POEF-SH-30

Nuclear Criticality Safety Calculational Analysis for Small-Diameter Containers

November 1995

by

Maria S. LeTellier
David J. Smallwood
Jeffrey A. Henkel
David E. Smith

Battelle

Under Contract 400183

LOCKHEED MARTIN UTILITY SERVICES, INC.

PORTSMOUTH GASEOUS DIFFUSION PLANT
P.O. Box 628 Piketon, Ohio 45661

Under Contract USECHQ-93-C-0001

to the

U.S. ENRICHMENT CORPORATION

Available to DOE and DOE Contractors from the Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831; prices available from (615) 576-8401, FTS/626-8401.

Available to the public from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161.

DISTRIBUTION

LOCKHEED MARTIN UTILITY SERVICES, INC.

PORTSMOUTH

R. Oxenham
R. Lemming
D. D'Aquila (10)
Central Files (2)
X-710 Technical Library (2)
Technical Review (2)

BATTELLE

R. Tayloe
J. Henkel
B. Lee
M. LeTellier
D. Lindenschmidt
D. Smallwood
D. Smith
V. Pasupathi

OAK RIDGE

C. Haught
H. Dyer
C. Jordan
S. Love
K. Shaffer

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES (continued)

LIST OF FIGURES (continued)

LIST OF TABLES

1.0 INTRODUCTION

This report documents calculations performed to establish a technical basis for the nuclear criticality safety of favorable geometry containers, sometimes referred to as 5-inch containers, in use at the Portsmouth Gaseous Diffusion Plant. A list of containers currently used in the plant is shown in Table 1.0-1. These containers are currently used throughout the plant with no mass limits. The use of containers with geometries or material types other than those addressed in this evaluation must be bounded by this analysis or have an additional analysis performed. The following five basic container geometries were modeled and bound all container geometries in Table 1.0-1:

1. 4.32-inch-diameter by 50-inch-high polyethylene bottle
2. 5.0-inch-diameter by 24-inch-high polyethylene bottle
3. 5.25-inch-diameter by 24-inch-high steel can ("F-can")
4. 5.25-inch-diameter by 15-inch-high steel can ("Z-can")
5. 5.0-inch-diameter by 9-inch-high polybottle ("CO-4")

Each container type is evaluated using five basic reflection and interaction models that include single containers and multiple containers in normal and in credible abnormal conditions. The uranium materials evaluated are UO_2F_2+H_2O and UF_4+oil materials at 100% and 10% enrichments and U_3O_8 and H_2O at 100% enrichment. The design basis safe criticality limit for the Portsmouth facility is $k_{eff} + 2\sigma < 0.95$. The KENO study results may be used as the basis for evaluating general use of these containers in the plant.

Table 1.0-1. Small-Diameter Uranium-Bearing Containers

Container Type	References	Dimensions		
		Inner Diameter (inches)	Height (inches)	Wall Thickness (inches)
"744G" Polyethylene Bottle	(DWG. DX-761-2340-M, Rev.0)	4.25 (+/- 0.07-in)	50.373	0.125 (+.07,-.000)
"24-in Polybottle" Polyethylene Bottle	(DWG. BX-761-M373 Rev 0)	5.0	24.0	Min. 0.1875
"GP Container" Polyethylene Container	(DWG. DX-761-2586-M Rev 0)	5.0	23.75	0.13
"OG Container" Polyethylene Container (Conceptual)	Not Available	4.25	24.0	Not Available
"CO-4 Polybottles" Polyethylene Bottle (DWG Not Available)	Not Available	5.0	9.0	Not Available
"F-Can" Tin Plated Steel Container	(DWG. DX-761-M-981)	5.25	24.0	Min. 0.015
"Z-Can" Tin Plated Steel Container	(DWG. DX-761-2331-M)	5.25	15.0	Min. 0.015

2.0 ANALYSIS ASSUMPTIONS

2.1 Models

All calculations were performed on the Battelle Process Safety and Risk Management IBM RS/6000 workstation implementation of SCALE-4.2. The validation performed on this software/hardware combination and its area of applicability are discussed in *Validation of the CSAS25 Calculation Sequence in Scale--4.2 and the 27 Energy Group ENDF/B-IV Cross Sections on the Battelle Process Safety and Risk Management IBM RS/6000 Workstation* (Ref. 6) and *Conditional Validation of CSAS25 on Battelle Process Safety and Risk Management RS/6000* (Ref. 7). Configuration control of this software/hardware combination is documented in *Configuration Control Plan for Process Safety and Risk Management Nuclear Safety Software & Hardware Systems (IBM/RS6000)* (Ref. 8). The SCALE system of computer codes is a large collection of modularized computer codes useful for performing a variety of nuclear safety calculations, including criticality calculations. The results presented in the following sections were all obtained using the CSAS25 calculational sequence. The CSAS25 modules consist of BONAMI, NITAWL, and KENO Va. The BONAMI and NITAWL adjust the cross-sections data for the specific problem at hand (e.g., performance of resonance self-shielding corrections). The 27 energy group cross-sections available in SCALE were used for all calculations. The critical experiment that validates the code for UF_4+oil is CAS14 (TM-238) (Ref. 6).

Validation Argument: The validaton report (Ref . 7) states that for the vast majority of fissile systems found at Portsmouth Gaseous Diffusion Plant, it is appropriate to use the CSAS25 sequence of SCALE-4.2 to analyze them. The different types of low-enriched systems for which critical experiments were preformed include uranium metal at enrichments of 3.85% and 4.89%, moderated and reflected by H_2O ; U_3O_8 sterotex blocks at 4.89%, both reflected and unreflected by H_2O; UO_2F_2 solution at 4.89% enrichment, and U^{235} densities ranging from approximately 22.1 to 42.5 gU^{235}/l; and UF_4 (paraffin) systems at enrichments of 1.4% to 3%, H/X ratios from 133 to 971, reflected and unreflected, to simulate UF_6. The highly enriched systems include UO_2F_2 solutions at approximately 93%, with solutions at enrichments of 93.2% with uranium densities ranging from 55 to 364 gU/l, reflected and unreflected; and uranium metal systems between 93% and 97%, enrichment unreflected. The validation covers all the materials analyzed in this report.

The enrichment of UF_4+oil analyzed in this report is 100% while the validation of a similar material UF_4 (paraffin) was performed at a maximum of 3% (Ref. 6.0). Highly enriched uranium metal, and UO_2F_2 systems have been validated; therefore, the confidence of the highly enriched UF_4+oil cases remains within the $k_{eff}+2\sigma<0.95$ calculational acceptance criteria.

Each of the geometry options used to model the systems analyzed in this report has been validiated in Reference 7.

2.1.1 Description of Standard Geometry Models

Each of the containers discussed in this document is analyzed in accordance with *Standards for Analysis of Small Containers at the Portsmouth Plant* (Ref. 9), which defines the standard reflection models to be used when evaluating small-container nuclear criticality safety. Each of the geometry models from this reference is described in detail in the following sections and is assigned an acronym for identification purposes. The Appendix contains sample input files.

2.1.2 Standard Room (SR)

This model applies to all cases with the exception of the full water reflection case, which does not require the addition of any external reflector. The basic conditions include

Floor:	24-inch-thick regular concrete floor
Ceiling:	12-inch-thick regular concrete ceiling (10 feet high)
Walls:	12-inch-thick concrete walls

When any of the above described surfaces is in contact with the container being analyzed, the concrete surface is extended away from the container at least a distance equal to the height of the fuel/container from that surface.

2.1.3 Single Container Standard Reflection Models

Full Reflection (SFR). Each of the containers is analyzed as a single container under conditions of full water reflection. The container is modeled as sitting on a standard room floor with 12 inches of close-fitting, full-density water on all other surfaces (around container and top).

In a Concrete Corner (SCC). A single container is placed in a concrete corner in contact with two walls and the floor. The model includes contact by the person handling the container. The person is modeled as ~100 kg of water that is L-shaped around the container as shown in Figure 2.1.3-1. The height of the water reflector is 50 inches for the 4.32-inch containers and 48 inches for 5.0-inch and 5.25-inch containers.

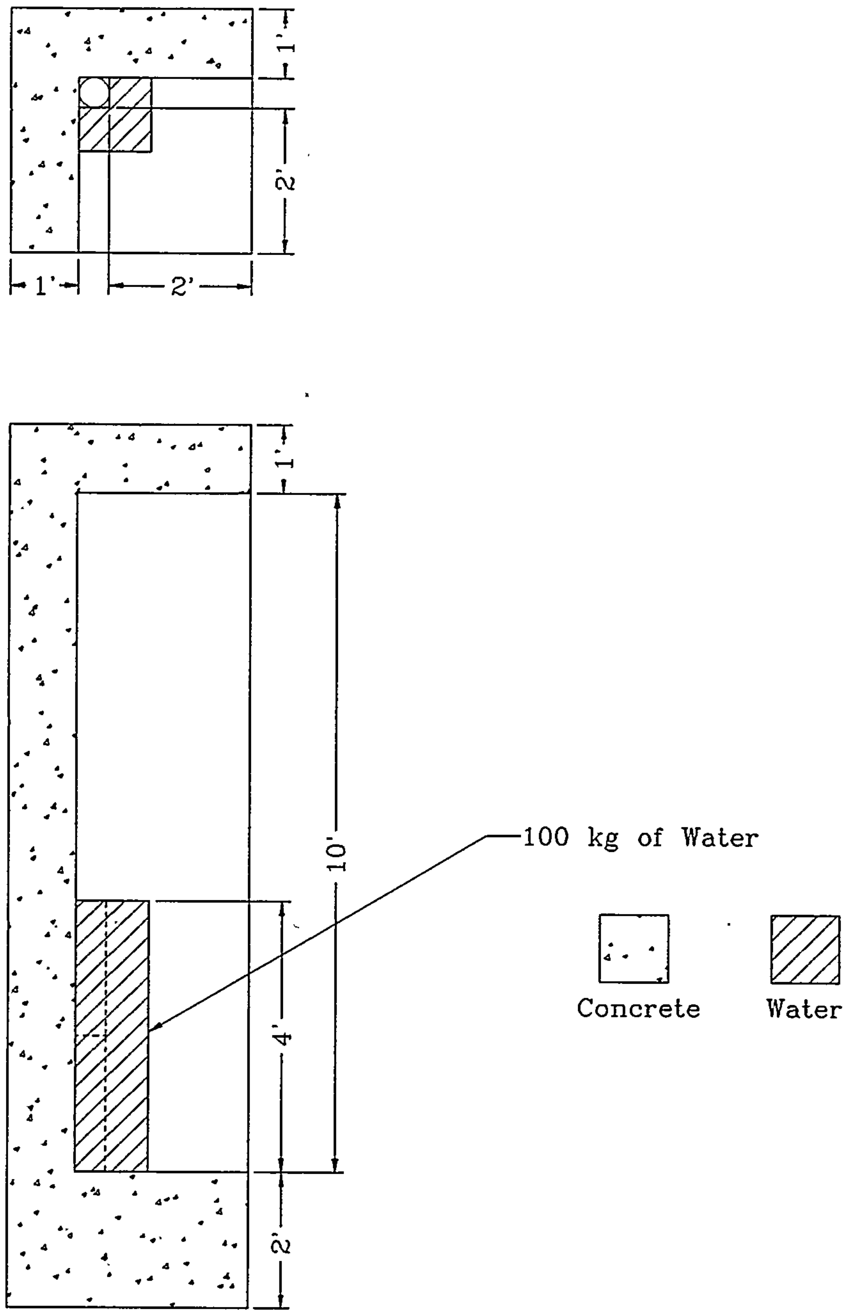


Figure 2.1.3-1. Single Container in a Corner with Water Reflector Simulating a Person

More Reactive Contents (SMRC). The standard material is replaced with a more reactive material present in the facility. The container is modeled assuming 24 inches of concrete on the bottom and 1 inch of close-fitting water reflection on the other surfaces.

2.1.4 Two Containers Touching Reflection Models

Adjacent to a Concrete Wall (TACW). The model simulates two containers touching in a position adjacent to a concrete wall and reflected by a person. The person is modeled as a ~100 kg, 18-inch-wide by 7-inch-deep by 4-foot-high block with hands modeled as 1-inch-thick slabs against the outside of the containers as shown in Figure 2.1.4-1. This analysis assumes no storage locations close to the containers. The model also incorporates the standard room reflection conditions.

One Foot From a Concrete Wall (TSCW). This model is the same as the previous model with the exception that the two containers are moved a distance of one foot from the concrete wall. This configuration is represented in Figure 2.1.4-2.

2.1.5 Array Models

Arrays in a Concrete Enclosure (ACE). This standard configuration models four double rows of containers located in a concrete enclosure (the concrete floor, ceiling, and wall thickness are described in Section 2.1.2). A double row consists of 2 rows of containers separated by 23 inches center-to-center. The model includes the maximum polyethylene bottle thickness of 0.195 inches for the bottles but does not include the steel container thickness for the 5.25-inch diameter F and Z Cans. The rows are 40 units long. Each double row is separated by 6-foot aisles, and the array is a minimum of 2 feet from the concrete walls. A sketch of the standard array model is shown in Figure 2.1.5-1.

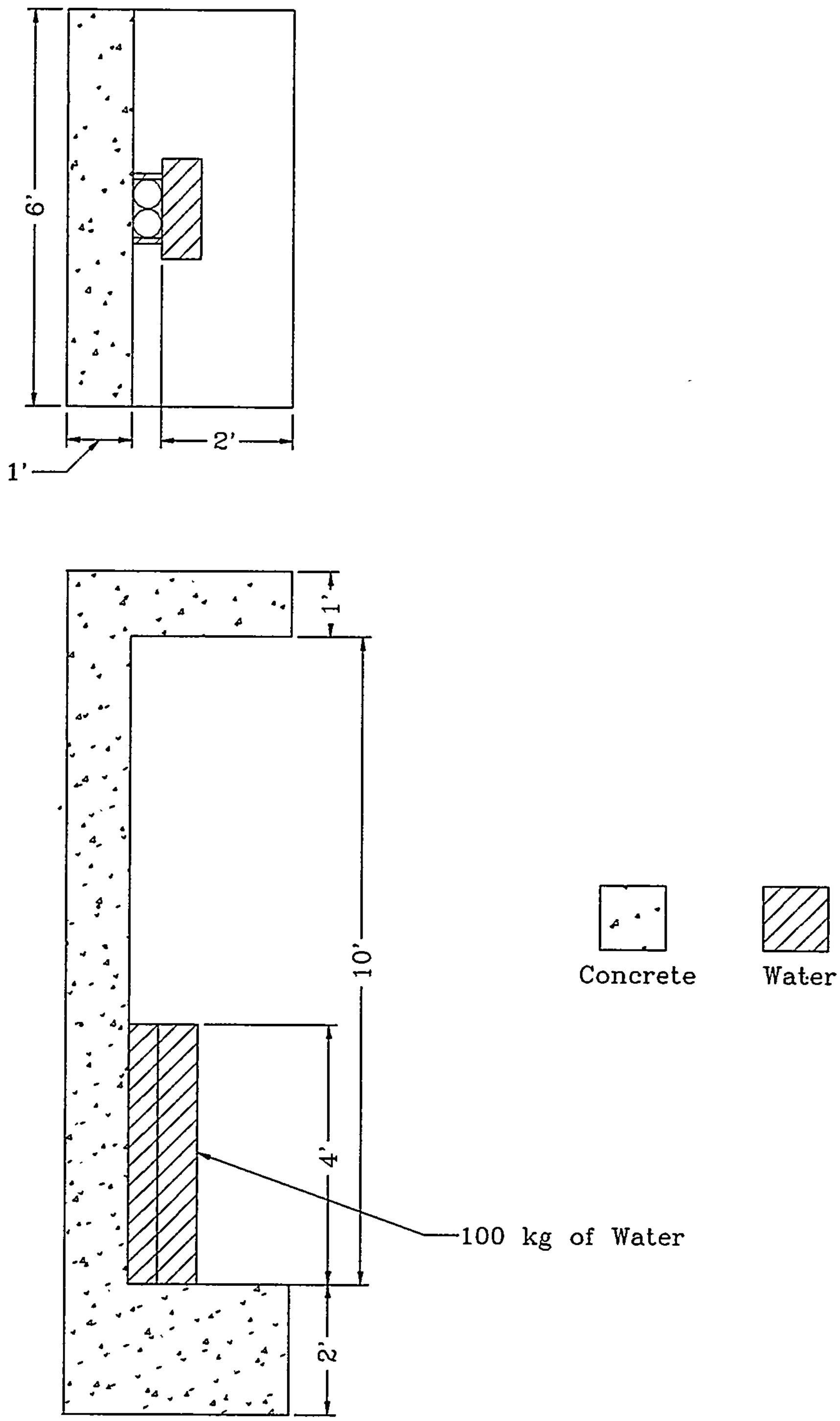


Figure 2.1.4-1 Two Containers Next to a Wall with Water Reflector Simulating a Person

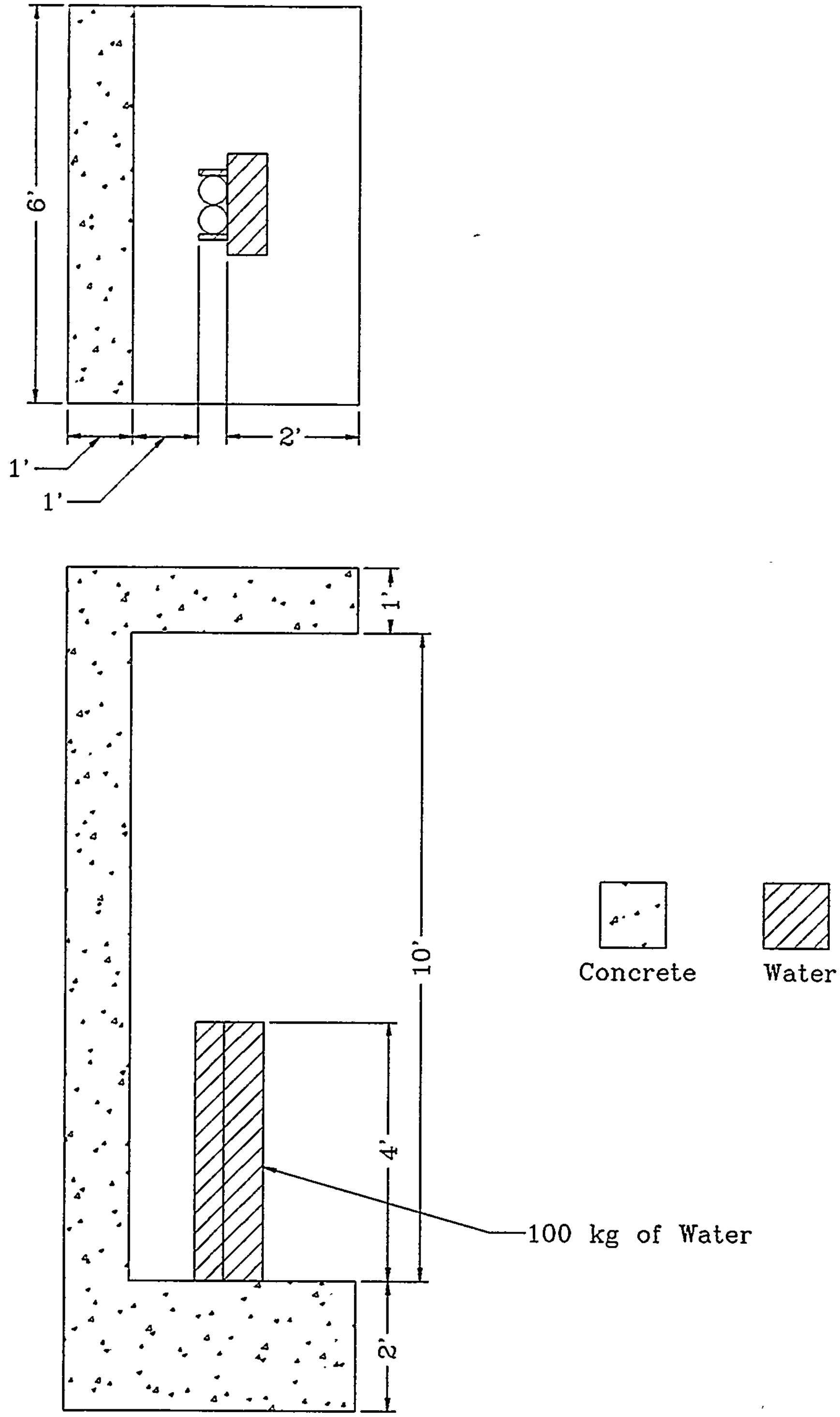


Figure 2.1.4-2. Two Containers 1-Foot from a Wall with Water Reflector Simulating a Person

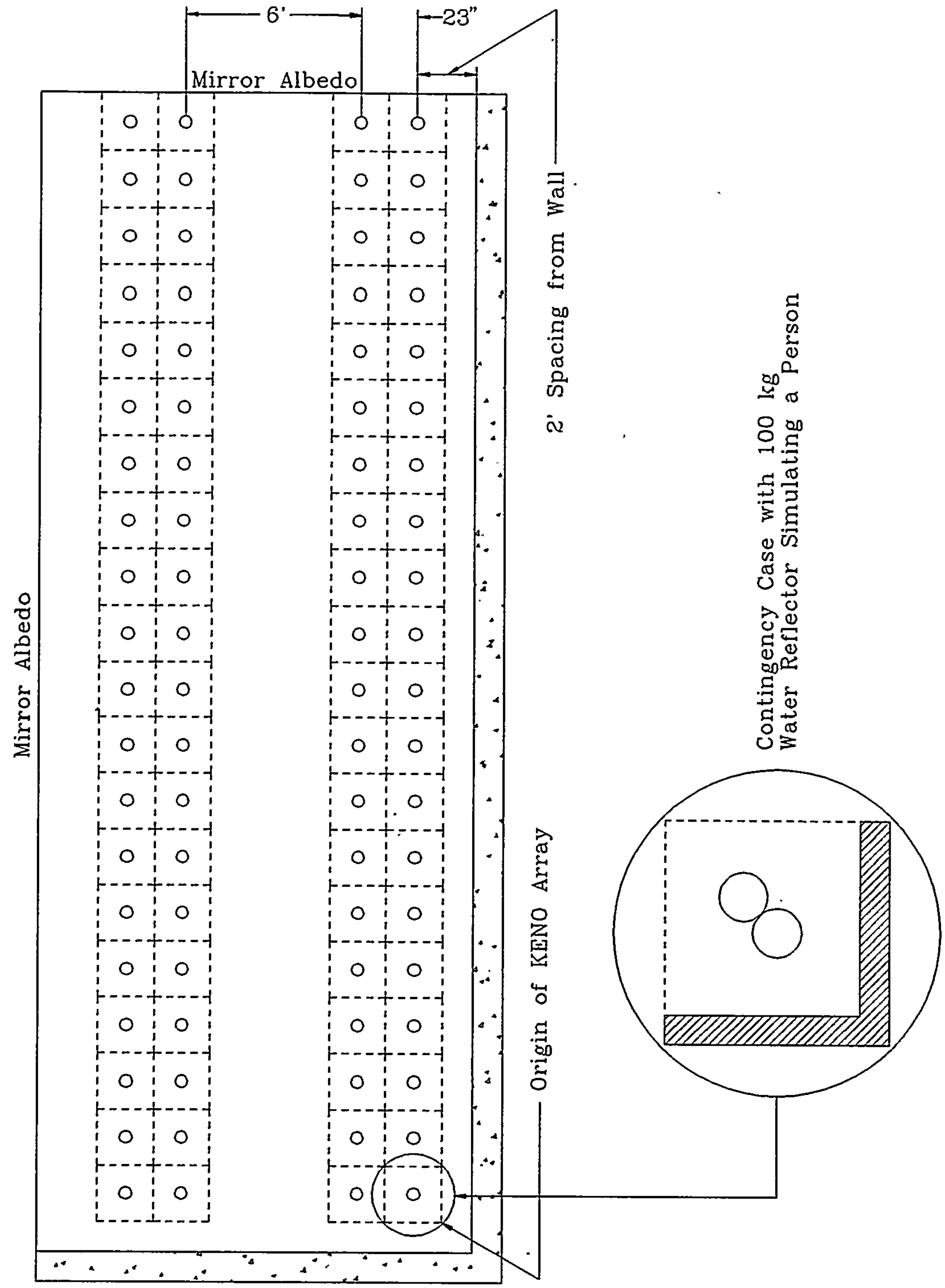


Figure 2.1.5-1. Standard Array Configuration with Concrete Reflector

Interstitial Moderation (AI). This model analyzes the effect of adding interstitial moderation to the spaces separating the units in the standard array model (ACE). The optimum H/U ratio from the standard model and H/U values above and below this peak are evaluated for a range of water densities. The water density that produces the peak k_{eff} is compared with the physical limits of the sprinkler system or other sources of moderation. Each of the container types is evaluated using this model.

