281	160	6.25365E-10	3.90853E-06
43	410	3	1	2.38736E-12	2.38736E-06
	total	9685821	3589328	2.38510E-05	6.64498E-06

score misses

russian roulette on pd 0
 psc=0. 300410
 russian roulette in transmission 9384720
 underflow in transmission 691
 hit a zero-importance cell 0
 energy cutoff 0

detector symmetric about z-axis located at z =-4.69846E+01 with radius = 1.71010E+01
 2.50994E-03 0.0026

detector symmetric about z-axis located at z =-4.69846E+01 with radius = 1.71010E+01
 uncollided neutron flux
 4.02016E-04 0.0015

detector score diagnostics cumulative tally cumulative

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SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

times average score	transmissions	fraction of transmissions	per history	fraction of total tally
1.00000E-01	1632144	0.47796	3.86903E-06	0.16327
1.00000E+00	1584093	0.94185	1.14484E-05	0.64640
2.00000E+00	145214	0.98438	4.69495E-06	0.84453
5.00000E+00	47580	0.99831	3.15067E-06	0.97749
1.00000E+01	2883	0.99916	4.25923E-07	0.99546
1.00000E+02	286	0.99924	1.02905E-07	0.99981
1.00000E+03	0	0.99924	0.00000E+00	0.99981
1.00000E+38	0	0.99924	0.00000E+00	0.99981
1st 200 histories	2597	1.00000	4.59957E-09	1.00000

average tally per history = 2.36965E-05 largest score = 1.69866E-03
 (largest score)/(average tally) = 7.16839E+01 nps of largest score = 769882

score contributions by cell

cell	misses	hits	tally per history	weight per hit	
1	300	14161	11799	3.08416E-07	2.61392E-05
2	301	56869	42816	1.06390E-06	2.48483E-05
3	302	8644571	2835664	2.06796E-05	7.29269E-06
4	303	63179	9018	3.06597E-08	3.39983E-06
5	304	17	7	1.84251E-11	2.63216E-06
6	305	1651	2874	4.13074E-08	1.43728E-05
7	306	4	8	1.16120E-10	1.45150E-05
8	307	9288	4630	2.44960E-08	5.29071E-06
9	320	55646	12027	4.04983E-08	3.36728E-06
10	321	6289	4990	2.56569E-08	5.14166E-06
11	322	57690	14825	5.04804E-08	3.40509E-06
12	323	128	21	5.89094E-11	2.80521E-06
13	324	67	3	7.10791E-12	2.36930E-06
14	330	3628	1698	1.08710E-08	6.40222E-06
15	340	1	0	0.00000E+00	0.00000E+00
16	341	187655	60562	2.01476E-07	3.32678E-06
17	342	850	48	1.15889E-10	2.41435E-06
19	344	466	32	8.05043E-11	2.51576E-06
21	346	520	45	1.12629E-10	2.50286E-06
22	347	1	0	0.00000E+00	0.00000E+00
23	348	510	50	1.35325E-10	2.70649E-06
24	349	9	6	1.53085E-11	2.55142E-06
25	350	502	377	1.63034E-09	4.32450E-06
27	352	261	217	8.58561E-10	3.95650E-06
28	353	0	1	4.77965E-12	4.77965E-06
29	354	472	386	2.05024E-09	5.31151E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	65057	18806	8.71075E-08	4.63190E-06
33	422	1067	749	7.56693E-09	1.01027E-05
35	426	949	699	5.75087E-09	8.22728E-06
36	427	626408	374101	1.04927E-06	2.80477E-06
37	430	1503	145	3.58731E-10	2.47401E-06
39	436	2379	191	5.21810E-10	2.73199E-06

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

172/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. MCCONN

DATE: 03/21/10

40	404	585	59	1.41348E-10	2.39573E-06
41	402	57711	17754	6.22455E-08	3.50600E-06
42	400	252	189	9.37454E-10	4.96007E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	9860352	3414797	2.36965E-05	6.93936E-06

score misses

russian roulette on pd	0
psc=0.	300105
russian roulette in transmission	9559550
underflow in transmission	697
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = -4.92404E+01 with radius = 8.68241E+00
2.50615E-03 0.0029

detector symmetric about z-axis located at z = -4.92404E+01 with radius = 8.68241E+00
uncollided neutron flux
3.78321E-04 0.0015

detector score diagnostics		cumulative	tally	cumulative
times average score	transmissions	fraction of	per	fraction of
		transmissions	per	total tally
			history	
1.00000E-01	1542463	0.47982	3.64437E-06	0.15442
1.00000E+00	1466767	0.93609	1.05799E-05	0.60273
2.00000E+00	140018	0.97964	4.54759E-06	0.79543
5.00000E+00	57255	0.99745	3.88792E-06	0.96018
1.00000E+01	5101	0.99904	7.61707E-07	0.99245
1.00000E+02	489	0.99919	1.73699E-07	0.99981
1.00000E+03	0	0.99919	0.00000E+00	0.99981
1.00000E+38	0	0.99919	0.00000E+00	0.99981
1st 200 histories	2601	1.00000	4.44873E-09	1.00000

average tally per history = 2.35996E-05 largest score = 2.17871E-03
(largest score)/(average tally) = 9.23198E+01 nps of largest score = 807287

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1	300	14971	3.07267E-07	2.79613E-05
2	301	59783	1.06251E-06	2.66280E-05
3	302	8832546	2.05322E-05	7.75475E-06
4	303	62072	3.75444E-08	3.70809E-06
5	304	20	1.00895E-11	2.52237E-06
6	305	1623	5.83731E-08	2.01148E-05
7	306	1	4.42388E-10	4.02171E-05
8	307	9077	3.37984E-08	6.98170E-06
9	320	54036	5.23636E-08	3.83981E-06
10	321	6024	3.55748E-08	6.76971E-06
11	322	54976	6.55993E-08	3.74020E-06

CALCULATION SHEET

PROJECT No.:

CALC No.:

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173/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

12	323	119	30	8.02650E-11	2.67550E-06
13	324	67	3	7.09302E-12	2.36434E-06
14	330	3525	1801	1.66021E-08	9.21828E-06
15	340	1	0	0.00000E+00	0.00000E+00
16	341	185131	63086	2.30701E-07	3.65693E-06
17	342	824	74	1.75125E-10	2.36655E-06
19	344	452	46	1.11201E-10	2.41742E-06
21	346	506	59	1.47482E-10	2.49969E-06
22	347	1	0	0.00000E+00	0.00000E+00
23	348	480	80	1.95850E-10	2.44813E-06
24	349	12	3	1.41466E-11	4.71553E-06
25	350	487	392	2.10530E-09	5.37066E-06
27	352	247	231	1.27051E-09	5.50004E-06
28	353	0	1	3.69510E-12	3.69510E-06
29	354	504	354	2.39858E-09	6.77565E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	66323	17540	8.61386E-08	4.91098E-06
33	422	1057	759	9.71342E-09	1.27977E-05
35	426	882	766	6.95551E-09	9.08031E-06
36	427	641494	359015	9.90592E-07	2.75919E-06
37	430	1481	167	4.01742E-10	2.40564E-06
39	436	2370	200	5.24596E-10	2.62298E-06
40	404	589	55	1.30453E-10	2.37187E-06
41	402	58520	16945	6.47370E-08	3.82042E-06
42	400	248	193	9.68261E-10	5.01690E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	10060455	3214694	2.35996E-05	7.34117E-06

score misses

russian roulette on pd 0
 psc=0. 300899
 russian roulette in transmission 9758891
 underflow in transmission 665
 hit a zero-importance cell 0
 energy cutoff 0

detector symmetric about z-axis located at z =-5.00000E+01 with radius = 1.00000E+00
 7.83745E-03 0.0014

detector symmetric about z-axis located at z =-5.00000E+01 with radius = 1.00000E+00
 uncollided neutron flux
 4.84131E-03 0.0007

detector score diagnostics	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
times average score				
1.00000E-01	1075405	0.33292	4.25379E-06	0.10770
1.00000E+00	2038759	0.96408	2.69184E-05	0.78922
2.00000E+00	82895	0.98974	4.48275E-06	0.90271
5.00000E+00	28121	0.99845	3.09198E-06	0.98099

CALCULATION SHEET

PROJECT No.:

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

1.00000E+01	2038	0.99908	5.20503E-07	0.99417
1.00000E+02	371	0.99919	2.22378E-07	0.99980
1.00000E+03	0	0.99919	0.00000E+00	0.99980
1.00000E+38	0	0.99919	0.00000E+00	0.99980
1st 200 histories	2607	1.00000	7.84605E-09	1.00000

average tally per history = 3.94977E-05 largest score = 2.69321E-03
 (largest score)/(average tally) = 6.81865E+01 nps of largest score = 527552

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	16427	9533	3.07207E-07	3.22256E-05
2 301	65138	34547	1.05656E-06	3.05833E-05
3 302	9539460	1940775	2.03115E-05	1.04657E-05
4 303	65770	6427	3.32153E-08	5.16809E-06
5 304	24	0	0.00000E+00	0.00000E+00
6 305	2208	2317	9.73405E-08	4.20114E-05
7 306	1	11	6.72461E-10	6.11328E-05
8 307	10550	3368	3.10889E-08	9.23068E-06
9 320	57484	10189	5.00415E-08	4.91132E-06
10 321	6698	4581	9.73994E-08	2.12616E-05
11 322	62809	9706	4.84787E-08	4.99471E-06
12 323	126	23	9.41672E-11	4.09423E-06
13 324	56	14	7.29347E-11	5.20962E-06
14 330	3251	2075	6.69401E-08	3.22603E-05
15 340	1	0	0.00000E+00	0.00000E+00
16 341	169578	78639	1.13232E-06	1.43990E-05
17 342	834	64	2.53384E-10	3.95913E-06
19 344	467	31	1.22747E-10	3.95958E-06
21 346	526	39	1.60201E-10	4.10772E-06
22 347	1	0	0.00000E+00	0.00000E+00
23 348	515	45	1.83845E-10	4.08545E-06
24 349	11	4	1.58100E-11	3.95249E-06
25 350	608	271	1.68687E-09	6.22461E-06
27 352	333	145	8.55839E-10	5.90234E-06
28 353	0	1	7.24311E-12	7.24311E-06
29 354	571	287	2.00854E-09	6.99839E-06
31 356	0	2	1.94469E-11	9.72347E-06
32 420	20175	63688	9.29173E-07	1.45894E-05
33 422	26	1790	1.14837E-07	6.41548E-05
35 426	45	1603	8.09849E-08	5.05208E-05
36 427	8025	992484	1.41351E-05	1.42421E-05
37 430	345	1303	1.20347E-08	9.23617E-06
39 436	1177	1393	9.92154E-09	7.12242E-06
40 404	245	399	3.04167E-09	7.62324E-06
41 402	11465	64000	9.56752E-07	1.49492E-05
42 400	2	439	1.75591E-08	3.99979E-05
43 410	1	3	3.09680E-11	1.03227E-05
total	10044953	3230196	3.94977E-05	1.22276E-05

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

```
score misses
russian roulette on pd      0
psc=0.                    301518
russian roulette in transmission  9742825
underflow in transmission  610
hit a zero-importance cell  0
energy cutoff              0
```

=====

results of 10 statistical checks for the estimated answer for the tally fluctuation chart (tfc) bin of tally 25

tfc bin behavior	--mean-- behavior	-----relative error----- value decrease decrease rate	----variance of the variance---- value decrease decrease rate	--figure of merit-- value behavior	-pdf- slope
desired	random	<0.05 yes 1/sqrt(nps)	<0.10 yes 1/nps	constant random	>3.00
observed	random	0.00 yes yes	0.00 yes yes	constant random	10.00
passed?	yes	yes yes yes	yes yes yes	yes yes	yes

this tally meets the statistical criteria used to form confidence intervals: check the tally fluctuation chart to verify.
the results in other bins associated with this tally may not meet these statistical criteria.

----- estimated confidence intervals: -----

estimated asymmetric confidence interval(1,2,3 sigma): 1.3282E-02 to 1.3316E-02; 1.3266E-02 to 1.3333E-02; 1.3249E-02 to 1.3349E-02
estimated symmetric confidence interval(1,2,3 sigma): 1.3282E-02 to 1.3316E-02; 1.3266E-02 to 1.3332E-02; 1.3249E-02 to 1.3349E-02

lanalysis of the results in the tally fluctuation chart bin (tfc) for tally 25 with nps = 1000000 print table 160

normed average tally per history = 1.32991E-02	unnormed average tally per history = 1.32991E-02
estimated tally relative error = 0.0013	estimated variance of the variance = 0.0001
relative error from zero tallies = 0.0000	relative error from nonzero scores = 0.0013
number of nonzero history tallies = 998319	efficiency for the nonzero tallies = 0.9983
history number of largest tally = 606076	largest unnormalized history tally = 8.99903E-01
(largest tally)/(average tally) = 6.76666E+01	(largest tally)/(avg nonzero tally) = 6.75529E+01
(confidence interval shift)/mean = 0.0000	shifted confidence interval center = 1.32991E-02

if the largest history score sampled so far were to occur on the next history, the tfc bin quantities would change as follows:

estimated quantities	value at nps	value at nps+1	value(nps+1)/value(nps)-1.
mean	1.32991E-02	1.33000E-02	0.000067

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SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

relative error	1.25502E-03	1.25671E-03	0.001342
variance of the variance	1.32141E-04	1.39309E-04	0.054241
shifted center	1.32991E-02	1.32991E-02	0.000000
figure of merit	1.19265E+04	1.18946E+04	-0.002679

the estimated slope of the 200 largest tallies starting at 3.03797E-01 appears to be decreasing at least exponentially.
the large score tail of the empirical history score probability density function appears to have no unsampled regions.

fom = (histories/minute)*(f(x) signal-to-noise ratio)**2 = (1.879E+04)*(7.968E-01)**2 = (1.879E+04)*(6.349E-01) = 1.193E+04

1tally 35 nps = 1000000
+ Point Detector at 90 Degrees
tally type 5 particle flux at a point detector.
tally for neutrons

this tally is modified by a dose function.

detector located at x,y,z = 0.00000E+00 0.00000E+00 5.00000E+01
1.64643E-02 0.0010

detector located at x,y,z = 0.00000E+00 0.00000E+00 5.00000E+01
uncollided neutron flux
8.54286E-03 0.0002

detector score diagnostics		cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
times average score	transmissions			
1.00000E-01	1303316	0.33078	8.57372E-06	0.13032
1.00000E+00	2575610	0.98446	5.11513E-05	0.90784
2.00000E+00	49830	0.99711	4.24428E-06	0.97235
5.00000E+00	8010	0.99914	1.45218E-06	0.99443
1.00000E+01	726	0.99933	3.04393E-07	0.99905
1.00000E+02	53	0.99934	4.92191E-08	0.99980
1.00000E+03	0	0.99934	0.00000E+00	0.99980
1.00000E+38	0	0.99934	0.00000E+00	0.99980
1st 200 histories	2599	1.00000	1.31175E-08	1.00000

average tally per history = 6.57882E-05 largest score = 2.20380E-03
(largest score)/(average tally) = 3.34984E+01 nps of largest score = 756939

score contributions by cell				
cell	misses	hits	tally per history	weight per hit
1 300	13409	12551	4.68272E-07	3.73095E-05
2 301	56525	43160	1.51484E-06	3.50982E-05
3 302	9179280	2300955	3.04873E-05	1.32499E-05
4 303	16222	55975	7.24353E-07	1.29407E-05
5 304	4	20	3.84804E-10	1.92402E-05
6 305	2983	1542	1.12596E-08	7.30196E-06
7 306	9	3	2.15814E-11	7.19379E-06
8 307	2402	11516	1.16749E-07	1.01380E-05

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PROJECT No.:

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178/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

=====

this tally meets the statistical criteria used to form confidence intervals: check the tally fluctuation chart to verify.
the results in other bins associated with this tally may not meet these statistical criteria.

----- estimated confidence intervals: -----

estimated asymmetric confidence interval(1,2,3 sigma): 1.6448E-02 to 1.6481E-02; 1.6431E-02 to 1.6498E-02; 1.6414E-02 to 1.6514E-02
estimated symmetric confidence interval(1,2,3 sigma): 1.6448E-02 to 1.6481E-02; 1.6431E-02 to 1.6498E-02; 1.6414E-02 to 1.6514E-02

lanalysis of the results in the tally fluctuation chart bin (tfc) for tally 35 with nps = 1000000 print table 160

normed average tally per history = 1.64643E-02
estimated tally relative error = 0.0010
relative error from zero tallies = 0.0000

unnormed average tally per history = 1.64643E-02
estimated variance of the variance = 0.0001
relative error from nonzero scores = 0.0010

number of nonzero history tallies = 999993
history number of largest tally = 304467
(largest tally)/(average tally) = 3.52864E+01

efficiency for the nonzero tallies = 1.0000
largest unnormalized history tally = 5.80967E-01
(largest tally)/(avg nonzero tally) = 3.52862E+01

(confidence interval shift)/mean = 0.0000

shifted confidence interval center = 1.64644E-02

if the largest history score sampled so far were to occur on the next history, the tfc bin quantities would change as follows:

estimated quantities	value at nps	value at nps+1	value(nps+1)/value(nps)-1.
mean	1.64643E-02	1.64649E-02	0.000034
relative error	1.01183E-03	1.01237E-03	0.000539
variance of the variance	7.07941E-05	7.19441E-05	0.016245
shifted center	1.64644E-02	1.64644E-02	0.000000
figure of merit	1.83487E+04	1.83289E+04	-0.001076

the estimated slope of the 200 largest tallies starting at 2.72447E-01 appears to be decreasing at least exponentially.
the large score tail of the empirical history score probability density function appears to have no unsampled regions.

fom = (histories/minute)*(f(x) signal-to-noise ratio)**2 = (1.879E+04)*(9.883E-01)**2 = (1.879E+04)*(9.768E-01) = 1.835E+04

1tally 45 nps = 1000000

+ Point Detector at -90 Degrees
tally type 5 particle flux at a point detector.
tally for neutrons

this tally is modified by a dose function.

detector located at x,y,z = 0.00000E+00 0.00000E+00-5.00000E+01
9.67783E-03 0.0011

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

detector located at x,y,z = 0.00000E+00 0.00000E+00-5.00000E+01
 uncollided neutron flux
 5.91197E-03 0.0003

detector score diagnostics		cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
times average score	transmissions			
1.00000E-01	1085594	0.32233	4.35681E-06	0.10867
1.00000E+00	2175049	0.96813	2.90228E-05	0.83258
2.00000E+00	88358	0.99437	4.68521E-06	0.94944
5.00000E+00	15024	0.99883	1.62370E-06	0.98994
1.00000E+01	1199	0.99918	3.15741E-07	0.99782
1.00000E+02	144	0.99923	7.93767E-08	0.99980
1.00000E+03	0	0.99923	0.00000E+00	0.99980
1.00000E+38	0	0.99923	0.00000E+00	0.99980
1st 200 histories	2606	1.00000	8.15061E-09	1.00000

average tally per history = 4.00918E-05 largest score = 2.14806E-03
 (largest score)/(average tally) = 5.35787E+01 nps of largest score = 527552

score contributions by cell					
cell	misses	hits	tally per history	weight per hit	
1	300	16389	9571	3.08259E-07	3.22076E-05
2	301	64573	35112	1.05676E-06	3.00969E-05
3	302	9459460	2020775	2.02919E-05	1.00416E-05
4	303	65658	6539	3.32784E-08	5.08922E-06
5	304	21	3	1.20363E-11	4.01209E-06
6	305	638	3887	1.08076E-07	2.78045E-05
7	306	0	12	6.54048E-10	5.45040E-05
8	307	10681	3237	2.93872E-08	9.07854E-06
9	320	56726	10947	5.19213E-08	4.74297E-06
10	321	6406	4873	1.00247E-07	2.05720E-05
11	322	62647	9868	4.77700E-08	4.84090E-06
12	323	123	26	1.05439E-10	4.05536E-06
13	324	51	19	9.48928E-11	4.99436E-06
14	330	3021	2305	6.72846E-08	2.91907E-05
15	340	1	0	0.00000E+00	0.00000E+00
16	341	134012	114205	1.28128E-06	1.12192E-05
17	342	859	39	1.56476E-10	4.01220E-06
19	344	469	29	1.16400E-10	4.01379E-06
21	346	525	40	1.63286E-10	4.08214E-06
22	347	1	0	0.00000E+00	0.00000E+00
23	348	506	54	2.27569E-10	4.21424E-06
24	349	13	2	8.01864E-12	4.00932E-06
25	350	582	297	1.69263E-09	5.69909E-06
27	352	317	161	9.06826E-10	5.63246E-06
28	353	0	1	5.54737E-12	5.54737E-06
29	354	590	268	2.00772E-09	7.49150E-06
31	356	0	2	3.34852E-11	1.67426E-05

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

32	420	17013	66850	8.95651E-07	1.33979E-05
33	422	16	1800	1.15153E-07	6.39736E-05
35	426	33	1615	8.32809E-08	5.15671E-05
36	427	1005	999504	1.45805E-05	1.45877E-05
37	430	271	1377	1.29950E-08	9.43721E-06
39	436	1069	1501	9.89398E-09	6.59159E-06
40	404	194	450	2.87074E-09	6.37943E-06
41	402	3303	72162	9.90180E-07	1.37216E-05
42	400	1	440	1.89036E-08	4.29626E-05
43	410	1	3	4.75814E-11	1.58605E-05
	total	9907175	3367974	4.00918E-05	1.19038E-05

score misses

russian roulette on pd	0
psc=0.	301313
russian roulette in transmission	9605245
underflow in transmission	617
hit a zero-importance cell	0
energy cutoff	0

results of 10 statistical checks for the estimated answer for the tally fluctuation chart (tfc) bin of tally 45

tfc bin	--mean--	-----relative error-----			----variance of the variance----			--figure of merit--		-pdf-
behavior	behavior	value	decrease	decrease rate	value	decrease	decrease rate	value	behavior	slope
desired	random	<0.05	yes	1/sqrt(nps)	<0.10	yes	1/nps	constant	random	>3.00
observed	random	0.00	yes	yes	0.00	yes	yes	constant	random	10.00
passed?	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

this tally meets the statistical criteria used to form confidence intervals: check the tally fluctuation chart to verify. the results in other bins associated with this tally may not meet these statistical criteria.