2.2 Uranium Compounds Analyzed

Uranium is present in many chemical forms at the Portsmouth Plant. The scope of this analysis is limited to the following three material types: UO_2F_2/water, UF_4/oil, and U_3O_8.

2.2.1 $UO_2F_2+H_2O$

Of the chemical forms present, $UO_2F_2+H_2O$ is of primary concern because of its high uranium solubility and it is the most common material handled.

2.2.2 UF_4+Oil

The UF_4+oil primarily is present in vacuum pump lubricating oil that has been in contact with UF_6 in the gaseous diffusion process and is analyzed because the reactivity is potentially higher than $UO_2F_2+H_2O$. The composition of oil used in the analysis was assumed to be CH_2 with an assumed density of 0.87g/cc (Ref. 10). The H/C ratio varies with oil type with typical oil having an H/C ratio of approximately 2.0. The reaction is discussed in Reference 10.

2.2.3 U_3O_8

The U_3O_8 is produced in the calciner by exposing uranyl nitrate solutions to high-temperature air, which results in the removal of water and the subsequent conversion to U_3O_8. Calciner operations are located in Building X-705. The theoretical density of U_3O_8 is 8.21 gU/cc (Ref. 16). The UO_2 is not considered a product from the calciners, because the physical conditions required to convert uranyl nitrate to UO_2 are not achieved under normal operating conditions. Conversion to UO_2 requires a reducing agent such as H_2, which is not present in the calciner design (Ref. 18). Therefore, producing UO_2 and storing it in a Z-Can or CO-4 polybottle is considered a credible contingency.

3.0 DETERMINATION OF NUMBER DENSITIES

3.1 UO_2F_2

3.1.1 Determination of Number Density

Uranyl fluoride (UO_2F_2) is a hygroscopic material. In high-moisture environments and at moderate temperatures, UO_2F_2 can absorb moisture and form an aqueous solution. The H/U ratios of over 30 can be reached when initially dry material is exposed to humid air (Ref. 11). For this reason, all UO_2F_2 cases assume the presence of H_2O. The number densities determined in this analysis of the various UO_2F_2 and water mixtures were calculated through the utilization of the existing program NUMDEN (Ref. 12). NUMDEN is a FORTRAN code capable of both computing densities for a host of mixtures of uranium and moderating materials as well as atomic number density data. This information then can be used as input parameters in the KENO Va code for the determination of k_{eff}. NUMDEN can perform number density calculations using a variety of correlations. This analysis uses the Barber method to calculate the uranium densities for the UO_2F_2 solutions investigated in this report. The Barber method is composed of the following two equations:

$$\rho_u = 4.96 - 0.32\,(H/U) \qquad \text{For H/U} < 4$$

$$\rho_u = \frac{a_u}{v_{UO_2F_2*2H_2O} + \dfrac{(H/U-4)v_{H_2O}}{2}} \qquad \text{For H/U} \geq 4$$

3.1.2 Justification for Using a Uranium Density of 3.2 g/cc for H/U Less Than 4.0

The application of the Barber relationship (Ref. 12) for H/U values less than 4 produces a highly conservative uranium density. The high uranium density at an H/U of 4 results in a discontinuous maximum peak in k_{eff} for several of the cases tested. The peak is the only H/U point that exceeds the limiting condition in several of the contingencies tested.

The theoretical density of UO_2F_2 is 6.37g/cc (Ref 13), which produces a uranium density of 4.97g/cc. In an unsaturated atmosphere and at moderate temperatures, uranyl fluoride (UO_2F_2) will absorb moisture and form hydrates. The stable hydrate $UO_2F_2*2H_2O$ is the most likely to be formed. Historically, the gaseous diffusion plants have used a maximum uranium density of 3.2 gU/cc (Ref. 17). Undisturbed cascade deposits may approach theoretical density. However, once disturbed by mechanical recovery or exposure to ambient air, UO_2F_2 behaves as a bulk powder even if dried back to the anhydrous state. The use of 3.2gU/cc as a maximum uranium density for deposits removed from cascade equipment is considered to conservatively bound the actual bulk density of UO_2F_2.

3.2 UF_4+Oil Number Density Determination

The UF_4+oil is present at the Portsmouth Plant in contaminated equipment. The volume-additive method was used to calculate number density (Ref. 10). The following information is required to perform this calculation:

UF_4 Density = 6.70g/cm^3 (Ref. 15)
Oil Density = 0.87g/cm^3 (Ref. 10)
MW Fluorine = 18.99g/mole (Ref. 14)
MW Uranium = 235g/mole (Ref. 14, assumed to be 100% enriched)
MW Carbon = 12.011g/mole (Ref. 14)
MW Hydrogen = 1.00 (Ref. 14)

Avogadro's Number = 0.602214E+24 atom/mole (Ref. 14)

cm^2 to barns conversion multiply by 1E-24

The equation for calculating number density is

$$ND = [(MD)(AV)]/MW$$

where

ND =	Number Density (atoms/barn-cm)
MD =	Element Density in the mixture (g/cm^3)
AV =	Avogadro's Number multiplied by the conversion factor (atoms-cm^2/barn-mole)
MW =	Molecular Weight of the Element (g/mole)

To calculate the density of each element in the compound, the ratio of the molecular weight of the element and the molecular weight of the compound is multiplied by the product of the compound density and the volume fraction. Once the number density for each element is determined, the H/U ratio can be determined. The H/U ratio is simply the ratio of the hydrogen number density to the uranium number density. Table 3.2-1 shows the computed values for the number densities of the UF_4 + oil case for 100% uranium enrichment, and Table 3.2-2 lists the number densities for the 10% uranium enrichment case.

Table 3.2-1. Number Densities (atoms/barn-cm) for UF_4 + Oil for 100% Enriched Uranium

H/U Ratio	Carbon	Hydrogen	Uranium - 235	Fluorine
570.6	0.03702	0.07404	0.00013	0.00052
186.4	0.03627	0.07254	0.00039	0.00156
109.5	0.03552	0.07105	0.00065	0.0026
76.6	0.03478	0.06955	0.00091	0.00363
58.3	0.03403	0.06806	0.00117	0.00467
51.9	0.03366	0.06731	0.0013	0.00519
46.6	0.03328	0.06656	0.00143	0.00571
23.1	0.02992	0.05983	0.0026	0.01038
13.4	0.02618	0.05235	0.00389	0.01557
8.6	0.02244	0.04487	0.00519	0.02076
5.8	0.0187	0.03739	0.00649	0.02595
3.8	0.01496	0.02992	0.00779	0.03114
2.5	0.01122	0.02244	0.00908	0.03633
1.4	0.00748	0.01496	0.01038	0.04152
0.64	0.00374	0.00748	0.01168	0.04671

Table 3.2-2. Number Densities (atoms/barn-cm) for UF_4 + Oil for 10% Enriched Uranium

H/U Ratio	Carbon	Hydrogen	U-235	U-238	Fluorine
576.1	.03702	.07404	.0000129	.000116	.000514
188.2	.036272	.072544	.0000386	.000347	.001542
110.6	.035524	.071048	.0000643	.000578	.00257
77.3	.034776	.069553	.00009	.00081	.003598
71.8	.034589	.069179	.0000964	.000867	.003855
66.9	.034402	.068805	.000103	.000925	.004112
62.6	.034215	.068431	.000109	.000983	.004369
58.8	.034028	.068057	.000116	.001041	.004627
52.4	.033655	.067309	.000129	.001157	.005141
47.1	.033281	.066561	.000141	.001272	.005655
23.3	.029915	.05983	.000257	.002313	.010281
13.6	.026176	.052351	.000386	.00347	.015422
8.7	.022436	.044873	.000514	.004627	.020562
5.8	.018697	.037394	.000643	.005783	.025703
3.9	.014958	.029915	.000771	.00694	.030843
2.5	.011218	.022436	.0009	.008096	.035984
1.5	.007479	.014958	.001028	.009253	.041125
0.64	.003739	.007479	.001157	.01041	.046265

4.0 RESULTS

4.1 Supporting Analysis

The file designation system and a summary of the acronyms used to annotate each of the geometry models is summarized in Table 4.1-1. File names, material type, and geometry models are provided for each of the cases presented in Section 4.0. Keno results are presented in tabular form with the following abbreviations: "K_sig" is used to mean one sigma on the calculated value of k-effective and "2*K_sig" is used for twice the sigma. A detailed description of each geometry model is found in Section 2.0.

Table 4.1-1. Geometry Model Summary

Geometry Model Designator	Description of the Model
SFR	Single container full reflection
SCC	Single container in a concrete corner reflected by 100 kg of water
SMRC	Single container with more reactive contents and 1 inch of reflection
TACW	Two containers touching and adjacent to a concrete wall with 100 kg water reflection in contact
TSCW	Two containers touching, 1 foot from concrete wall with 100 kg water reflection in contact
ACE	Standard array case of double rows
AI	Standard array with interstitial moderation
AOSP	Standard array with one overloaded storage position

4.1.1 Use of Barber Formula for H/U Less Than 4.0

The use of the Barber formula (Ref. 9) for H/U values less than 4.0 results in a peak k_{eff} at an H/U of 3.99. These peak values are conservative but are not considered entirely reasonable from a physical standpoint as discussed in Section 3.2.1. More continuous results are obtained by fixing the uranium density to 3.2 gU/cc for H/U values less than 4.0.

All standard contingencies were initially evaluated using the Barber formula. Four 5.0-inch-diameter container contingencies were selected to be reevaluated using the constant uranium density of 3.2gU/cc. The case selection criterion was based on the results of each case using the Barber formula. Cases that produced $k_{eff}+2\sigma$ values of >0.95 for H/U values less than but not greater than 4.0 using the Barber formula make up the 4 cases reevaluated. All 10% enriched cases were evaluated using the Barber formula and produced k_{eff} values within the criterion.

4.1.2 Container Thickness Study

A container thickness study was performed to determine the effect of polyethylene bottle thickness on k_{eff}. The actual maximum thickness is 0.195 inches based on plant drawings (Ref. 3). The SFR and the TSCW models were evaluated for both the UO_2F_2+H_2O and the UF_4+oil cases. Containers modeled adjacent to a wall were not used, because the container thickness would not add significantly to the total reflection of the system.

The results indicate that, for the full reflection model, no significant change in reactivity is noted; however, the two-container case shows a statistically significant increase in reactivity as container thickness increases. For this reason, the two standard reflection models that have containers offset from the concrete walls incorporate the maximum bottle thickness of 0.195 inches. Table 4.1.2-0 illustrates the container thickness results summary.

Table 4.1.2-0. Container Thickness Result Summary

Geometry Model	Material	Figure/Table Number
SFR	UO_2F_2+H_2O	4.1.2-1
TSCW	UO_2F_2+H_2O	4.1.2-2
SFR	UF_4+oil	4.1.2-3
TSCW	UF_4+oil	4.1.2-4

The figures and tables listed in Table 4.1.2-0 follow Section 4.2.

4.1.3 Random Number Generation

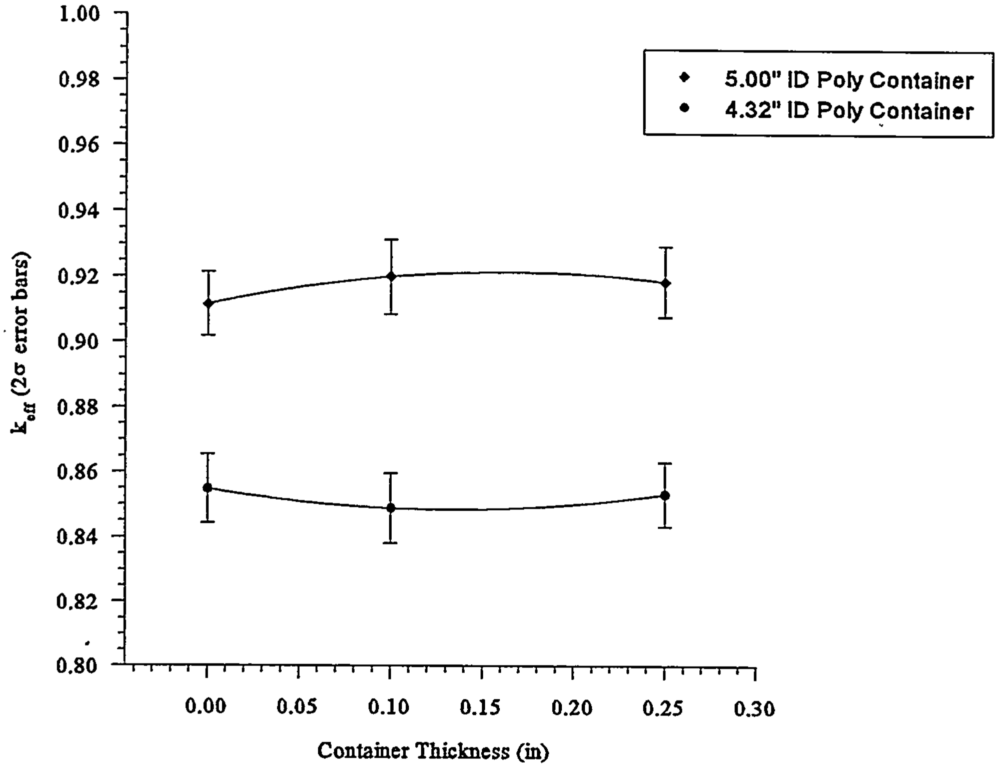
The KENO Va code has an option to change the random number that the run starts. This investigation shows that, depending on the initial number selected, the output can vary by as much as 3σ. This phenomenon is one possible explanation of the variance that is noted between KENO runs using basically the same input parameters. This range of variance is compensated for by the criteria for a safe condition, which is defined as $k_{eff}+2\sigma < 0.95$. The full reflection model was used for this evaluation.

4.1.4 GP Container Model Assumptions

GP containers are modeled as 5.0" x 24" polyethylene cylinders. The actual cylinders have two hollow handle mounts that protrude outside of the 5.0" diameter. Each mount is 1.5" x 1.5" x 1"-deep (Ref. 3). They are positioned 180 degrees apart, 20-inches from the base of the container. The calculated volume for each mount assuming no polyethylene thickness is 2.25 in^3. Two comparison cases were analyzed to show that a simplified model (i.e., no mounts) is adequate for the small container analysis. Both cases model a 5.0" x 24" container filled with UO_2F_2 + H_2O under full reflection conditions. One case adds a 1.5" x 1.5" x 1.0"- deep

Figure 4.1.2-1. Thickness Study for a Single Container of UO_2F_2

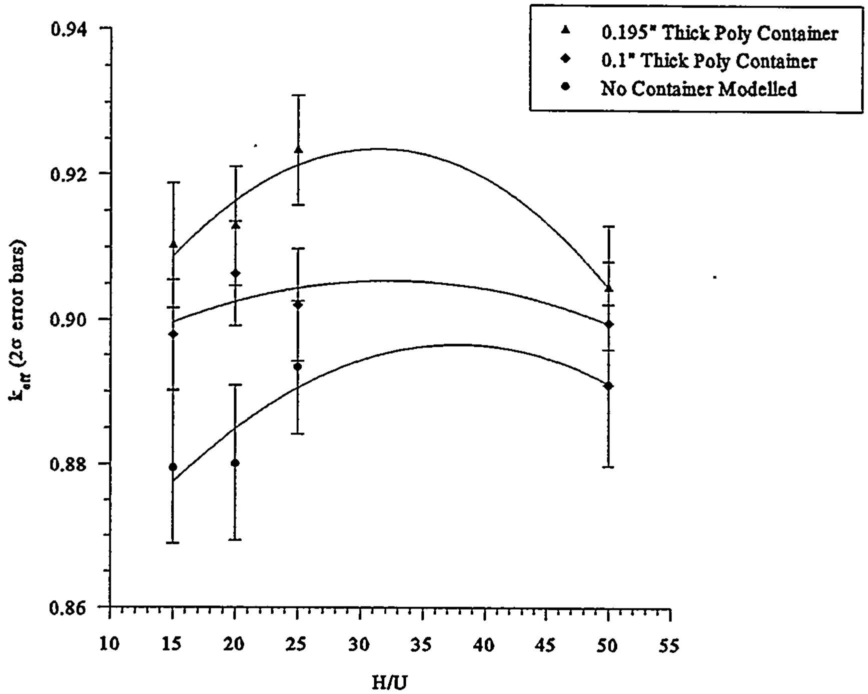
Fully Reflected Geometry, 100% enrichment, 24" concrete floor, 12" (minimum) water reflector on all other sides



Single Container Thickness Study for UO2F2+H2O with 100% Enrichment and Full Reflection					
Case	H/U	Cont Thick	Keff	K_sig	2*K_sig
fra011n.o	25	0	0.8548	0.0053	0.0106
fra-c1n.o	25	0.1	0.8488	0.0054	0.0108
fra-c2n.o	25	0.25	0.8532	0.005	0.01
Case	H/U	Cont Thick	Keff	K_sig	2*K_sig
frb011n.o	25	0	0.9116	0.0049	0.0098
frb-c1n.o	25	0.1	0.92	0.0057	0.0114
frb-c2n.o	25	0.25	0.9185	0.0054	0.0108

Figure 4.1.2-2. Thickness Study for Two 5.00" ID x 24" Tall Cylinders of UO_2F_2

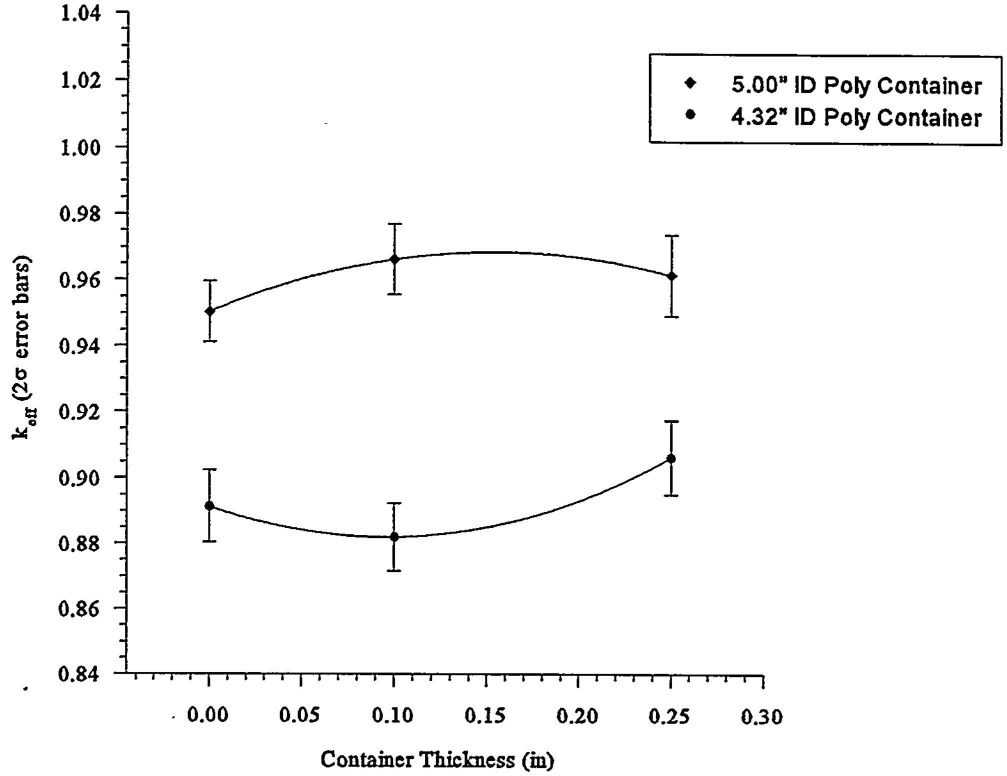
100% enrichment, 24" concrete floor, 12" concrete wall and ceiling, 12" from Wall, ~100 kg water reflector simulating a person



Container Thickness Study for 5.0 in. Containers				
of UO2F2+H2O with Full Reflection, 100% Enrichment				
0.195" Cont				
H/U	Case	Keff	K_sig	2*K_sig
15	apb05n-c.o	0.9102	0.0043	0.0086
20	apb06n-c.o	0.9129	0.0041	0.0082
25	apb07n-c.o	0.9234	0.0038	0.0076
50	apb08n-c.o	0.9045	0.0043	0.0086
0.10" Cont				
H/U	Case	Keff	K_sig	2*K_sig
15	apb01n-c.o	0.8979	0.0038	0.0076
20	apb02n-c.o	0.9064	0.0036	0.0072
25	apb03n-c.o	0.902	0.0039	0.0078
50	apb04n-c.o	0.8996	0.0043	0.0086
No Cont				
H/U	Case	Keff	K_sig	2*K_sig
15	apb009n.o	0.8795	0.0053	0.0106
20	apb010n.o	0.8801	0.0054	0.0108
25	apb011n.o	0.8934	0.0046	0.0092
50	apb012n.o	0.891	0.0056	0.0112

Figure 4.1.2-3. Thickness Study for a Single Container of UF_4 and Oil

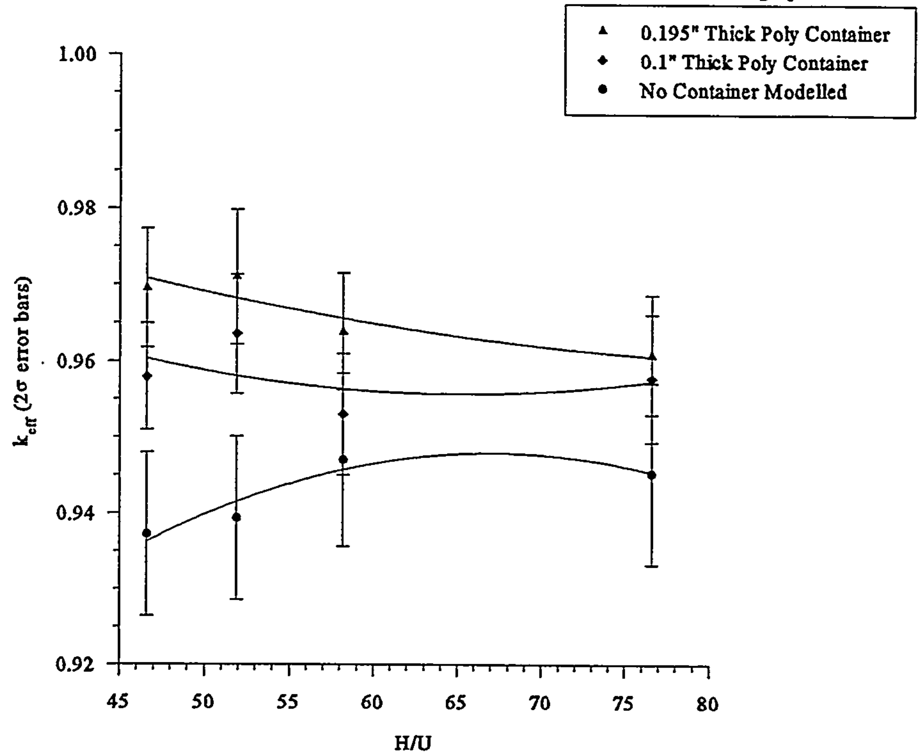
Fully Reflected Geometry, 100% enrichment, 24" concrete floor, 12" (minimum) water reflector on all other sides



Single Container Study for UF4 and Oil with Full Reflection and 100% Enrichment					
Case	H/U	Cont Thick	Keff	K_sig	2*K_sig
frd011n.o	58.2	0	0.8913	0.0055	0.011
frd-c1n.o	58.2	0.1	0.882	0.0052	0.0104
frd-c2n.o	58.2	0.25	0.9063	0.0056	0.0112
Case	H/U	Cont Thick	Keff	K_sig	2*K_sig
fre011n.o	58.2	0	0.9505	0.0046	0.0092
fre-c1n.o	58.2	0.1	0.9663	0.0053	0.0106
fre-c2n.o	58.2	0.25	0.9616	0.0061	0.0122

Figure 4.1.2-4. Thickness Study for Two 5.00" ID x 24" Tall Cylinders of UF_4 and Oil

100% enrichment, 24" concrete floor, 12" concrete wall and ceiling, 12" from Wall ~100 kg water reflector simulating a person



Two 5.00 in. Diameter Containers of UF4 and Oil				
1 ft. from a Wall for 100% Enrichment				
0.195" Cont				
Case	H/U	Keff	K_sig	2*K_sig
ape05n-c.o	46.6	0.9695	0.0039	0.0078
ape06n-c.o	51.9	0.971	0.0044	0.0088
ape07n-c.o	58.2	0.9638	0.0038	0.0076
ape08n-c.o	76.6	0.9608	0.0039	0.0078
0.1" Cont				
Case	H/U	Keff	K_sig	2*K_sig
ape01n-c.o	46.6	0.9579	0.0035	0.007
ape02n-c.o	51.9	0.9635	0.0039	0.0078
ape03n-c.o	58.2	0.953	0.004	0.008
ape04n-c.o	76.6	0.9577	0.0042	0.0084
No Cont				
Case	H/U	Keff	K_sig	2*K_sig
ape009n.o	46.6	0.9372	0.0054	0.0108
ape010n.o	51.9	0.9393	0.0054	0.0108
ape011n.o	58.2	0.947	0.0057	0.0114
ape012n.o	76.6	0.9452	0.006	0.012

ring around the container at a height of 20-inches on the bottle, while in the second case the ring is removed. The results are shown in Table 4.1.4-1. Since the difference in k_{eff} is small, and the actual container mounts only occupy 20% of the total circumference, the simpler model (no mounts) is used throughout this analysis.

Table 4.1.4-1. GP Container Model Assumptions Summary Table

Case	File Name	H/U	keff + 2sigma
5" x 24" container with hollow ring simulating handle mounts (UO2F2+H2O fully reflected)	fr-hand.500	20	0.9363
Without hollow ring	fr-nohnd.500	20	0.92244

4.2 General Discussion of Plotted k_{eff} versus H/U Results

The k_{eff} versus H/U plots are generated using SigmaPlot Version 2.0. The curve is a polynomial regression using k_{eff} +2σ data points. The K_{eff} and σ values are generated as part of the output data from the KENO analysis. The error bars represent ± 2σ for each of the data points. All supporting data, including case identifiers for each of the plots, are presented in tabular form immediately following the plotted results.

The cases employing a constant uranium density of 3.2 gU/cc for H/U values less than 4.0 produce results with a discontinuity at H/U= 4.0. For this reason, an independent polynomial regression is performed for data points below an H/U of 4.0 (i.e., the plot is made up of two independent curve fits).

4.3 4.32-inch-Diameter by 50-inch Polyethylene Bottle

This section presents calculations to model the "744G" and "OG" containers described in Table 1.0-1.

4.3.1 100% Enriched UO_2F_2+H_2O and UF_4+Oil

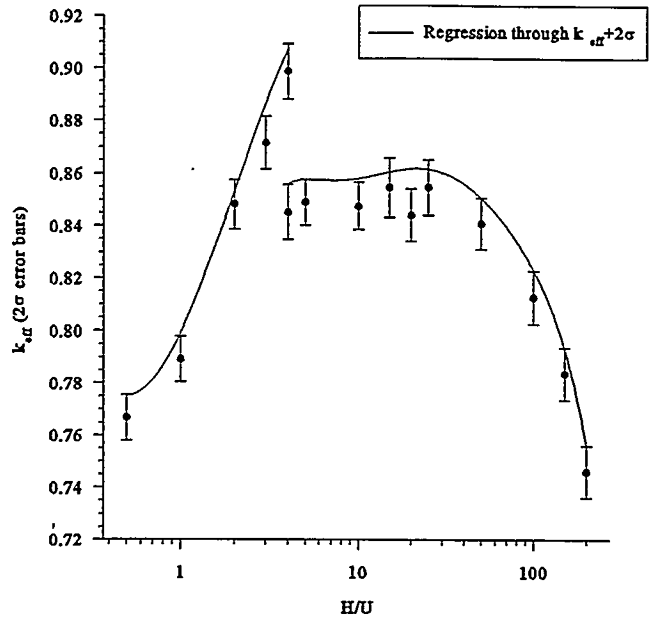
Table 4.3.1-0. lists the geometry model, figure, table number, and material type for 100% enriched 4.32-inch cases. The geometry model designators are explained in Table 4.1-1. The result of overloading a storage position in an array are shown as data points on the k_{eff} versus H/U graphs. The plotted curve is through the $k_{eff}+2\sigma$ data for the standard array.

Table 4.3.1-0. Summary of 4.32-inch-Diameter Container Results for 100% Enrichment

Geometry Model	Material	Figure/Table Number
SFR	UO_2F_2+H_2O	4.3.1-1
SCC	UO_2F_2+H_2O	4.3.1-2
TACW	UO_2F_2+H_2O	4.3.1-3
TSCW	UO_2F_2+H_2O	4.3.1-4
SFR	UF_4+oil	4.3.1-5
SCC	UF_4+oil	4.3.1-6
TACW	UF_4+oil	4.3.1-7
TSCW	UF_4+oil	4.3.1-8
ACE	UO_2F_2+H_2O	4.3.1-9
ACE	UF_4+oil	4.3.1-10
AI	UO_2F_2+H_2O	4.3.1-11
AI	UF_4+oil	4.3.1-12
AOSP	UO_2F_2 + H_2O	4.3.1-13
AOSP	UF_4 + oil	4.3.1-14

Figure 4.3.1-1. Single Fully Reflected 4.32" ID x 50" Tall Cylinder of UO_2F_2

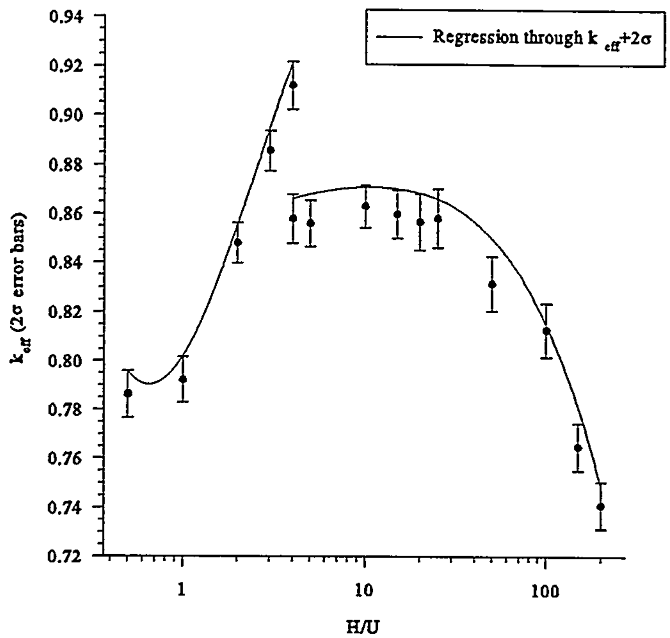
100% enrichment, 24" concrete floor, 12" (minimum) water reflector on all other sides



Single 4.32 in. Diameter Poly. Container w/ Full Reflection for 100% Enriched UO2F2+H2O					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
fra001n.o	0.5	0.7668	0.0044	0.0088	0.7756
fra002n.o	1	0.7892	0.0043	0.0086	0.7978
fra003n.o	2	0.8483	0.0047	0.0094	0.8577
fra004n.o	3	0.8716	0.005	0.01	0.8816
fra005n.o	3.99	0.8987	0.0053	0.0106	0.9093
fra006n.o	4	0.8453	0.0053	0.0106	0.8559
fra007n.o	5	0.8491	0.0044	0.0088	0.8579
fra008n.o	10	0.8478	0.0045	0.009	0.8568
fra009n.o	15	0.8548	0.0056	0.0112	0.866
fra010n.o	20	0.8443	0.005	0.01	0.8543
fra011n.o	25	0.8548	0.0053	0.0106	0.8654
fra012n.o	50	0.8411	0.0049	0.0098	0.8509
fra013n.o	100	0.8127	0.0051	0.0102	0.8229
fra014n.o	150	0.7836	0.005	0.01	0.7936
fra015n.o	200	0.746	0.0049	0.0098	0.7558

Figure 4.3.1-2. Single 4.32" ID x 50" Tall Cylinder of UO_2F_2 in a Concrete Corner

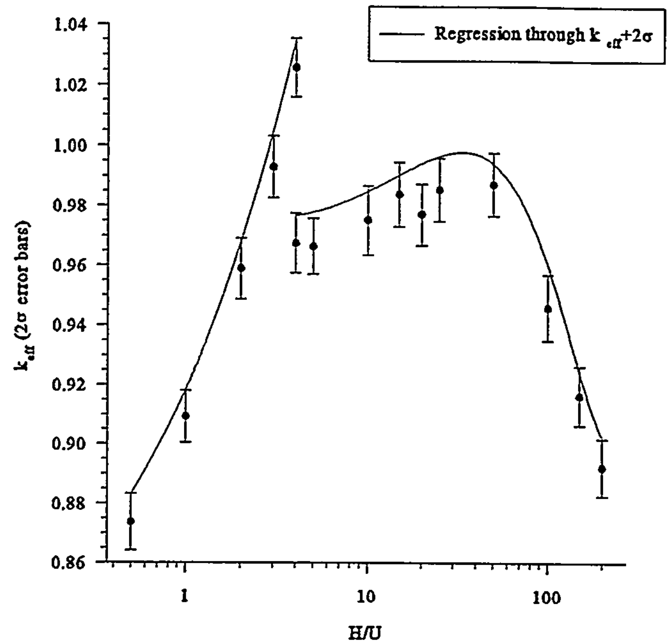
100% enrichment, 24" concrete floor, 12" concrete walls and ceiling, ~100 kg water reflector simulating a person



Single 4.32 in. Diameter Poly. Container in a Corner for 100% Enriched UO2F2+H2O					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
cpa001n.o	0.5	0.7862	0.0048	0.0096	0.7958
cpa002n.o	1	0.7922	0.0047	0.0094	0.8016
cpa003n.o	2	0.8481	0.0042	0.0084	0.8565
cpa004n.o	3	0.8857	0.004	0.008	0.8937
cpa005n.o	3.99	0.912	0.0049	0.0098	0.9218
cpa006n.o	4	0.8579	0.0049	0.0098	0.8677
cpa007n.o	5	0.8561	0.0047	0.0094	0.8655
cpa008n.o	10	0.8631	0.0044	0.0088	0.8719
cpa009n.o	15	0.8598	0.0049	0.0098	0.8696
cpa010n.o	20	0.8566	0.0057	0.0114	0.868
cpa011n.o	25	0.8581	0.006	0.012	0.8701
cpa012n.o	50	0.8316	0.0055	0.011	0.8426
cpa013n.o	100	0.8127	0.0055	0.011	0.8237
cpa014n.o	150	0.7648	0.0048	0.0096	0.7744
cpa015n.o	200	0.741	0.0048	0.0096	0.7506

Figure 4.3.1-3. Two 4.32" ID x 50" Tall Cylinders of UO_2F_2 Next to a Wall

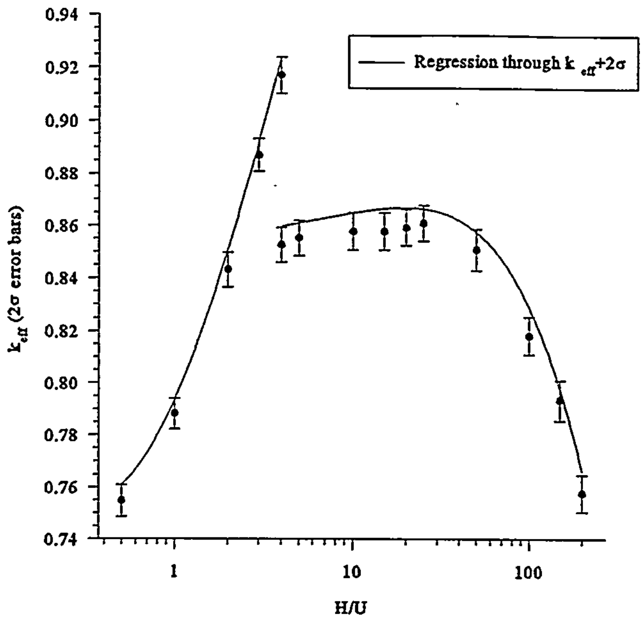
100% enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 4.32 in. Diameter Poly. Containers Adjacent to Concrete Wall for 100% Enriched UO2F2+H2O					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
npa001n.o	0.5	0.8736	0.0048	0.0096	0.8832
npa002n.o	1	0.9093	0.0044	0.0088	0.9181
npa003n.o	2	0.9589	0.0051	0.0102	0.9691
npa004n.o	3	0.9929	0.0051	0.0102	1.0031
npa005n.o	3.99	1.0258	0.0049	0.0098	1.0356
npa006n.o	4	0.9674	0.005	0.01	0.9774
npa007n.o	5	0.9663	0.0047	0.0094	0.9757
npa008n.o	10	0.9752	0.0058	0.0116	0.9868
npa009n.o	15	0.9839	0.0054	0.0108	0.9947
npa010n.o	20	0.9771	0.0052	0.0104	0.9875
npa011n.o	25	0.9854	0.0053	0.0106	0.996
npa012n.o	50	0.9871	0.0053	0.0106	0.9977
npa013n.o	100	0.9459	0.0055	0.011	0.9569
npa014n.o	150	0.9163	0.005	0.01	0.9263
npa015n.o	200	0.8921	0.0048	0.0096	0.9017

Figure 4.3.1-4. Two 4.32" ID x 50" Tall Cylinders of UO_2F_2 One Foot from a Wall

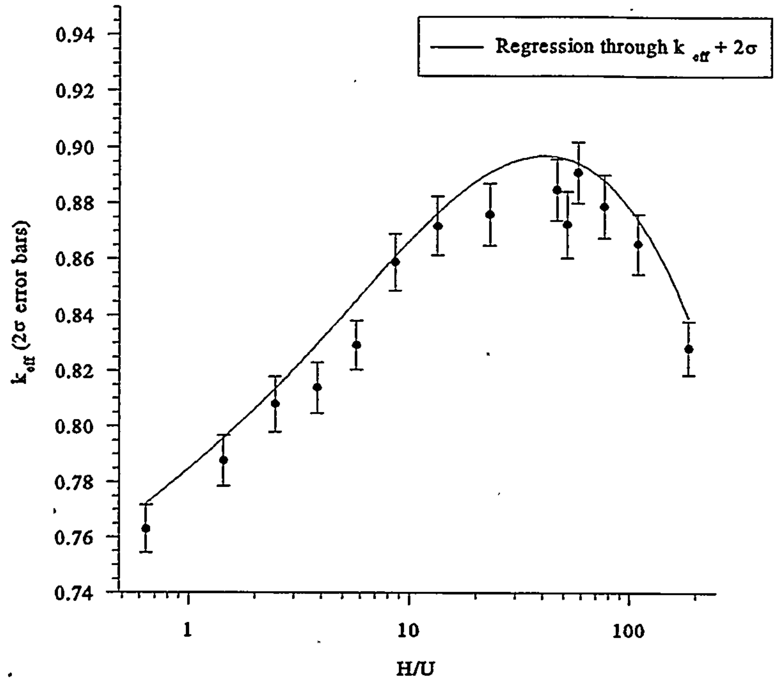
100% enrichment, 0.195" thick Poly container, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 4.32 in. Diameter Poly. Containers 1' from Concrete Wall for 100% Enriched UO2F2+H2O					
H/U	Case	Keff	K_sig	2*K_sig	Keff+2*K_sig
0.5	apa01n-c.o	0.7548	0.0031	0.0062	0.761
1	apa02n-c.o	0.7881	0.0029	0.0058	0.7939
2	apa03n-c.o	0.8431	0.0033	0.0066	0.8497
3	apa04n-c.o	0.8871	0.0031	0.0062	0.8933
3.99	apa05n-c.o	0.917	0.0035	0.007	0.924
4	apa06n-c.o	0.8526	0.0033	0.0066	0.8592
5	apa07n-c.o	0.8552	0.0034	0.0068	0.862
10	apa08n-c.o	0.8578	0.0036	0.0072	0.865
15	apa09n-c.o	0.8578	0.0036	0.0072	0.865
20	apa10n-c.o	0.8593	0.0035	0.007	0.8663
25	apa11n-c.o	0.861	0.0034	0.0068	0.8678
50	apa12n-c.o	0.8509	0.004	0.008	0.8589
100	apa13n-c.o	0.8181	0.0036	0.0072	0.8253
150	apa14n-c.o	0.7934	0.0039	0.0078	0.8012
200	apa15n-c.o	0.7577	0.0036	0.0072	0.7649

Figure 4.3.1-5. Single Fully Reflected 4.32" ID x 50" Tall Cylinder of UF_4 and Oil

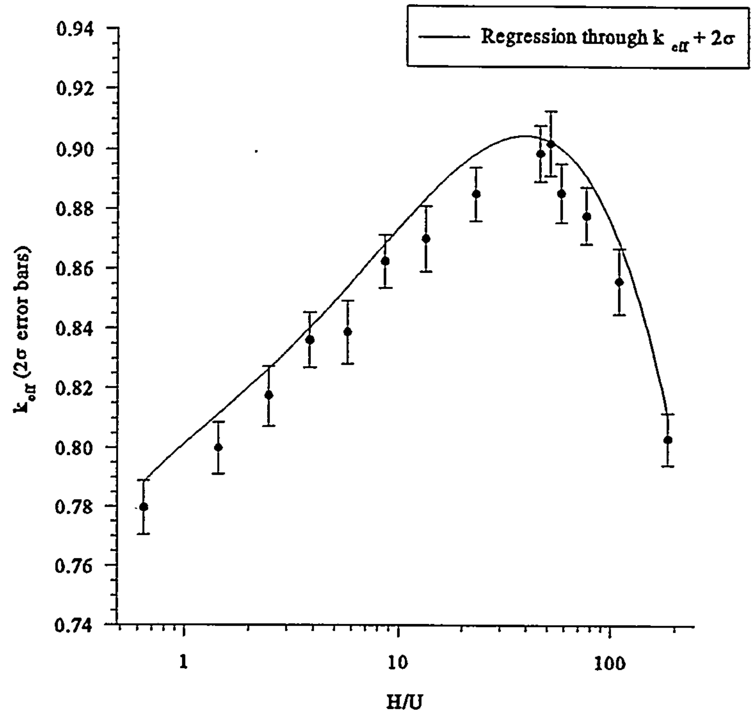
100% enrichment, 24" concrete floor, 12" (minimum) water reflector on all other sides



Single 4.32 in. Diameter Poly. Container w/ Full Reflection for 100% Enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
frd001n.o	0.64	0.763	0.0043	0.0086	0.7716
frd002n.o	1.44	0.7877	0.0045	0.009	0.7967
frd003n.o	2.47	0.808	0.005	0.01	0.818
frd004n.o	3.84	0.814	0.0046	0.0092	0.8232
frd005n.o	5.76	0.8293	0.0044	0.0088	0.8381
frd006n.o	8.64	0.859	0.0051	0.0102	0.8692
frd007n.o	13.4	0.872	0.0053	0.0106	0.8826
frd008n.o	23.1	0.8761	0.0056	0.0112	0.8873
frd009n.o	46.6	0.8851	0.0055	0.011	0.8961
frd010n.o	51.9	0.8726	0.006	0.012	0.8846
frd011n.o	58.2	0.8913	0.0055	0.011	0.9023
frd012n.o	76.6	0.8791	0.0057	0.0114	0.8905
frd013n.o	109.5	0.8656	0.0054	0.0108	0.8764
frd014n.o	186.4	0.8283	0.0048	0.0096	0.8379

Figure 4.3.1-6. Single 4.32" ID x 50" Tall Cylinder of UF_4 and Oil in a Concrete Corner

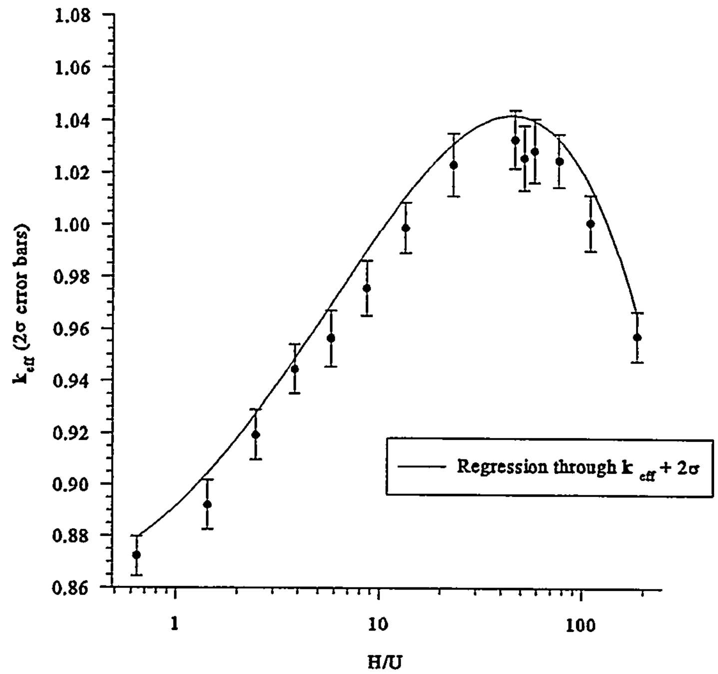
100% enrichment, 24" concrete floor, 12" concrete walls and ceiling, ~100 kg water reflector simulating a person