----- estimated confidence intervals: -----

estimated asymmetric confidence interval(1,2,3 sigma): 9.6669E-03 to 9.6889E-03; 9.6559E-03 to 9.6998E-03; 9.6449E-03 to 9.7108E-03
 estimated symmetric confidence interval(1,2,3 sigma): 9.6669E-03 to 9.6888E-03; 9.6559E-03 to 9.6998E-03; 9.6449E-03 to 9.7108E-03

lanalysis of the results in the tally fluctuation chart bin (tfc) for tally 45 with nps = 1000000 print table 160

normed average tally per history	= 9.67783E-03	unnormed average tally per history	= 9.67783E-03
estimated tally relative error	= 0.0011	estimated variance of the variance	= 0.0001
relative error from zero tallies	= 0.0000	relative error from nonzero scores	= 0.0011

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PROJECT No.:

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. MCCONN

DATE: 03/21/10

number of nonzero history tallies = 999694	efficiency for the nonzero tallies = 0.9997
history number of largest tally = 77153	largest unnormalized history tally = 6.05261E-01
(largest tally)/(average tally) = 6.25410E+01	(largest tally)/(avg nonzero tally) = 6.25219E+01
(confidence interval shift)/mean = 0.0000	shifted confidence interval center = 9.67788E-03

if the largest history score sampled so far were to occur on the next history, the tfc bin quantities would change as follows:

estimated quantities	value at nps	value at nps+1	value(nps+1)/value(nps)-1.
mean	9.67783E-03	9.67843E-03	0.000062
relative error	1.13437E-03	1.13597E-03	0.001408
variance of the variance	1.22366E-04	1.30253E-04	0.064452
shifted center	9.67788E-03	9.67788E-03	0.000000
figure of merit	1.45984E+04	1.45574E+04	-0.002810

the estimated slope of the 200 largest tallies starting at 1.97869E-01 appears to be decreasing at least exponentially. the large score tail of the empirical history score probability density function appears to have no unsampled regions.

form = (histories/minute)*(f(x) signal-to-noise ratio)**2 = (1.879E+04)*(8.815E-01)**2 = (1.879E+04)*(7.771E-01) = 1.460E+04

1tally 55 nps = 1000000
 + 50 cm Tally Ring
 tally type 5 particle flux at a ring detector.
 tally for neutrons

this tally is modified by a dose function.

detector symmetric about z-axis located at z = 5.00000E+01 with radius = 1.00000E+00
 1.62951E-02 0.0012

detector symmetric about z-axis located at z = 5.00000E+01 with radius = 1.00000E+00
 uncollided neutron flux
 8.32354E-03 0.0007

detector score diagnostics		cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
times average score	transmissions	transmissions	history	total tally
1.00000E-01	1291242	0.34256	8.45887E-06	0.12927
1.00000E+00	2386370	0.97566	4.72019E-05	0.85064
2.00000E+00	72586	0.99491	6.35937E-06	0.94783
5.00000E+00	15178	0.99894	2.71048E-06	0.98925
1.00000E+01	1223	0.99926	5.23673E-07	0.99725
1.00000E+02	177	0.99931	1.66881E-07	0.99980
1.00000E+03	0	0.99931	0.00000E+00	0.99980
1.00000E+38	0	0.99931	0.00000E+00	0.99980
1st 200 histories	2601	1.00000	1.28455E-08	1.00000

average tally per history = 6.54340E-05 largest score = 4.20558E-03

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PROJECT No.:

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182/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

(largest score)/(average tally) = 6.42722E+01 nps of largest score = 199661

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	13487	12473	4.66377E-07	3.73909E-05
2 301	56968	42717	1.51931E-06	3.55670E-05
3 302	9290599	2189636	3.06441E-05	1.39951E-05
4 303	24551	47646	7.84987E-07	1.64754E-05
5 304	6	18	3.51918E-10	1.95510E-05
6 305	3344	1181	8.89028E-09	7.52776E-06
7 306	8	4	2.61905E-11	6.54762E-06
8 307	4543	9375	1.08901E-07	1.16161E-05
9 320	15404	52269	1.14299E-06	2.18675E-05
10 321	5206	6073	6.40287E-08	1.05432E-05
11 322	19367	53148	1.52778E-06	2.87458E-05
12 323	22	127	3.18919E-09	2.51117E-05
13 324	0	70	4.06473E-09	5.80676E-05
14 330	1276	4050	4.76311E-08	1.17608E-05
15 340	0	1	6.86104E-11	6.86104E-05
16 341	32347	215870	5.10292E-06	2.36389E-05
17 342	0	898	5.53273E-08	6.16116E-05
19 344	0	498	2.47982E-08	4.97956E-05
21 346	3	562	2.70876E-08	4.81986E-05
22 347	0	1	2.26801E-11	2.26801E-05
23 348	0	560	2.37523E-08	4.24148E-05
24 349	0	15	2.62810E-10	1.75207E-05
25 350	107	772	9.25106E-09	1.19832E-05
27 352	67	411	4.55121E-09	1.10735E-05
28 353	0	1	1.58642E-11	1.58642E-05
29 354	191	667	7.12164E-09	1.06771E-05
31 356	1	1	8.20152E-12	8.20152E-06
32 420	20329	63534	1.41047E-06	2.22002E-05
33 422	895	921	9.88740E-09	1.07355E-05
35 426	404	1244	1.84294E-08	1.48146E-05
36 427	6975	993534	2.05898E-05	2.07238E-05
37 430	42	1606	1.16106E-07	7.22953E-05
39 436	27	2543	2.33243E-07	9.17194E-05
40 404	0	644	5.08236E-08	7.89187E-05
41 402	9402	66063	1.42502E-06	2.15706E-05
42 400	200	241	2.23839E-09	9.28794E-06
43 410	1	3	5.11824E-11	1.70608E-05
total	9505772	3769377	6.54340E-05	1.73594E-05

score misses

russian roulette on pd	0
psc=0.	304031
russian roulette in transmission	9201160
underflow in transmission	581
hit a zero-importance cell	0
energy cutoff	0

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SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

detector symmetric about z-axis located at z = 4.92404E+01 with radius = 8.68241E+00
9.18839E-03 0.0016

detector symmetric about z-axis located at z = 4.92404E+01 with radius = 8.68241E+00
uncollided neutron flux
2.93698E-03 0.0009

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	1720273	0.43303	8.16081E-06	0.17199
1.00000E+00	2118422	0.96629	2.90124E-05	0.78343
2.00000E+00	106574	0.99311	6.80419E-06	0.92683
5.00000E+00	23342	0.99899	2.97146E-06	0.98946
1.00000E+01	1246	0.99930	3.79683E-07	0.99746
1.00000E+02	173	0.99935	1.11014E-07	0.99980
1.00000E+03	0	0.99935	0.00000E+00	0.99980
1.00000E+38	0	0.99935	0.00000E+00	0.99980
1st 200 histories	2598	1.00000	9.62699E-09	1.00000

average tally per history = 4.74492E-05 largest score = 1.97666E-03
(largest score)/(average tally) = 4.16584E+01 nps of largest score = 550896

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	12420	13540	4.67005E-07	3.44908E-05
2 301	52704	46981	1.51135E-06	3.21693E-05
3 302	8706855	2773380	3.22834E-05	1.16405E-05
4 303	44576	27621	6.88551E-07	2.49285E-05
5 304	13	11	3.81610E-10	3.46918E-05
6 305	4347	178	8.45253E-10	4.74861E-06
7 306	12	0	0.00000E+00	0.00000E+00
8 307	12139	1779	1.14305E-08	6.42525E-06
9 320	38168	29505	8.04482E-07	2.72660E-05
10 321	9859	1420	7.71699E-09	5.43450E-06
11 322	33153	39362	9.61166E-07	2.44186E-05
12 323	77	72	1.57888E-09	2.19289E-05
13 324	5	65	2.91954E-09	4.49161E-05
14 330	4357	969	5.20832E-09	5.37494E-06
15 340	0	1	4.75135E-12	4.75135E-06
16 341	113497	134720	2.07771E-06	1.54224E-05
17 342	182	716	2.29278E-08	3.20220E-05
19 344	124	374	1.05116E-08	2.81060E-05
21 346	150	415	9.95967E-09	2.39992E-05
22 347	0	1	4.85628E-12	4.85628E-06
23 348	160	400	9.45255E-09	2.36314E-05
24 349	10	5	1.16441E-10	2.32881E-05
25 350	642	237	1.82238E-09	7.68936E-06
27 352	340	138	9.85368E-10	7.14035E-06

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SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

28	353	0	1	3.20328E-11	3.20328E-05
29	354	653	205	1.36477E-09	6.65741E-06
31	356	1	1	4.74363E-12	4.74363E-06
32	420	36149	47714	6.46080E-07	1.35407E-05
33	422	1423	393	2.03987E-09	5.19050E-06
35	426	1056	592	3.41242E-09	5.76422E-06
36	427	199387	801122	7.12418E-06	8.89275E-06
37	430	189	1459	5.48410E-08	3.75881E-05
39	436	179	2391	1.17260E-07	4.90423E-05
40	404	19	625	2.90976E-08	4.65561E-05
41	402	29329	46136	5.90833E-07	1.28063E-05
42	400	344	97	4.72217E-10	4.86821E-06
43	410	2	2	1.93592E-11	9.67962E-06
	total	9302521	3972628	4.74492E-05	1.19440E-05

score misses

russian roulette on pd	0
psc=0.	301985
russian roulette in transmission	8999901
underflow in transmission	635
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = 4.69846E+01 with radius = 1.71010E+01
6.15727E-03 0.0018

detector symmetric about z-axis located at z = 4.69846E+01 with radius = 1.71010E+01
uncollided neutron flux
1.07425E-03 0.0012

detector score diagnostics		cumulative	tally	cumulative
times average score	transmissions	fraction of	per	fraction of
		transmissions	history	total tally
1.00000E-01	1867164	0.46696	7.35773E-06	0.18664
1.00000E+00	1984569	0.96328	2.28747E-05	0.76688
2.00000E+00	117782	0.99274	6.24433E-06	0.92527
5.00000E+00	25393	0.99909	2.64005E-06	0.99224
1.00000E+01	944	0.99932	2.35446E-07	0.99821
1.00000E+02	107	0.99935	6.32631E-08	0.99982
1.00000E+03	0	0.99935	0.00000E+00	0.99982
1.00000E+38	0	0.99935	0.00000E+00	0.99982
1st 200 histories	2603	1.00000	7.28092E-09	1.00000

average tally per history = 3.94228E-05 largest score = 1.83157E-03
(largest score)/(average tally) = 4.64597E+01 nps of largest score = 352653

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1	300	11463	14497	4.59201E-07
2	301	49216	50469	1.49354E-06

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

3	302	8297607	3182628	3.22507E-05	1.01334E-05
4	303	46555	25642	4.27392E-07	1.66676E-05
5	304	17	7	1.81041E-10	2.58630E-05
6	305	4467	58	2.30202E-10	3.96901E-06
7	306	12	0	0.00000E+00	0.00000E+00
8	307	13459	459	1.79948E-09	3.92044E-06
9	320	40367	27306	5.22272E-07	1.91266E-05
10	321	10695	584	2.30159E-09	3.94109E-06
11	322	40304	32211	5.77088E-07	1.79159E-05
12	323	87	62	1.05201E-09	1.69679E-05
13	324	8	62	1.95558E-09	3.15416E-05
14	330	4911	415	1.64248E-09	3.95779E-06
15	340	0	1	6.01351E-12	6.01351E-06
16	341	153086	95131	6.65627E-07	6.99695E-06
17	342	279	619	8.83159E-09	1.42675E-05
19	344	185	313	3.43578E-09	1.09769E-05
21	346	184	381	4.09896E-09	1.07584E-05
22	347	0	1	4.54121E-12	4.54121E-06
23	348	214	346	3.09129E-09	8.93437E-06
24	349	14	1	3.94552E-12	3.94552E-06
25	350	769	110	4.47893E-10	4.07176E-06
27	352	441	37	1.46854E-10	3.96903E-06
28	353	0	1	4.90701E-12	4.90701E-06
29	354	782	76	3.04692E-10	4.00910E-06
31	356	1	1	3.94299E-12	3.94299E-06
32	420	56417	27446	2.16421E-07	7.88535E-06
33	422	1625	191	8.01953E-10	4.19871E-06
35	426	1363	285	1.16640E-09	4.09263E-06
36	427	492102	508407	2.55356E-06	5.02267E-06
37	430	635	1013	1.50148E-08	1.48221E-05
39	436	899	1671	2.92272E-08	1.74908E-05
40	404	150	494	7.40100E-09	1.49818E-05
41	402	47872	27593	1.73665E-07	6.29380E-06
42	400	397	44	1.76571E-10	4.01297E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	9276587	3998562	3.94228E-05	9.85924E-06

score misses

russian roulette on pd	0
psc=0.	300713
russian roulette in transmission	8975226
underflow in transmission	648
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = 4.33013E+01 with radius = 2.50000E+01
5.56290E-03 0.0017

detector symmetric about z-axis located at z = 4.33013E+01 with radius = 2.50000E+01
uncollided neutron flux

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

9.08896E-04 0.0013

detector score diagnostics		cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
times average score	transmissions			
1.00000E-01	1946029	0.47047	7.24272E-06	0.19446
1.00000E+00	2057005	0.96777	2.25232E-05	0.79919
2.00000E+00	111454	0.99472	5.50420E-06	0.94697
5.00000E+00	18663	0.99923	1.80239E-06	0.99537
1.00000E+01	535	0.99936	1.25800E-07	0.99875
1.00000E+02	67	0.99937	3.95938E-08	0.99981
1.00000E+03	0	0.99937	0.00000E+00	0.99981
1.00000E+38	0	0.99937	0.00000E+00	0.99981
1st 200 histories	2595	1.00000	7.13533E-09	1.00000

average tally per history = 3.72450E-05 largest score = 1.47543E-03
(largest score)/(average tally) = 3.96141E+01 nps of largest score = 98438

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	10572	15388	4.56209E-07	2.96470E-05
2 301	46263	53422	1.47242E-06	2.75621E-05
3 302	8095576	3384659	3.13161E-05	9.25237E-06
4 303	48280	23917	2.84603E-07	1.18996E-05
5 304	17	7	4.92977E-11	7.04253E-06
6 305	4477	48	1.78617E-10	3.72119E-06
7 306	12	0	0.00000E+00	0.00000E+00
8 307	13565	353	1.30442E-09	3.69524E-06
9 320	42134	25539	3.66943E-07	1.43680E-05
10 321	10764	515	1.92301E-09	3.73400E-06
11 322	43118	29397	4.04653E-07	1.37651E-05
12 323	89	60	9.16397E-10	1.52733E-05
13 324	12	58	1.52248E-09	2.62496E-05
14 330	5025	301	1.14946E-09	3.81882E-06
15 340	0	1	3.72436E-12	3.72436E-06
16 341	164349	83868	4.59000E-07	5.47289E-06
17 342	346	552	5.14515E-09	9.32093E-06
19 344	197	301	2.43807E-09	8.09991E-06
21 346	210	355	2.61240E-09	7.35887E-06
22 347	0	1	4.02132E-12	4.02132E-06
23 348	253	307	2.04453E-09	6.65969E-06
24 349	13	2	7.43850E-12	3.71925E-06
25 350	791	88	3.29370E-10	3.74284E-06
27 352	436	42	1.56340E-10	3.72237E-06
28 353	0	1	4.17780E-12	4.17780E-06
29 354	784	74	2.77146E-10	3.74522E-06
31 356	2	0	0.00000E+00	0.00000E+00
32 420	59287	24576	1.63198E-07	6.64053E-06
33 422	1645	171	6.42474E-10	3.75716E-06
35 426	1385	263	1.02133E-09	3.88339E-06

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SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

36	427	534837	465672	2.15260E-06	4.62257E-06
37	430	832	816	7.96010E-09	9.75503E-06
39	436	1178	1392	1.27240E-08	9.14079E-06
40	404	223	421	3.30396E-09	7.84789E-06
41	402	51726	23739	1.23397E-07	5.19807E-06
42	400	399	42	1.59840E-10	3.80571E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	9138801	4136348	3.72450E-05	9.00432E-06

score misses

russian roulette on pd	0
psc=0.	300657
russian roulette in transmission	8837447
underflow in transmission	697
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = 3.83022E+01 with radius = 3.21394E+01
5.17860E-03 0.0016

detector symmetric about z-axis located at z = 3.83022E+01 with radius = 3.21394E+01
uncollided neutron flux
8.27300E-04 0.0013

detector score diagnostics		cumulative	tally	cumulative
times average score	transmissions	fraction of	per	fraction of
		transmissions	history	total tally
1.00000E-01	2016521	0.47219	7.16850E-06	0.20168
1.00000E+00	2136106	0.97239	2.23966E-05	0.83180
2.00000E+00	102873	0.99647	4.76946E-06	0.96599
5.00000E+00	12065	0.99930	1.09499E-06	0.99679
1.00000E+01	341	0.99938	7.84809E-08	0.99900
1.00000E+02	51	0.99939	2.90923E-08	0.99982
1.00000E+03	0	0.99939	0.00000E+00	0.99982
1.00000E+38	0	0.99939	0.00000E+00	0.99982
1st 200 histories	2597	1.00000	6.36943E-09	1.00000

average tally per history = 3.55435E-05 largest score = 2.31279E-03
(largest score)/(average tally) = 6.50692E+01 nps of largest score = 840639

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1	300	9943	16017	4.44898E-07
2	301	43567	56118	1.44775E-06
3	302	7929900	3550335	3.02967E-05
4	303	49633	22564	2.02157E-07
5	304	18	6	4.57166E-11
6	305	4474	51	1.83279E-10
7	306	12	0	0.00000E+00
8	307	13520	398	1.40723E-09

CALCULATION SHEET

PROJECT No.:

CALC No.:

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

9	320	43449	24224	2.70965E-07	1.11858E-05
10	321	10774	505	1.80093E-09	3.56620E-06
11	322	45028	27487	2.92222E-07	1.06313E-05
12	323	91	58	6.99274E-10	1.20564E-05
13	324	16	54	1.13911E-09	2.10946E-05
14	330	5018	308	1.10582E-09	3.59034E-06
15	340	1	0	0.00000E+00	0.00000E+00
16	341	170145	78072	3.68651E-07	4.72194E-06
17	342	388	510	3.47978E-09	6.82309E-06
19	344	211	287	1.63943E-09	5.71232E-06
21	346	263	302	1.75305E-09	5.80480E-06
22	347	0	1	6.49816E-12	6.49816E-06
23	348	268	292	1.53761E-09	5.26580E-06
24	349	11	4	1.42194E-11	3.55484E-06
25	350	797	82	2.97410E-10	3.62695E-06
27	352	440	38	1.35188E-10	3.55758E-06
28	353	1	0	0.00000E+00	0.00000E+00
29	354	780	78	2.77252E-10	3.55451E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	60758	23105	1.32433E-07	5.73180E-06
33	422	1661	155	5.97551E-10	3.85517E-06
35	426	1404	244	8.78768E-10	3.60151E-06
36	427	555431	445078	1.95603E-06	4.39481E-06
37	430	973	675	5.58006E-09	8.26675E-06
39	436	1453	1117	6.25721E-09	5.60180E-06
40	404	299	345	1.56491E-09	4.53598E-06
41	402	53458	22007	1.01160E-07	4.59673E-06
42	400	404	37	1.31713E-10	3.55981E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	9004595	4270554	3.55435E-05	8.32293E-06

score misses

russian roulette on pd	0
psc=0.	299686
russian roulette in transmission	8704212
underflow in transmission	697
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = 3.21394E+01 with radius = 3.83022E+01
4.85091E-03 0.0015

detector symmetric about z-axis located at z = 3.21394E+01 with radius = 3.83022E+01
uncollided neutron flux
7.62716E-04 0.0013

detector score diagnostics	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
times average score	2088479	0.47548	7.09216E-06	0.20866
1.00000E-01				

CALCULATION SHEET

PROJECT No.:

CALC No.:

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

1.00000E+00	2199767	0.97630	2.20246E-05	0.85666
2.00000E+00	92912	0.99746	4.05067E-06	0.97584
5.00000E+00	8231	0.99933	7.12206E-07	0.99679
1.00000E+01	283	0.99940	6.31219E-08	0.99865
1.00000E+02	62	0.99941	3.53047E-08	0.99969
1.00000E+03	1	0.99941	4.29122E-09	0.99981
1.00000E+38	0	0.99941	0.00000E+00	0.99981
1st 200 histories	2591	1.00000	6.29558E-09	1.00000

average tally per history = 3.39886E-05 largest score = 4.29122E-03
 (largest score)/(average tally) = 1.26255E+02 nps of largest score = 677577

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	9358	16602	4.33507E-07	2.61117E-05
2 301	41212	58473	1.40863E-06	2.40902E-05
3 302	7785238	3694997	2.92515E-05	7.91652E-06
4 303	51223	20974	1.43863E-07	6.85911E-06
5 304	19	5	3.04618E-11	6.09237E-06
6 305	4473	52	1.76703E-10	3.39814E-06
7 306	12	0	0.00000E+00	0.00000E+00
8 307	13504	414	1.39317E-09	3.36515E-06
9 320	44533	23140	2.00409E-07	8.66074E-06
10 321	10720	559	1.90814E-09	3.41349E-06
11 322	46324	26191	2.19260E-07	8.37157E-06
12 323	96	53	4.72518E-10	8.91544E-06
13 324	16	54	7.70926E-10	1.42764E-05
14 330	5004	322	1.09446E-09	3.39893E-06
15 340	1	0	0.00000E+00	0.00000E+00
16 341	173724	74493	3.12733E-07	4.19816E-06
17 342	439	459	2.27944E-09	4.96610E-06
19 344	258	240	1.22701E-09	5.11256E-06
21 346	298	267	1.25820E-09	4.71236E-06
22 347	0	1	4.87335E-12	4.87335E-06
23 348	315	245	1.16045E-09	4.73655E-06
24 349	14	1	3.39140E-12	3.39140E-06
25 350	784	95	3.23532E-10	3.40560E-06
27 352	435	43	1.61159E-10	3.74788E-06
28 353	1	0	0.00000E+00	0.00000E+00
29 354	804	54	1.92156E-10	3.55844E-06
31 356	2	0	0.00000E+00	0.00000E+00
32 420	62342	21521	1.11187E-07	5.16645E-06
33 422	1660	156	5.53920E-10	3.55077E-06
35 426	1411	237	8.27226E-10	3.49040E-06
36 427	569997	430512	1.80101E-06	4.18342E-06
37 430	1093	555	3.13539E-09	5.64935E-06
39 436	1735	835	3.38908E-09	4.05878E-06
40 404	381	263	9.71658E-10	3.69452E-06
41 402	54982	20483	8.50518E-08	4.15231E-06
42 400	411	30	1.02680E-10	3.42265E-06

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PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

43	410	4	0	0.00000E+00	0.00000E+00
	total	8882823	4392326	3.39886E-05	7.73818E-06

score misses

russian roulette on pd	0
psc=0.	299386
russian roulette in transmission	8582778
underflow in transmission	659
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = 2.50000E+01 with radius = 4.33013E+01
4.55255E-03 0.0015

detector symmetric about z-axis located at z = 2.50000E+01 with radius = 4.33013E+01
uncollided neutron flux
7.03133E-04 0.0014