Single 4.32 in. Diameter Poly. Container in a Corner for 100% Enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
cpd001n.o	0.64	0.7797	0.0046	0.0092	0.7889
cpd002n.o	1.44	0.7999	0.0044	0.0088	0.8087
cpd003n.o	2.47	0.8174	0.005	0.01	0.8274
cpd004n.o	3.84	0.8361	0.0046	0.0092	0.8453
cpd005n.o	5.76	0.8387	0.0053	0.0106	0.8493
cpd006n.o	8.64	0.8624	0.0044	0.0088	0.8712
cpd007n.o	13.4	0.87	0.0055	0.011	0.881
cpd008n.o	23.1	0.8851	0.0045	0.009	0.8941
cpd009n.o	46.6	0.8988	0.0047	0.0094	0.9082
cpd010n.o	51.9	0.9021	0.0054	0.0108	0.9129
cpd011n.o	58.2	0.8855	0.0049	0.0098	0.8953
cpd012n.o	76.6	0.8779	0.0048	0.0096	0.8875
cpd013n.o	109.5	0.856	0.0055	0.011	0.867
cpd014n.o	186.4	0.8032	0.0044	0.0088	0.812

Figure 4.3.1-7. Two 4.32" ID x 50" Tall Cylinders of UF_4 and Oil Next to a Wall

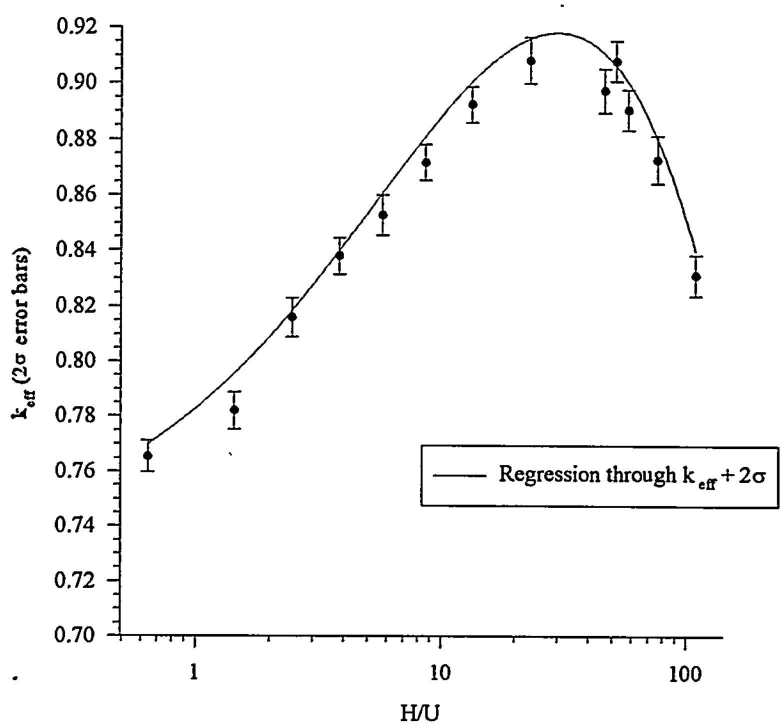
100% enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 4.32 in. Diameter Poly. Containers Adjacent to Concrete Wall for 100% Enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
npd001n.o	0.64	0.8722	0.0038	0.0076	0.8798
npd002n.o	1.44	0.892	0.0048	0.0096	0.9016
npd003n.o	2.47	0.9192	0.0048	0.0096	0.9288
npd004n.o	3.84	0.9446	0.0047	0.0094	0.954
npd005n.o	5.76	0.9565	0.0054	0.0108	0.9673
npd006n.o	8.64	0.9758	0.0052	0.0104	0.9862
npd007n.o	13.4	0.999	0.0049	0.0098	1.0088
npd008n.o	23.1	1.0234	0.0061	0.0122	1.0356
npd009n.o	46.6	1.0331	0.0055	0.011	1.0441
npd010n.o	51.9	1.026	0.0063	0.0126	1.0386
npd011n.o	58.2	1.0287	0.0061	0.0122	1.0409
npd012n.o	76.6	1.025	0.0051	0.0102	1.0352
npd013n.o	109.5	1.0011	0.0054	0.0108	1.0119
npd014n.o	186.4	0.9574	0.0048	0.0096	0.967

Figure 4.3.1-8. Two 4.32" ID x 50" Tall Cylinders of UF_4 and Oil One Foot from a Wall

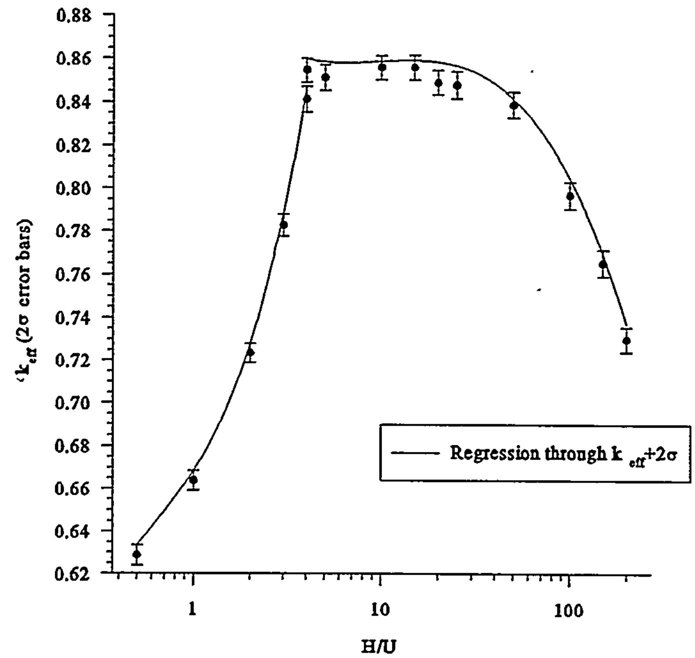
100% enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 4.32 in. Diameter Poly. Containers 1' from Concrete Wall for 100% Enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
d12n-432.0p6	0.64	0.7655	0.00291	0.00582	0.77132
d12n-432.144	1.44	0.782	0.00344	0.00688	0.78888
d12n-432.384	3.84	0.816	0.0035	0.007	0.823
d12n-432.576	5.76	0.838	0.00327	0.00654	0.84454
d12n-432.864	8.64	0.8528	0.00364	0.00728	0.86008
d12n-432.134	13.4	0.8718	0.00322	0.00644	0.87824
d12n-432.231	23.1	0.8924	0.00319	0.00638	0.89878
d12n-432.466	46.6	0.9081	0.00418	0.00836	0.91646
d12n-432.519	51.9	0.8974	0.00395	0.0079	0.9053
d12n-432.582	58.2	0.908	0.00365	0.0073	0.9153
d12n-432.766	76.6	0.8906	0.00358	0.00716	0.89776
d12n-432.109	109.5	0.873	0.00425	0.0085	0.8815
d12n-432.186	186.4	0.8312	0.00367	0.00734	0.83854

Figure 4.3.1-9. An Array of 4.32" ID x 50" Tall Cylinders of UO $_2$F$_2$

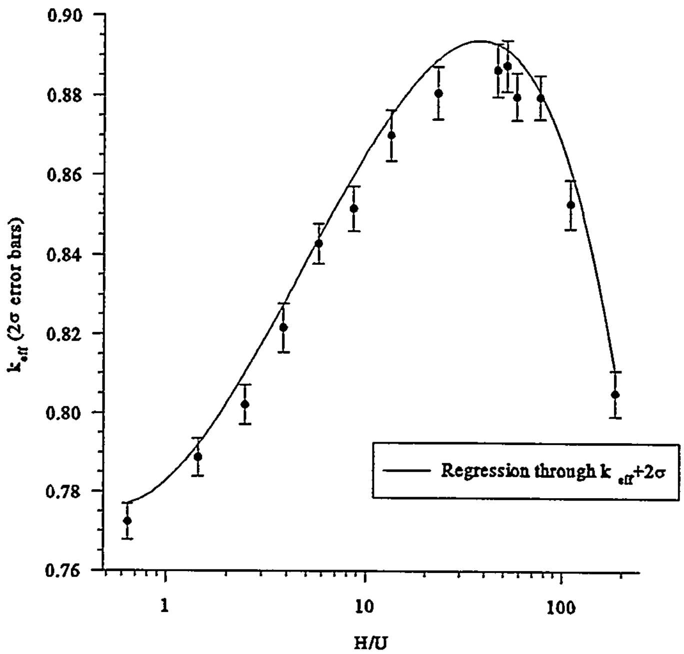
100% enrichment, 0.195" thick Poly containers, 24" concrete floor, 12" concrete walls and ceiling, 6' spacing between row sets, 23" spacing between containers, 2' spacing from walls



An Array of 4.32-in. Containers of UO2F2					
For 100% Enrichment					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
arra01n-c.o	0.5	0.6285	0.0024	0.0048	0.6333
arra02n-c.o	1	0.6637	0.0023	0.0046	0.6683
arra03n-c.o	2	0.7233	0.0023	0.0046	0.7279
arra04n-c.o	3	0.7827	0.0027	0.0054	0.7881
arra05n-c.o	3.99	0.8413	0.0029	0.0058	0.8471
arra06n-c.o	4	0.8546	0.0028	0.0056	0.8602
arra07n-c.o	5	0.8512	0.0029	0.0058	0.857
arra08n-c.o	10	0.8558	0.0028	0.0056	0.8614
arra09n-c.o	15	0.8559	0.0029	0.0058	0.8617
arra10n-c.o	20	0.849	0.0028	0.0056	0.8546
arra11n-c.o	25	0.8479	0.0031	0.0062	0.8541
arra12n-c.o	50	0.8388	0.0029	0.0058	0.8446
arra13n-c.o	100	0.797	0.0031	0.0062	0.8032
arra14n-c.o	150	0.7653	0.003	0.006	0.7713
arra15n-c.o	200	0.7299	0.003	0.006	0.7359

Figure 4.3.1-10. An Array of 4.32" ID x 50" Tall Cylinders of UF_4 + Oil

100% enrichment, 0.195" thick Poly containers, 24" concrete floor, 12" concrete walls and ceiling, 6' spacing between row sets, 23" spacing between containers, 2' spacing from walls



An Array of 4.32-in. Poly. Containers of UF4+Oil					
For 100% Enrichment					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
arrd01n-c.o	0.64	0.7723	0.0023	0.0046	0.7769
arrd02n-c.o	1.44	0.7887	0.0024	0.0048	0.7935
arrd03n-c.o	2.47	0.8021	0.0025	0.005	0.8071
arrd04n-c.o	3.84	0.8217	0.0031	0.0062	0.8279
arrd05n-c.o	5.76	0.8428	0.0025	0.005	0.8478
arrd06n-c.o	8.64	0.8516	0.0028	0.0056	0.8572
arrd07n-c.o	13.4	0.8701	0.0032	0.0064	0.8765
arrd08n-c.o	23.1	0.8807	0.0032	0.0064	0.8871
arrd09n-c.o	46.6	0.8864	0.0033	0.0066	0.893
arrd10n-c.o	51.9	0.8875	0.0032	0.0064	0.8939
arrd11n-c.o	58.2	0.8798	0.0029	0.0058	0.8856
arrd12n-c.o	76.6	0.8796	0.0027	0.0054	0.885
arrd13n-c.o	109.5	0.8529	0.0031	0.0062	0.8591
arrd14n-c.o	186.4	0.8051	0.0029	0.0058	0.8109

Figure 4.3.1-11. The Effects of Interstitial Water Volume Fraction on k_{eff}

Standard array geometry with 4.32" ID x 50" tall containers of UO_2F_2 with 0.195" thick Poly walls

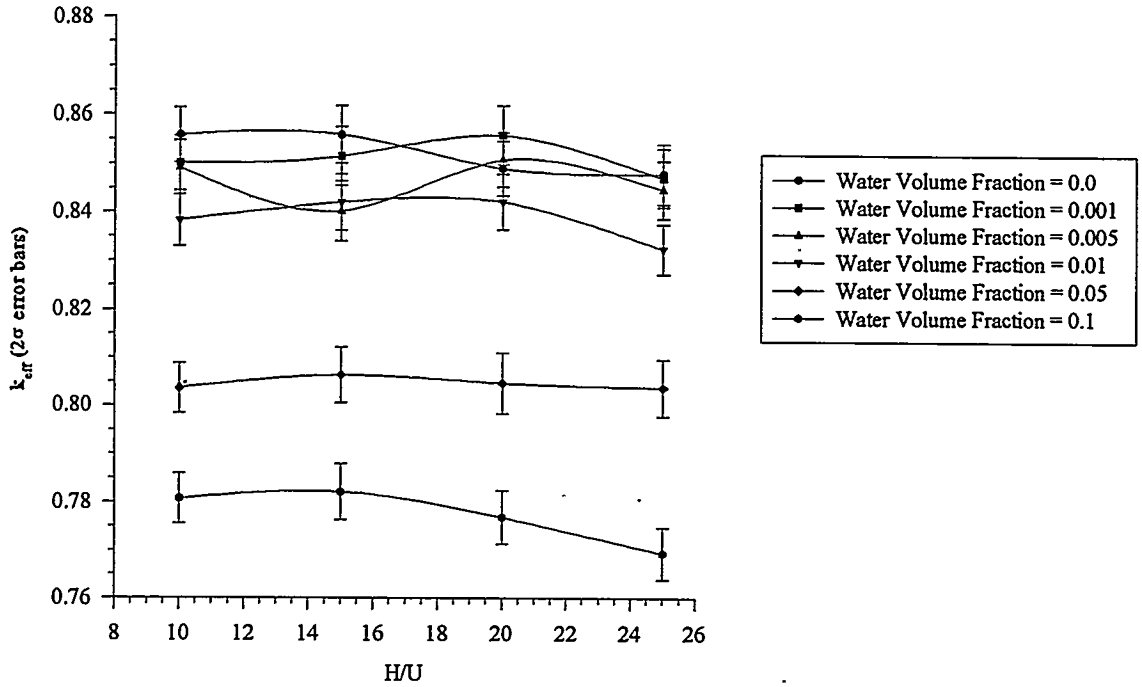


Figure 4.3.1-11a. The Effects of Interstitial Water Volume Fraction on k_{eff}
Standard array geometry with 4.32" ID x 50" tall containers of UO_2F_2 with 0.195" thick Poly walls

The Effects of Interstitial Water Volume Fraction for a Standard Array of 4.32-in. Diameter Containers of UO2F2+H2O					
Case	H/U	Keff	K sig	2*K sig	Keff+2*K sig
Interstitial	Water =	0			
arra08n-c.o	10	0.8558	0.0028	0.0056	0.8614
arra09n-c.o	15	0.8559	0.0029	0.0058	0.8617
arra10n-c.o	20	0.849	0.0028	0.0056	0.8546
arra11n-c.o	25	0.8479	0.0031	0.0062	0.8541
Interstitial	Water =	0.001			
aaw101n-c.o	10	0.8501	0.0028	0.0056	0.8557
aaw102n-c.o	15	0.8515	0.003	0.006	0.8575
aaw103n-c.o	20	0.8558	0.003	0.006	0.8618
aaw104n-c.o	25	0.8471	0.003	0.006	0.8531
Interstitial	Water =	0.005			
aaw201n-c.o	10	0.8492	0.0028	0.0056	0.8548
aaw202n-c.o	15	0.8402	0.0031	0.0062	0.8464
aaw203n-c.o	20	0.8508	0.0028	0.0056	0.8564
aaw204n-c.o	25	0.8447	0.003	0.006	0.8507
Interstitial	Water =	0.01			
aaw301n-c.o	10	0.8383	0.0027	0.0054	0.8437
aaw302n-c.o	15	0.842	0.0029	0.0058	0.8478
aaw303n-c.o	20	0.8421	0.0029	0.0058	0.8479
aaw304n-c.o	25	0.8324	0.0026	0.0052	0.8376
Interstitial	Water =	0.05			
aaw401n-c.o	10	0.8036	0.0026	0.0052	0.8088
aaw402n-c.o	15	0.8063	0.0029	0.0058	0.8121
aaw403n-c.o	20	0.8046	0.0032	0.0064	0.811
aaw404n-c.o	25	0.8037	0.003	0.006	0.8097
Interstitial	Water =	0.1			
aaw501n-c.o	10	0.7807	0.0026	0.0052	0.7859
aaw502n-c.o	15	0.7821	0.0029	0.0058	0.7879
aaw503n-c.o	20	0.7768	0.0028	0.0056	0.7824
aaw504n-c.o	25	0.7693	0.0027	0.0054	0.7747

Figure 4.3.1-12. The Effects of Interstitial Water Volume Fraction on k_{eff}

Standard array geometry with 4.32" ID x 50" tall containers of UF_4 and Oil with 0.195" thick Poly walls

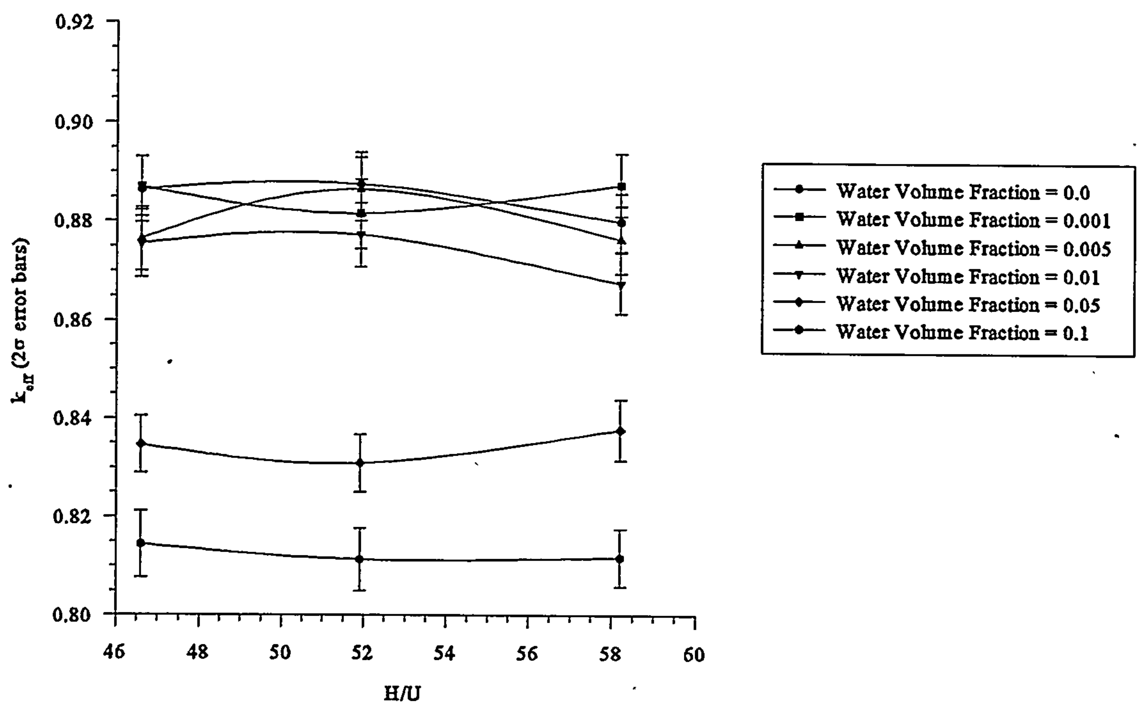


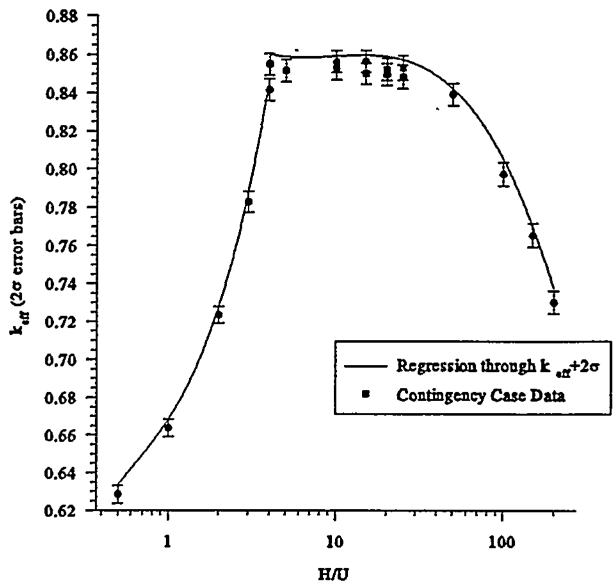
Figure 4.3.1-12a. The Effects of Interstitial Water Volume Fraction on k_{eff}

Standard array geometry with 4.32" ID x 50" tall containers of UF_4 and Oil with 0.195" thick Poly walls

The Effects of Interstitial Water Volume Fraction for a Standard Array of 5.25" ID x 15" Tin/Steel Containers of U3O8					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
Interstitial	Water =	0			
71.2	array-z.05.o	0.7402	0.0031	0.0062	0.7464
33.7	array-z.10.o	0.7533	0.0029	0.0058	0.7591
21.2	array-z.15.o	0.7612	0.0031	0.0062	0.7674
15	array-z.20.o	0.7549	0.003	0.006	0.7609
Interstitial	Water =	0.001			
71.2	arrz105.out	0.6981	0.0031	0.0062	0.7043
33.7	arrz110.out	0.725	0.0029	0.0058	0.7308
21.2	arrz115.out	0.7326	0.003	0.006	0.7386
15	arrz120.out	0.7282	0.0026	0.0052	0.7334
Interstitial	Water =	0.005			
71.2	arrz205.out	0.7007	0.0027	0.0054	0.7061
33.7	arrz210.out	0.7281	0.0032	0.0064	0.7345
21.2	arrz215.out	0.7317	0.0027	0.0054	0.7371
15	arrz220.out	0.7282	0.0031	0.0062	0.7344
Interstitial	Water =	0.01			
71.2	arrz305.out	0.694	0.003	0.006	0.7
33.7	arrz310.out	0.7254	0.0026	0.0052	0.7306
21.2	arrz315.out	0.7326	0.0029	0.0058	0.7384
15	arrz320.out	0.7348	0.0031	0.0062	0.741
Interstitial	Water =	0.05			
71.2	arrz405.out	0.7014	0.003	0.006	0.7074
33.7	arrz410.out	0.7255	0.0027	0.0054	0.7309
21.2	arrz415.out	0.7271	0.0033	0.0066	0.7337
15	arrz420.out	0.7285	0.0027	0.0054	0.7339
Interstitial	Water =	0.1			
71.2	arrz505.out	0.7178	0.0026	0.0052	0.723
33.7	arrz510.out	0.7449	0.003	0.006	0.7509
21.2	arrz515.out	0.7385	0.0034	0.0068	0.7453
15	arrz520.out	0.7334	0.0028	0.0056	0.739

Figure 4.3.1-13. An Array of 4.32" ID x 50" Tall Cylinders of UO_2F_2

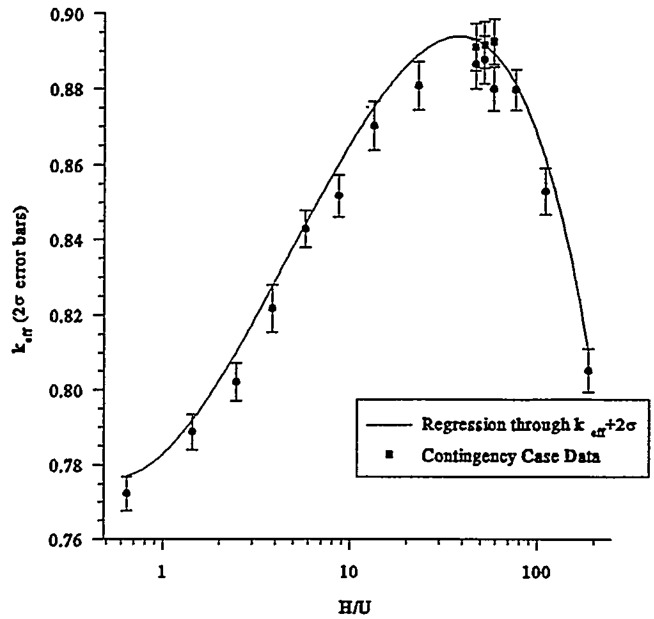
100% enrichment, 0.195" thick Poly containers, 24" concrete floor, 12" concrete walls and ceiling, 6' spacing between row sets, 23" spacing between containers, 2' spacing from walls



An Array of 4.32-in. Containers of UO2F2 (Contingency Data) For 100% Enrichment					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
arra01n-c.o	0.5	0.6285	0.0024	0.0048	0.6333
arra02n-c.o	1	0.6637	0.0023	0.0046	0.6683
arra03n-c.o	2	0.7233	0.0023	0.0046	0.7279
arra04n-c.o	3	0.7827	0.0027	0.0054	0.7881
arra05n-c.o	3.99	0.8413	0.0029	0.0058	0.8471
arra06n-c.o	4	0.8546	0.0028	0.0056	0.8602
arra07n-c.o	5	0.8512	0.0029	0.0058	0.857
arra08n-c.o	10	0.8558	0.0028	0.0056	0.8614
arra09n-c.o	15	0.8559	0.0029	0.0058	0.8617
arra10n-c.o	20	0.849	0.0028	0.0056	0.8546
arra11n-c.o	25	0.8479	0.0031	0.0062	0.8541
arra12n-c.o	50	0.8388	0.0029	0.0058	0.8446
arra13n-c.o	100	0.797	0.0031	0.0062	0.8032
arra14n-c.o	150	0.7653	0.003	0.006	0.7713
arra15n-c.o	200	0.7299	0.003	0.006	0.7359
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
aracn08-c.o	10	0.8526	0.0031	0.0062	0.8588
aracn09-c.o	15	0.8496	0.0028	0.0056	0.8552
aracn10-c.o	20	0.8519	0.0028	0.0056	0.8575
aracn11-c.o	25	0.8525	0.0031	0.0062	0.8587

Figure 4.3.1-14. An Array of 4.32" ID x 50" Tall Cylinders of UF $_4$ + Oil

100% enrichment, 0.195" thick Poly containers, 24" concrete floor, 12" concrete walls and ceiling, 6' spacing between row sets, 23" spacing between containers, 2' spacing from walls



An Array of 4.32-in. Poly. Containers of UF4+Oil For 100% Enrichment - Overloaded Storage Position					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
arrd01n-c.o	0.64	0.7723	0.0023	0.0046	0.7769
arrd02n-c.o	1.44	0.7887	0.0024	0.0048	0.7935
arrd03n-c.o	2.47	0.8021	0.0025	0.005	0.8071
arrd04n-c.o	3.84	0.8217	0.0031	0.0062	0.8279
arrd05n-c.o	5.76	0.8428	0.0025	0.005	0.8478
arrd06n-c.o	8.64	0.8516	0.0028	0.0056	0.8572
arrd07n-c.o	13.4	0.8701	0.0032	0.0064	0.8765
arrd08n-c.o	23.1	0.8807	0.0032	0.0064	0.8871
arrd09n-c.o	46.6	0.8864	0.0033	0.0066	0.893
arrd10n-c.o	51.9	0.8875	0.0032	0.0064	0.8939
arrd11n-c.o	58.2	0.8798	0.0029	0.0058	0.8856
arrd12n-c.o	76.6	0.8796	0.0027	0.0054	0.885
arrd13n-c.o	109.5	0.8529	0.0031	0.0062	0.8591
arrd14n-c.o	186.4	0.8051	0.0029	0.0058	0.8109
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
ardcn09-c.o	46.6	0.8909	0.0031	0.0062	0.8971
ardcn10-c.o	51.9	0.8915	0.0031	0.0062	0.8977
ardcn11-c.o	58.2	0.8924	0.003	0.006	0.8984

4.3.2 10% Enriched UO_2F_2+H_2O and UF_4+oil

Table 4.3.2-0 gives the figures and table numbers that contain the result data for this container with various geometry models and fuel materials. The geometry model designators are explained in Table 4.1.1.

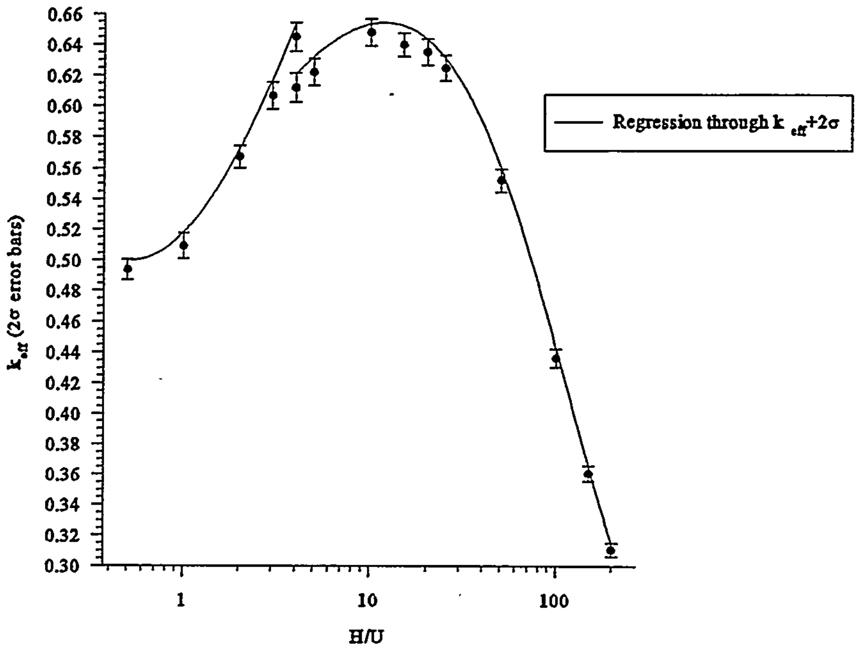
The three standard array cases were not analyzed because the 100% enriched standard array cases fell within the safety criterion. Container thickness was not included in the 10% enriched cases because all of the more reactive 100% cases met the safety criterion.

Table 4.3.2-0. Summary of 4.32-inch Container Results for 10% Enrichment

Geometry Model	Material	Figure/Table Number
SFR	UO_2F_2+H_2O	4.3.2-1
SCC	UO_2F_2+H_2O	4.3.2-2
TACW	UO_2F_2+H_2O	4.3.2-3
TSCW	UO_2F_2+H_2O	4.3.2-4
SFR	UF_4+oil	4.3.2-5
SCC	UF_4+oil	4.3.2-6
TACW	UF_4+oil	4.3.2-7
TSCW	UF_4+oil	4.3.2-8

Figure 4.3.2-1. Single Fully Reflected 4.32" ID x 50" Tall Cylinder of UO_2F_2

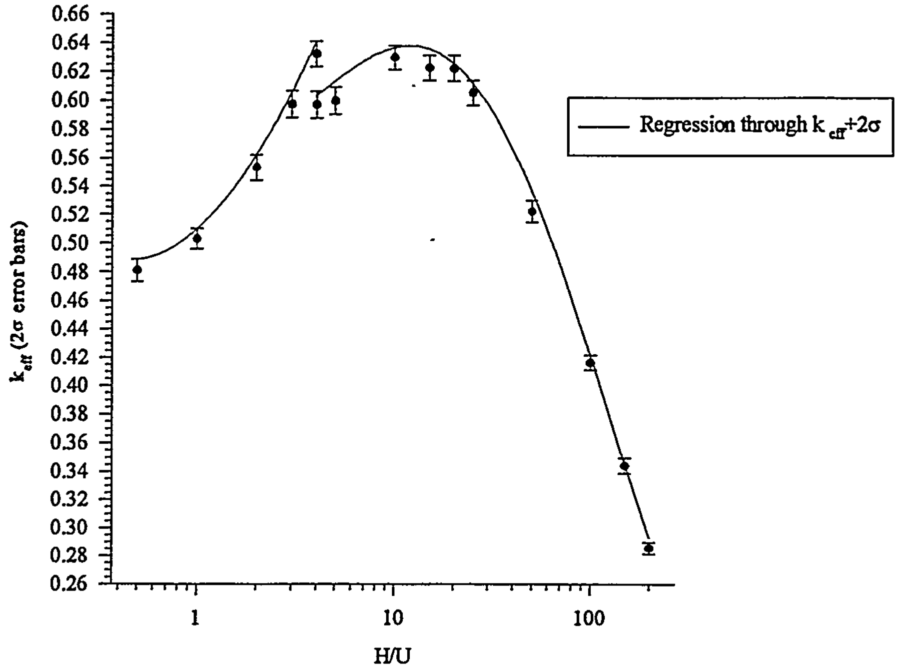
10% enrichment, 24" concrete floor, 12" (minimum) water reflector on all other sides



Single 4.32 in. Diameter Poly. Container w/ Full Reflection for 10% Enriched UO2F2+H2O					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
fru001n.o	0.5	0.4938	0.0034	0.0068	0.5006
fru002n.o	1	0.5092	0.0041	0.0082	0.5174
fru003n.o	2	0.5672	0.0036	0.0072	0.5744
fru004n.o	3	0.6064	0.0044	0.0088	0.6152
fru005n.o	3.99	0.6446	0.0046	0.0092	0.6538
fru006n.o	4	0.6117	0.0048	0.0096	0.6213
fru007n.o	5	0.6219	0.0043	0.0086	0.6305
fru008n.o	10	0.6475	0.0044	0.0088	0.6563
fru009n.o	15	0.6395	0.0038	0.0076	0.6471
fru010n.o	20	0.6348	0.0043	0.0086	0.6434
fru011n.o	25	0.6243	0.0041	0.0082	0.6325
fru012n.o	50	0.5517	0.0037	0.0074	0.5591
fru013n.o	100	0.4362	0.0029	0.0058	0.442
fru014n.o	150	0.3605	0.0026	0.0052	0.3657
fru015n.o	200	0.3106	0.0022	0.0044	0.315

Figure 4.3.2-2. Single 4.32" ID x 50" Tall Cylinder of UO_2F_2 in a Concrete Corner

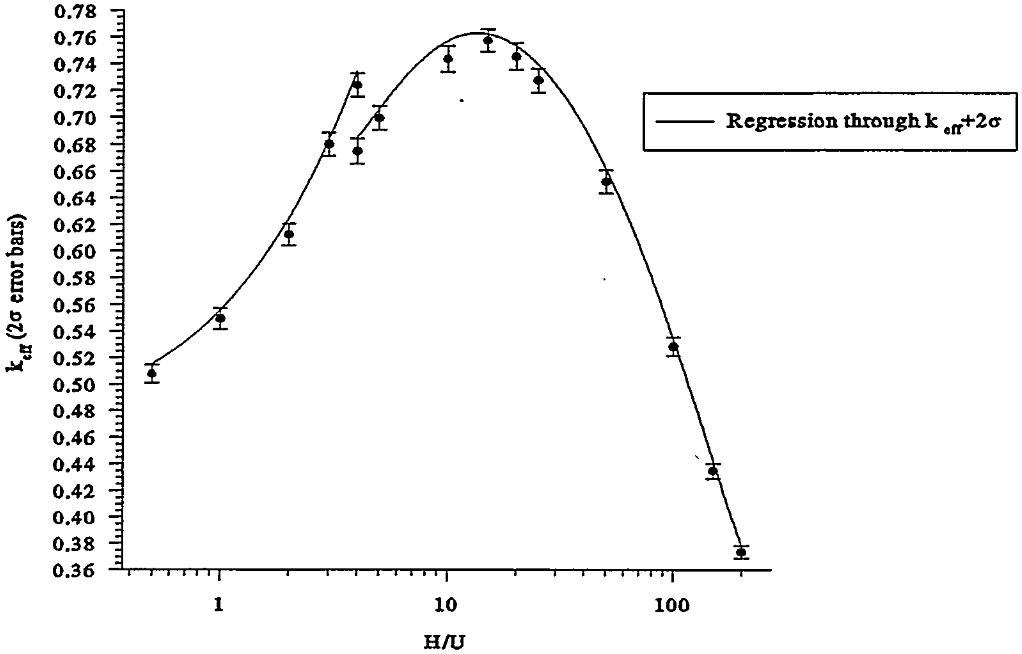
10% enrichment, 24" concrete floor, 12" concrete walls and ceiling, ~100 kg water reflector simulating a person



Single 4.32 in. Diameter Poly. Container in a Corner for 10% Enriched UO2F2+H2O					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
cpu001n.o	0.5	0.4811	0.0038	0.0076	0.4887
cpu002n.o	1	0.5031	0.0035	0.007	0.5101
cpu003n.o	2	0.5533	0.0044	0.0088	0.5621
cpu004n.o	3	0.5969	0.0047	0.0094	0.6063
cpu005n.o	3.99	0.6316	0.0044	0.0088	0.6404
cpu006n.o	4	0.5965	0.0047	0.0094	0.6059
cpu007n.o	5	0.5992	0.0046	0.0092	0.6084
cpu008n.o	10	0.6289	0.0042	0.0084	0.6373
cpu009n.o	15	0.6217	0.0043	0.0086	0.6303
cpu010n.o	20	0.6214	0.0044	0.0088	0.6302
cpu011n.o	25	0.6046	0.0043	0.0086	0.6132
cpu012n.o	50	0.5216	0.0038	0.0076	0.5292
cpu013n.o	100	0.4162	0.0027	0.0054	0.4216
cpu014n.o	150	0.3441	0.0027	0.0054	0.3495
cpu015n.o	200	0.2854	0.0021	0.0042	0.2896

Figure 4.3.2-3. Two 4.32" ID x 50" Tall Cylinders of UO_2F_2 Next to a Wall

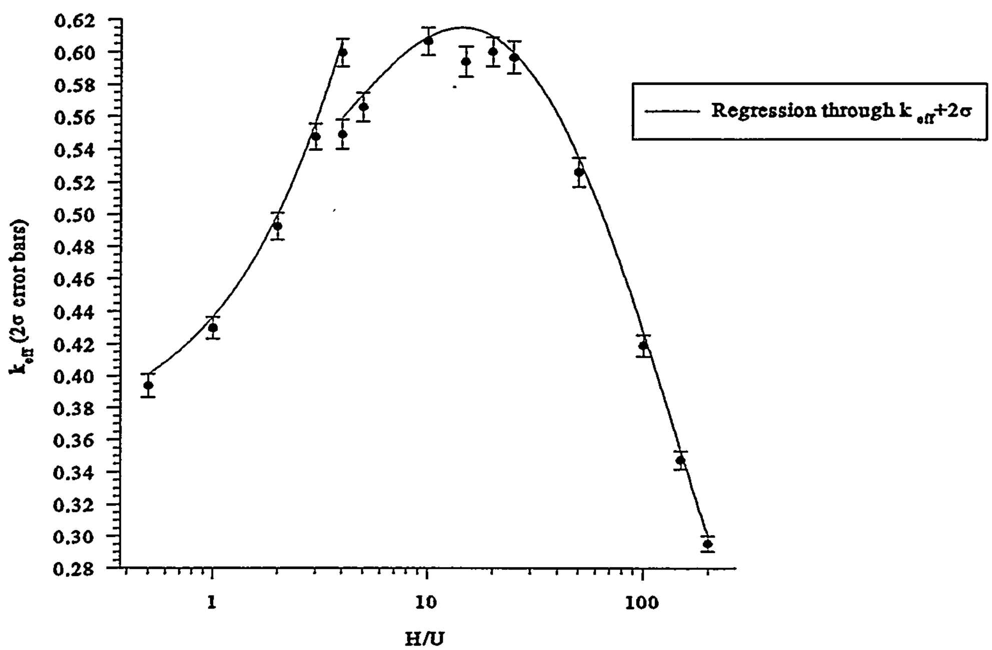
10% enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 4.32 in. Diameter Poly. Containers Adjacent to Concrete Wall for 10% Enriched UO2F2+H2O					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
npu001n.o	0.5	0.5079	0.0035	0.007	0.5149
npu002n.o	1	0.5496	0.0039	0.0078	0.5574
npu003n.o	2	0.6123	0.0041	0.0082	0.6205
npu004n.o	3	0.6799	0.0043	0.0086	0.6885
npu005n.o	3.99	0.7235	0.0043	0.0086	0.7321
npu006n.o	4	0.6747	0.0047	0.0094	0.6841
npu007n.o	5	0.6991	0.0043	0.0086	0.7077
npu008n.o	10	0.7429	0.0049	0.0098	0.7527
npu009n.o	15	0.7566	0.0042	0.0084	0.765
npu010n.o	20	0.7447	0.0049	0.0098	0.7545
npu011n.o	25	0.7269	0.0045	0.009	0.7359
npu012n.o	50	0.6518	0.0043	0.0086	0.6604
npu013n.o	100	0.5281	0.0035	0.007	0.5351
npu014n.o	150	0.4346	0.0027	0.0054	0.44
npu015n.o	200	0.3736	0.0024	0.0048	0.3784

Figure 4.3.2-4. Two 4.32" ID x 50" Tall Cylinders of UO_2F_2 One Foot from a Wall

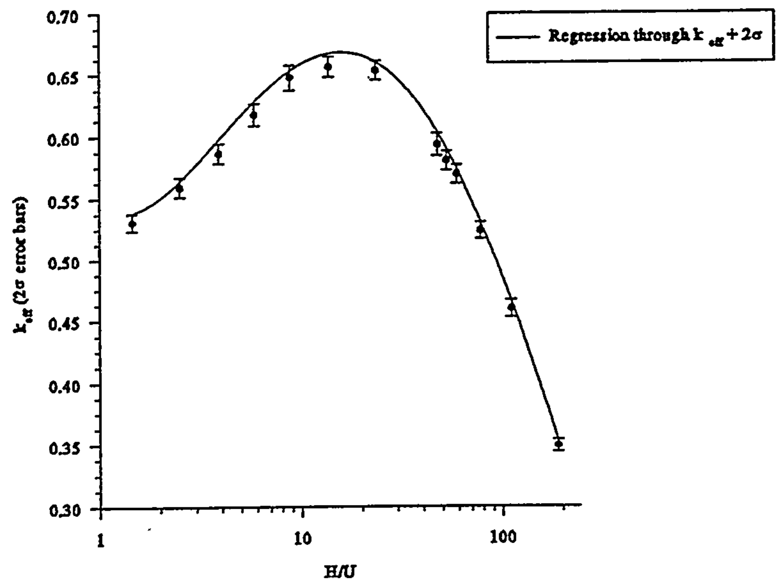
10% enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 4.32 in. Diameter Poly. Containers 1' from Concrete Wall for 10% Enriched UO2F2+H2O					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
apu001n.o	0.5	0.3938	0.0036	0.0072	0.401
apu002n.o	1	0.4297	0.0033	0.0066	0.4363
apu003n.o	2	0.4925	0.0041	0.0082	0.5007
apu004n.o	3	0.5475	0.0039	0.0078	0.5553
apu005n.o	3.99	0.5991	0.0042	0.0084	0.6075
apu006n.o	4	0.5489	0.0044	0.0088	0.5577
apu007n.o	5	0.5654	0.0044	0.0088	0.5742
apu008n.o	10	0.6061	0.0042	0.0084	0.6145
apu009n.o	15	0.5934	0.0046	0.0092	0.6026
apu010n.o	20	0.5996	0.0044	0.0088	0.6084
apu011n.o	25	0.596	0.0049	0.0098	0.6058
apu012n.o	50	0.5257	0.0044	0.0088	0.5345
apu013n.o	100	0.4186	0.0033	0.0066	0.4252
apu014n.o	150	0.3473	0.0028	0.0056	0.3529
apu015n.o	200	0.2953	0.0024	0.0048	0.3001

Figure 4.3.2-5. Single Fully Reflected 4.32" ID x 50" Tall Cylinder of UF_4 and Oil

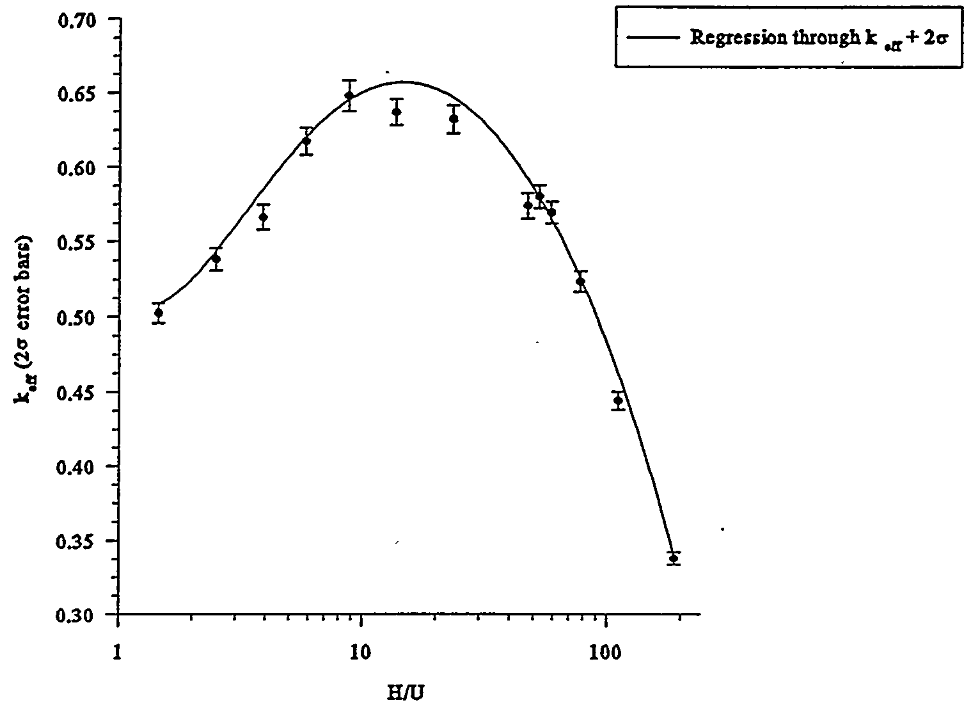
10% enrichment, 24" concrete floor, 12" (minimum) water reflector on all other sides



Single 4.32 in Diameter poly container w/ Full Reflection					
for 10% enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
sfr-432.p65.o	0.65	0.50459	0.00362	0.00724	0.51183
sfr-432.145.o	1.45	0.5308	0.0035	0.007	0.5378
sfr-432.249.o	2.49	0.55949	0.00394	0.00788	0.56737
sfr-432.388.o	3.88	0.58617	0.00393	0.00786	0.59403
sfr-432.582.o	5.82	0.61712	0.00452	0.00904	0.62616
sfr-432.873.o	8.73	0.64738	0.00522	0.01044	0.65782
sfr-432.136.o	13.6	0.65605	0.00427	0.00854	0.66459
sfr-432.233.o	23.3	0.65272	0.00394	0.00788	0.6606
sfr-432.471.o	47.1	0.59258	0.00444	0.00888	0.60146
sfr-432.524.o	52.4	0.57976	0.00377	0.00754	0.5873
sfr-432.588.o	58.8	0.56906	0.00363	0.00726	0.57632
sfr-432.773.o	77.3	0.52313	0.00344	0.00688	0.53001
sfr-432.110.o	110.6	0.45904	0.00345	0.0069	0.46594
sfr-432.188.o	188.2	0.34878	0.0025	0.005	0.35378