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	2155759	0.48105	6.99801E-06	0.21541
1.00000E+00	2230687	0.97881	2.13215E-05	0.87173
2.00000E+00	85509	0.99789	3.52064E-06	0.98010
5.00000E+00	6495	0.99934	5.47295E-07	0.99695
1.00000E+01	281	0.99940	5.89574E-08	0.99876
1.00000E+02	65	0.99942	3.34796E-08	0.99979
1.00000E+03	0	0.99942	0.00000E+00	0.99979
1.00000E+38	0	0.99942	0.00000E+00	0.99979
1st 200 histories	2602	1.00000	6.70269E-09	1.00000

average tally per history = 3.24866E-05 largest score = 1.45674E-03
(largest score)/(average tally) = 4.48415E+01 nps of largest score = 995627

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	8834	17126	4.18599E-07	2.44423E-05
2 301	39220	60465	1.36961E-06	2.26513E-05
3 302	7671988	3808247	2.81712E-05	7.39741E-06
4 303	53558	18639	9.95454E-08	5.34070E-06
5 304	15	9	3.52691E-11	3.91879E-06
6 305	4437	88	2.85680E-10	3.24637E-06
7 306	12	0	0.00000E+00	0.00000E+00
8 307	13408	510	1.67070E-09	3.27588E-06
9 320	46160	21513	1.50693E-07	7.00474E-06
10 321	10619	660	2.17752E-09	3.29927E-06
11 322	48152	24363	1.62309E-07	6.66210E-06
12 323	95	54	3.10323E-10	5.74673E-06
13 324	30	40	4.90888E-10	1.22722E-05
14 330	4998	328	1.07030E-09	3.26310E-06

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PROJECT No.:

CALC No.:

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

15	340	1	0	0.00000E+00	0.00000E+00
16	341	177794	70423	2.68766E-07	3.81646E-06
17	342	469	429	1.65329E-09	3.85382E-06
19	344	314	184	7.11751E-10	3.86821E-06
21	346	331	234	9.07879E-10	3.87982E-06
22	347	0	1	3.24593E-12	3.24593E-06
23	348	345	215	8.44000E-10	3.92558E-06
24	349	11	4	1.29845E-11	3.24613E-06
25	350	796	83	2.73625E-10	3.29669E-06
27	352	431	47	1.57749E-10	3.35637E-06
28	353	1	0	0.00000E+00	0.00000E+00
29	354	788	70	2.27930E-10	3.25615E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	63670	20193	9.55608E-08	4.73237E-06
33	422	1658	158	5.60062E-10	3.54470E-06
35	426	1402	246	8.41761E-10	3.42179E-06
36	427	583781	416728	1.65850E-06	3.97980E-06
37	430	1202	446	2.18642E-09	4.90228E-06
39	436	1947	623	2.26811E-09	3.64062E-06
40	404	436	208	7.37229E-10	3.54437E-06
41	402	56445	19020	7.42380E-08	3.90315E-06
42	400	397	44	1.45500E-10	3.30682E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	8793751	4481398	3.24866E-05	7.24920E-06

score misses

russian roulette on pd 0
 psc=0. 299797
 russian roulette in transmission 8493301
 underflow in transmission 653
 hit a zero-importance cell 0
 energy cutoff 0

detector symmetric about z-axis located at z = 1.71010E+01 with radius = 4.69846E+01
 4.27380E-03 0.0015

detector symmetric about z-axis located at z = 1.71010E+01 with radius = 4.69846E+01
 uncollided neutron flux
 6.48766E-04 0.0014

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	2210752	0.48787	6.86253E-06	0.22092
1.00000E+00	2229800	0.97995	2.03921E-05	0.87739
2.00000E+00	81665	0.99797	3.20899E-06	0.98069
5.00000E+00	6223	0.99935	5.06925E-07	0.99701
1.00000E+01	292	0.99941	5.89936E-08	0.99891
1.00000E+02	58	0.99943	2.75501E-08	0.99980
1.00000E+03	0	0.99943	0.00000E+00	0.99980

CALCULATION SHEET

PROJECT NO.:

CALC NO.:

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. MCCONN

DATE: 03/21/10

1.00000E+38	0	0.99943	0.00000E+00	0.99980
1st 200 histories	2605	1.00000	6.33726E-09	1.00000

average tally per history = 3.10634E-05 largest score = 1.79692E-03
 (largest score)/(average tally) = 5.78468E+01 nps of largest score = 78185

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	8207	17753	4.12452E-07	2.32328E-05
2 301	37464	62221	1.34790E-06	2.16631E-05
3 302	7596909	3883326	2.70745E-05	6.97198E-06
4 303	56145	16052	6.88068E-08	4.28649E-06
5 304	14	10	4.68842E-11	4.68842E-06
6 305	4406	119	3.69739E-10	3.10705E-06
7 306	11	1	3.10571E-12	3.10571E-06
8 307	13278	640	2.01135E-09	3.14274E-06
9 320	48080	19593	1.12471E-07	5.74034E-06
10 321	10500	779	2.43986E-09	3.13205E-06
11 322	50299	22216	1.21723E-07	5.47906E-06
12 323	112	37	2.12558E-10	5.74481E-06
13 324	31	39	4.11030E-10	1.05392E-05
14 330	4912	414	1.30579E-09	3.15408E-06
15 340	0	1	3.10302E-12	3.10302E-06
16 341	182336	65881	2.33730E-07	3.54775E-06
17 342	587	311	1.02161E-09	3.28493E-06
19 344	341	157	5.12692E-10	3.26556E-06
21 346	367	198	6.88844E-10	3.47901E-06
22 347	1	0	0.00000E+00	0.00000E+00
23 348	383	177	6.28847E-10	3.55281E-06
24 349	14	1	3.10443E-12	3.10443E-06
25 350	775	104	3.28414E-10	3.15783E-06
27 352	421	57	1.78166E-10	3.12571E-06
28 353	0	1	3.10340E-12	3.10340E-06
29 354	769	89	2.76500E-10	3.10674E-06
31 356	2	0	0.00000E+00	0.00000E+00
32 420	65091	18772	8.17645E-08	4.35566E-06
33 422	1607	209	6.77761E-10	3.24288E-06
35 426	1384	264	8.67725E-10	3.28684E-06
36 427	597461	403048	1.52830E-06	3.79186E-06
37 430	1253	395	1.78617E-09	4.52195E-06
39 436	2140	430	1.46528E-09	3.40762E-06
40 404	496	148	4.69080E-10	3.16946E-06
41 402	57553	17912	6.59754E-08	3.68331E-06
42 400	401	40	1.29226E-10	3.23065E-06
43 410	4	0	0.00000E+00	0.00000E+00
total	8743754	4531395	3.10634E-05	6.85515E-06

score misses

russian roulette on pd 0
 psc=0. 298077

CALCULATION SHEET

PROJECT No.:

CALC No.:

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

russian roulette in transmission 8445004
 underflow in transmission 673
 hit a zero-importance cell 0
 energy cutoff 0

detector symmetric about z-axis located at z = 8.68241E+00 with radius = 4.92404E+01
 4.02241E-03 0.0015

detector symmetric about z-axis located at z = 8.68241E+00 with radius = 4.92404E+01
 uncollided neutron flux
 6.00467E-04 0.0014

detector score diagnostics		cumulative	tally	cumulative
times average score	transmissions	fraction of	per	fraction of
		transmissions	history	total tally
1.00000E-01	2239538	0.49379	6.64025E-06	0.22364
1.00000E+00	2202754	0.97948	1.93043E-05	0.87382
2.00000E+00	83771	0.99795	3.15457E-06	0.98006
5.00000E+00	6323	0.99934	4.94907E-07	0.99673
1.00000E+01	321	0.99941	6.25000E-08	0.99883
1.00000E+02	63	0.99942	2.82800E-08	0.99979
1.00000E+03	0	0.99942	0.00000E+00	0.99979
1.00000E+38	0	0.99942	0.00000E+00	0.99979
1st 200 histories	2610	1.00000	6.31740E-09	1.00000

average tally per history = 2.96912E-05 largest score = 9.22088E-04
 (largest score)/(average tally) = 3.10560E+01 nps of largest score = 425819

score contributions by cell					
cell	misses	hits	tally per history	weight per hit	
1	300	8023	17937	3.92938E-07	2.19066E-05
2	301	36325	63360	1.29534E-06	2.04442E-05
3	302	7571584	3908651	2.60033E-05	6.65275E-06
4	303	58680	13517	4.92073E-08	3.64040E-06
5	304	20	4	1.69785E-11	4.24461E-06
6	305	4318	207	6.21686E-10	3.00332E-06
7	306	12	0	0.00000E+00	0.00000E+00
8	307	13152	766	2.29619E-09	2.99764E-06
9	320	50596	17077	8.47043E-08	4.96014E-06
10	321	10232	1047	3.13188E-09	2.99129E-06
11	322	52671	19844	9.45121E-08	4.76275E-06
12	323	119	30	1.62043E-10	5.40143E-06
13	324	39	31	3.73458E-10	1.20470E-05
14	330	4854	472	1.41878E-09	3.00590E-06
15	340	1	0	0.00000E+00	0.00000E+00
16	341	185342	62875	2.10239E-07	3.34376E-06
17	342	700	198	5.98558E-10	3.02302E-06
19	344	390	108	3.36268E-10	3.11359E-06
21	346	423	142	4.29997E-10	3.02815E-06
22	347	1	0	0.00000E+00	0.00000E+00

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

23	348	423	137	4.20978E-10	3.07283E-06
24	349	12	3	8.89624E-12	2.96541E-06
25	350	758	121	3.66911E-10	3.03232E-06
27	352	430	48	1.43195E-10	2.98324E-06
28	353	1	0	0.00000E+00	0.00000E+00
29	354	753	105	3.11984E-10	2.97128E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	66063	17800	7.31333E-08	4.10861E-06
33	422	1601	215	6.55411E-10	3.04842E-06
35	426	1369	279	8.91169E-10	3.19415E-06
36	427	607925	392584	1.41368E-06	3.60096E-06
37	430	1338	310	1.14618E-09	3.69735E-06
39	436	2154	416	1.27769E-09	3.07136E-06
40	404	508	136	4.11709E-10	3.02727E-06
41	402	58541	16924	5.90243E-08	3.48761E-06
42	400	405	36	1.06757E-10	2.96546E-06
43	410	4	0	0.00000E+00	0.00000E+00
total	8739769	4535380		2.96912E-05	6.54657E-06

score misses

russian roulette on pd	0
psc=0.	298348
russian roulette in transmission	8440627
underflow in transmission	794
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = 0.00000E+00 with radius = 5.00000E+01
3.79362E-03 0.0015

detector symmetric about z-axis located at z = 0.00000E+00 with radius = 5.00000E+01
uncollided neutron flux
5.54785E-04 0.0015

detector score diagnostics		cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
times average score	transmissions	transmissions	history	total tally
1.00000E-01	2228068	0.49660	6.33970E-06	0.22272
1.00000E+00	2157685	0.97752	1.82190E-05	0.86277
2.00000E+00	91004	0.99780	3.29187E-06	0.97841
5.00000E+00	6869	0.99933	5.17475E-07	0.99659
1.00000E+01	344	0.99941	6.38501E-08	0.99884
1.00000E+02	59	0.99942	2.71973E-08	0.99979
1.00000E+03	0	0.99942	0.00000E+00	0.99979
1.00000E+38	0	0.99942	0.00000E+00	0.99979
1st 200 histories	2603	1.00000	5.93692E-09	1.00000

average tally per history = 2.84650E-05 largest score = 1.58165E-03
(largest score)/(average tally) = 5.55648E+01 nps of largest score = 221756

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

195/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

score	contributions by cell			tally per history	weight per hit
	cell	misses	hits		
1	300	8074	17886	3.80588E-07	2.12785E-05
2	301	36124	63561	1.26282E-06	1.98679E-05
3	302	7596046	3884189	2.50096E-05	6.43883E-06
4	303	61186	11011	3.73233E-08	3.38964E-06
5	304	20	4	1.13834E-11	2.84586E-06
6	305	4102	423	1.22306E-09	2.89139E-06
7	306	10	2	5.69256E-12	2.84628E-06
8	307	13032	886	2.57716E-09	2.90876E-06
9	320	52631	15042	6.70996E-08	4.46082E-06
10	321	9994	1285	3.76018E-09	2.92621E-06
11	322	55009	17506	7.47177E-08	4.26812E-06
12	323	120	29	1.30262E-10	4.49181E-06
13	324	47	23	2.23179E-10	9.70343E-06
14	330	4705	621	1.82569E-09	2.93991E-06
15	340	1	0	0.00000E+00	0.00000E+00
16	341	188629	59588	1.90387E-07	3.19506E-06
17	342	752	146	4.20375E-10	2.87928E-06
19	344	421	77	2.20272E-10	2.86067E-06
21	346	451	114	3.33866E-10	2.92865E-06
22	347	1	0	0.00000E+00	0.00000E+00
23	348	450	110	3.17048E-10	2.88226E-06
24	349	9	6	1.70651E-11	2.84419E-06
25	350	716	163	4.65435E-10	2.85543E-06
27	352	402	76	2.35004E-10	3.09216E-06
28	353	0	1	2.84326E-12	2.84326E-06
29	354	708	150	4.45938E-10	2.97292E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	66617	17246	6.80578E-08	3.94630E-06
33	422	1595	221	6.46298E-10	2.92443E-06
35	426	1351	297	9.76859E-10	3.28909E-06
36	427	621276	379233	1.30511E-06	3.44144E-06
37	430	1390	258	8.39020E-10	3.25202E-06
39	436	2226	344	1.00385E-09	2.91816E-06
40	404	552	92	2.63942E-10	2.86893E-06
41	402	59474	15991	5.31889E-08	3.32618E-06
42	400	391	50	1.42284E-10	2.84568E-06
43	410	3	1	2.84326E-12	2.84326E-06
	total	8788517	4486632	2.84650E-05	6.34441E-06

score misses
 russian roulette on pd 0
 psc=0. 299079
 russian roulette in transmission 8488657
 underflow in transmission 781
 hit a zero-importance cell 0
 energy cutoff 0

detector symmetric about z-axis located at z = -8.68241E+00 with radius = 4.92404E+01

CALCULATION SHEET

PROJECT NO.:

CALC NO.:

REVISION NO.: 0

SHEET NO.:

196/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

3.58311E-03 0.0016

detector symmetric about z-axis located at z = -8.68241E+00 with radius = 4.92404E+01
 uncollided neutron flux
 5.15750E-04 0.0015

detector score diagnostics		cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
times average score	transmissions			
1.00000E-01	2178244	0.49438	5.93815E-06	0.21757
1.00000E+00	2114300	0.97425	1.71421E-05	0.84564
2.00000E+00	102462	0.99751	3.54615E-06	0.97557
5.00000E+00	7939	0.99931	5.66968E-07	0.99635
1.00000E+01	356	0.99939	6.33344E-08	0.99867
1.00000E+02	74	0.99941	3.06255E-08	0.99979
1.00000E+03	0	0.99941	0.00000E+00	0.99979
1.00000E+38	0	0.99941	0.00000E+00	0.99979
1st 200 histories	2601	1.00000	5.77068E-09	1.00000

average tally per history = 2.72931E-05 largest score = 1.09283E-03
 (largest score)/(average tally) = 4.00404E+01 nps of largest score = 90048

score contributions by cell				
cell	misses	hits	tally per history	weight per hit
1 300	8650	17310	3.65675E-07	2.11251E-05
2 301	38032	61653	1.21189E-06	1.96567E-05
3 302	7657765	3822470	2.40476E-05	6.29111E-06
4 303	62537	9660	3.17976E-08	3.29168E-06
5 304	20	4	1.08968E-11	2.72419E-06
6 305	3724	801	2.46207E-09	3.07375E-06
7 306	8	4	1.09118E-11	2.72796E-06
8 307	12771	1147	3.19387E-09	2.78454E-06
9 320	54198	13475	5.35756E-08	3.97593E-06
10 321	9578	1701	4.72177E-09	2.77588E-06
11 322	56643	15872	6.08007E-08	3.83069E-06
12 323	128	21	9.50409E-11	4.52576E-06
13 324	55	15	1.94112E-10	1.29408E-05
14 330	4605	721	2.09332E-09	2.90336E-06
15 340	1	0	0.00000E+00	0.00000E+00
16 341	190294	57923	1.77291E-07	3.06080E-06
17 342	810	88	2.40857E-10	2.73702E-06
19 344	428	70	1.90867E-10	2.72667E-06
21 346	474	91	2.51685E-10	2.76577E-06
22 347	1	0	0.00000E+00	0.00000E+00
23 348	470	90	2.51443E-10	2.79381E-06
24 349	13	2	5.45380E-12	2.72690E-06
25 350	694	185	5.13622E-10	2.77633E-06
27 352	376	102	2.86344E-10	2.80729E-06
28 353	0	1	2.72603E-12	2.72603E-06
29 354	683	175	4.97128E-10	2.84073E-06

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

197/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

31	356	2	0	0.00000E+00	0.00000E+00
32	420	66980	16883	6.44137E-08	3.81530E-06
33	422	1577	239	6.63960E-10	2.77807E-06
35	426	1346	302	1.03200E-09	3.41722E-06
36	427	631565	368944	1.21248E-06	3.28634E-06
37	430	1420	228	6.73502E-10	2.95396E-06
39	436	2306	264	7.48587E-10	2.83556E-06
40	404	581	63	1.72334E-10	2.73546E-06
41	402	60049	15416	4.91579E-08	3.18876E-06
42	400	385	56	1.55939E-10	2.78462E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	8869173	4405976	2.72931E-05	6.19457E-06

score misses

russian roulette on pd	0
psc=0.	298856
russian roulette in transmission	8569572
underflow in transmission	745
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = -1.71010E+01 with radius = 4.69846E+01
3.40965E-03 0.0016

detector symmetric about z-axis located at z = -1.71010E+01 with radius = 4.69846E+01
uncollided neutron flux
4.83843E-04 0.0015

detector score diagnostics		cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
times average score	transmissions	transmissions	history	total tally
1.00000E-01	2097045	0.48931	5.51730E-06	0.20987
1.00000E+00	2062262	0.97050	1.62004E-05	0.82610
2.00000E+00	114132	0.99713	3.83598E-06	0.97201
5.00000E+00	9207	0.99928	6.31742E-07	0.99604
1.00000E+01	423	0.99937	7.09698E-08	0.99874
1.00000E+02	75	0.99939	2.73345E-08	0.99978
1.00000E+03	0	0.99939	0.00000E+00	0.99978
1.00000E+38	0	0.99939	0.00000E+00	0.99978
1st 200 histories	2609	1.00000	5.69645E-09	1.00000

average tally per history = 2.62894E-05 largest score = 9.61596E-04
(largest score)/(average tally) = 3.65773E+01 nps of largest score = 427168

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1	300	9412	16548	3.52798E-07
2	301	40750	58935	1.17799E-06
3	302	7761573	3718662	2.31980E-05
4	303	63280	8917	2.93191E-08

CALCULATION SHEET

PROJECT No.:

CALC No.:

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SHEET No.:

198/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

5	304	20	4	1.05148E-11	2.62869E-06
6	305	3297	1228	4.51667E-09	3.67807E-06
7	306	9	3	2.95267E-11	9.84222E-06
8	307	12250	1668	4.52538E-09	2.71306E-06
9	320	55186	12487	4.38913E-08	3.51496E-06
10	321	8937	2342	6.52108E-09	2.78441E-06
11	322	57686	14829	5.01081E-08	3.37906E-06
12	323	129	20	6.07085E-11	3.03543E-06
13	324	59	11	9.19343E-11	8.35766E-06
14	330	4480	846	2.36794E-09	2.79899E-06
15	340	1	0	0.00000E+00	0.00000E+00
16	341	192083	56134	1.68321E-07	2.99855E-06
17	342	819	79	2.14908E-10	2.72036E-06
19	344	450	48	1.26228E-10	2.62975E-06
21	346	503	62	1.65399E-10	2.66773E-06
22	347	0	1	2.62721E-12	2.62721E-06
23	348	509	51	1.32630E-10	2.60060E-06
24	349	13	2	5.74422E-12	2.87211E-06
25	350	656	223	6.51186E-10	2.92012E-06
27	352	368	110	3.25502E-10	2.95911E-06
28	353	1	0	0.00000E+00	0.00000E+00
29	354	623	235	6.62604E-10	2.81959E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	67586	16277	6.14102E-08	3.77282E-06
33	422	1558	258	7.29763E-10	2.82854E-06
35	426	1319	329	1.12506E-09	3.41964E-06
36	427	640841	359668	1.13682E-06	3.16076E-06
37	430	1445	203	5.61711E-10	2.76705E-06
39	436	2306	264	7.08762E-10	2.68470E-06
40	404	602	42	1.12504E-10	2.67866E-06
41	402	60273	15192	4.68912E-08	3.08657E-06
42	400	366	75	2.08028E-10	2.77371E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	8989396	4285753	2.62894E-05	6.13414E-06

score misses

russian roulette on pd	0
psc=0.	299593
russian roulette in transmission	8689095
underflow in transmission	708
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = -2.50000E+01 with radius = 4.33013E+01
3.26670E-03 0.0017

detector symmetric about z-axis located at z = -2.50000E+01 with radius = 4.33013E+01
uncollided neutron flux
4.56219E-04 0.0015

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

199/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

detector score diagnostics		cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
times average score	transmissions			
1.00000E-01	1999804	0.48353	5.09010E-06	0.20014
1.00000E+00	1992802	0.96536	1.52348E-05	0.79916
2.00000E+00	128536	0.99644	4.23724E-06	0.96576
5.00000E+00	11608	0.99925	7.59387E-07	0.99562
1.00000E+01	441	0.99936	7.40342E-08	0.99853
1.00000E+02	72	0.99937	2.95564E-08	0.99969
1.00000E+03	1	0.99937	2.99322E-09	0.99981
1.00000E+38	0	0.99937	0.00000E+00	0.99981
1st 200 histories	2594	1.00000	4.86017E-09	1.00000

average tally per history = 2.54330E-05 largest score = 2.99322E-03
 (largest score)/(average tally) = 1.17690E+02 nps of largest score = 333516