Figure 4.3.2-6. Single 4.32" ID x 50" Tall Cylinder of UF $_4$ and Oil in a Concrete Corner

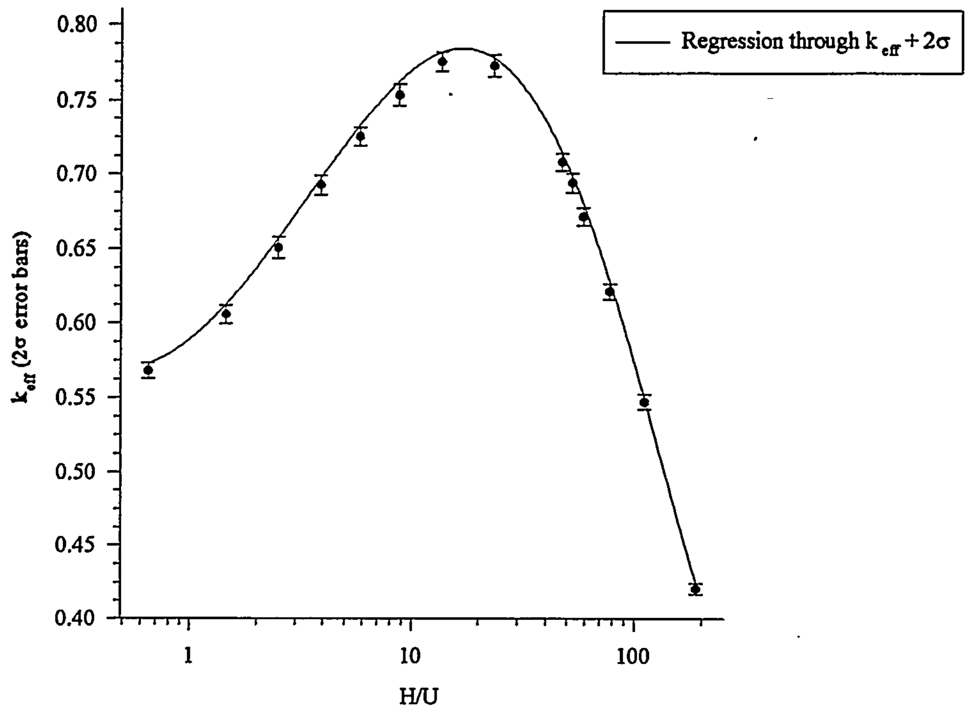
10% enrichment, 24" concrete floor, 12" concrete walls and ceiling, ~100 kg water reflector simulating a person



Single 4.32-inch Diameter Poly Container in a Corner					
For 10% Enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2sig
scc-432.145.o	1.45	0.50244	0.00324	0.00648	0.50892
scc-432.249.o	2.49	0.5382	0.00371	0.00742	0.54562
scc-432.388.o	3.88	0.5662	0.00426	0.00852	0.57472
scc-432.582.o	5.82	0.61712	0.00452	0.00904	0.62616
scc-432.873.o	8.73	0.64738	0.00522	0.01044	0.65782
scc-432.136.o	13.6	0.63631	0.00445	0.0089	0.64521
scc-432.233.o	23.3	0.63145	0.00471	0.00942	0.64087
scc-432.471.o	47.1	0.57369	0.00421	0.00842	0.58211
scc-432.524.o	52.4	0.57976	0.00377	0.00754	0.5873
scc-432.588.o	58.8	0.56906	0.00363	0.00726	0.57632
scc-432.773.o	77.3	0.52313	0.00344	0.00688	0.53001
scc-432.110.o	110.6	0.4439	0.00302	0.00604	0.44994
scc-432.188.o	188.2	0.33789	0.00209	0.00418	0.34207

Figure 4.3.2-7. Two 4.32" ID x 50" Tall Cylinders of UF_4 and Oil Next to a Wall

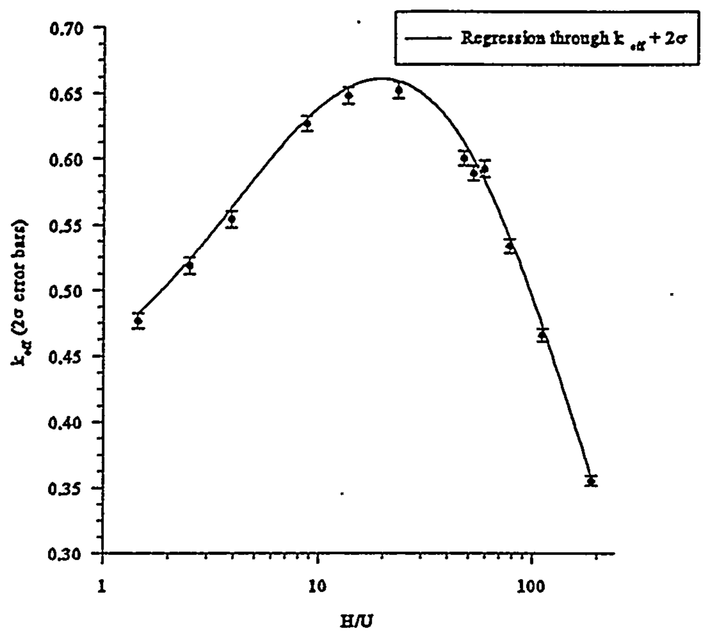
10% enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 4.32 in. Diameter Poly. Containers Adjacent to Concrete Wall for 10% Enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
d00n-432.p65	0.65	0.5679	0.00252	0.00504	0.57294
d00n-432.145	1.45	0.6059	0.003	0.006	0.6119
d00n-432.249	2.49	0.6506	0.00349	0.00698	0.65758
d00n-432.388	3.88	0.6924	0.00329	0.00658	0.69898
d00n-432.582	5.82	0.7251	0.00309	0.00618	0.73128
d00n-432.873	8.73	0.753	0.00355	0.0071	0.7601
d00n-432.136	13.6	0.775	0.00318	0.00636	0.78136
d00n-432.233	23.3	0.7724	0.00363	0.00726	0.77966
d00n-432.471	47.1	0.7079	0.00291	0.00582	0.71372
d00n-432.524	52.4	0.6936	0.0032	0.0064	0.7
d00n-432.588	58.8	0.6712	0.00293	0.00586	0.67706
d00n-432.773	77.3	0.6212	0.00255	0.0051	0.6263
d00n-432.110	110.6	0.5472	0.00246	0.00492	0.55212
d00n-432.188	188.2	0.4207	0.00175	0.0035	0.4242

Figure 4.3.2-8. Two 4.32" ID x 50" Tall Cylinders of UF_4 and Oil One Foot from a Wall

10% enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 4.32 in. Diameter Poly. Containers 1' from Concrete Wall					
for 10% Enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
d12n-432.p65.o	0.65	0.44499	0.00257	0.00514	0.45013
d12n-432.145.o	1.45	0.47623	0.00299	0.00598	0.48221
d12n-432.249.o	2.49	0.51829	0.00312	0.00624	0.52453
d12n-432.388.o	3.88	0.55363	0.00311	0.00622	0.55985
d12n-432.873.o	8.73	0.62622	0.00295	0.0059	0.63212
d12n-432.136.o	13.6	0.64784	0.00318	0.00636	0.6542
d12n-432.233.o	23.3	0.65206	0.00311	0.00622	0.65828
d12n-432.471.o	47.1	0.59997	0.00271	0.00542	0.60539
d12n-432.524.o	52.4	0.58895	0.00282	0.00564	0.59459
d12n-432.588.o	58.8	0.59217	0.00327	0.00654	0.59871
d12n-432.773.o	77.3	0.53367	0.00271	0.00542	0.53909
d12n-432.110.o	110.6	0.46546	0.00238	0.00476	0.47022
d12n-432.188.o	188.2	0.35535	0.00178	0.00356	0.35891

4.4 5.0-inch-Diameter by 24-inch-Tall Polyethylene Container

This section presents results of calculations designed to model the "24-inch polybottle," "GP container," and "CO-4 polybottle" containers described in Table 1.0-1.

4.4.1 100% Enriched UO_2F_2+H_2O and UF_4+Oil

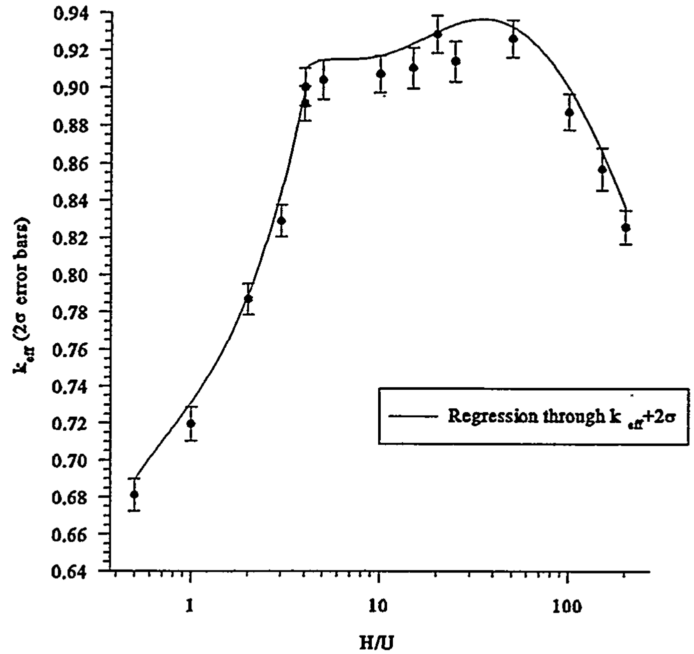
Table 4.4.1-0 gives the figures and table numbers that contain the results data for this container with various geometry models and fuel materials. The geometry model designators are explained in Table 4.1-1. Some of the UO_2F_2 cases were reevaluated using a constant uranium density of 3.2 gU/cc as discussed in Section 4.1. Where this option was used, the titles of the figures reflect the difference. The TSCW UO_2F_2+H_2O case includes the maximum polybottle thickness. The other cases effected by bottle thickness were not evaluated because original (no poly) cases failed the safety criterion. The result of overloading a storage position in an array are shown as data points on the k_{eff} versus H/U graphs. The plotted curve is through the $k_{eff}+2\sigma$ data for the standard array.

Table 4.4.1-0. Summary of 5.0-inch References for 100% Enrichment

Geometry Model	Material	Figure/Table Number
SFR	UO_2F_2+H_2O	4.4.1-1
SCC	UO_2F_2+H_2O	4.4.1-2
TACW	UO_2F_2+H_2O	4.4.1-3
TSCW	UO_2F_2+H_2O	4.4.1-4
SFR	UF_4+oil	4.4.1-5
SCC	UF_4+oil	4.4.1-6
TACW	UF_4+oil	4.4.1-7
TSCW	UF_4+oil	4.4.1-8
ACE	UO_2F_2+H_2O	4.4.1-9
ACE	UF_4+oil	4.4.1-10
AI	UO_2F_2+H_2O	4.4.1-11
AOSP	UO_2F_2 + H_2O	4.4.1-12

Figure 4.4.1-1. Single Fully Reflected 5.00" ID x 24" Tall Cylinder of UO_2F_2

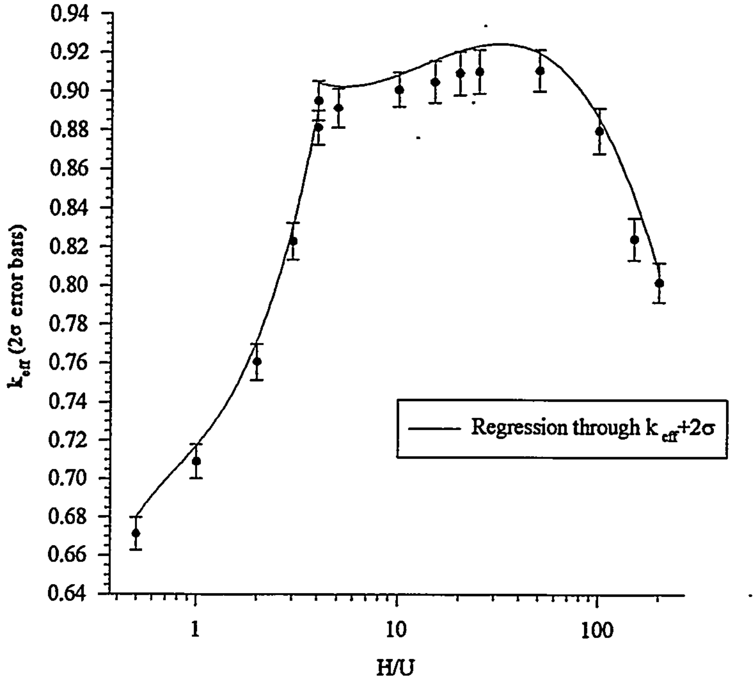
100% enrichment, ρ_u=3.2 g/cc for H/U<4, 0.195" thick Poly container, 24" concrete floor, 12" (minimum) water reflector on all other sides



Single 5.0 in. Diameter Poly. Container w/ Full Reflection for UO2F2+H2O , Uranium Density = 3.2 gU/cc					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
frb01n-c	0.5	0.681	0.0044	0.0088	0.6898
frb02n-c	1	0.7196	0.0047	0.0094	0.729
frb03n-c	2	0.7868	0.0042	0.0084	0.7952
frb04n-c	3	0.8287	0.0042	0.0084	0.8371
frb05n-c	3.99	0.8912	0.0046	0.0092	0.9004
frb06n-c	4	0.8999	0.005	0.01	0.9099
frb07n-c	5	0.9037	0.0051	0.0102	0.9139
frb08n-c	10	0.9068	0.0049	0.0098	0.9166
frb09n-c	15	0.9098	0.0054	0.0108	0.9206
frb10n-c	20	0.9279	0.005	0.01	0.9379
frb11n-c	25	0.9134	0.0054	0.0108	0.9242
frb12n-c	50	0.9254	0.005	0.01	0.9354
frb13n-c	100	0.8865	0.0048	0.0096	0.8961
frb14n-c	150	0.8563	0.0057	0.0114	0.8677
frb15n-c	200	0.8252	0.0045	0.009	0.8342

Figure 4.4.1-2. Single 5.00" ID x 24" Tall Cylinder of UO_2F_2 in a Concrete Corner

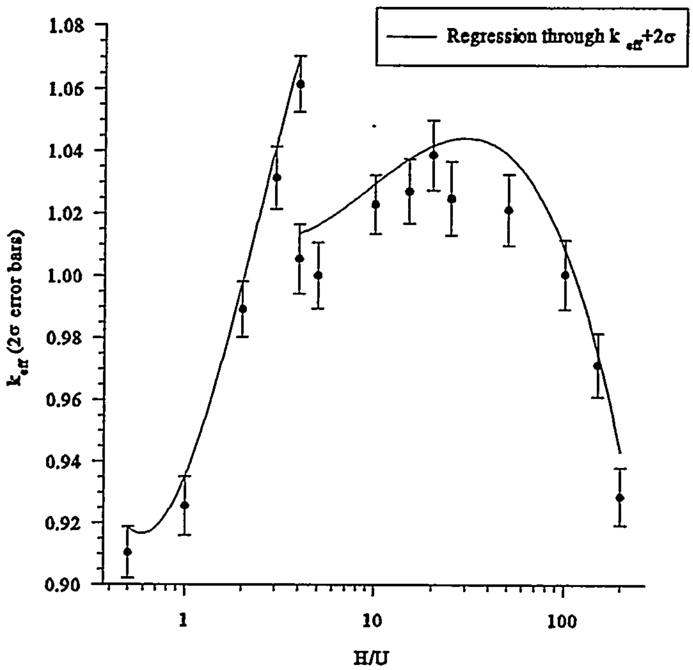
100% enrichment, ρ_u=3.2 g/cc for H/U<4, 0.195" thick Poly container, 24" concrete floor, 12" concrete walls and ceiling, ~100 kg water reflector simulating a person



Single 5.0 in. Diameter Poly. Container in a Corner					
for UO2F2+H2O , Uranium Density = 3.2 gU/cc					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
cpb01n-c	0.5	0.6713	0.0043	0.0086	0.6799
cpb02n-c	1	0.7092	0.0044	0.0088	0.718
cpb03n-c	2	0.7606	0.0046	0.0092	0.7698
cpb04n-c	3	0.8228	0.0048	0.0096	0.8324
cpb05n-c	3.99	0.8811	0.0044	0.0088	0.8899
cpb06n-c	4	0.8949	0.0051	0.0102	0.9051
cpb07n-c	5	0.8911	0.005	0.01	0.9011
cpb08n-c	10	0.9006	0.0045	0.009	0.9096
cpb09n-c	15	0.9045	0.0053	0.0106	0.9151
cpb10n-c	20	0.909	0.0055	0.011	0.92
cpb11n-c	25	0.9097	0.0056	0.0112	0.9209
cpb12n-c	50	0.9103	0.0053	0.0106	0.9209
cpb13n-c	100	0.8792	0.0058	0.0116	0.8908
cpb14n-c	150	0.8238	0.0054	0.0108	0.8346
cpb15n-c	200	0.8014	0.0051	0.0102	0.8116

Figure 4.4.1-3. Two 5.00" ID x 24" Tall Cylinders of UO_2F_2 Next to a Wall

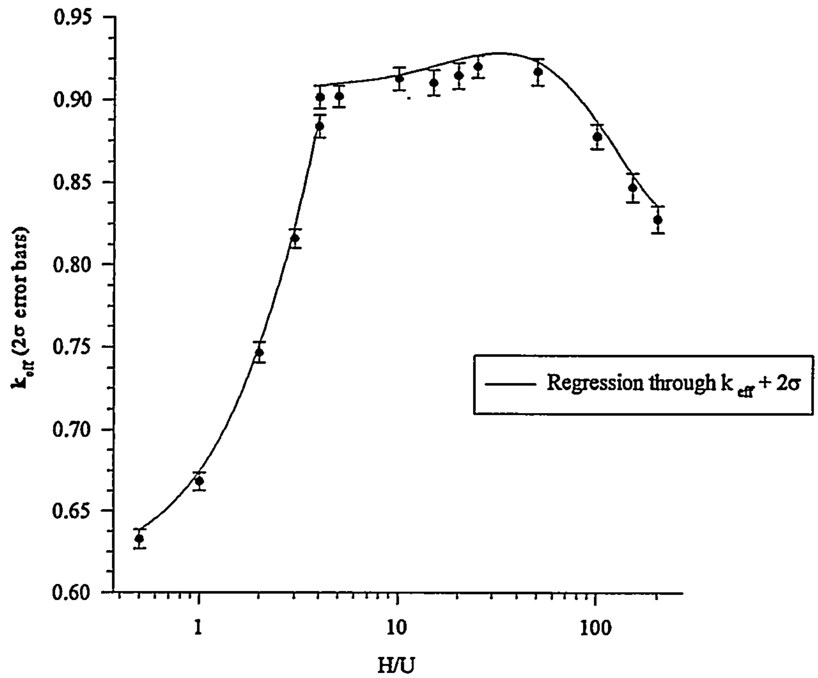
100% enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 5.0 in. Diameter Poly. Containers Adjacent to Concrete Wall for 100% Enriched UO2F2+H2O					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
npb001n.o	0.5	0.9104	0.0042	0.0084	0.9188
npb002n.o	1	0.9257	0.0048	0.0096	0.9353
npb003n.o	2	0.9891	0.0045	0.009	0.9981
npb004n.o	3	1.0313	0.005	0.01	1.0413
npb005n.o	3.99	1.0614	0.0044	0.0088	1.0702
npb006n.o	4	1.0053	0.0056	0.0112	1.0165
npb007n.o	5	1	0.0053	0.0106	1.0106
npb008n.o	10	1.0228	0.0047	0.0094	1.0322
npb009n.o	15	1.027	0.0052	0.0104	1.0374
npb010n.o	20	1.0386	0.0056	0.0112	1.0498
npb011n.o	25	1.0247	0.0059	0.0118	1.0365
npb012n.o	50	1.021	0.0057	0.0114	1.0324
npb013n.o	100	1.0003	0.0056	0.0112	1.0115
npb014n.o	150	0.9711	0.0051	0.0102	0.9813
npb015n.o	200	0.9288	0.0047	0.0094	0.9382

Figure 4.4.1-4. Two 5.00" ID x 24" Tall Cylinders of UO_2F_2 One Foot from a Wall

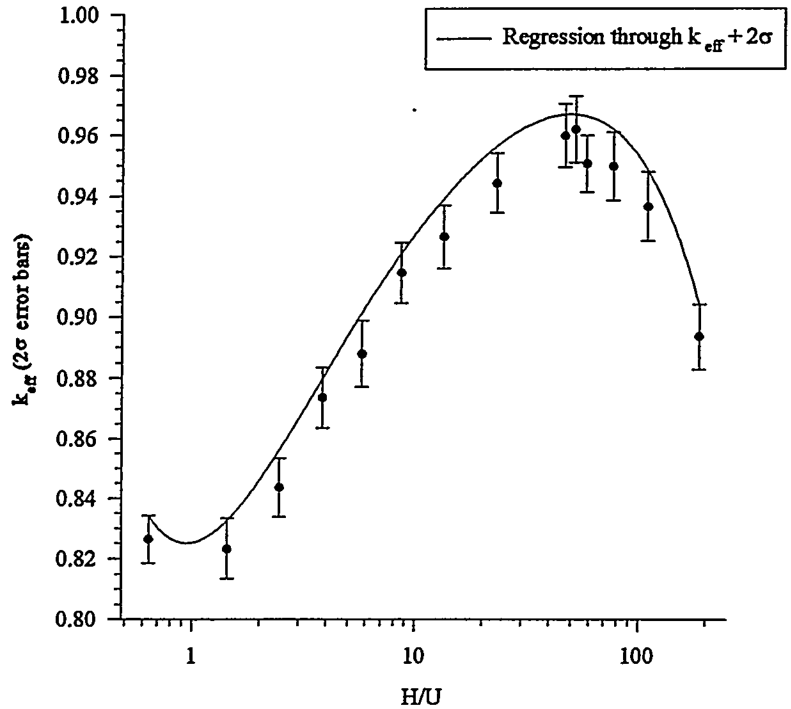
100% enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 5.0 in. Diameter Poly. Containers 1' from Concrete Wall for 100% Enriched UO2F2+H2O					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
d12n-500.0p5	0.5	0.6327	0.00297	0.00594	0.63864
d12n-500.1	1	0.6684	0.00281	0.00562	0.67402
d12n-500.2	2	0.7465	0.00303	0.00606	0.75256
d12n-500.3	3	0.8158	0.00283	0.00566	0.82146
d12n-500.3p9	3.99	0.8835	0.00348	0.00696	0.89046
d12n-500.4	4	0.9013	0.00343	0.00686	0.90816
d12n-500.5	5	0.9018	0.00327	0.00654	0.90834
d12n-500.10	10	0.9125	0.00341	0.00682	0.91932
d12n-500.15	15	0.9099	0.00386	0.00772	0.91762
d12n-500.20	20	0.9143	0.00395	0.0079	0.9222
d12n-500.25	25	0.9197	0.00338	0.00676	0.92646
d12n-500.50	50	0.9164	0.00404	0.00808	0.92448
d12n-500.100	100	0.8772	0.0036	0.0072	0.8844
d12n-500.150	150	0.8467	0.0043	0.0086	0.8553
d12n-500.200	200	0.8275	0.00397	0.00794	0.83544