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	10477	15483	3.40224E-07	2.19741E-05
2 301	44117	55568	1.14455E-06	2.05973E-05
3 302	7898916	3581319	2.24637E-05	6.27245E-06
4 303	63613	8584	2.81030E-08	3.27388E-06
5 304	20	4	1.01709E-11	2.54272E-06
6 305	2733	1792	8.48170E-09	4.73309E-06
7 306	5	7	3.32583E-11	4.75119E-06
8 307	11626	2292	6.37621E-09	2.78194E-06
9 320	55768	11905	3.76171E-08	3.15977E-06
10 321	8294	2985	8.54837E-09	2.86378E-06
11 322	58496	14019	4.35566E-08	3.10697E-06
12 323	132	17	4.33094E-11	2.54761E-06
13 324	63	7	4.14731E-11	5.92473E-06
14 330	4275	1051	2.90585E-09	2.76484E-06
15 340	1	0	0.00000E+00	0.00000E+00
16 341	192637	55580	1.65031E-07	2.96925E-06
17 342	844	54	1.38638E-10	2.56737E-06
19 344	453	45	1.14591E-10	2.54646E-06
21 346	517	48	1.24058E-10	2.58454E-06
22 347	1	0	0.00000E+00	0.00000E+00
23 348	501	59	1.47803E-10	2.50514E-06
24 349	10	5	1.59667E-11	3.19333E-06
25 350	619	260	7.98046E-10	3.06941E-06
27 352	319	159	4.75631E-10	2.99139E-06
28 353	0	1	2.54470E-12	2.54470E-06
29 354	582	276	8.34951E-10	3.02518E-06
31 356	1	1	2.54295E-12	2.54295E-06
32 420	67523	16340	6.05108E-08	3.70323E-06
33 422	1540	276	7.58494E-10	2.74817E-06
35 426	1280	368	1.47230E-09	4.00081E-06
36 427	648747	351762	1.07143E-06	3.04590E-06
37 430	1475	173	4.48936E-10	2.59500E-06

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

200/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

39	436	2336	234	6.24781E-10	2.67001E-06
40	404	594	50	1.27214E-10	2.54428E-06
41	402	60424	15041	4.55105E-08	3.02576E-06
42	400	348	93	2.55042E-10	2.74238E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	9139291	4135858	2.54330E-05	6.14938E-06

score misses

russian roulette on pd	0
psc=0.	299390
russian roulette in transmission	8839189
underflow in transmission	712
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = -3.21394E+01 with radius = 3.83022E+01
3.15514E-03 0.0019

detector symmetric about z-axis located at z = -3.21394E+01 with radius = 3.83022E+01
uncollided neutron flux
4.38073E-04 0.0016

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	1896398	0.47855	4.69525E-06	0.18992
1.00000E+00	1907406	0.95988	1.42770E-05	0.76743
2.00000E+00	138548	0.99484	4.51950E-06	0.95024
5.00000E+00	17158	0.99917	1.08713E-06	0.99421
1.00000E+01	583	0.99932	9.29633E-08	0.99797
1.00000E+02	112	0.99934	4.51620E-08	0.99980
1.00000E+03	0	0.99934	0.00000E+00	0.99980
1.00000E+38	0	0.99934	0.00000E+00	0.99980
1st 200 histories	2598	1.00000	4.90434E-09	1.00000

average tally per history = 2.47220E-05 largest score = 1.41452E-03
(largest score)/(average tally) = 5.72171E+01 nps of largest score = 111062

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1	300	11417	14543	3.31928E-07
2	301	47273	52412	1.11502E-06
3	302	8066023	3414212	2.18226E-05
4	303	63600	8597	2.83039E-08
5	304	20	4	9.89148E-12
6	305	2331	2194	1.24703E-08
7	306	5	7	1.25693E-10
8	307	10880	3038	9.04606E-09
9	320	56305	11368	3.45466E-08
10	321	7614	3665	1.16725E-08

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

201/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

11	322	58877	13638	4.13373E-08	3.03104E-06
12	323	126	23	5.75330E-11	2.50144E-06
13	324	69	1	2.47697E-12	2.47697E-06
14	330	4057	1269	3.85183E-09	3.03532E-06
15	340	1	0	0.00000E+00	0.00000E+00
16	341	192931	55286	1.66169E-07	3.00563E-06
17	342	858	40	9.90254E-11	2.47564E-06
19	344	470	28	7.16245E-11	2.55802E-06
21	346	521	44	1.08912E-10	2.47527E-06
22	347	1	0	0.00000E+00	0.00000E+00
23	348	508	52	1.29364E-10	2.48777E-06
24	349	10	5	1.26782E-11	2.53564E-06
25	350	577	302	1.00374E-09	3.32364E-06
27	352	321	157	5.00168E-10	3.18578E-06
28	353	1	0	0.00000E+00	0.00000E+00
29	354	551	307	1.08415E-09	3.53142E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	67063	16800	6.23909E-08	3.71375E-06
33	422	1406	410	1.18156E-09	2.88186E-06
35	426	1162	486	1.97261E-09	4.05886E-06
36	427	652407	348102	1.02870E-06	2.95517E-06
37	430	1488	160	4.03906E-10	2.52441E-06
39	436	2369	201	5.27534E-10	2.62455E-06
40	404	590	54	1.33645E-10	2.47490E-06
41	402	60183	15282	4.62179E-08	3.02433E-06
42	400	325	116	2.98554E-10	2.57374E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	9312346	3962803	2.47220E-05	6.23850E-06

score misses

russian roulette on pd	0
psc=0.	299667
russian roulette in transmission	9011987
underflow in transmission	692
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = -3.83022E+01 with radius = 3.21394E+01
3.08214E-03 0.0021

detector symmetric about z-axis located at z = -3.83022E+01 with radius = 3.21394E+01
uncollided neutron flux
4.26178E-04 0.0016

detector score diagnostics	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
times average score				
1.00000E-01	1796967	0.47571	4.35185E-06	0.17993
1.00000E+00	1805323	0.95363	1.33117E-05	0.73033
2.00000E+00	145692	0.99220	4.71457E-06	0.92526

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

202/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

5.00000E+00	25984	0.99908	1.64135E-06	0.99312
1.00000E+01	760	0.99928	1.16968E-07	0.99796
1.00000E+02	125	0.99931	4.40625E-08	0.99978
1.00000E+03	0	0.99931	0.00000E+00	0.99978
1.00000E+38	0	0.99931	0.00000E+00	0.99978
1st 200 histories	2600	1.00000	5.26357E-09	1.00000

average tally per history = 2.41857E-05 largest score = 9.68980E-04
 (largest score)/(average tally) = 4.00641E+01 nps of largest score = 336843

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	12294	13666	3.25897E-07	2.38473E-05
2 301	50541	49144	1.09395E-06	2.22602E-05
3 302	8249336	3230899	2.13031E-05	6.59355E-06
4 303	63744	8453	2.87195E-08	3.39756E-06
5 304	21	3	7.26059E-12	2.42020E-06
6 305	1983	2542	1.97374E-08	7.76450E-06
7 306	4	8	8.98611E-11	1.12326E-05
8 307	10229	3689	1.30100E-08	3.52671E-06
9 320	56359	11314	3.51978E-08	3.11100E-06
10 321	7126	4153	1.55482E-08	3.74385E-06
11 322	58888	13627	4.29139E-08	3.14918E-06
12 323	130	19	4.81409E-11	2.53373E-06
13 324	69	1	2.42097E-12	2.42097E-06
14 330	3872	1454	5.48637E-09	3.77329E-06
15 340	1	0	0.00000E+00	0.00000E+00
16 341	192317	55900	1.73926E-07	3.11138E-06
17 342	850	48	1.16231E-10	2.42147E-06
19 344	467	31	7.65504E-11	2.46937E-06
21 346	526	39	9.65145E-11	2.47473E-06
22 347	1	0	0.00000E+00	0.00000E+00
23 348	517	43	1.27655E-10	2.96872E-06
24 349	11	4	1.12727E-11	2.81819E-06
25 350	545	334	1.29091E-09	3.86501E-06
27 352	307	171	5.99969E-10	3.50859E-06
28 353	0	1	2.87844E-12	2.87844E-06
29 354	531	327	1.30857E-09	4.00173E-06
31 356	2	0	0.00000E+00	0.00000E+00
32 420	66574	17289	6.72339E-08	3.88882E-06
33 422	1237	579	2.23700E-09	3.86356E-06
35 426	1055	593	2.73656E-09	4.61477E-06
36 427	653692	346817	1.00100E-06	2.88625E-06
37 430	1505	143	3.84756E-10	2.69060E-06
39 436	2383	187	4.99073E-10	2.66884E-06
40 404	610	34	8.42192E-11	2.47703E-06
41 402	59676	15789	4.98334E-08	3.15621E-06
42 400	291	150	4.71620E-10	3.14414E-06
43 410	4	0	0.00000E+00	0.00000E+00
total	9497698	3777451	2.41857E-05	6.40266E-06

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

203/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

score misses

russian roulette on pd	0
psc=0.	299705
russian roulette in transmission	9197267
underflow in transmission	726
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = -4.33013E+01 with radius = 2.50000E+01
3.05070E-03 0.0023

detector symmetric about z-axis located at z = -4.33013E+01 with radius = 2.50000E+01
uncollided neutron flux
4.28882E-04 0.0015

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	1707076	0.47560	4.07727E-06	0.17095
1.00000E+00	1694166	0.94760	1.23670E-05	0.68946
2.00000E+00	147207	0.98861	4.75251E-06	0.88872
5.00000E+00	36682	0.99883	2.36756E-06	0.98798
1.00000E+01	1414	0.99922	2.10681E-07	0.99681
1.00000E+02	184	0.99928	7.11905E-08	0.99980
1.00000E+03	0	0.99928	0.00000E+00	0.99980
1.00000E+38	0	0.99928	0.00000E+00	0.99980
1st 200 histories	2599	1.00000	4.79179E-09	1.00000

average tally per history = 2.38510E-05 largest score = 2.28606E-03
(largest score)/(average tally) = 9.58474E+01 nps of largest score = 963000

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	13230	12730	3.18472E-07	2.50175E-05
2 301	53742	45943	1.08216E-06	2.35544E-05
3 302	8445652	3034583	2.09252E-05	6.89558E-06
4 303	63548	8649	2.94419E-08	3.40409E-06
5 304	19	5	1.19367E-11	2.38734E-06
6 305	1741	2784	2.74531E-08	9.86104E-06
7 306	4	8	1.00338E-10	1.25422E-05
8 307	9671	4247	1.80257E-08	4.24433E-06
9 320	56251	11422	3.67824E-08	3.22031E-06
10 321	6594	4685	2.02778E-08	4.32825E-06
11 322	58480	14035	4.58173E-08	3.26450E-06
12 323	121	28	7.15686E-11	2.55602E-06
13 324	68	2	4.76974E-12	2.38487E-06
14 330	3749	1577	7.88631E-09	5.00083E-06
15 340	1	0	0.00000E+00	0.00000E+00
16 341	190839	57378	1.86302E-07	3.24692E-06

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

204/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

17	342	852	46	1.10235E-10	2.39642E-06
19	344	471	27	6.81865E-11	2.52543E-06
21	346	520	45	1.07796E-10	2.39546E-06
22	347	1	0	0.00000E+00	0.00000E+00
23	348	516	44	1.08098E-10	2.45678E-06
24	349	10	5	1.31794E-11	2.63589E-06
25	350	518	361	1.47345E-09	4.08158E-06
27	352	283	195	7.31658E-10	3.75209E-06
28	353	0	1	3.12971E-12	3.12971E-06
29	354	513	345	1.64283E-09	4.76182E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	66240	17623	7.56763E-08	4.29418E-06
33	422	1107	709	4.44689E-09	6.27205E-06
35	426	1009	639	4.39124E-09	6.87205E-06
36	427	646301	354208	1.00793E-06	2.84558E-06
37	430	1519	129	3.45975E-10	2.68198E-06
39	436	2392	178	4.35373E-10	2.44591E-06
40	404	587	57	1.36747E-10	2.39907E-06
41	402	58986	16479	5.47655E-08	3.32335E-06
42	400	281	160	6.25365E-10	3.90853E-06
43	410	3	1	2.38736E-12	2.38736E-06
	total	9685821	3589328	2.38510E-05	6.64498E-06

score misses

russian roulette on pd 0
 psc=0. 300410
 russian roulette in transmission 9384720
 underflow in transmission 691
 hit a zero-importance cell 0
 energy cutoff 0

detector symmetric about z-axis located at z = -4.69846E+01 with radius = 1.71010E+01
 3.06416E-03 0.0025

detector symmetric about z-axis located at z = -4.69846E+01 with radius = 1.71010E+01
 uncollided neutron flux
 4.45633E-04 0.0015

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	1632144	0.47796	3.86903E-06	0.16327
1.00000E+00	1584093	0.94185	1.14484E-05	0.64640
2.00000E+00	145214	0.98438	4.69495E-06	0.84453
5.00000E+00	47580	0.99831	3.15067E-06	0.97749
1.00000E+01	2883	0.99916	4.25923E-07	0.99546
1.00000E+02	286	0.99924	1.02905E-07	0.99981
1.00000E+03	0	0.99924	0.00000E+00	0.99981
1.00000E+38	0	0.99924	0.00000E+00	0.99981
1st 200 histories	2597	1.00000	4.59957E-09	1.00000

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

205/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

average tally per history = 2.36965E-05 largest score = 1.69866E-03
 (largest score)/(average tally) = 7.16839E+01 nps of largest score = 769882

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	14161	11799	3.08416E-07	2.61392E-05
2 301	56869	42816	1.06390E-06	2.48483E-05
3 302	8644571	2835664	2.06796E-05	7.29269E-06
4 303	63179	9018	3.06597E-08	3.39983E-06
5 304	17	7	1.84251E-11	2.63216E-06
6 305	1651	2874	4.13074E-08	1.43728E-05
7 306	4	8	1.16120E-10	1.45150E-05
8 307	9288	4630	2.44960E-08	5.29071E-06
9 320	55646	12027	4.04983E-08	3.36728E-06
10 321	6289	4990	2.56569E-08	5.14166E-06
11 322	57690	14825	5.04804E-08	3.40509E-06
12 323	128	21	5.89094E-11	2.80521E-06
13 324	67	3	7.10791E-12	2.36930E-06
14 330	3628	1698	1.08710E-08	6.40222E-06
15 340	1	0	0.00000E+00	0.00000E+00
16 341	187655	60562	2.01476E-07	3.32678E-06
17 342	850	48	1.15889E-10	2.41435E-06
19 344	466	32	8.05043E-11	2.51576E-06
21 346	520	45	1.12629E-10	2.50286E-06
22 347	1	0	0.00000E+00	0.00000E+00
23 348	510	50	1.35325E-10	2.70649E-06
24 349	9	6	1.53085E-11	2.55142E-06
25 350	502	377	1.63034E-09	4.32450E-06
27 352	261	217	8.58561E-10	3.95650E-06
28 353	0	1	4.77965E-12	4.77965E-06
29 354	472	386	2.05024E-09	5.31151E-06
31 356	2	0	0.00000E+00	0.00000E+00
32 420	65057	18806	8.71075E-08	4.63190E-06
33 422	1067	749	7.56693E-09	1.01027E-05
35 426	949	699	5.75087E-09	8.22728E-06
36 427	626408	374101	1.04927E-06	2.80477E-06
37 430	1503	145	3.58731E-10	2.47401E-06
39 436	2379	191	5.21810E-10	2.73199E-06
40 404	585	59	1.41348E-10	2.39573E-06
41 402	57711	17754	6.22455E-08	3.50600E-06
42 400	252	189	9.37454E-10	4.96007E-06
43 410	4	0	0.00000E+00	0.00000E+00
total	9860352	3414797	2.36965E-05	6.93936E-06

score misses

russian roulette on pd	0
psc=0.	300105
russian roulette in transmission	9559550
underflow in transmission	697

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

206/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

hit a zero-importance cell 0
energy cutoff 0

detector symmetric about z-axis located at z = -4.92404E+01 with radius = 8.68241E+00
3.06258E-03 0.0028

detector symmetric about z-axis located at z = -4.92404E+01 with radius = 8.68241E+00
uncollided neutron flux
4.20590E-04 0.0015

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	1542463	0.47982	3.64437E-06	0.15442
1.00000E+00	1466767	0.93609	1.05799E-05	0.60273
2.00000E+00	140018	0.97964	4.54759E-06	0.79543
5.00000E+00	57255	0.99745	3.88792E-06	0.96018
1.00000E+01	5101	0.99904	7.61707E-07	0.99245
1.00000E+02	489	0.99919	1.73699E-07	0.99981
1.00000E+03	0	0.99919	0.00000E+00	0.99981
1.00000E+38	0	0.99919	0.00000E+00	0.99981
1st 200 histories	2601	1.00000	4.44873E-09	1.00000

average tally per history = 2.35996E-05 largest score = 2.17871E-03
(largest score)/(average tally) = 9.23198E+01 nps of largest score = 807287

score contributions by cell

cell	misses	hits	tally per history	weight per hit	
1	300	14971	10989	3.07267E-07	2.79613E-05
2	301	59783	39902	1.06251E-06	2.66280E-05
3	302	8832546	2647689	2.05322E-05	7.75475E-06
4	303	62072	10125	3.75444E-08	3.70809E-06
5	304	20	4	1.00895E-11	2.52237E-06
6	305	1623	2902	5.83731E-08	2.01148E-05
7	306	1	11	4.42388E-10	4.02171E-05
8	307	9077	4841	3.37984E-08	6.98170E-06
9	320	54036	13637	5.23636E-08	3.83981E-06
10	321	6024	5255	3.55748E-08	6.76971E-06
11	322	54976	17539	6.55993E-08	3.74020E-06
12	323	119	30	8.02650E-11	2.67550E-06
13	324	67	3	7.09302E-12	2.36434E-06
14	330	3525	1801	1.66021E-08	9.21828E-06
15	340	1	0	0.00000E+00	0.00000E+00
16	341	185131	63086	2.30701E-07	3.65693E-06
17	342	824	74	1.75125E-10	2.36655E-06
19	344	452	46	1.11201E-10	2.41742E-06
21	346	506	59	1.47482E-10	2.49969E-06
22	347	1	0	0.00000E+00	0.00000E+00
23	348	480	80	1.95850E-10	2.44813E-06
24	349	12	3	1.41466E-11	4.71553E-06

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

207/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

25	350	487	392	2.10530E-09	5.37066E-06
27	352	247	231	1.27051E-09	5.50004E-06
28	353	0	1	3.69510E-12	3.69510E-06
29	354	504	354	2.39858E-09	6.77565E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	66323	17540	8.61386E-08	4.91098E-06
33	422	1057	759	9.71342E-09	1.27977E-05
35	426	882	766	6.95551E-09	9.08031E-06
36	427	641494	359015	9.90592E-07	2.75919E-06
37	430	1481	167	4.01742E-10	2.40564E-06
39	436	2370	200	5.24596E-10	2.62298E-06
40	404	589	55	1.30453E-10	2.37187E-06
41	402	58520	16945	6.47370E-08	3.82042E-06
42	400	248	193	9.68261E-10	5.01690E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	10060455	3214694	2.35996E-05	7.34117E-06

score misses

russian roulette on pd	0
psc=0.	300899
russian roulette in transmission	9758891
underflow in transmission	665
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = -5.00000E+01 with radius = 1.00000E+00
9.44318E-03 0.0013

detector symmetric about z-axis located at z = -5.00000E+01 with radius = 1.00000E+00
uncollided neutron flux
5.73315E-03 0.0007

detector score diagnostics		cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
times average score	transmissions			
1.00000E-01	1075405	0.33292	4.25379E-06	0.10770
1.00000E+00	2038759	0.96408	2.69184E-05	0.78922
2.00000E+00	82895	0.98974	4.48275E-06	0.90271
5.00000E+00	28121	0.99845	3.09198E-06	0.98099
1.00000E+01	2038	0.99908	5.20503E-07	0.99417
1.00000E+02	371	0.99919	2.22378E-07	0.99980
1.00000E+03	0	0.99919	0.00000E+00	0.99980
1.00000E+38	0	0.99919	0.00000E+00	0.99980
1st 200 histories	2607	1.00000	7.84605E-09	1.00000

average tally per history = 3.94977E-05 largest score = 2.69321E-03
(largest score)/(average tally) = 6.81865E+01 nps of largest score = 527552

score contributions by cell

cell	misses	hits	tally per history	weight per hit
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CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

208/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

1	300	16427	9533	3.07207E-07	3.22256E-05
2	301	65138	34547	1.05656E-06	3.05833E-05
3	302	9539460	1940775	2.03115E-05	1.04657E-05
4	303	65770	6427	3.32153E-08	5.16809E-06
5	304	24	0	0.00000E+00	0.00000E+00
6	305	2208	2317	9.73405E-08	4.20114E-05
7	306	1	11	6.72461E-10	6.11328E-05
8	307	10550	3368	3.10889E-08	9.23068E-06
9	320	57484	10189	5.00415E-08	4.91132E-06
10	321	6698	4581	9.73994E-08	2.12616E-05
11	322	62809	9706	4.84787E-08	4.99471E-06
12	323	126	23	9.41672E-11	4.09423E-06
13	324	56	14	7.29347E-11	5.20962E-06
14	330	3251	2075	6.69401E-08	3.22603E-05
15	340	1	0	0.00000E+00	0.00000E+00
16	341	169578	78639	1.13232E-06	1.43990E-05
17	342	834	64	2.53384E-10	3.95913E-06
19	344	467	31	1.22747E-10	3.95958E-06
21	346	526	39	1.60201E-10	4.10772E-06
22	347	1	0	0.00000E+00	0.00000E+00
23	348	515	45	1.83845E-10	4.08545E-06
24	349	11	4	1.58100E-11	3.95249E-06
25	350	608	271	1.68687E-09	6.22461E-06
27	352	333	145	8.55839E-10	5.90234E-06
28	353	0	1	7.24311E-12	7.24311E-06
29	354	571	287	2.00854E-09	6.99839E-06
31	356	0	2	1.94469E-11	9.72347E-06
32	420	20175	63688	9.29173E-07	1.45894E-05
33	422	26	1790	1.14837E-07	6.41548E-05
35	426	45	1603	8.09849E-08	5.05208E-05
36	427	8025	992484	1.41351E-05	1.42421E-05
37	430	345	1303	1.20347E-08	9.23617E-06
39	436	1177	1393	9.92154E-09	7.12242E-06
40	404	245	399	3.04167E-09	7.62324E-06
41	402	11465	64000	9.56752E-07	1.49492E-05
42	400	2	439	1.75591E-08	3.99979E-05
43	410	1	3	3.09680E-11	1.03227E-05
	total	10044953	3230196	3.94977E-05	1.22276E-05

score misses

russian roulette on pd	0
psc=0.	301518
russian roulette in transmission	9742825
underflow in transmission	610
hit a zero-importance cell	0
energy cutoff	0

CALCULATION SHEET

PROJECT NO.:

CALC NO.:

REVISION NO.: 0

SHEET NO.:

209/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

results of 10 statistical checks for the estimated answer for the tally fluctuation chart (tfc) bin of tally 55

tfc bin	--mean--	-----relative error-----			----variance of the variance----			--figure of merit--		-pdf-
behavior	behavior	value	decrease	decrease rate	value	decrease	decrease rate	value	behavior	slope
desired	random	<0.05	yes	1/sqrt(nps)	<0.10	yes	1/nps	constant	random	>3.00
observed	random	0.00	yes	yes	0.00	yes	yes	constant	random	10.00
passed?	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

this tally meets the statistical criteria used to form confidence intervals: check the tally fluctuation chart to verify. the results in other bins associated with this tally may not meet these statistical criteria.