Figure 4.4.1-5. Single Fully Reflected 5.00" ID x 24" Tall Cylinder of UF_4 and Oil

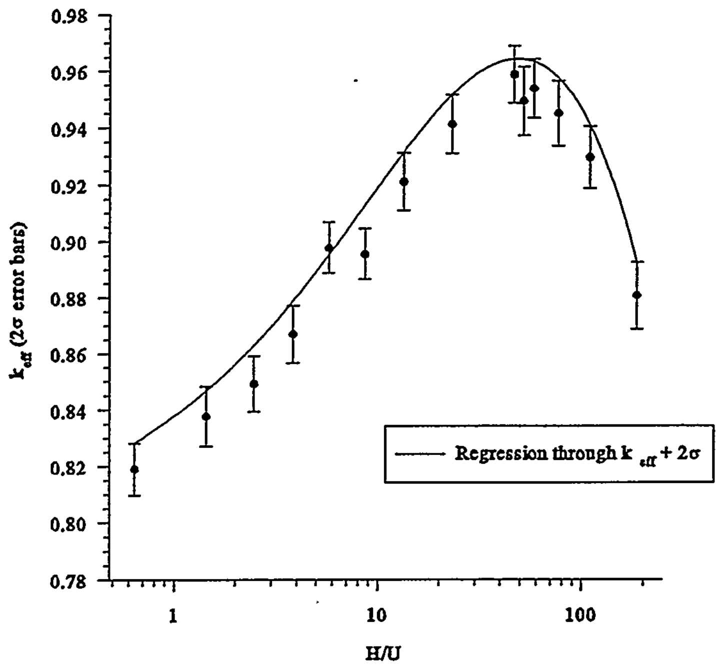
100% enrichment, 24" concrete floor, 12" (minimum) water reflector on all other sides



Single 5.0 in. Diameter Poly. Container w/ Full Reflection for 100% Enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
fre001n.o	0.64	0.8264	0.0039	0.0078	0.8342
fre002n.o	1.44	0.8233	0.005	0.01	0.8333
fre003n.o	2.47	0.8436	0.0049	0.0098	0.8534
fre004n.o	3.84	0.8735	0.005	0.01	0.8835
fre005n.o	5.76	0.8879	0.0054	0.0108	0.8987
fre006n.o	8.64	0.9145	0.005	0.01	0.9245
fre007n.o	13.4	0.9264	0.0052	0.0104	0.9368
fre008n.o	23.1	0.9441	0.0048	0.0096	0.9537
fre009n.o	46.6	0.9596	0.0052	0.0104	0.97
fre010n.o	51.9	0.9617	0.0055	0.011	0.9727
fre011n.o	58.2	0.9505	0.0046	0.0092	0.9597
fre012n.o	76.6	0.9496	0.0056	0.0112	0.9608
fre013n.o	109.5	0.9365	0.0057	0.0114	0.9479
fre014n.o	186.4	0.8935	0.0053	0.0106	0.9041

Figure 4.4.1-6. Single 5.00" ID x 24" Tall Cylinder of UF_4 and Oil in a Concrete Corner

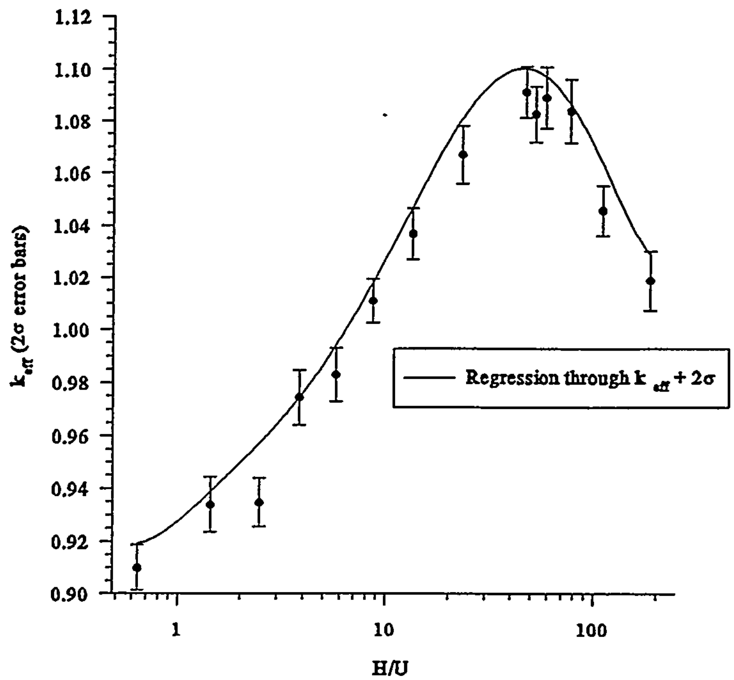
100% enrichment, 24" concrete floor, 12" concrete walls and ceiling, ~100 kg water reflector simulating a person



Single 5.0 in. Diameter Poly. Container in a Corner for 100% Enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
cpe001n.o	0.64	0.819	0.0046	0.0092	0.8282
cpe002n.o	1.44	0.8377	0.0053	0.0106	0.8483
cpe003n.o	2.47	0.8491	0.0049	0.0098	0.8589
cpe004n.o	3.84	0.8667	0.0051	0.0102	0.8769
cpe005n.o	5.76	0.8975	0.0045	0.009	0.9065
cpe006n.o	8.64	0.8952	0.0045	0.009	0.9042
cpe007n.o	13.4	0.9208	0.0051	0.0102	0.931
cpe008n.o	23.1	0.9409	0.0051	0.0102	0.9511
cpe009n.o	46.6	0.9583	0.005	0.01	0.9683
cpe010n.o	51.9	0.9489	0.006	0.012	0.9609
cpe011n.o	58.2	0.9533	0.0052	0.0104	0.9637
cpe012n.o	76.6	0.9445	0.0057	0.0114	0.9559
cpe013n.o	109.5	0.9292	0.0054	0.0108	0.94
cpe014n.o	186.4	0.8803	0.006	0.012	0.8923

Figure 4.4.1-7. Two 5.00" ID x 24" Tall Cylinders of UF_4 and Oil Next to a Wall

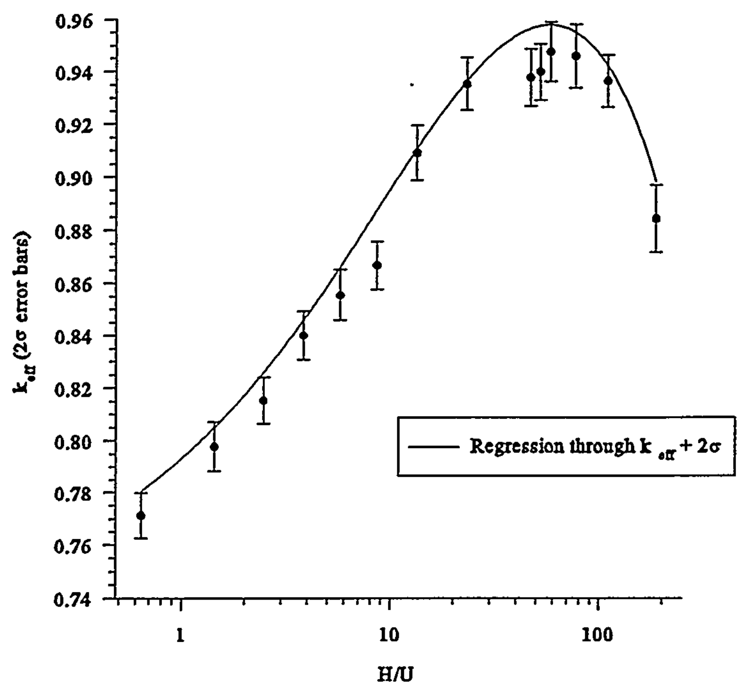
100% enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 5.0 in. Diameter Poly. Containers Adjacent to Concrete Wall for 100% Enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
npe001n.o	0.64	0.9099	0.0044	0.0088	0.9187
npe002n.o	1.44	0.9339	0.0052	0.0104	0.9443
npe003n.o	2.47	0.9346	0.0046	0.0092	0.9438
npe004n.o	3.84	0.9743	0.0051	0.0102	0.9845
npe005n.o	5.76	0.9829	0.005	0.01	0.9929
npe006n.o	8.64	1.0108	0.0042	0.0084	1.0192
npe007n.o	13.4	1.0366	0.0049	0.0098	1.0464
npe008n.o	23.1	1.0667	0.0055	0.011	1.0777
npe009n.o	46.6	1.0908	0.0049	0.0098	1.1006
npe010n.o	51.9	1.0822	0.0054	0.0108	1.093
npe011n.o	58.2	1.0886	0.0059	0.0118	1.1004
npe012n.o	76.6	1.0834	0.0061	0.0122	1.0956
npe013n.o	109.5	1.0455	0.0048	0.0096	1.0551
npe014n.o	186.4	1.0185	0.0057	0.0114	1.0299

Figure 4.4.1-8. Two 5.00" ID x 24" Tall Cylinders of UF_4 and Oil One Foot from a Wall

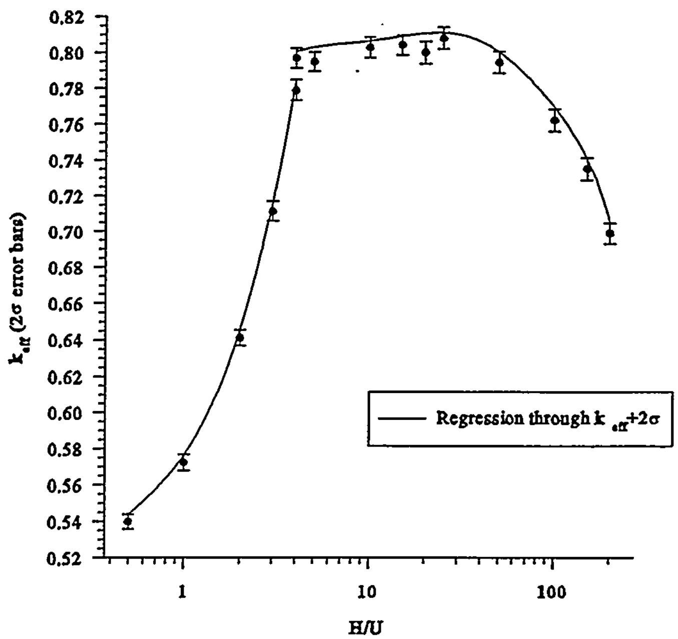
100% enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 5.0 in. Diameter Poly. Containers 1' from Concrete Wall for 100% Enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
ape001n.o	0.64	0.7712	0.0043	0.0086	0.7798
ape002n.o	1.44	0.7978	0.0047	0.0094	0.8072
ape003n.o	2.47	0.8152	0.0044	0.0088	0.824
ape004n.o	3.84	0.8398	0.0046	0.0092	0.849
ape005n.o	5.76	0.8552	0.0048	0.0096	0.8648
ape006n.o	8.64	0.8664	0.0045	0.009	0.8754
ape007n.o	13.4	0.9087	0.0052	0.0104	0.9191
ape008n.o	23.1	0.9348	0.005	0.01	0.9448
ape009n.o	46.6	0.9372	0.0054	0.0108	0.948
ape010n.o	51.9	0.9393	0.0054	0.0108	0.9501
ape011n.o	58.2	0.947	0.0057	0.0114	0.9584
ape012n.o	76.6	0.9452	0.006	0.012	0.9572
ape013n.o	109.5	0.9357	0.0049	0.0098	0.9455
ape014n.o	186.4	0.8838	0.0063	0.0126	0.8964

Figure 4.4.1-9. An Array of 5.00" ID x 24" Tall Cylinders of UO_2F_2

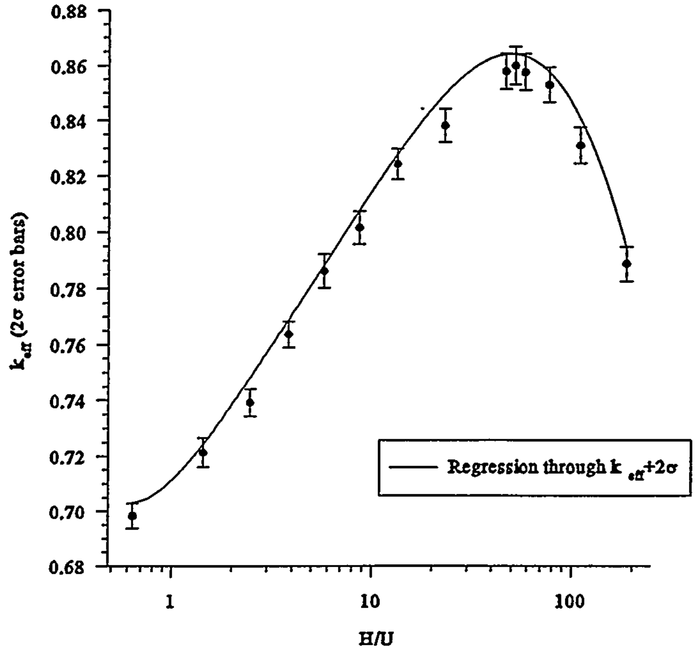
100% enrichment, 0.195" thick Poly containers, 24" concrete floor, 12" concrete walls and ceiling, 6' spacing between row sets, 23" spacing between containers, 2' spacing from walls



An Array of 5.00-in. Poly. Containers of UO2F2 For 100% Enrichment					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
arrb01n-c.o	0.5	0.5399	0.002	0:004	0.5439
arrb02n-c.o	1	0.5724	0.0022	0.0044	0.5768
arrb03n-c.o	2	0.6409	0.0022	0.0044	0.6453
arrb04n-c.o	3	0.7112	0.0028	0.0056	0.7168
arrb05n-c.o	3.99	0.7786	0.0029	0.0058	0.7844
arrb06n-c.o	4	0.7965	0.0027	0.0054	0.8019
arrb07n-c.o	5	0.7945	0.0026	0.0052	0.7997
arrb08n-c.o	10	0.8024	0.0028	0.0056	0.808
arrb09n-c.o	15	0.8036	0.0028	0.0056	0.8092
arrb10n-c.o	20	0.7994	0.0031	0.0062	0.8056
arrb11n-c.o	25	0.8074	0.003	0.006	0.8134
arrb12n-c.o	50	0.7938	0.003	0.006	0.7998
arrb13n-c.o	100	0.7614	0.0031	0.0062	0.7676
arrb14n-c.o	150	0.7345	0.0031	0.0062	0.7407
arrb15n-c.o	200	0.6985	0.0029	0.0058	0.7043

Figure 4.4.1-10. An Array of 5.00" ID x 24" Tall Cylinders of UF_4 + Oil

100% enrichment, 0.195" thick Poly containers, 24" concrete floor, 12" concrete walls and ceiling, 6' spacing between row sets, 23" spacing between containers, 2' spacing from walls



An Array of 5.0-in. Poly Cylinders of UF4+Oil For 100% Enrichment					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
arre01n-c.o	0.64	0.6983	0.0023	0.0046	0.7029
arre02n-c.o	1.44	0.7213	0.0027	0.0054	0.7267
arre03n-c.o	2.47	0.7391	0.0024	0.0048	0.7439
arre04n-c.o	3.84	0.7635	0.0024	0.0048	0.7683
arre05n-c.o	5.76	0.786	0.003	0.006	0.792
arre06n-c.o	8.64	0.8012	0.0029	0.0058	0.807
arre07n-c.o	13.4	0.8239	0.0028	0.0056	0.8295
arre08n-c.o	23.1	0.8377	0.003	0.006	0.8437
arre09n-c.o	46.6	0.8574	0.0032	0.0064	0.8638
arre10n-c.o	51.9	0.8594	0.0034	0.0068	0.8662
arre11n-c.o	58.2	0.857	0.0033	0.0066	0.8636
arre12n-c.o	76.6	0.8524	0.0032	0.0064	0.8588
arre13n-c.o	109.5	0.8304	0.0033	0.0066	0.837
arre14n-c.o	186.4	0.7882	0.0031	0.0062	0.7944

Figure 4.4.1-11. The Effects of Interstitial Water Volume Fraction on k_{eff}

Standard array geometry with 5.00" ID x 24" tall containers of UO_2F_2 with 0.195" thick Poly walls

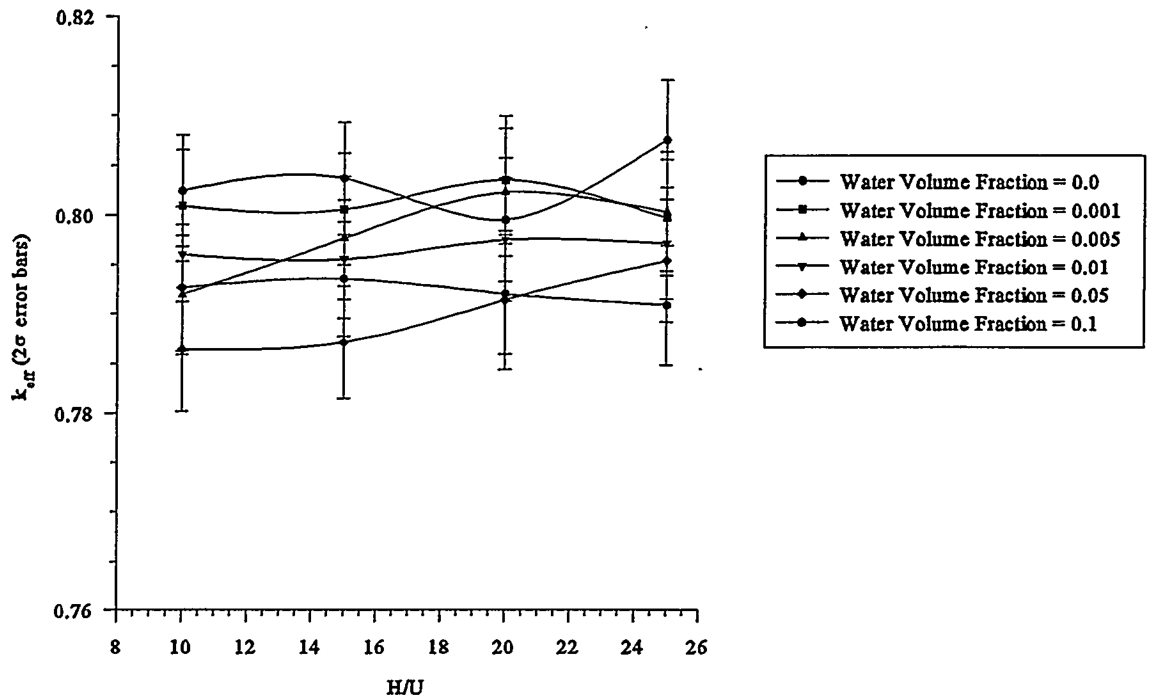


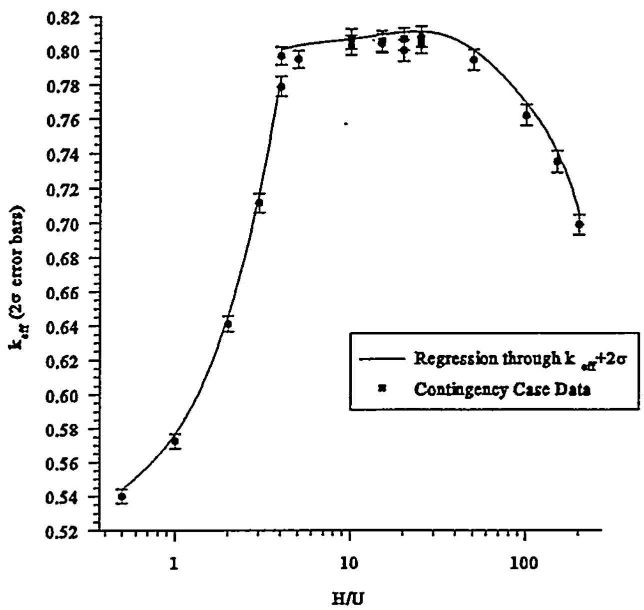
Figure 4.4.1-11a. The Effects of Interstitial Water Volume Fraction on k_{eff}

Standard array geometry with 5.00" ID x 24" tall containers of UO_2F_2 with 0.195" thick Poly walls

The Effects of Interstitial Water Volume Fraction for a Standard					
Array of 5.00-in. Diameter Containers of UO2F2+H2O					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
Interstitial	Water =	0			
arrb08n-c.o	10	0.8024	0.0028	0.0056	0.808
arrb09n-c.o	15	0.8036	0.0028	0.0056	0.8092
arrb10n-c.o	20	0.7994	0.0031	0.0062	0.8056
arrb11n-c.o	25	0.8074	0.003	0.006	0.8134
Interstitial	Water =	0.001			
abw101n-c.o	10	0.8009	0.0028	0.0056	0.8065
abw102n-c.o	15	0.8005	0.0028	0.0056	0.8061
abw103n-c.o	20	0.8034	0.0032	0.0064	0.8098
abw104n-c.o	25	0.7996	0.0029	0.0058	0.8054
Interstitial	Water =	0.005			
abw201n-c.o	10	0.7919	0.003	0.006	0.7979
abw202n-c.o	15	0.7976	0.0031	0.0062	0.8038
abw203n-c.o	20	0.8022	0.0032	0.0064	0.8086
abw204n-c.o	25	0.8002	0.003	0.006	0.8062
Interstitial	Water =	0.01			
abw301n-c.o	10	0.796	0.0024	0.0048	0.8008
abw302n-c.o	15	0.7955	0.003	0.006	0.8015
abw303n-c.o	20	0.7974	0.0031	0.0062	0.8036
abw304n-c.o	25	0.797	0.0028	0.0056	0.8026
Interstitial	Water =	0.05			
abw401n-c.o	10	0.7864	0.0031	0.0062	0.7926
abw402n-c.o	15	0.7871	0.0028	0.0056	0.7927
abw403n-c.o	20	0.7913	0.0035	0.007	0.7983
abw404n-c.o	25	0.7953	0.0031	0.0062	0.8015
Interstitial	Water =	0.1			
abw501n-c.o	10	0.7926	0.0032	0.0064	0.799
abw502n-c.o	15	0.7935	0.0029	0.0058	0.7993
abw503n-c.o	20	0.7919	0.003	0.006	0.7979
abw504n-c.o	25	0.7908	0.003	0.006	0.7968

Figure 4.4.1-12. An Array of 5.00" ID x 24" Tall Cylinders of UO_2F_2

100% enrichment, 0.195" thick Poly containers, 24" concrete floor, 12" concrete walls and ceiling, 6' spacing between row sets, 23" spacing between containers, 2' spacing from walls



An Array of 5.00-in. Containers of UO2F2 (Contingency Data)					
For 100% Enrichment					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
arrb01n-c.o	0.5	0.5399	0.002	0.004	0.5439
arrb02n-c.o	1	0.5724	0.0022	0.0044	0.5768
arrb03n-c.o	2	0.6409	0.0022	0.0044	0.6453
arrb04n-c.o	3	0.7112	0.0028	0.0056	0.7168
arrb05n-c.o	3.99	0.7786	0.0029	0.0058	0.7844
arrb06n-c.o	4	0.7965	0.0027	0.0054	0.8019
arrb07n-c.o	5	0.7945	0.0026	0.0052	0.7997
arrb08n-c.o	10	0.8024	0.0028	0.0056	0.808
arrb09n-c.o	15	0.8036	0.0028	0.0056	0.8092
arrb10n-c.o	20	0.7994	0.0031	0.0062	0.8056
arrb11n-c.o	25	0.8074	0.003	0.006	0.8134
arrb12n-c.o	50	0.7938	0.003	0.006	0.7998
arrb13n-c.o	100	0.7614	0.0031	0.0062	0.7676
arrb14n-c.o	150	0.7345	0.0031	0.0062	0.7407
arrb15n-c.o	200	0.6985	0.0029	0.0058	0.7043
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
arbcn08-c.o	10	0.8061	0.0029	0.0058	0.8119
arbcn09-c.o	15	0.8048	0.003	0.006	0.8108
arbcn10-c.o	20	0.8061	0.0032	0.0064	0.8125
arbcn11-c.o	25	0.8039	0.0031	0.0062	0.8101

4.4.2 10% Enriched $UO_2F_2+H_2O$ and UF_4+Oil

Each of the five standard contingency cases was repeated for both material types. Table 4.4.2-0 gives the figure and table numbers that contain the results data for this container with various geometry models and fuel materials. The geometry model designators are explained in Table 4.1-1.