----- estimated confidence intervals: -----

estimated asymmetric confidence interval(1,2,3 sigma): 1.6276E-02 to 1.6314E-02; 1.6257E-02 to 1.6333E-02; 1.6238E-02 to 1.6352E-02
 estimated symmetric confidence interval(1,2,3 sigma): 1.6276E-02 to 1.6314E-02; 1.6257E-02 to 1.6333E-02; 1.6238E-02 to 1.6352E-02

1analysis of the results in the tally fluctuation chart bin (tfc) for tally 55 with nps = 1000000 print table 160

normed average tally per history = 1.62951E-02	unnormed average tally per history = 1.62951E-02
estimated tally relative error = 0.0012	estimated variance of the variance = 0.0001
relative error from zero tallies = 0.0000	relative error from nonzero scores = 0.0012
number of nonzero history tallies = 998319	efficiency for the nonzero tallies = 0.9983
history number of largest tally = 606076	largest unnormalized history tally = 9.28939E-01
(largest tally)/(average tally) = 5.70073E+01	(largest tally)/(avg nonzero tally) = 5.69115E+01
(confidence interval shift)/mean = 0.0000	shifted confidence interval center = 1.62951E-02

if the largest history score sampled so far were to occur on the next history, the tfc bin quantities would change as follows:

estimated quantities	value at nps	value at nps+1	value(nps+1)/value(nps)-1.
mean	1.62951E-02	1.62960E-02	0.000056
relative error	1.17047E-03	1.17175E-03	0.001087
variance of the variance	1.02659E-04	1.07403E-04	0.046213
shifted center	1.62951E-02	1.62951E-02	0.000000
figure of merit	1.37118E+04	1.36820E+04	-0.002171

the estimated slope of the 200 largest tallies starting at 3.28387E-01 appears to be decreasing at least exponentially. the large score tail of the empirical history score probability density function appears to have no unsampled regions.

fom = (histories/minute)*(f(x) signal-to-noise ratio)**2 = (1.879E+04)*(8.544E-01)**2 = (1.879E+04)*(7.299E-01) = 1.371E+04

ltally 65 nps = 1000000

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

210/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

+ Point Detector at 90 Degrees
tally type 5 particle flux at a point detector.
tally for neutrons

this tally is modified by a dose function.

detector located at x,y,z = 0.00000E+00 0.00000E+00 5.00000E+01
1.58321E-02 0.0010

detector located at x,y,z = 0.00000E+00 0.00000E+00 5.00000E+01
uncollided neutron flux
8.21547E-03 0.0002

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	1303316	0.33078	8.57372E-06	0.13032
1.00000E+00	2575610	0.98446	5.11513E-05	0.90784
2.00000E+00	49830	0.99711	4.24428E-06	0.97235
5.00000E+00	8010	0.99914	1.45218E-06	0.99443
1.00000E+01	726	0.99933	3.04393E-07	0.99905
1.00000E+02	53	0.99934	4.92191E-08	0.99980
1.00000E+03	0	0.99934	0.00000E+00	0.99980
1.00000E+38	0	0.99934	0.00000E+00	0.99980
1st 200 histories	2599	1.00000	1.31175E-08	1.00000

average tally per history = 6.57882E-05 largest score = 2.20380E-03
(largest score)/(average tally) = 3.34984E+01 nps of largest score = 756939

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	13409	12551	4.68272E-07	3.73095E-05
2 301	56525	43160	1.51484E-06	3.50982E-05
3 302	9179280	2300955	3.04873E-05	1.32499E-05
4 303	16222	55975	7.24353E-07	1.29407E-05
5 304	4	20	3.84804E-10	1.92402E-05
6 305	2983	1542	1.12596E-08	7.30196E-06
7 306	9	3	2.15814E-11	7.19379E-06
8 307	2402	11516	1.16749E-07	1.01380E-05
9 320	12429	55244	1.01140E-06	1.83078E-05
10 321	4015	7264	6.78538E-08	9.34111E-06
11 322	5004	67511	1.70212E-06	2.52125E-05
12 323	4	145	3.12295E-09	2.15376E-05
13 324	0	70	4.22546E-09	6.03638E-05
14 330	1050	4276	4.66490E-08	1.09095E-05
15 340	0	1	3.88434E-11	3.88434E-05
16 341	19189	229028	5.11746E-06	2.23442E-05
17 342	0	898	5.50246E-08	6.12746E-05
19 344	0	498	2.54392E-08	5.10827E-05
21 346	1	564	2.66475E-08	4.72473E-05

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

211/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. MCCONN

DATE: 03/21/10

22	347	0	1	4.26574E-11	4.26574E-05
23	348	0	560	2.37766E-08	4.24582E-05
24	349	0	15	2.70660E-10	1.80440E-05
25	350	138	741	7.97257E-09	1.07592E-05
27	352	80	398	4.05598E-09	1.01909E-05
28	353	0	1	2.46027E-11	2.46027E-05
29	354	220	638	6.25395E-09	9.80243E-06
31	356	0	2	1.75551E-11	8.77755E-06
32	420	16774	67089	1.35876E-06	2.02531E-05
33	422	809	1007	9.70467E-09	9.63721E-06
35	426	280	1368	1.94955E-08	1.42511E-05
36	427	108	1000401	2.11397E-05	2.11312E-05
37	430	42	1606	1.21045E-07	7.53708E-05
39	436	29	2541	2.34787E-07	9.23993E-05
40	404	0	644	5.28630E-08	8.20855E-05
41	402	3843	71622	1.42362E-06	1.98768E-05
42	400	155	286	2.52428E-09	8.82617E-06
43	410	1	3	8.03408E-11	2.67803E-05
	total	9335005	3940144	6.57882E-05	1.66969E-05

score misses

russian roulette on pd	0
psc=0.	301395
russian roulette in transmission	9032986
underflow in transmission	624
hit a zero-importance cell	0
energy cutoff	0

results of 10 statistical checks for the estimated answer for the tally fluctuation chart (tfc) bin of tally 65

tfc bin	--mean--	-----relative error-----			----variance of the variance----			--figure of merit--		-pdf-
behavior	behavior	value	decrease	decrease rate	value	decrease	decrease rate	value	behavior	slope
desired	random	<0.05	yes	1/sqrt(nps)	<0.10	yes	1/nps	constant	random	>3.00
observed	random	0.00	yes	yes	0.00	yes	yes	constant	random	10.00
passed?	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

this tally meets the statistical criteria used to form confidence intervals: check the tally fluctuation chart to verify. the results in other bins associated with this tally may not meet these statistical criteria.

----- estimated confidence intervals: -----

estimated asymmetric confidence interval(1,2,3 sigma): 1.5816E-02 to 1.5848E-02; 1.5800E-02 to 1.5864E-02; 1.5784E-02 to 1.5880E-02
 estimated symmetric confidence interval(1,2,3 sigma): 1.5816E-02 to 1.5848E-02; 1.5800E-02 to 1.5864E-02; 1.5784E-02 to 1.5880E-02

CALCULATION SHEET

PROJECT NO.:

CALC NO.:

REVISION NO.: 0

SHEET NO.:

212/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

lanalysis of the results in the tally fluctuation chart bin (tfc) for tally 65 with nps = 1000000 print table 160

normed average tally per history = 1.58321E-02	unnormed average tally per history = 1.58321E-02
estimated tally relative error = 0.0010	estimated variance of the variance = 0.0001
relative error from zero tallies = 0.0000	relative error from nonzero scores = 0.0010
number of nonzero history tallies = 999993	efficiency for the nonzero tallies = 1.0000
history number of largest tally = 304467	largest unnormalized history tally = 5.41737E-01
(largest tally)/(average tally) = 3.42176E+01	(largest tally)/(avg nonzero tally) = 3.42174E+01
(confidence interval shift)/mean = 0.0000	shifted confidence interval center = 1.58322E-02

if the largest history score sampled so far were to occur on the next history, the tfc bin quantities would change as follows:

estimated quantities	value at nps	value at nps+1	value (nps+1)/value (nps) -1.
mean	1.58321E-02	1.58326E-02	0.000033
relative error	1.00949E-03	1.01000E-03	0.000507
variance of the variance	6.74565E-05	6.84776E-05	0.015137
shifted center	1.58322E-02	1.58322E-02	0.000000
figure of merit	1.84339E+04	1.84153E+04	-0.001013

the estimated slope of the 200 largest tallies starting at 2.58088E-01 appears to be decreasing at least exponentially. the large score tail of the empirical history score probability density function appears to have no unsampled regions.

fom = (histories/minute)*(f(x) signal-to-noise ratio)**2 = (1.879E+04)*(9.906E-01)**2 = (1.879E+04)*(9.813E-01) = 1.843E+04

ltally 75 nps = 1000000
 + Point Detector at -90 Degrees
 tally type 5 particle flux at a point detector.
 tally for neutrons
 this tally is modified by a dose function.

detector located at x,y,z = 0.00000E+00 0.00000E+00-5.00000E+01
 9.30039E-03 0.0011

detector located at x,y,z = 0.00000E+00 0.00000E+00-5.00000E+01
 uncollided neutron flux
 5.68493E-03 0.0003

detector score diagnostics	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
times average score	1085594	0.32233	4.35681E-06	0.10867
1.00000E-01	2175049	0.96813	2.90228E-05	0.83258
2.00000E+00	88358	0.99437	4.68521E-06	0.94944

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

213/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

5.00000E+00	15024	0.99883	1.62370E-06	0.98994
1.00000E+01	1199	0.99918	3.15741E-07	0.99782
1.00000E+02	144	0.99923	7.93767E-08	0.99980
1.00000E+03	0	0.99923	0.00000E+00	0.99980
1.00000E+38	0	0.99923	0.00000E+00	0.99980
1st 200 histories	2606	1.00000	8.15061E-09	1.00000

average tally per history = 4.00918E-05 largest score = 2.14806E-03
(largest score)/(average tally) = 5.35787E+01 nps of largest score = 527552

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	16389	9571	3.08259E-07	3.22076E-05
2 301	64573	35112	1.05676E-06	3.00969E-05
3 302	9459460	2020775	2.02919E-05	1.00416E-05
4 303	65658	6539	3.32784E-08	5.08922E-06
5 304	21	3	1.20363E-11	4.01209E-06
6 305	638	3887	1.08076E-07	2.78045E-05
7 306	0	12	6.54048E-10	5.45040E-05
8 307	10681	3237	2.93872E-08	9.07854E-06
9 320	56726	10947	5.19213E-08	4.74297E-06
10 321	6406	4873	1.00247E-07	2.05720E-05
11 322	62647	9868	4.77700E-08	4.84090E-06
12 323	123	26	1.05439E-10	4.05536E-06
13 324	51	19	9.48928E-11	4.99436E-06
14 330	3021	2305	6.72846E-08	2.91907E-05
15 340	1	0	0.00000E+00	0.00000E+00
16 341	134012	114205	1.28128E-06	1.12192E-05
17 342	859	39	1.56476E-10	4.01220E-06
19 344	469	29	1.16400E-10	4.01379E-06
21 346	525	40	1.63286E-10	4.08214E-06
22 347	1	0	0.00000E+00	0.00000E+00
23 348	506	54	2.27569E-10	4.21424E-06
24 349	13	2	8.01864E-12	4.00932E-06
25 350	582	297	1.69263E-09	5.69909E-06
27 352	317	161	9.06826E-10	5.63246E-06
28 353	0	1	5.54737E-12	5.54737E-06
29 354	590	268	2.00772E-09	7.49150E-06
31 356	0	2	3.34852E-11	1.67426E-05
32 420	17013	66850	8.95651E-07	1.33979E-05
33 422	16	1800	1.15153E-07	6.39736E-05
35 426	33	1615	8.32809E-08	5.15671E-05
36 427	1005	999504	1.45805E-05	1.45877E-05
37 430	271	1377	1.29950E-08	9.43721E-06
39 436	1069	1501	9.89398E-09	6.59159E-06
40 404	194	450	2.87074E-09	6.37943E-06
41 402	3303	72162	9.90180E-07	1.37216E-05
42 400	1	440	1.89036E-08	4.29626E-05
43 410	1	3	4.75814E-11	1.58605E-05
total	9907175	3367974	4.00918E-05	1.19038E-05

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

214/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

```
score misses
russian roulette on pd      0
psc=0.                      301313
russian roulette in transmission 9605245
underflow in transmission   617
hit a zero-importance cell  0
energy cutoff               0
```

=====

results of 10 statistical checks for the estimated answer for the tally fluctuation chart (tfc) bin of tally 75

tfc bin	--mean--	-----relative error-----			----variance of the variance----				--figure of merit--		-pdf-
behavior	behavior	value	decrease	decrease rate	value	decrease	decrease rate	value	behavior	value	slope
desired	random	<0.05	yes	1/sqrt (nps)	<0.10	yes	1/nps	constant	random	>3.00	
observed	random	0.00	yes	yes	0.00	yes	yes	constant	decrease	10.00	
passed?	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	

=====

warning. the tally in the tally fluctuation chart bin did not pass 1 of the 10 statistical checks.

lanalysis of the results in the tally fluctuation chart bin (tfc) for tally 75 with nps = 1000000 print table 160

normed average tally per history = 9.30039E-03	unnormed average tally per history = 9.30039E-03
estimated tally relative error = 0.0011	estimated variance of the variance = 0.0001
relative error from zero tallies = 0.0000	relative error from nonzero scores = 0.0011
number of nonzero history tallies = 999694	efficiency for the nonzero tallies = 0.9997
history number of largest tally = 77153	largest unnormalized history tally = 5.53636E-01
(largest tally)/(average tally) = 5.95283E+01	(largest tally)/(avg nonzero tally) = 5.95101E+01
(confidence interval shift)/mean = 0.0000	shifted confidence interval center = 9.30043E-03

if the largest history score sampled so far were to occur on the next history, the tfc bin quantities would change as follows:

estimated quantities	value at nps	value at nps+1	value (nps+1) /value (nps) -1.
mean	9.30039E-03	9.30093E-03	0.000059
relative error	1.13111E-03	1.13255E-03	0.001278
variance of the variance	1.17518E-04	1.24015E-04	0.055284
shifted center	9.30043E-03	9.30043E-03	0.000000
figure of merit	1.46829E+04	1.46454E+04	-0.002552

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

217/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

14	330	1276	4050	4.76311E-08	1.17608E-05
15	340	0	1	6.86104E-11	6.86104E-05
16	341	32347	215870	5.10292E-06	2.36389E-05
17	342	0	898	5.53273E-08	6.16116E-05
19	344	0	498	2.47982E-08	4.97956E-05
21	346	3	562	2.70876E-08	4.81986E-05
22	347	0	1	2.26801E-11	2.26801E-05
23	348	0	560	2.37523E-08	4.24148E-05
24	349	0	15	2.62810E-10	1.75207E-05
25	350	107	772	9.25106E-09	1.19832E-05
27	352	67	411	4.55121E-09	1.10735E-05
28	353	0	1	1.58642E-11	1.58642E-05
29	354	191	667	7.12164E-09	1.06771E-05
31	356	1	1	8.20152E-12	8.20152E-06
32	420	20329	63534	1.41047E-06	2.22002E-05
33	422	895	921	9.88740E-09	1.07355E-05
35	426	404	1244	1.84294E-08	1.48146E-05
36	427	6975	993534	2.05898E-05	2.07238E-05
37	430	42	1606	1.16106E-07	7.22953E-05
39	436	27	2543	2.33243E-07	9.17194E-05
40	404	0	644	5.08236E-08	7.89187E-05
41	402	9402	66063	1.42502E-06	2.15706E-05
42	400	200	241	2.23839E-09	9.28794E-06
43	410	1	3	5.11824E-11	1.70608E-05
	total	9505772	3769377	6.54340E-05	1.73594E-05

score misses

russian roulette on pd	0
psc=0.	304031
russian roulette in transmission	9201160
underflow in transmission	581
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = 4.92404E+01 with radius = 8.68241E+00
8.82758E-03 0.0016

detector symmetric about z-axis located at z = 4.92404E+01 with radius = 8.68241E+00
uncollided neutron flux
2.82043E-03 0.0009

detector score diagnostics

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	1720273	0.43303	8.16081E-06	0.17199
1.00000E+00	2118422	0.96629	2.90124E-05	0.78343
2.00000E+00	106574	0.99311	6.80419E-06	0.92683
5.00000E+00	23342	0.99899	2.97146E-06	0.98946
1.00000E+01	1246	0.99930	3.79683E-07	0.99746
1.00000E+02	173	0.99935	1.11014E-07	0.99980

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

218/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

1.00000E+03	0	0.99935	0.00000E+00	0.99980
1.00000E+38	0	0.99935	0.00000E+00	0.99980
1st 200 histories	2598	1.00000	9.62699E-09	1.00000

average tally per history = 4.74492E-05 largest score = 1.97666E-03
 (largest score)/(average tally) = 4.16584E+01 nps of largest score = 550896

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	12420	13540	4.67005E-07	3.44908E-05
2 301	52704	46981	1.51135E-06	3.21693E-05
3 302	8706855	2773380	3.22834E-05	1.16405E-05
4 303	44576	27621	6.88551E-07	2.49285E-05
5 304	13	11	3.81610E-10	3.46918E-05
6 305	4347	178	8.45253E-10	4.74861E-06
7 306	12	0	0.00000E+00	0.00000E+00
8 307	12139	1779	1.14305E-08	6.42525E-06
9 320	38168	29505	8.04482E-07	2.72660E-05
10 321	9859	1420	7.71699E-09	5.43450E-06
11 322	33153	39362	9.61166E-07	2.44186E-05
12 323	77	72	1.57888E-09	2.19289E-05
13 324	5	65	2.91954E-09	4.49161E-05
14 330	4357	969	5.20832E-09	5.37494E-06
15 340	0	1	4.75135E-12	4.75135E-06
16 341	113497	134720	2.07771E-06	1.54224E-05
17 342	182	716	2.29278E-08	3.20220E-05
19 344	124	374	1.05116E-08	2.81060E-05
21 346	150	415	9.95967E-09	2.39992E-05
22 347	0	1	4.85628E-12	4.85628E-06
23 348	160	400	9.45255E-09	2.36314E-05
24 349	10	5	1.16441E-10	2.32881E-05
25 350	642	237	1.82238E-09	7.68936E-06
27 352	340	138	9.85368E-10	7.14035E-06
28 353	0	1	3.20328E-11	3.20328E-05
29 354	653	205	1.36477E-09	6.65741E-06
31 356	1	1	4.74363E-12	4.74363E-06
32 420	36149	47714	6.46080E-07	1.35407E-05
33 422	1423	393	2.03987E-09	5.19050E-06
35 426	1056	592	3.41242E-09	5.76422E-06
36 427	199387	801122	7.12418E-06	8.89275E-06
37 430	189	1459	5.48410E-08	3.75881E-05
39 436	179	2391	1.17260E-07	4.90423E-05
40 404	19	625	2.90976E-08	4.65561E-05
41 402	29329	46136	5.90833E-07	1.28063E-05
42 400	344	97	4.72217E-10	4.86821E-06
43 410	2	2	1.93592E-11	9.67962E-06
total	9302521	3972628	4.74492E-05	1.19440E-05

score misses

russian roulette on pd

0

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

219/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

psc=0. 301985
 russian roulette in transmission 8999901
 underflow in transmission 635
 hit a zero-importance cell 0
 energy cutoff 0

detector symmetric about z-axis located at z = 4.69846E+01 with radius = 1.71010E+01
 5.90998E-03 0.0018

detector symmetric about z-axis located at z = 4.69846E+01 with radius = 1.71010E+01
 uncollided neutron flux
 1.02845E-03 0.0012

detector score diagnostics		cumulative	tally	cumulative
times average score	transmissions	fraction of	per	fraction of
		transmissions	history	total tally
1.00000E-01	1867164	0.46696	7.35773E-06	0.18664
1.00000E+00	1984569	0.96328	2.28747E-05	0.76688
2.00000E+00	117782	0.99274	6.24433E-06	0.92527
5.00000E+00	25393	0.99909	2.64005E-06	0.99224
1.00000E+01	944	0.99932	2.35446E-07	0.99821
1.00000E+02	107	0.99935	6.32631E-08	0.99982
1.00000E+03	0	0.99935	0.00000E+00	0.99982
1.00000E+38	0	0.99935	0.00000E+00	0.99982
1st 200 histories	2603	1.00000	7.28092E-09	1.00000

average tally per history = 3.94228E-05 largest score = 1.83157E-03
 (largest score)/(average tally) = 4.64597E+01 nps of largest score = 352653

score contributions by cell					
cell	misses	hits	tally per history	weight per hit	
1	300	11463	14497	4.59201E-07	3.16756E-05
2	301	49216	50469	1.49354E-06	2.95932E-05
3	302	8297607	3182628	3.22507E-05	1.01334E-05
4	303	46555	25642	4.27392E-07	1.66676E-05
5	304	17	7	1.81041E-10	2.58630E-05
6	305	4467	58	2.30202E-10	3.96901E-06
7	306	12	0	0.00000E+00	0.00000E+00
8	307	13459	459	1.79948E-09	3.92044E-06
9	320	40367	27306	5.22272E-07	1.91266E-05
10	321	10695	584	2.30159E-09	3.94109E-06
11	322	40304	32211	5.77088E-07	1.79159E-05
12	323	87	62	1.05201E-09	1.69679E-05
13	324	8	62	1.95558E-09	3.15416E-05
14	330	4911	415	1.64248E-09	3.95779E-06
15	340	0	1	6.01351E-12	6.01351E-06
16	341	153086	95131	6.65627E-07	6.99695E-06
17	342	279	619	8.83159E-09	1.42675E-05
19	344	185	313	3.43578E-09	1.09769E-05
21	346	184	381	4.09896E-09	1.07584E-05

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

220/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

22	347	0	1	4.54121E-12	4.54121E-06
23	348	214	346	3.09129E-09	8.93437E-06
24	349	14	1	3.94552E-12	3.94552E-06
25	350	769	110	4.47893E-10	4.07176E-06
27	352	441	37	1.46854E-10	3.96903E-06
28	353	0	1	4.90701E-12	4.90701E-06
29	354	782	76	3.04692E-10	4.00910E-06
31	356	1	1	3.94299E-12	3.94299E-06
32	420	56417	27446	2.16421E-07	7.88535E-06
33	422	1625	191	8.01953E-10	4.19871E-06
35	426	1363	285	1.16640E-09	4.09263E-06
36	427	492102	508407	2.55356E-06	5.02267E-06
37	430	635	1013	1.50148E-08	1.48221E-05
39	436	899	1671	2.92272E-08	1.74908E-05
40	404	150	494	7.40100E-09	1.49818E-05
41	402	47872	27593	1.73665E-07	6.29380E-06
42	400	397	44	1.76571E-10	4.01297E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	9276587	3998562	3.94228E-05	9.85924E-06

score misses

russian roulette on pd 0
 psc=0. 300713
 russian roulette in transmission 8975226
 underflow in transmission 648
 hit a zero-importance cell 0
 energy cutoff 0

detector symmetric about z-axis located at z = 4.33013E+01 with radius = 2.50000E+01
 5.33794E-03 0.0017

detector symmetric about z-axis located at z = 4.33013E+01 with radius = 2.50000E+01
 uncollided neutron flux
 8.69491E-04 0.0013

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	1946029	0.47047	7.24272E-06	0.19446
1.00000E+00	2057005	0.96777	2.25232E-05	0.79919
2.00000E+00	111454	0.99472	5.50420E-06	0.94697
5.00000E+00	18663	0.99923	1.80239E-06	0.99537
1.00000E+01	535	0.99936	1.25800E-07	0.99875
1.00000E+02	67	0.99937	3.95938E-08	0.99981
1.00000E+03	0	0.99937	0.00000E+00	0.99981
1.00000E+38	0	0.99937	0.00000E+00	0.99981
1st 200 histories	2595	1.00000	7.13533E-09	1.00000

average tally per history = 3.72450E-05 largest score = 1.47543E-03
 (largest score)/(average tally) = 3.96141E+01 nps of largest score = 98438

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

221/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

score contributions by cell					
cell	misses	hits	tally per history	weight per hit	
1	300	10572	15388	4.56209E-07	2.96470E-05
2	301	46263	53422	1.47242E-06	2.75621E-05
3	302	8095576	3384659	3.13161E-05	9.25237E-06
4	303	48280	23917	2.84603E-07	1.18996E-05
5	304	17	7	4.92977E-11	7.04253E-06
6	305	4477	48	1.78617E-10	3.72119E-06
7	306	12	0	0.00000E+00	0.00000E+00
8	307	13565	353	1.30442E-09	3.69524E-06
9	320	42134	25539	3.66943E-07	1.43680E-05
10	321	10764	515	1.92301E-09	3.73400E-06
11	322	43118	29397	4.04653E-07	1.37651E-05
12	323	89	60	9.16397E-10	1.52733E-05
13	324	12	58	1.52248E-09	2.62496E-05
14	330	5025	301	1.14946E-09	3.81882E-06
15	340	0	1	3.72436E-12	3.72436E-06
16	341	164349	83868	4.59000E-07	5.47289E-06
17	342	346	552	5.14515E-09	9.32093E-06
19	344	197	301	2.43807E-09	8.09991E-06
21	346	210	355	2.61240E-09	7.35887E-06
22	347	0	1	4.02132E-12	4.02132E-06
23	348	253	307	2.04453E-09	6.65969E-06
24	349	13	2	7.43850E-12	3.71925E-06
25	350	791	88	3.29370E-10	3.74284E-06
27	352	436	42	1.56340E-10	3.72237E-06
28	353	0	1	4.17780E-12	4.17780E-06
29	354	784	74	2.77146E-10	3.74522E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	59287	24576	1.63198E-07	6.64053E-06
33	422	1645	171	6.42474E-10	3.75716E-06
35	426	1385	263	1.02133E-09	3.88339E-06
36	427	534837	465672	2.15260E-06	4.62257E-06
37	430	832	816	7.96010E-09	9.75503E-06
39	436	1178	1392	1.27240E-08	9.14079E-06
40	404	223	421	3.30396E-09	7.84789E-06
41	402	51726	23739	1.23397E-07	5.19807E-06
42	400	399	42	1.59840E-10	3.80571E-06
43	410	4	0	0.00000E+00	0.00000E+00
total	9138801	4136348	3.72450E-05	9.00432E-06	

score misses	
russian roulette on pd	0
psc=0.	300657
russian roulette in transmission	8837447
underflow in transmission	697
hit a zero-importance cell	0
energy cutoff	0

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

222/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

detector symmetric about z-axis located at z = 3.83022E+01 with radius = 3.21394E+01
4.96824E-03 0.0016

detector symmetric about z-axis located at z = 3.83022E+01 with radius = 3.21394E+01
uncollided neutron flux
7.91104E-04 0.0013

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	2016521	0.47219	7.16850E-06	0.20168
1.00000E+00	2136106	0.97239	2.23966E-05	0.83180
2.00000E+00	102873	0.99647	4.76946E-06	0.96599
5.00000E+00	12065	0.99930	1.09499E-06	0.99679
1.00000E+01	341	0.99938	7.84809E-08	0.99900
1.00000E+02	51	0.99939	2.90923E-08	0.99982
1.00000E+03	0	0.99939	0.00000E+00	0.99982
1.00000E+38	0	0.99939	0.00000E+00	0.99982
1st 200 histories	2597	1.00000	6.36943E-09	1.00000

average tally per history = 3.55435E-05 largest score = 2.31279E-03
(largest score)/(average tally) = 6.50692E+01 nps of largest score = 840639

score contributions by cell					
cell	misses	hits	tally per history	weight per hit	
1	300	9943	16017	4.44898E-07	2.77766E-05
2	301	43567	56118	1.44775E-06	2.57983E-05
3	302	7929900	3550335	3.02967E-05	8.53349E-06
4	303	49633	22564	2.02157E-07	8.95925E-06
5	304	18	6	4.57166E-11	7.61943E-06
6	305	4474	51	1.83279E-10	3.59371E-06
7	306	12	0	0.00000E+00	0.00000E+00
8	307	13520	398	1.40723E-09	3.53575E-06
9	320	43449	24224	2.70965E-07	1.11858E-05
10	321	10774	505	1.80093E-09	3.56620E-06
11	322	45028	27487	2.92222E-07	1.06313E-05
12	323	91	58	6.99274E-10	1.20564E-05
13	324	16	54	1.13911E-09	2.10946E-05
14	330	5018	308	1.10582E-09	3.59034E-06
15	340	1	0	0.00000E+00	0.00000E+00
16	341	170145	78072	3.68651E-07	4.72194E-06
17	342	388	510	3.47978E-09	6.82309E-06
19	344	211	287	1.63943E-09	5.71232E-06
21	346	263	302	1.75305E-09	5.80480E-06
22	347	0	1	6.49816E-12	6.49816E-06
23	348	268	292	1.53761E-09	5.26580E-06
24	349	11	4	1.42194E-11	3.55484E-06
25	350	797	82	2.97410E-10	3.62695E-06
27	352	440	38	1.35188E-10	3.55758E-06
28	353	1	0	0.00000E+00	0.00000E+00

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

223/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

29	354	780	78	2.77252E-10	3.55451E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	60758	23105	1.32433E-07	5.73180E-06
33	422	1661	155	5.97551E-10	3.85517E-06
35	426	1404	244	8.78768E-10	3.60151E-06
36	427	555431	445078	1.95603E-06	4.39481E-06
37	430	973	675	5.58006E-09	8.26675E-06
39	436	1453	1117	6.25721E-09	5.60180E-06
40	404	299	345	1.56491E-09	4.53598E-06
41	402	53458	22007	1.01160E-07	4.59673E-06
42	400	404	37	1.31713E-10	3.55981E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	9004595	4270554	3.55435E-05	8.32293E-06

score misses

russian roulette on pd	0
psc=0.	299686
russian roulette in transmission	8704212
underflow in transmission	697
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = 3.21394E+01 with radius = 3.83022E+01
4.65301E-03 0.0015

detector symmetric about z-axis located at z = 3.21394E+01 with radius = 3.83022E+01
uncollided neutron flux
7.29148E-04 0.0013

detector score diagnostics		cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
times average score	transmissions			
1.00000E-01	2088479	0.47548	7.09216E-06	0.20866
1.00000E+00	2199767	0.97630	2.20246E-05	0.85666
2.00000E+00	92912	0.99746	4.05067E-06	0.97584
5.00000E+00	8231	0.99933	7.12206E-07	0.99679
1.00000E+01	283	0.99940	6.31219E-08	0.99865
1.00000E+02	62	0.99941	3.53047E-08	0.99969
1.00000E+03	1	0.99941	4.29122E-09	0.99981
1.00000E+38	0	0.99941	0.00000E+00	0.99981
1st 200 histories	2591	1.00000	6.29558E-09	1.00000

average tally per history = 3.39886E-05 largest score = 4.29122E-03
(largest score)/(average tally) = 1.26255E+02 nps of largest score = 677577

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	9358	16602	4.33507E-07	2.61117E-05
2 301	41212	58473	1.40863E-06	2.40902E-05
3 302	7785238	3694997	2.92515E-05	7.91652E-06

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

224/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

4	303	51223	20974	1.43863E-07	6.85911E-06
5	304	19	5	3.04618E-11	6.09237E-06
6	305	4473	52	1.76703E-10	3.39814E-06
7	306	12	0	0.00000E+00	0.00000E+00
8	307	13504	414	1.39317E-09	3.36515E-06
9	320	44533	23140	2.00409E-07	8.66074E-06
10	321	10720	559	1.90814E-09	3.41349E-06
11	322	46324	26191	2.19260E-07	8.37157E-06
12	323	96	53	4.72518E-10	8.91544E-06
13	324	16	54	7.70926E-10	1.42764E-05
14	330	5004	322	1.09446E-09	3.39893E-06
15	340	1	0	0.00000E+00	0.00000E+00
16	341	173724	74493	3.12733E-07	4.19816E-06
17	342	439	459	2.27944E-09	4.96610E-06
19	344	258	240	1.22701E-09	5.11256E-06
21	346	298	267	1.25820E-09	4.71236E-06
22	347	0	1	4.87335E-12	4.87335E-06
23	348	315	245	1.16045E-09	4.73655E-06
24	349	14	1	3.39140E-12	3.39140E-06
25	350	784	95	3.23532E-10	3.40560E-06
27	352	435	43	1.61159E-10	3.74788E-06
28	353	1	0	0.00000E+00	0.00000E+00
29	354	804	54	1.92156E-10	3.55844E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	62342	21521	1.11187E-07	5.16645E-06
33	422	1660	156	5.53920E-10	3.55077E-06
35	426	1411	237	8.27226E-10	3.49040E-06
36	427	569997	430512	1.80101E-06	4.18342E-06
37	430	1093	555	3.13539E-09	5.64935E-06
39	436	1735	835	3.38908E-09	4.05878E-06
40	404	381	263	9.71658E-10	3.69452E-06
41	402	54982	20483	8.50518E-08	4.15231E-06
42	400	411	30	1.02680E-10	3.42265E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	8882823	4392326	3.39886E-05	7.73818E-06

score misses

russian roulette on pd	0
psc=0.	299386
russian roulette in transmission	8582778
underflow in transmission	659
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = 2.50000E+01 with radius = 4.33013E+01
4.36614E-03 0.0015

detector symmetric about z-axis located at z = 2.50000E+01 with radius = 4.33013E+01
uncollided neutron flux
6.72040E-04 0.0014

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

225/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	2155759	0.48105	6.99801E-06	0.21541
1.00000E+00	2230687	0.97881	2.13215E-05	0.87173
2.00000E+00	85509	0.99789	3.52064E-06	0.98010
5.00000E+00	6495	0.99934	5.47295E-07	0.99695
1.00000E+01	281	0.99940	5.89574E-08	0.99876
1.00000E+02	65	0.99942	3.34796E-08	0.99979
1.00000E+03	0	0.99942	0.00000E+00	0.99979
1.00000E+38	0	0.99942	0.00000E+00	0.99979
1st 200 histories	2602	1.00000	6.70269E-09	1.00000

average tally per history = 3.24866E-05 largest score = 1.45674E-03
 (largest score)/(average tally) = 4.48415E+01 nps of largest score = 995627

score contributions by cell				
cell	misses	hits	tally per history	weight per hit
1	300	8834	17126	4.18599E-07
2	301	39220	60465	1.36961E-06
3	302	7671988	3808247	2.81712E-05
4	303	53558	18639	9.95454E-08
5	304	15	9	3.52691E-11
6	305	4437	88	2.85680E-10
7	306	12	0	0.00000E+00
8	307	13408	510	1.67070E-09
9	320	46160	21513	1.50693E-07
10	321	10619	660	2.17752E-09
11	322	48152	24363	1.62309E-07
12	323	95	54	3.10323E-10
13	324	30	40	4.90888E-10
14	330	4998	328	1.07030E-09
15	340	1	0	0.00000E+00
16	341	177794	70423	2.68766E-07
17	342	469	429	1.65329E-09
19	344	314	184	7.11751E-10
21	346	331	234	9.07879E-10
22	347	0	1	3.24593E-12
23	348	345	215	8.44000E-10
24	349	11	4	1.29845E-11
25	350	796	83	2.73625E-10
27	352	431	47	1.57749E-10
28	353	1	0	0.00000E+00
29	354	788	70	2.27930E-10
31	356	2	0	0.00000E+00
32	420	63670	20193	9.55608E-08
33	422	1658	158	5.60062E-10
35	426	1402	246	8.41761E-10
36	427	583781	416728	1.65850E-06

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

226/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. MCCONN

DATE: 03/21/10

37	430	1202	446	2.18642E-09	4.90228E-06
39	436	1947	623	2.26811E-09	3.64062E-06
40	404	436	208	7.37229E-10	3.54437E-06
41	402	56445	19020	7.42380E-08	3.90315E-06
42	400	397	44	1.45500E-10	3.30682E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	8793751	4481398	3.24866E-05	7.24920E-06

score misses

russian roulette on pd	0
psc=0.	299797
russian roulette in transmission	8493301
underflow in transmission	653
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = 1.71010E+01 with radius = 4.69846E+01
4.09811E-03 0.0015

detector symmetric about z-axis located at z = 1.71010E+01 with radius = 4.69846E+01
uncollided neutron flux
6.19941E-04 0.0014

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	2210752	0.48787	6.86253E-06	0.22092
1.00000E+00	2229800	0.97995	2.03921E-05	0.87739
2.00000E+00	81665	0.99797	3.20899E-06	0.98069
5.00000E+00	6223	0.99935	5.06925E-07	0.99701
1.00000E+01	292	0.99941	5.89936E-08	0.99891
1.00000E+02	58	0.99943	2.75501E-08	0.99980
1.00000E+03	0	0.99943	0.00000E+00	0.99980
1.00000E+38	0	0.99943	0.00000E+00	0.99980
1st 200 histories	2605	1.00000	6.33726E-09	1.00000

average tally per history = 3.10634E-05 largest score = 1.79692E-03
(largest score)/(average tally) = 5.78468E+01 nps of largest score = 78185

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	8207	17753	4.12452E-07	2.32328E-05
2 301	37464	62221	1.34790E-06	2.16631E-05
3 302	7596909	3883326	2.70745E-05	6.97198E-06
4 303	56145	16052	6.88068E-08	4.28649E-06
5 304	14	10	4.68842E-11	4.68842E-06
6 305	4406	119	3.69739E-10	3.10705E-06
7 306	11	1	3.10571E-12	3.10571E-06
8 307	13278	640	2.01135E-09	3.14274E-06
9 320	48080	19593	1.12471E-07	5.74034E-06

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

227/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

10	321	10500	779	2.43986E-09	3.13205E-06
11	322	50299	22216	1.21723E-07	5.47906E-06
12	323	112	37	2.12558E-10	5.74481E-06
13	324	31	39	4.11030E-10	1.05392E-05
14	330	4912	414	1.30579E-09	3.15408E-06
15	340	0	1	3.10302E-12	3.10302E-06
16	341	182336	65881	2.33730E-07	3.54775E-06
17	342	587	311	1.02161E-09	3.28493E-06
19	344	341	157	5.12692E-10	3.26556E-06
21	346	367	198	6.88844E-10	3.47901E-06
22	347	1	0	0.00000E+00	0.00000E+00
23	348	383	177	6.28847E-10	3.55281E-06
24	349	14	1	3.10443E-12	3.10443E-06
25	350	775	104	3.28414E-10	3.15783E-06
27	352	421	57	1.78166E-10	3.12571E-06
28	353	0	1	3.10340E-12	3.10340E-06
29	354	769	89	2.76500E-10	3.10674E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	65091	18772	8.17645E-08	4.35566E-06
33	422	1607	209	6.77761E-10	3.24288E-06
35	426	1384	264	8.67725E-10	3.28684E-06
36	427	597461	403048	1.52830E-06	3.79186E-06
37	430	1253	395	1.78617E-09	4.52195E-06
39	436	2140	430	1.46528E-09	3.40762E-06
40	404	496	148	4.69080E-10	3.16946E-06
41	402	57553	17912	6.59754E-08	3.68331E-06
42	400	401	40	1.29226E-10	3.23065E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	8743754	4531395	3.10634E-05	6.85515E-06

score misses

russian roulette on pd	0
psc=0.	298077
russian roulette in transmission	8445004
underflow in transmission	673
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = 8.68241E+00 with radius = 4.92404E+01
3.85654E-03 0.0015

detector symmetric about z-axis located at z = 8.68241E+00 with radius = 4.92404E+01
uncollided neutron flux
5.73696E-04 0.0014

detector score diagnostics		cumulative	tally	cumulative
times average score	transmissions	fraction of	per	fraction of
		transmissions	history	total tally
1.00000E-01	2239538	0.49379	6.64025E-06	0.22364
1.00000E+00	2202754	0.97948	1.93043E-05	0.87382

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

228/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

2.00000E+00	83771	0.99795	3.15457E-06	0.98006
5.00000E+00	6323	0.99934	4.94907E-07	0.99673
1.00000E+01	321	0.99941	6.25000E-08	0.99883
1.00000E+02	63	0.99942	2.82800E-08	0.99979
1.00000E+03	0	0.99942	0.00000E+00	0.99979
1.00000E+38	0	0.99942	0.00000E+00	0.99979
1st 200 histories	2610	1.00000	6.31740E-09	1.00000

average tally per history = 2.96912E-05 largest score = 9.22088E-04
 (largest score)/(average tally) = 3.10560E+01 nps of largest score = 425819

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	8023	17937	3.92938E-07	2.19066E-05
2 301	36325	63360	1.29534E-06	2.04442E-05
3 302	7571584	3908651	2.60033E-05	6.65275E-06
4 303	58680	13517	4.92073E-08	3.64040E-06
5 304	20	4	1.69785E-11	4.24461E-06
6 305	4318	207	6.21686E-10	3.00332E-06
7 306	12	0	0.00000E+00	0.00000E+00
8 307	13152	766	2.29619E-09	2.99764E-06
9 320	50596	17077	8.47043E-08	4.96014E-06
10 321	10232	1047	3.13188E-09	2.99129E-06
11 322	52671	19844	9.45121E-08	4.76275E-06
12 323	119	30	1.62043E-10	5.40143E-06
13 324	39	31	3.73458E-10	1.20470E-05
14 330	4854	472	1.41878E-09	3.00590E-06
15 340	1	0	0.00000E+00	0.00000E+00
16 341	185342	62875	2.10239E-07	3.34376E-06
17 342	700	198	5.98558E-10	3.02302E-06
19 344	390	108	3.36268E-10	3.11359E-06
21 346	423	142	4.29997E-10	3.02815E-06
22 347	1	0	0.00000E+00	0.00000E+00
23 348	423	137	4.20978E-10	3.07283E-06
24 349	12	3	8.89624E-12	2.96541E-06
25 350	758	121	3.66911E-10	3.03232E-06
27 352	430	48	1.43195E-10	2.98324E-06
28 353	1	0	0.00000E+00	0.00000E+00
29 354	753	105	3.11984E-10	2.97128E-06
31 356	2	0	0.00000E+00	0.00000E+00
32 420	66063	17800	7.31333E-08	4.10861E-06
33 422	1601	215	6.55411E-10	3.04842E-06
35 426	1369	279	8.91169E-10	3.19415E-06
36 427	607925	392584	1.41368E-06	3.60096E-06
37 430	1338	310	1.14618E-09	3.69735E-06
39 436	2154	416	1.27769E-09	3.07136E-06
40 404	508	136	4.11709E-10	3.02727E-06
41 402	58541	16924	5.90243E-08	3.48761E-06
42 400	405	36	1.06757E-10	2.96546E-06
43 410	4	0	0.00000E+00	0.00000E+00

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

229/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

total 8739769 4535380 2.96912E-05 6.54657E-06

score misses

russian roulette on pd	0
psc=0.	298348
russian roulette in transmission	8440627
underflow in transmission	794
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = 0.00000E+00 with radius = 5.00000E+01
3.63676E-03 0.0015

detector symmetric about z-axis located at z = 0.00000E+00 with radius = 5.00000E+01
uncollided neutron flux
5.29952E-04 0.0015

detector score diagnostics

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	2228068	0.49660	6.33970E-06	0.22272
1.00000E+00	2157685	0.97752	1.82190E-05	0.86277
2.00000E+00	91004	0.99780	3.29187E-06	0.97841
5.00000E+00	6869	0.99933	5.17475E-07	0.99659
1.00000E+01	344	0.99941	6.38501E-08	0.99884
1.00000E+02	59	0.99942	2.71973E-08	0.99979
1.00000E+03	0	0.99942	0.00000E+00	0.99979
1.00000E+38	0	0.99942	0.00000E+00	0.99979
1st 200 histories	2603	1.00000	5.93692E-09	1.00000

average tally per history = 2.84650E-05 largest score = 1.58165E-03
(largest score)/(average tally) = 5.55648E+01 nps of largest score = 221756

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	8074	17886	3.80588E-07	2.12785E-05
2 301	36124	63561	1.26282E-06	1.98679E-05
3 302	7596046	3884189	2.50096E-05	6.43883E-06
4 303	61186	11011	3.73233E-08	3.38964E-06
5 304	20	4	1.13834E-11	2.84586E-06
6 305	4102	423	1.22306E-09	2.89139E-06
7 306	10	2	5.69256E-12	2.84628E-06
8 307	13032	886	2.57716E-09	2.90876E-06
9 320	52631	15042	6.70996E-08	4.46082E-06
10 321	9994	1285	3.76018E-09	2.92621E-06
11 322	55009	17506	7.47177E-08	4.26812E-06
12 323	120	29	1.30262E-10	4.49181E-06
13 324	47	23	2.23179E-10	9.70343E-06
14 330	4705	621	1.82569E-09	2.93991E-06
15 340	1	0	0.00000E+00	0.00000E+00

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

230/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

16	341	188629	59588	1.90387E-07	3.19506E-06
17	342	752	146	4.20375E-10	2.87928E-06
19	344	421	77	2.20272E-10	2.86067E-06
21	346	451	114	3.33866E-10	2.92865E-06
22	347	1	0	0.00000E+00	0.00000E+00
23	348	450	110	3.17048E-10	2.88226E-06
24	349	9	6	1.70651E-11	2.84419E-06
25	350	716	163	4.65435E-10	2.85543E-06
27	352	402	76	2.35004E-10	3.09216E-06
28	353	0	1	2.84326E-12	2.84326E-06
29	354	708	150	4.45938E-10	2.97292E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	66617	17246	6.80578E-08	3.94630E-06
33	422	1595	221	6.46298E-10	2.92443E-06
35	426	1351	297	9.76859E-10	3.28909E-06
36	427	621276	379233	1.30511E-06	3.44144E-06
37	430	1390	258	8.39020E-10	3.25202E-06
39	436	2226	344	1.00385E-09	2.91816E-06
40	404	552	92	2.63942E-10	2.86893E-06
41	402	59474	15991	5.31889E-08	3.32618E-06
42	400	391	50	1.42284E-10	2.84568E-06
43	410	3	1	2.84326E-12	2.84326E-06
total	8788517	4486632		2.84650E-05	6.34441E-06

score misses

russian roulette on pd	0
psc=0.	299079
russian roulette in transmission	8488657
underflow in transmission	781
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = -8.68241E+00 with radius = 4.92404E+01
3.43451E-03 0.0016

detector symmetric about z-axis located at z = -8.68241E+00 with radius = 4.92404E+01
uncollided neutron flux
4.92598E-04 0.0015

detector score diagnostics

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	2178244	0.49438	5.93815E-06	0.21757
1.00000E+00	2114300	0.97425	1.71421E-05	0.84564
2.00000E+00	102462	0.99751	3.54615E-06	0.97557
5.00000E+00	7939	0.99931	5.66968E-07	0.99635
1.00000E+01	356	0.99939	6.33344E-08	0.99867
1.00000E+02	74	0.99941	3.06255E-08	0.99979
1.00000E+03	0	0.99941	0.00000E+00	0.99979
1.00000E+38	0	0.99941	0.00000E+00	0.99979

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

231/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²CF NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. MCCONN

DATE: 03/21/10

1st 200 histories 2601 1.00000 5.77068E-09 1.00000

average tally per history = 2.72931E-05 largest score = 1.09283E-03
 (largest score)/(average tally) = 4.00404E+01 nps of largest score = 90048

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	8650	17310	3.65675E-07	2.11251E-05
2 301	38032	61653	1.21189E-06	1.96567E-05
3 302	7657765	3822470	2.40476E-05	6.29111E-06
4 303	62537	9660	3.17976E-08	3.29168E-06
5 304	20	4	1.08968E-11	2.72419E-06
6 305	3724	801	2.46207E-09	3.07375E-06
7 306	8	4	1.09118E-11	2.72796E-06
8 307	12771	1147	3.19387E-09	2.78454E-06
9 320	54198	13475	5.35756E-08	3.97593E-06
10 321	9578	1701	4.72177E-09	2.77588E-06
11 322	56643	15872	6.08007E-08	3.83069E-06
12 323	128	21	9.50409E-11	4.52576E-06
13 324	55	15	1.94112E-10	1.29408E-05
14 330	4605	721	2.09332E-09	2.90336E-06
15 340	1	0	0.00000E+00	0.00000E+00
16 341	190294	57923	1.77291E-07	3.06080E-06
17 342	810	88	2.40857E-10	2.73702E-06
19 344	428	70	1.90867E-10	2.72667E-06
21 346	474	91	2.51685E-10	2.76577E-06
22 347	1	0	0.00000E+00	0.00000E+00
23 348	470	90	2.51443E-10	2.79381E-06
24 349	13	2	5.45380E-12	2.72690E-06
25 350	694	185	5.13622E-10	2.77633E-06
27 352	376	102	2.86344E-10	2.80729E-06
28 353	0	1	2.72603E-12	2.72603E-06
29 354	683	175	4.97128E-10	2.84073E-06
31 356	2	0	0.00000E+00	0.00000E+00
32 420	66980	16883	6.44137E-08	3.81530E-06
33 422	1577	239	6.63960E-10	2.77807E-06
35 426	1346	302	1.03200E-09	3.41722E-06
36 427	631565	368944	1.21248E-06	3.28634E-06
37 430	1420	228	6.73502E-10	2.95396E-06
39 436	2306	264	7.48587E-10	2.83556E-06
40 404	581	63	1.72334E-10	2.73546E-06
41 402	60049	15416	4.91579E-08	3.18876E-06
42 400	385	56	1.55939E-10	2.78462E-06
43 410	4	0	0.00000E+00	0.00000E+00
total	8869173	4405976	2.72931E-05	6.19457E-06

score misses

russian roulette on pd 0
 psc=0. 298856
 russian roulette in transmission 8569572

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

232/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

underflow in transmission 745
hit a zero-importance cell 0
energy cutoff 0

detector symmetric about z-axis located at z = -1.71010E+01 with radius = 4.69846E+01
3.26793E-03 0.0016

detector symmetric about z-axis located at z = -1.71010E+01 with radius = 4.69846E+01
uncollided neutron flux
4.62072E-04 0.0015

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	2097045	0.48931	5.51730E-06	0.20987
1.00000E+00	2062262	0.97050	1.62004E-05	0.82610
2.00000E+00	114132	0.99713	3.83598E-06	0.97201
5.00000E+00	9207	0.99928	6.31742E-07	0.99604
1.00000E+01	423	0.99937	7.09698E-08	0.99874
1.00000E+02	75	0.99939	2.73345E-08	0.99978
1.00000E+03	0	0.99939	0.00000E+00	0.99978
1.00000E+38	0	0.99939	0.00000E+00	0.99978
1st 200 histories	2609	1.00000	5.69645E-09	1.00000

average tally per history = 2.62894E-05 largest score = 9.61596E-04
(largest score)/(average tally) = 3.65773E+01 nps of largest score = 427168

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	9412	16548	3.52798E-07	2.13197E-05
2 301	40750	58935	1.17799E-06	1.99880E-05
3 302	7761573	3718662	2.31980E-05	6.23826E-06
4 303	63280	8917	2.93191E-08	3.28800E-06
5 304	20	4	1.05148E-11	2.62869E-06
6 305	3297	1228	4.51667E-09	3.67807E-06
7 306	9	3	2.95267E-11	9.84222E-06
8 307	12250	1668	4.52538E-09	2.71306E-06
9 320	55186	12487	4.38913E-08	3.51496E-06
10 321	8937	2342	6.52108E-09	2.78441E-06
11 322	57686	14829	5.01081E-08	3.37906E-06
12 323	129	20	6.07085E-11	3.03543E-06
13 324	59	11	9.19343E-11	8.35766E-06
14 330	4480	846	2.36794E-09	2.79899E-06
15 340	1	0	0.00000E+00	0.00000E+00
16 341	192083	56134	1.68321E-07	2.99855E-06
17 342	819	79	2.14908E-10	2.72036E-06
19 344	450	48	1.26228E-10	2.62975E-06
21 346	503	62	1.65399E-10	2.66773E-06
22 347	0	1	2.62721E-12	2.62721E-06
23 348	509	51	1.32630E-10	2.60060E-06

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

233/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

24	349	13	2	5.74422E-12	2.87211E-06
25	350	656	223	6.51186E-10	2.92012E-06
27	352	368	110	3.25502E-10	2.95911E-06
28	353	1	0	0.00000E+00	0.00000E+00
29	354	623	235	6.62604E-10	2.81959E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	67586	16277	6.14102E-08	3.77282E-06
33	422	1558	258	7.29763E-10	2.82854E-06
35	426	1319	329	1.12506E-09	3.41964E-06
36	427	640841	359668	1.13682E-06	3.16076E-06
37	430	1445	203	5.61711E-10	2.76705E-06
39	436	2306	264	7.08762E-10	2.68470E-06
40	404	602	42	1.12504E-10	2.67866E-06
41	402	60273	15192	4.68912E-08	3.08657E-06
42	400	366	75	2.08028E-10	2.77371E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	8989396	4285753	2.62894E-05	6.13414E-06

score misses

russian roulette on pd	0
psc=0.	299593
russian roulette in transmission	8689095
underflow in transmission	708
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = -2.50000E+01 with radius = 4.33013E+01
3.13068E-03 0.0018

detector symmetric about z-axis located at z = -2.50000E+01 with radius = 4.33013E+01
uncollided neutron flux
4.35666E-04 0.0015

detector score diagnostics		cumulative	tally	cumulative
times	average score	fraction of	per	fraction of
	transmissions	transmissions	history	total tally
1.00000E-01	1999804	0.48353	5.09010E-06	0.20014
1.00000E+00	1992802	0.96536	1.52348E-05	0.79916
2.00000E+00	128536	0.99644	4.23724E-06	0.96576
5.00000E+00	11608	0.99925	7.59387E-07	0.99562
1.00000E+01	441	0.99936	7.40342E-08	0.99853
1.00000E+02	72	0.99937	2.95564E-08	0.99969
1.00000E+03	1	0.99937	2.99322E-09	0.99981
1.00000E+38	0	0.99937	0.00000E+00	0.99981
1st 200 histories	2594	1.00000	4.86017E-09	1.00000

average tally per history = 2.54330E-05 largest score = 2.99322E-03
(largest score)/(average tally) = 1.17690E+02 nps of largest score = 333516

score contributions by cell

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

234/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

	cell	misses	hits	tally per history	weight per hit
1	300	10477	15483	3.40224E-07	2.19741E-05
2	301	44117	55568	1.14455E-06	2.05973E-05
3	302	7898916	3581319	2.24637E-05	6.27245E-06
4	303	63613	8584	2.81030E-08	3.27388E-06
5	304	20	4	1.01709E-11	2.54272E-06
6	305	2733	1792	8.48170E-09	4.73309E-06
7	306	5	7	3.32583E-11	4.75119E-06
8	307	11626	2292	6.37621E-09	2.78194E-06
9	320	55768	11905	3.76171E-08	3.15977E-06
10	321	8294	2985	8.54837E-09	2.86378E-06
11	322	58496	14019	4.35566E-08	3.10697E-06
12	323	132	17	4.33094E-11	2.54761E-06
13	324	63	7	4.14731E-11	5.92473E-06
14	330	4275	1051	2.90585E-09	2.76484E-06
15	340	1	0	0.00000E+00	0.00000E+00
16	341	192637	55580	1.65031E-07	2.96925E-06
17	342	844	54	1.38638E-10	2.56737E-06
19	344	453	45	1.14591E-10	2.54646E-06
21	346	517	48	1.24058E-10	2.58454E-06
22	347	1	0	0.00000E+00	0.00000E+00
23	348	501	59	1.47803E-10	2.50514E-06
24	349	10	5	1.59667E-11	3.19333E-06
25	350	619	260	7.98046E-10	3.06941E-06
27	352	319	159	4.75631E-10	2.99139E-06
28	353	0	1	2.54470E-12	2.54470E-06
29	354	582	276	8.34951E-10	3.02518E-06
31	356	1	1	2.54295E-12	2.54295E-06
32	420	67523	16340	6.05108E-08	3.70323E-06
33	422	1540	276	7.58494E-10	2.74817E-06
35	426	1280	368	1.47230E-09	4.00081E-06
36	427	648747	351762	1.07143E-06	3.04590E-06
37	430	1475	173	4.48936E-10	2.59500E-06
39	436	2336	234	6.24781E-10	2.67001E-06
40	404	594	50	1.27214E-10	2.54428E-06
41	402	60424	15041	4.55105E-08	3.02576E-06
42	400	348	93	2.55042E-10	2.74238E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	9139291	4135858	2.54330E-05	6.14938E-06

score misses

russian roulette on pd 0
 psc=0. 299390
 russian roulette in transmission 8839189
 underflow in transmission 712
 hit a zero-importance cell 0
 energy cutoff 0

detector symmetric about z-axis located at z =-3.21394E+01 with radius = 3.83022E+01
 3.02356E-03 0.0019

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

235/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. MCCONN

DATE: 03/21/10

detector symmetric about z-axis located at z = -3.21394E+01 with radius = 3.83022E+01
 uncollided neutron flux
 4.18317E-04 0.0015

detector score diagnostics		cumulative	tally	cumulative
times average score	transmissions	fraction of	per	fraction of
		transmissions	history	total tally
1.00000E-01	1896398	0.47855	4.69525E-06	0.18992
1.00000E+00	1907406	0.95988	1.42770E-05	0.76743
2.00000E+00	138548	0.99484	4.51950E-06	0.95024
5.00000E+00	17158	0.99917	1.08713E-06	0.99421
1.00000E+01	583	0.99932	9.29633E-08	0.99797
1.00000E+02	112	0.99934	4.51620E-08	0.99980
1.00000E+03	0	0.99934	0.00000E+00	0.99980
1.00000E+38	0	0.99934	0.00000E+00	0.99980
1st 200 histories	2598	1.00000	4.90434E-09	1.00000

average tally per history = 2.47220E-05 largest score = 1.41452E-03
 (largest score)/(average tally) = 5.72171E+01 nps of largest score = 111062

score contributions by cell				
cell	misses	hits	tally per history	weight per hit
1 300	11417	14543	3.31928E-07	2.28239E-05
2 301	47273	52412	1.11502E-06	2.12741E-05
3 302	8066023	3414212	2.18226E-05	6.39169E-06
4 303	63600	8597	2.83039E-08	3.29230E-06
5 304	20	4	9.89148E-12	2.47287E-06
6 305	2331	2194	1.24703E-08	5.68382E-06
7 306	5	7	1.25693E-10	1.79562E-05
8 307	10880	3038	9.04606E-09	2.97764E-06
9 320	56305	11368	3.45466E-08	3.03894E-06
10 321	7614	3665	1.16725E-08	3.18485E-06
11 322	58877	13638	4.13373E-08	3.03104E-06
12 323	126	23	5.75330E-11	2.50144E-06
13 324	69	1	2.47697E-12	2.47697E-06
14 330	4057	1269	3.85183E-09	3.03532E-06
15 340	1	0	0.00000E+00	0.00000E+00
16 341	192931	55286	1.66169E-07	3.00563E-06
17 342	858	40	9.90254E-11	2.47564E-06
19 344	470	28	7.16245E-11	2.55802E-06
21 346	521	44	1.08912E-10	2.47527E-06
22 347	1	0	0.00000E+00	0.00000E+00
23 348	508	52	1.29364E-10	2.48777E-06
24 349	10	5	1.26782E-11	2.53564E-06
25 350	577	302	1.00374E-09	3.32364E-06
27 352	321	157	5.00168E-10	3.18578E-06
28 353	1	0	0.00000E+00	0.00000E+00
29 354	551	307	1.08415E-09	3.53142E-06
31 356	2	0	0.00000E+00	0.00000E+00

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

236/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

32	420	67063	16800	6.23909E-08	3.71375E-06
33	422	1406	410	1.18156E-09	2.88186E-06
35	426	1162	486	1.97261E-09	4.05886E-06
36	427	652407	348102	1.02870E-06	2.95517E-06
37	430	1488	160	4.03906E-10	2.52441E-06
39	436	2369	201	5.27534E-10	2.62455E-06
40	404	590	54	1.33645E-10	2.47490E-06
41	402	60183	15282	4.62179E-08	3.02433E-06
42	400	325	116	2.98554E-10	2.57374E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	9312346	3962803	2.47220E-05	6.23850E-06

score misses

russian roulette on pd	0
psc=0.	299667
russian roulette in transmission	9011987
underflow in transmission	692
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = -3.83022E+01 with radius = 3.21394E+01
2.95351E-03 0.0021

detector symmetric about z-axis located at z = -3.83022E+01 with radius = 3.21394E+01
uncollided neutron flux
4.06998E-04 0.0015

detector score diagnostics		cumulative	tally	cumulative
times	average score	fraction of	per	fraction of
	transmissions	transmissions	history	total tally
1.00000E-01	1796967	0.47571	4.35185E-06	0.17993
1.00000E+00	1805323	0.95363	1.33117E-05	0.73033
2.00000E+00	145692	0.99220	4.71457E-06	0.92526
5.00000E+00	25984	0.99908	1.64135E-06	0.99312
1.00000E+01	760	0.99928	1.16968E-07	0.99796
1.00000E+02	125	0.99931	4.40625E-08	0.99978
1.00000E+03	0	0.99931	0.00000E+00	0.99978
1.00000E+38	0	0.99931	0.00000E+00	0.99978
1st 200 histories	2600	1.00000	5.26357E-09	1.00000

average tally per history = 2.41857E-05 largest score = 9.68980E-04
(largest score)/(average tally) = 4.00641E+01 nps of largest score = 336843

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	12294	13666	3.25897E-07	2.38473E-05
2 301	50541	49144	1.09395E-06	2.22602E-05
3 302	8249336	3230899	2.13031E-05	6.59355E-06
4 303	63744	8453	2.87195E-08	3.39756E-06
5 304	21	3	7.26059E-12	2.42020E-06

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

238/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. MCCONN

DATE: 03/21/10

times average score	transmissions	fraction of transmissions	per history	fraction of total tally
1.00000E-01	1707076	0.47560	4.07727E-06	0.17095
1.00000E+00	1694166	0.94760	1.23670E-05	0.68946
2.00000E+00	147207	0.98861	4.75251E-06	0.88872
5.00000E+00	36682	0.99883	2.36756E-06	0.98798
1.00000E+01	1414	0.99922	2.10681E-07	0.99681
1.00000E+02	184	0.99928	7.11905E-08	0.99980
1.00000E+03	0	0.99928	0.00000E+00	0.99980
1.00000E+38	0	0.99928	0.00000E+00	0.99980
1st 200 histories	2599	1.00000	4.79179E-09	1.00000

average tally per history = 2.38510E-05 largest score = 2.28606E-03
 (largest score)/(average tally) = 9.58474E+01 nps of largest score = 963000

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1	300	13230	12730	3.18472E-07
2	301	53742	45943	1.08216E-06
3	302	8445652	3034583	2.09252E-05
4	303	63548	8649	2.94419E-08
5	304	19	5	1.19367E-11
6	305	1741	2784	2.74531E-08
7	306	4	8	1.00338E-10
8	307	9671	4247	1.80257E-08
9	320	56251	11422	3.67824E-08
10	321	6594	4685	2.02778E-08
11	322	58480	14035	4.58173E-08
12	323	121	28	7.15686E-11
13	324	68	2	4.76974E-12
14	330	3749	1577	7.88631E-09
15	340	1	0	0.00000E+00
16	341	190839	57378	1.86302E-07
17	342	852	46	1.10235E-10
19	344	471	27	6.81865E-11
21	346	520	45	1.07796E-10
22	347	1	0	0.00000E+00
23	348	516	44	1.08098E-10
24	349	10	5	1.31794E-11
25	350	518	361	1.47345E-09
27	352	283	195	7.31658E-10
28	353	0	1	3.12971E-12
29	354	513	345	1.64283E-09
31	356	2	0	0.00000E+00
32	420	66240	17623	7.56763E-08
33	422	1107	709	4.44689E-09
35	426	1009	639	4.39124E-09
36	427	646301	354208	1.00793E-06
37	430	1519	129	3.45975E-10
39	436	2392	178	4.35373E-10

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

239/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

40	404	587	57	1.36747E-10	2.39907E-06
41	402	58986	16479	5.47655E-08	3.32335E-06
42	400	281	160	6.25365E-10	3.90853E-06
43	410	3	1	2.38736E-12	2.38736E-06
	total	9685821	3589328	2.38510E-05	6.64498E-06

score misses

russian roulette on pd	0
psc=0.	300410
russian roulette in transmission	9384720
underflow in transmission	691
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = -4.69846E+01 with radius = 1.71010E+01
2.93650E-03 0.0025

detector symmetric about z-axis located at z = -4.69846E+01 with radius = 1.71010E+01
uncollided neutron flux
4.25892E-04 0.0015

detector score diagnostics		cumulative	tally	cumulative
times average score	transmissions	fraction of	per	fraction of
		transmissions	per	total tally
			history	
1.00000E-01	1632144	0.47796	3.86903E-06	0.16327
1.00000E+00	1584093	0.94185	1.14484E-05	0.64640
2.00000E+00	145214	0.98438	4.69495E-06	0.84453
5.00000E+00	47580	0.99831	3.15067E-06	0.97749
1.00000E+01	2883	0.99916	4.25923E-07	0.99546
1.00000E+02	286	0.99924	1.02905E-07	0.99981
1.00000E+03	0	0.99924	0.00000E+00	0.99981
1.00000E+38	0	0.99924	0.00000E+00	0.99981
1st 200 histories	2597	1.00000	4.59957E-09	1.00000

average tally per history = 2.36965E-05 largest score = 1.69866E-03
(largest score)/(average tally) = 7.16839E+01 nps of largest score = 769882

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1	300	14161	11799	3.08416E-07
2	301	56869	42816	1.06390E-06
3	302	8644571	2835664	2.06796E-05
4	303	63179	9018	3.06597E-08
5	304	17	7	1.84251E-11
6	305	1651	2874	4.13074E-08
7	306	4	8	1.16120E-10
8	307	9288	4630	2.44960E-08
9	320	55646	12027	4.04983E-08
10	321	6289	4990	2.56569E-08
11	322	57690	14825	5.04804E-08

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

240/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

12	323	128	21	5.89094E-11	2.80521E-06
13	324	67	3	7.10791E-12	2.36930E-06
14	330	3628	1698	1.08710E-08	6.40222E-06
15	340	1	0	0.00000E+00	0.00000E+00
16	341	187655	60562	2.01476E-07	3.32678E-06
17	342	850	48	1.15889E-10	2.41435E-06
19	344	466	32	8.05043E-11	2.51576E-06
21	346	520	45	1.12629E-10	2.50286E-06
22	347	1	0	0.00000E+00	0.00000E+00
23	348	510	50	1.35325E-10	2.70649E-06
24	349	9	6	1.53085E-11	2.55142E-06
25	350	502	377	1.63034E-09	4.32450E-06
27	352	261	217	8.58561E-10	3.95650E-06
28	353	0	1	4.77965E-12	4.77965E-06
29	354	472	386	2.05024E-09	5.31151E-06
31	356	2	0	0.00000E+00	0.00000E+00
32	420	65057	18806	8.71075E-08	4.63190E-06
33	422	1067	749	7.56693E-09	1.01027E-05
35	426	949	699	5.75087E-09	8.22728E-06
36	427	626408	374101	1.04927E-06	2.80477E-06
37	430	1503	145	3.58731E-10	2.47401E-06
39	436	2379	191	5.21810E-10	2.73199E-06
40	404	585	59	1.41348E-10	2.39573E-06
41	402	57711	17754	6.22455E-08	3.50600E-06
42	400	252	189	9.37454E-10	4.96007E-06
43	410	4	0	0.00000E+00	0.00000E+00
	total	9860352	3414797	2.36965E-05	6.93936E-06

score misses

russian roulette on pd 0
 psc=0. 300105
 russian roulette in transmission 9559550
 underflow in transmission 697
 hit a zero-importance cell 0
 energy cutoff 0

detector symmetric about z-axis located at z = -4.92404E+01 with radius = 8.68241E+00
 2.93534E-03 0.0028

detector symmetric about z-axis located at z = -4.92404E+01 with radius = 8.68241E+00
 uncollided neutron flux
 4.02071E-04 0.0015

times average score	transmissions	cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
1.00000E-01	1542463	0.47982	3.64437E-06	0.15442
1.00000E+00	1466767	0.93609	1.05799E-05	0.60273
2.00000E+00	140018	0.97964	4.54759E-06	0.79543
5.00000E+00	57255	0.99745	3.88792E-06	0.96018

CALCULATION SHEET

PROJECT No.:

CALC No.:

REVISION No.: 0

SHEET No.:

241/246

PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. McCONN

DATE: 03/21/10

1.00000E+01	5101	0.99904	7.61707E-07	0.99245
1.00000E+02	489	0.99919	1.73699E-07	0.99981
1.00000E+03	0	0.99919	0.00000E+00	0.99981
1.00000E+38	0	0.99919	0.00000E+00	0.99981
1st 200 histories	2601	1.00000	4.44873E-09	1.00000

average tally per history = 2.35996E-05 largest score = 2.17871E-03
 (largest score)/(average tally) = 9.23198E+01 nps of largest score = 807287

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	14971	10989	3.07267E-07	2.79613E-05
2 301	59783	39902	1.06251E-06	2.66280E-05
3 302	8832546	2647689	2.05322E-05	7.75475E-06
4 303	62072	10125	3.75444E-08	3.70809E-06
5 304	20	4	1.00895E-11	2.52237E-06
6 305	1623	2902	5.83731E-08	2.01148E-05
7 306	1	11	4.42388E-10	4.02171E-05
8 307	9077	4841	3.37984E-08	6.98170E-06
9 320	54036	13637	5.23636E-08	3.83981E-06
10 321	6024	5255	3.55748E-08	6.76971E-06
11 322	54976	17539	6.55993E-08	3.74020E-06
12 323	119	30	8.02650E-11	2.67550E-06
13 324	67	3	7.09302E-12	2.36434E-06
14 330	3525	1801	1.66021E-08	9.21828E-06
15 340	1	0	0.00000E+00	0.00000E+00
16 341	185131	63086	2.30701E-07	3.65693E-06
17 342	824	74	1.75125E-10	2.36655E-06
19 344	452	46	1.11201E-10	2.41742E-06
21 346	506	59	1.47482E-10	2.49969E-06
22 347	1	0	0.00000E+00	0.00000E+00
23 348	480	80	1.95850E-10	2.44813E-06
24 349	12	3	1.41466E-11	4.71553E-06
25 350	487	392	2.10530E-09	5.37066E-06
27 352	247	231	1.27051E-09	5.50004E-06
28 353	0	1	3.69510E-12	3.69510E-06
29 354	504	354	2.39858E-09	6.77565E-06
31 356	2	0	0.00000E+00	0.00000E+00
32 420	66323	17540	8.61386E-08	4.91098E-06
33 422	1057	759	9.71342E-09	1.27977E-05
35 426	882	766	6.95551E-09	9.08031E-06
36 427	641494	359015	9.90592E-07	2.75919E-06
37 430	1481	167	4.01742E-10	2.40564E-06
39 436	2370	200	5.24596E-10	2.62298E-06
40 404	589	55	1.30453E-10	2.37187E-06
41 402	58520	16945	6.47370E-08	3.82042E-06
42 400	248	193	9.68261E-10	5.01690E-06
43 410	4	0	0.00000E+00	0.00000E+00
total	10060455	3214694	2.35996E-05	7.34117E-06

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PROJECT No.:

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

score misses

russian roulette on pd	0
psc=0.	300899
russian roulette in transmission	9758891
underflow in transmission	665
hit a zero-importance cell	0
energy cutoff	0

detector symmetric about z-axis located at z = -5.00000E+01 with radius = 1.00000E+00
9.07477E-03 0.0013

detector symmetric about z-axis located at z = -5.00000E+01 with radius = 1.00000E+00
uncollided neutron flux
5.51311E-03 0.0007

detector score diagnostics		cumulative fraction of transmissions	tally per history	cumulative fraction of total tally
times average score	transmissions			
1.00000E-01	1075405	0.33292	4.25379E-06	0.10770
1.00000E+00	2038759	0.96408	2.69184E-05	0.78922
2.00000E+00	82895	0.98974	4.48275E-06	0.90271
5.00000E+00	28121	0.99845	3.09198E-06	0.98099
1.00000E+01	2038	0.99908	5.20503E-07	0.99417
1.00000E+02	371	0.99919	2.22378E-07	0.99980
1.00000E+03	0	0.99919	0.00000E+00	0.99980
1.00000E+38	0	0.99919	0.00000E+00	0.99980
1st 200 histories	2607	1.00000	7.84605E-09	1.00000

average tally per history = 3.94977E-05 largest score = 2.69321E-03
(largest score)/(average tally) = 6.81865E+01 nps of largest score = 527552

score contributions by cell

cell	misses	hits	tally per history	weight per hit
1 300	16427	9533	3.07207E-07	3.22256E-05
2 301	65138	34547	1.05656E-06	3.05833E-05
3 302	9539460	1940775	2.03115E-05	1.04657E-05
4 303	65770	6427	3.32153E-08	5.16809E-06
5 304	24	0	0.00000E+00	0.00000E+00
6 305	2208	2317	9.73405E-08	4.20114E-05
7 306	1	11	6.72461E-10	6.11328E-05
8 307	10550	3368	3.10889E-08	9.23068E-06
9 320	57484	10189	5.00415E-08	4.91132E-06
10 321	6698	4581	9.73994E-08	2.12616E-05
11 322	62809	9706	4.84787E-08	4.99471E-06
12 323	126	23	9.41672E-11	4.09423E-06
13 324	56	14	7.29347E-11	5.20962E-06
14 330	3251	2075	6.69401E-08	3.22603E-05
15 340	1	0	0.00000E+00	0.00000E+00
16 341	169578	78639	1.13232E-06	1.43990E-05
17 342	834	64	2.53384E-10	3.95913E-06

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SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J.McCONN

DATE: 03/21/10

19	344	467	31	1.22747E-10	3.95958E-06
21	346	526	39	1.60201E-10	4.10772E-06
22	347	1	0	0.00000E+00	0.00000E+00
23	348	515	45	1.83845E-10	4.08545E-06
24	349	11	4	1.58100E-11	3.95249E-06
25	350	608	271	1.68687E-09	6.22461E-06
27	352	333	145	8.55839E-10	5.90234E-06
28	353	0	1	7.24311E-12	7.24311E-06
29	354	571	287	2.00854E-09	6.99839E-06
31	356	0	2	1.94469E-11	9.72347E-06
32	420	20175	63688	9.29173E-07	1.45894E-05
33	422	26	1790	1.14837E-07	6.41548E-05
35	426	45	1603	8.09849E-08	5.05208E-05
36	427	8025	992484	1.41351E-05	1.42421E-05
37	430	345	1303	1.20347E-08	9.23617E-06
39	436	1177	1393	9.92154E-09	7.12242E-06
40	404	245	399	3.04167E-09	7.62324E-06
41	402	11465	64000	9.56752E-07	1.49492E-05
42	400	2	439	1.75591E-08	3.99979E-05
43	410	1	3	3.09680E-11	1.03227E-05
total	10044953	3230196		3.94977E-05	1.22276E-05

score misses

russian roulette on pd 0
 psc=0. 301518
 russian roulette in transmission 9742825
 underflow in transmission 610
 hit a zero-importance cell 0
 energy cutoff 0

results of 10 statistical checks for the estimated answer for the tally fluctuation chart (tfc) bin of tally 85

tfc bin	--mean--	-----relative	-----	----variance of the variance----	--figure of merit--	-pdf-
behavior	behavior	value	decrease decrease rate	value decrease decrease rate	value behavior	slope
desired	random	<0.05	yes 1/sqrt(nps)	<0.10 yes 1/nps	constant random	>3.00
observed	random	0.00	yes yes	0.00 yes yes	constant random	10.00
passed?	yes	yes	yes yes	yes yes	yes yes	yes

this tally meets the statistical criteria used to form confidence intervals: check the tally fluctuation chart to verify. the results in other bins associated with this tally may not meet these statistical criteria.

----- estimated confidence intervals: -----

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PREPARED BY: R.J. TRAUB

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DATE: 03/21/10

estimated asymmetric confidence interval(1,2,3 sigma): 1.5651E-02 to 1.5688E-02; 1.5633E-02 to 1.5706E-02; 1.5615E-02 to 1.5725E-02
estimated symmetric confidence interval(1,2,3 sigma): 1.5651E-02 to 1.5688E-02; 1.5633E-02 to 1.5706E-02; 1.5615E-02 to 1.5724E-02

lanalysis of the results in the tally fluctuation chart bin (tfc) for tally 85 with nps = 1000000 print table 160

normed average tally per history = 1.56696E-02
estimated tally relative error = 0.0012
relative error from zero tallies = 0.0000

unnormed average tally per history = 1.56696E-02
estimated variance of the variance = 0.0001
relative error from nonzero scores = 0.0012

number of nonzero history tallies = 998319
history number of largest tally = 606076
(largest tally)/(average tally) = 5.65424E+01

efficiency for the nonzero tallies = 0.9983
largest unnormalized history tally = 8.85995E-01
(largest tally)/(avg nonzero tally) = 5.64474E+01

(confidence interval shift)/mean = 0.0000

shifted confidence interval center = 1.56696E-02

if the largest history score sampled so far were to occur on the next history, the tfc bin quantities would change as follows:

estimated quantities	value at nps	value at nps+1	value(nps+1)/value(nps)-1.
mean	1.56696E-02	1.56704E-02	0.000056
relative error	1.16818E-03	1.16943E-03	0.001073
variance of the variance	9.90342E-05	1.03670E-04	0.046807
shifted center	1.56696E-02	1.56696E-02	0.000000
figure of merit	1.37657E+04	1.37363E+04	-0.002143

the estimated slope of the 200 largest tallies starting at 3.13161E-01 appears to be decreasing at least exponentially.
the large score tail of the empirical history score probability density function appears to have no unsampled regions.

fom = (histories/minute)*(f(x) signal-to-noise ratio)**2 = (1.879E+04)*(8.560E-01)**2 = (1.879E+04)*(7.328E-01) = 1.377E+04

lstatus of the statistical checks used to form confidence intervals for the mean for each tally bin

tally result of statistical checks for the tfc bin (the first check not passed is listed) and error magnitude check for all bins

- 5 passed the 10 statistical checks for the tally fluctuation chart bin result
passed all bin error check: 2 tally bins all have relative errors less than 0.05 with no zero bins
- 15 passed the 10 statistical checks for the tally fluctuation chart bin result
passed all bin error check: 2 tally bins all have relative errors less than 0.05 with no zero bins
- 25 passed the 10 statistical checks for the tally fluctuation chart bin result
passed all bin error check: 38 tally bins all have relative errors less than 0.05 with no zero bins
- 35 passed the 10 statistical checks for the tally fluctuation chart bin result
passed all bin error check: 2 tally bins all have relative errors less than 0.05 with no zero bins
- 45 passed the 10 statistical checks for the tally fluctuation chart bin result

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SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

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DATE: 03/21/10

- passed all bin error check: 2 tally bins all have relative errors less than 0.05 with no zero bins
- 55 passed the 10 statistical checks for the tally fluctuation chart bin result
passed all bin error check: 38 tally bins all have relative errors less than 0.05 with no zero bins
- 65 passed the 10 statistical checks for the tally fluctuation chart bin result
passed all bin error check: 2 tally bins all have relative errors less than 0.05 with no zero bins
- 75 missed 1 of 10 tfc bin checks: the figure of merit has a trend during the last half of the problem
passed all bin error check: 2 tally bins all have relative errors less than 0.05 with no zero bins
- 85 passed the 10 statistical checks for the tally fluctuation chart bin result
passed all bin error check: 38 tally bins all have relative errors less than 0.05 with no zero bins

the 10 statistical checks are only for the tally fluctuation chart bin and do not apply to other tally bins.

warning. 1 of the 9 tally fluctuation chart bins did not pass all 10 statistical checks.
1 tally fluctuation charts

nps	tally 5					fom	tally 15					fom	tally 25					fom
	mean	error	vov	slope			mean	error	vov	slope			mean	error	vov	slope		
64000	1.3449E-02	0.0043	0.0012	9.5		16092	8.0697E-03	0.0048	0.0022	10.0	12498	1.3356E-02	0.0049	0.0015	7.0	12159		
128000	1.3462E-02	0.0030	0.0006	10.0		15954	8.0562E-03	0.0034	0.0015	7.1	12529	1.3371E-02	0.0035	0.0008	6.8	12013		
192000	1.3475E-02	0.0025	0.0004	10.0		15689	8.0455E-03	0.0028	0.0009	10.0	12745	1.3381E-02	0.0029	0.0005	7.1	11767		
256000	1.3455E-02	0.0022	0.0003	10.0		15644	8.0392E-03	0.0024	0.0006	10.0	13021	1.3344E-02	0.0025	0.0005	8.2	11645		
320000	1.3456E-02	0.0019	0.0003	10.0		15776	8.0313E-03	0.0021	0.0005	8.9	12958	1.3338E-02	0.0022	0.0004	8.6	11769		
384000	1.3446E-02	0.0018	0.0002	10.0		15840	8.0313E-03	0.0019	0.0004	10.0	12946	1.3322E-02	0.0020	0.0003	10.0	11826		
448000	1.3435E-02	0.0016	0.0002	10.0		16018	8.0327E-03	0.0018	0.0003	10.0	12987	1.3308E-02	0.0019	0.0003	10.0	11906		
512000	1.3446E-02	0.0015	0.0002	10.0		15871	8.0281E-03	0.0017	0.0003	10.0	13045	1.3313E-02	0.0018	0.0002	10.0	11875		
576000	1.3445E-02	0.0014	0.0002	10.0		15860	8.0268E-03	0.0016	0.0002	10.0	13062	1.3308E-02	0.0017	0.0002	10.0	11870		
640000	1.3447E-02	0.0014	0.0001	10.0		15863	8.0265E-03	0.0015	0.0002	9.3	13066	1.3303E-02	0.0016	0.0002	10.0	11869		
704000	1.3455E-02	0.0013	0.0001	10.0		15835	8.0306E-03	0.0014	0.0002	10.0	13002	1.3316E-02	0.0015	0.0002	10.0	11800		
768000	1.3450E-02	0.0012	0.0001	10.0		15865	8.0314E-03	0.0014	0.0002	10.0	12944	1.3309E-02	0.0014	0.0002	10.0	11792		
832000	1.3447E-02	0.0012	0.0001	10.0		15836	8.0336E-03	0.0013	0.0002	10.0	12913	1.3307E-02	0.0014	0.0002	10.0	11813		
896000	1.3444E-02	0.0011	0.0001	10.0		15875	8.0323E-03	0.0013	0.0002	10.0	12902	1.3302E-02	0.0013	0.0002	10.0	11863		
960000	1.3446E-02	0.0011	0.0001	10.0		15843	8.0334E-03	0.0012	0.0002	10.0	12848	1.3298E-02	0.0013	0.0001	10.0	11879		
1000000	1.3446E-02	0.0011	0.0001	10.0		15903	8.0338E-03	0.0012	0.0001	10.0	12833	1.3299E-02	0.0013	0.0001	10.0	11927		

nps	tally 35					fom	tally 45					fom	tally 55					fom
	mean	error	vov	slope			mean	error	vov	slope			mean	error	vov	slope		
64000	1.6461E-02	0.0040	0.0010	7.0		18540	9.7159E-03	0.0045	0.0020	9.5	14269	1.6351E-02	0.0046	0.0012	6.9	13948		
128000	1.6480E-02	0.0028	0.0005	8.8		18431	9.7046E-03	0.0032	0.0014	6.2	14266	1.6380E-02	0.0033	0.0006	9.7	13822		
192000	1.6491E-02	0.0023	0.0004	10.0		18167	9.6902E-03	0.0026	0.0008	7.5	14482	1.6384E-02	0.0027	0.0004	5.5	13574		
256000	1.6466E-02	0.0020	0.0003	10.0		18143	9.6849E-03	0.0022	0.0005	7.6	14770	1.6338E-02	0.0023	0.0004	10.0	13471		
320000	1.6471E-02	0.0018	0.0002	10.0		18235	9.6745E-03	0.0020	0.0004	6.4	14713	1.6334E-02	0.0021	0.0003	8.2	13593		
384000	1.6461E-02	0.0016	0.0002	10.0		18307	9.6746E-03	0.0018	0.0003	5.9	14702	1.6317E-02	0.0019	0.0002	10.0	13648		
448000	1.6449E-02	0.0015	0.0002	10.0		18467	9.6770E-03	0.0017	0.0003	9.0	14733	1.6303E-02	0.0018	0.0002	10.0	13704		
512000	1.6465E-02	0.0014	0.0001	10.0		18300	9.6725E-03	0.0016	0.0002	9.6	14787	1.6312E-02	0.0016	0.0002	10.0	13648		

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PNNL-19273

SUBJECT: CALCULATIONS THE SR-CF-3000 ²⁵²Cf NEUTRON SOURCE IN 318LOW SCATTER ROOM

PREPARED BY: R.J. TRAUB

DATE: 02/8/10

REVIEWED BY: R.J. MCCONN

DATE: 03/21/10

576000	1.6462E-02	0.0013	0.0001	10.0	18295	9.6705E-03	0.0015	0.0002	10.0	14816	1.6305E-02	0.0015	0.0002	10.0	13648
640000	1.6465E-02	0.0013	0.0001	10.0	18308	9.6710E-03	0.0014	0.0002	8.4	14817	1.6300E-02	0.0015	0.0002	9.5	13653
704000	1.6475E-02	0.0012	0.0001	10.0	18281	9.6757E-03	0.0013	0.0002	7.6	14753	1.6314E-02	0.0014	0.0002	9.7	13582
768000	1.6468E-02	0.0012	0.0001	10.0	18314	9.6756E-03	0.0013	0.0002	10.0	14702	1.6306E-02	0.0013	0.0001	10.0	13575
832000	1.6463E-02	0.0011	0.0001	10.0	18280	9.6777E-03	0.0012	0.0001	9.5	14677	1.6303E-02	0.0013	0.0001	10.0	13592
896000	1.6462E-02	0.0011	0.0001	10.0	18313	9.6764E-03	0.0012	0.0001	10.0	14663	1.6299E-02	0.0012	0.0001	10.0	13644
960000	1.6464E-02	0.0010	0.0001	10.0	18288	9.6774E-03	0.0012	0.0001	10.0	14614	1.6294E-02	0.0012	0.0001	10.0	13664
1000000	1.6464E-02	0.0010	0.0001	10.0	18349	9.6778E-03	0.0011	0.0001	10.0	14598	1.6295E-02	0.0012	0.0001	10.0	13712

ltally fluctuation charts

tally 65						tally 75						tally 85					
nps	mean	error	vov	slope	fom	mean	error	vov	slope	fom	mean	error	vov	slope	fom		
64000	1.5829E-02	0.0040	0.0010	6.6	18612	9.3363E-03	0.0045	0.0019	8.7	14374	1.5723E-02	0.0046	0.0011	6.2	13988		
128000	1.5847E-02	0.0028	0.0005	9.4	18505	9.3258E-03	0.0032	0.0012	6.9	14387	1.5752E-02	0.0033	0.0006	10.0	13859		
192000	1.5858E-02	0.0023	0.0003	10.0	18248	9.3120E-03	0.0026	0.0007	8.1	14584	1.5755E-02	0.0027	0.0004	6.9	13618		
256000	1.5834E-02	0.0020	0.0003	10.0	18218	9.3072E-03	0.0022	0.0005	8.8	14861	1.5711E-02	0.0023	0.0004	10.0	13515		
320000	1.5839E-02	0.0018	0.0002	10.0	18312	9.2972E-03	0.0020	0.0004	6.4	14801	1.5707E-02	0.0021	0.0003	9.2	13633		
384000	1.5829E-02	0.0016	0.0002	10.0	18387	9.2972E-03	0.0018	0.0003	6.5	14790	1.5690E-02	0.0019	0.0002	10.0	13689		
448000	1.5817E-02	0.0015	0.0002	10.0	18545	9.2994E-03	0.0017	0.0003	10.0	14824	1.5677E-02	0.0017	0.0002	8.0	13747		
512000	1.5833E-02	0.0014	0.0001	10.0	18386	9.2950E-03	0.0016	0.0002	10.0	14876	1.5685E-02	0.0016	0.0002	10.0	13697		
576000	1.5830E-02	0.0013	0.0001	10.0	18380	9.2933E-03	0.0015	0.0002	10.0	14903	1.5679E-02	0.0015	0.0002	10.0	13698		
640000	1.5833E-02	0.0013	0.0001	10.0	18389	9.2937E-03	0.0014	0.0002	10.0	14902	1.5674E-02	0.0015	0.0002	9.2	13700		
704000	1.5842E-02	0.0012	0.0001	10.0	18360	9.2983E-03	0.0013	0.0002	7.5	14840	1.5688E-02	0.0014	0.0001	10.0	13629		
768000	1.5835E-02	0.0012	0.0001	10.0	18394	9.2981E-03	0.0013	0.0002	10.0	14788	1.5680E-02	0.0013	0.0001	10.0	13627		
832000	1.5831E-02	0.0011	0.0001	10.0	18366	9.3002E-03	0.0012	0.0001	10.0	14762	1.5677E-02	0.0013	0.0001	10.0	13647		
896000	1.5830E-02	0.0011	0.0001	10.0	18401	9.2991E-03	0.0012	0.0001	10.0	14748	1.5673E-02	0.0012	0.0001	10.0	13699		
960000	1.5832E-02	0.0010	0.0001	10.0	18376	9.2999E-03	0.0012	0.0001	10.0	14698	1.5668E-02	0.0012	0.0001	10.0	13719		
1000000	1.5832E-02	0.0010	0.0001	10.0	18434	9.3004E-03	0.0011	0.0001	10.0	14683	1.5670E-02	0.0012	0.0001	10.0	13766		

 dump no. 2 on file mcnp.tpe nps = 1000000 coll = 12357143 ctm = 53.23 nrn = 710969452

tally data written to file mctal

13 warning messages so far.

run terminated when 1000000 particle histories were done.

computer time = 53.55 minutes

mcnp version 5 11012005

09/29/09 02:54:15

probid = 09/29/09 01:59:53



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