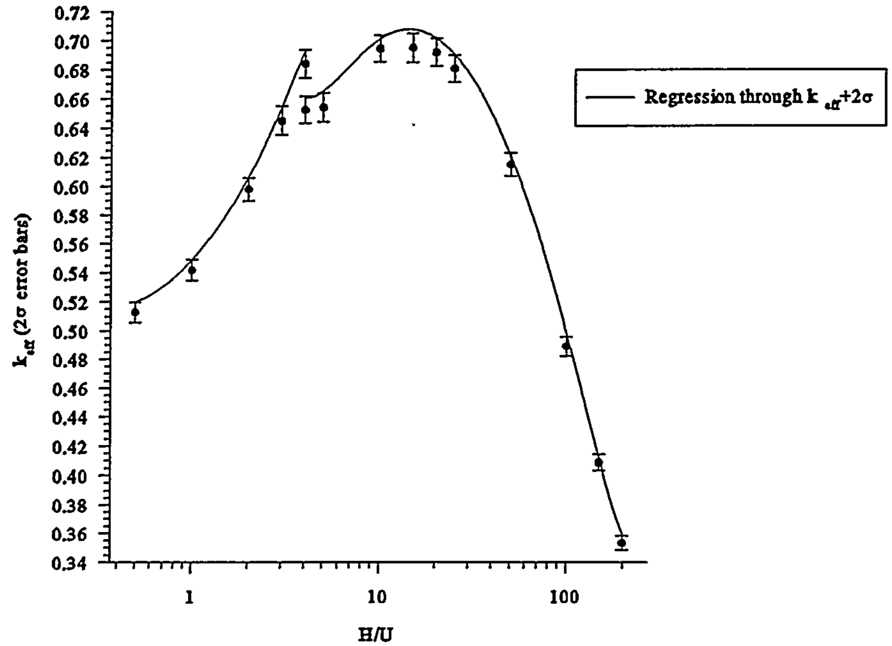
The three standard array cases were not analyzed because the 100% enriched standard array cases fell within the safety criterion. Container poly thickness was only considered for the TACW and TSCW UF_4+oil cases because these results bound the $UO_2F_2+H_2O$ cases.

Table 4.4.2-0. Summary of 5.0-inch Bottle References for 10% Enrichment

Geometry Model	Material	Figure/Table Number
SFR	$UO_2F_2+H_2O$	4.4.2-1
SCC	$UO_2F_2+H_2O$	4.4.2-2
TACW	$UO_2F_2+H_2O$	4.4.2-3
TSCW	$UO_2F_2+H_2O$	4.4.2-4
SFR	UF_4+oil	4.4.2-5
SCC	UF_4+oil	4.4.2-6
TACW	UF_4+oil	4.4.2-7
TSCW	UF_4+oil	4.4.2-8

Figure 4.4.2-1. Single Fully Reflected 5.00" ID x 24" Tall Cylinder of UO_2F_2

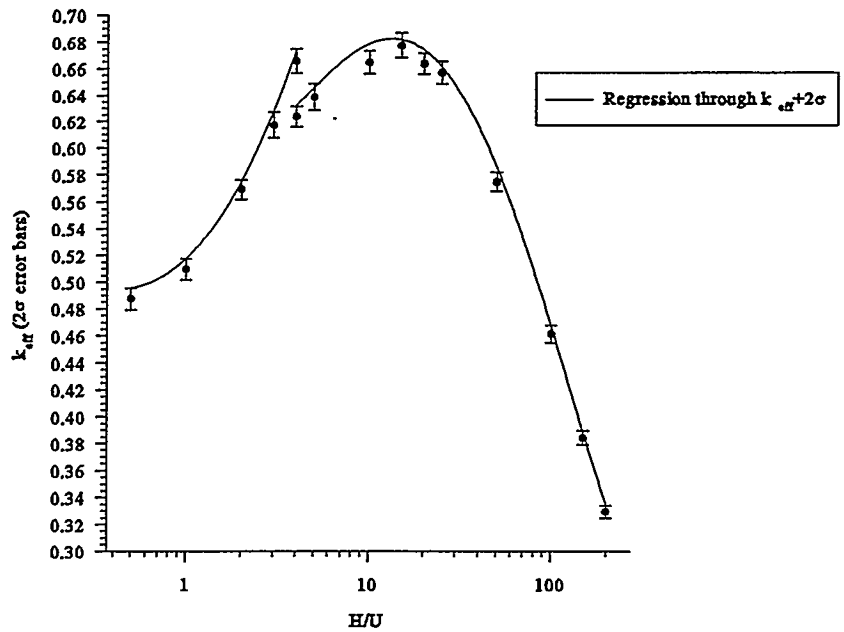
10% enrichment, 24" concrete floor, 12" (minimum) water reflector on all other sides



Single 5.0 in. Diameter Poly. Container w/ Full Reflection for 10% Enriched UO2F2+H2O					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
frv001n.o	0.5	0.5127	0.0034	0.0068	0.5195
frv002n.o	1	0.5417	0.0036	0.0072	0.5489
frv003n.o	2	0.5978	0.004	0.008	0.6058
frv004n.o	3	0.6446	0.0049	0.0098	0.6544
frv005n.o	3.99	0.6836	0.0049	0.0098	0.6934
frv006n.o	4	0.652	0.0045	0.009	0.661
frv007n.o	5	0.6537	0.0048	0.0096	0.6633
frv008n.o	10	0.6938	0.0046	0.0092	0.703
frv009n.o	15	0.6944	0.005	0.01	0.7044
frv010n.o	20	0.6912	0.0047	0.0094	0.7006
frv011n.o	25	0.68	0.0047	0.0094	0.6894
frv012n.o	50	0.6144	0.004	0.008	0.6224
frv013n.o	100	0.4887	0.0035	0.007	0.4957
frv014n.o	150	0.4086	0.0027	0.0054	0.414
frv015n.o	200	0.3533	0.0024	0.0048	0.3581

Figure 4.4.2-2. Single 5.00" ID x 24" Tall Cylinder of UO $_2F_2$ in a Concrete Corner

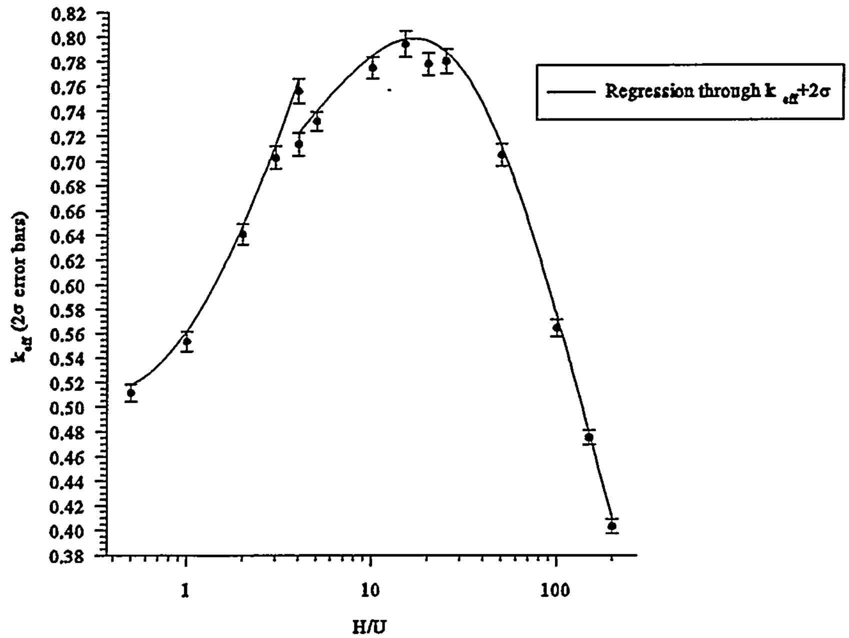
10% enrichment, 24" concrete floor, 12" concrete walls and ceiling, ~100 kg water reflector simulating a person



Single 5.0 in. Diameter Poly. Container in a Corner					
for 10% Enriched UO2F2+H2O					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
cpv001n.o	0.5	0.4873	0.0041	0.0082	0.4955
cpv002n.o	1	0.5095	0.0039	0.0078	0.5173
cpv003n.o	2	0.5689	0.0036	0.0072	0.5761
cpv004n.o	3	0.6168	0.0049	0.0098	0.6266
cpv005n.o	3.99	0.6652	0.0046	0.0092	0.6744
cpv006n.o	4	0.6233	0.0039	0.0078	0.6311
cpv007n.o	5	0.6382	0.005	0.01	0.6482
cpv008n.o	10	0.6642	0.0043	0.0086	0.6728
cpv009n.o	15	0.6769	0.0046	0.0092	0.6861
cpv010n.o	20	0.663	0.0039	0.0078	0.6708
cpv011n.o	25	0.6563	0.0042	0.0084	0.6647
cpv012n.o	50	0.5741	0.0035	0.007	0.5811
cpv013n.o	100	0.4609	0.0033	0.0066	0.4675
cpv014n.o	150	0.3844	0.0027	0.0054	0.3898
cpv015n.o	200	0.3294	0.0023	0.0046	0.334

Figure 4.4.2-3. Two 5.00" ID x 24" Tall Cylinders of UO $_2F_2$ Next to a Wall

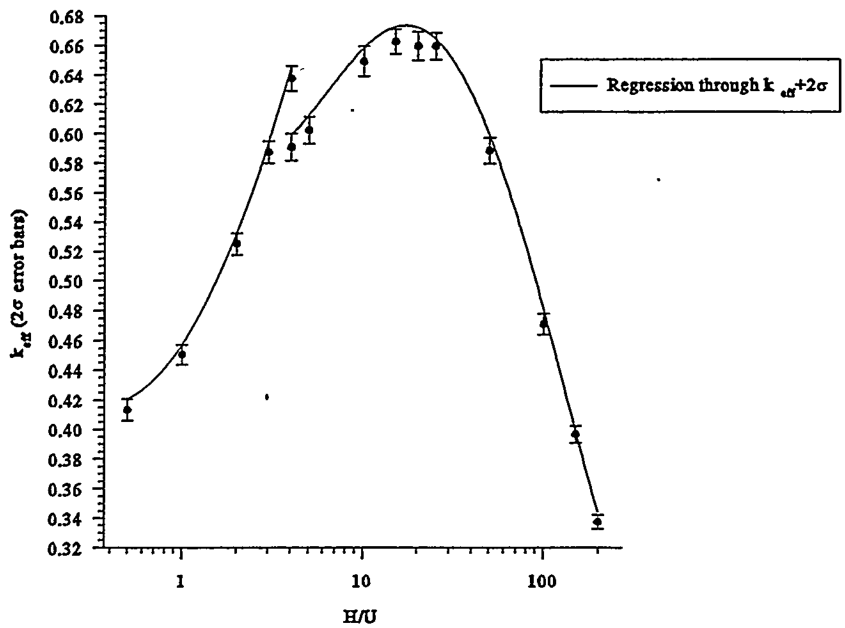
10% enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 5.0 in. Diameter Poly. Containers Adjacent to Concrete Wall for 10% Enriched UO2F2+H2O					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
npv001n.o	0.5	0.5114	0.0034	0.0068	0.5182
npv002n.o	1	0.5535	0.0041	0.0082	0.5617
npv003n.o	2	0.6405	0.0041	0.0082	0.6487
npv004n.o	3	0.7026	0.0046	0.0092	0.7118
npv005n.o	3.99	0.7556	0.0049	0.0098	0.7654
npv006n.o	4	0.7132	0.0045	0.009	0.7222
npv007n.o	5	0.7315	0.0039	0.0078	0.7393
npv008n.o	10	0.7745	0.0045	0.009	0.7835
npv009n.o	15	0.7936	0.0052	0.0104	0.804
npv010n.o	20	0.7775	0.0046	0.0092	0.7867
npv011n.o	25	0.7799	0.0049	0.0098	0.7897
npv012n.o	50	0.7045	0.0045	0.009	0.7135
npv013n.o	100	0.5641	0.0035	0.007	0.5711
npv014n.o	150	0.4753	0.0029	0.0058	0.4811
npv015n.o	200	0.4032	0.0028	0.0056	0.4088

Figure 4.4.2-4. Two 5.00" ID x 24" Tall Cylinders of UO $_2F_2$ One Foot from a Wall

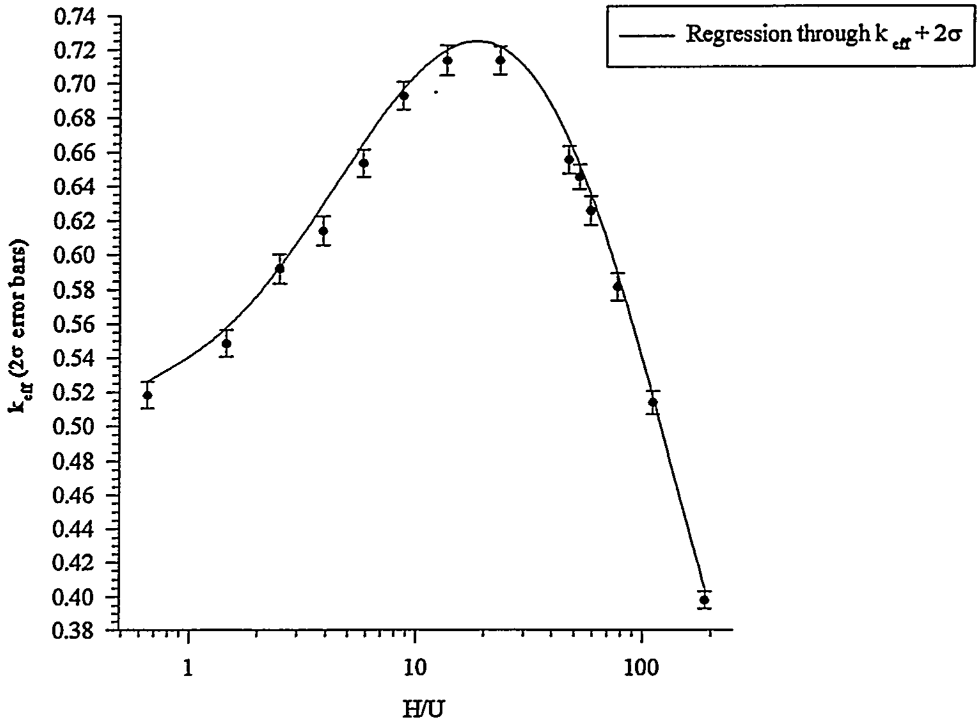
10% enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 5.0 in. Diameter Poly. Containers 1' from Concrete Wall for 10% Enriched UO2F2+H2O					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
apv001n.o	0.5	0.4134	0.0037	0.0074	0.4208
apv002n.o	1	0.4502	0.0035	0.007	0.4572
apv003n.o	2	0.5248	0.0037	0.0074	0.5322
apv004n.o	3	0.587	0.0037	0.0074	0.5944
apv005n.o	3.99	0.6374	0.0042	0.0084	0.6458
apv006n.o	4	0.5905	0.0045	0.009	0.5995
apv007n.o	5	0.602	0.0046	0.0092	0.6112
apv008n.o	10	0.6489	0.0051	0.0102	0.6591
apv009n.o	15	0.6621	0.0042	0.0084	0.6705
apv010n.o	20	0.659	0.0048	0.0096	0.6686
apv011n.o	25	0.6588	0.0045	0.009	0.6678
apv012n.o	50	0.5879	0.0044	0.0088	0.5967
apv013n.o	100	0.4706	0.0035	0.007	0.4776
apv014n.o	150	0.3963	0.0029	0.0058	0.4021
apv015n.o	200	0.3374	0.0025	0.005	0.3424

Figure 4.4.2-5. Single Fully Reflected 5.00" ID x 24" Tall Cylinder of UF_4 and Oil

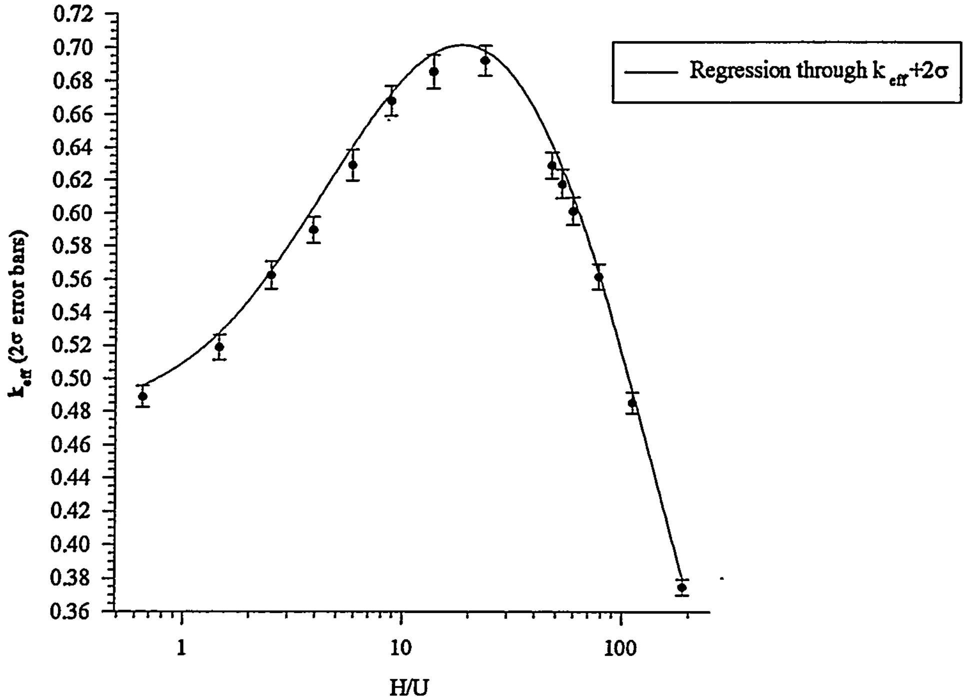
10% enrichment, 24" concrete floor, 12" (minimum) water reflector on all other sides



Single 5.0 in. Diameter Poly. Container w/ Full Reflection for 10% Enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
fr-500.p65.o	0.65	0.5183	0.0038	0.0076	0.5259
fr-500.145.o	1.45	0.5486	0.004	0.008	0.5566
fr-500.249.o	2.49	0.5917	0.0041	0.0082	0.5999
fr-500.388.o	3.88	0.6137	0.0042	0.0084	0.6221
fr-500.582.o	5.82	0.6532	0.004	0.008	0.6612
fr-500.873.o	8.73	0.6922	0.004	0.008	0.7002
fr-500.136.o	13.6	0.713	0.0045	0.009	0.722
fr-500.233.o	23.3	0.7128	0.0041	0.0082	0.721
fr-500.471.o	47.1	0.6551	0.004	0.008	0.6631
fr-500.524.o	52.4	0.6451	0.0036	0.0072	0.6523
fr-500.588.o	58.8	0.6252	0.0041	0.0082	0.6334
fr-500.773.o	77.3	0.5811	0.0039	0.0078	0.5889
fr-500.110.o	110.6	0.5138	0.0034	0.0068	0.5206
fr-500.188.o	188.2	0.3981	0.0026	0.0052	0.4033

Figure 4.4.2-6. Single 5.00" ID x 24" Tall Cylinder of UF_4 and Oil in a Concrete Corner

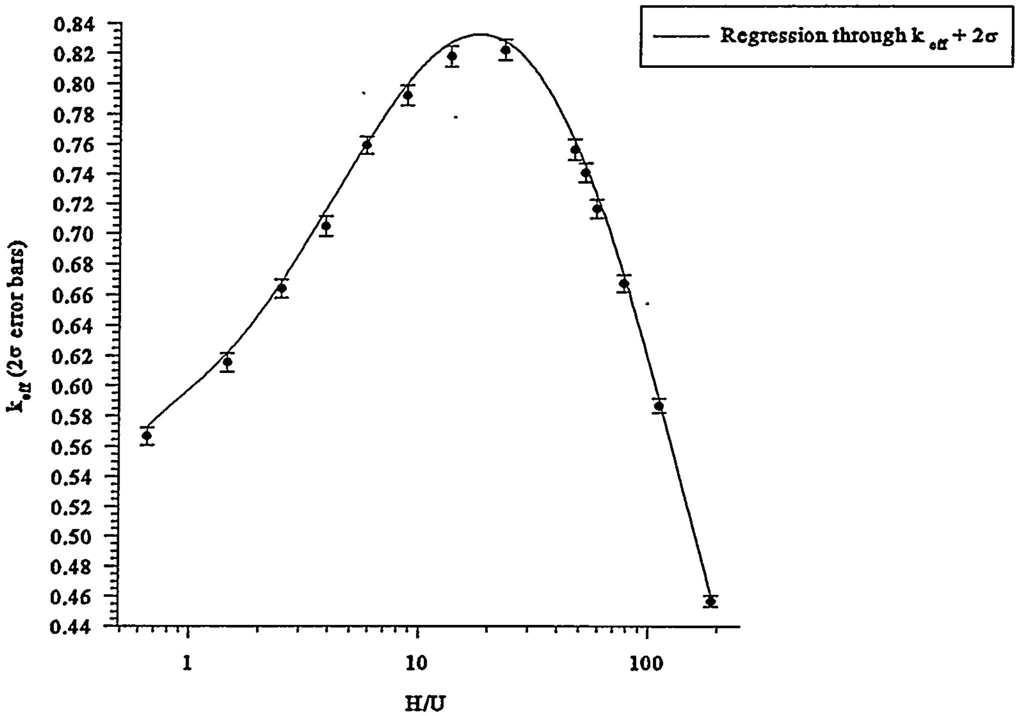
10% enrichment, 24" concrete floor, 12" concrete walls and ceiling, ~100 kg water reflector simulating a person



Single 5.0 in. Diameter Poly. Container in a Corner for 10% Enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
cr-500.p65.o	0.65	0.489	0.0033	0.0066	0.4956
cr-500.145.o	1.45	0.5188	0.0038	0.0076	0.5264
cr-500.249.o	2.49	0.5625	0.0042	0.0084	0.5709
cr-500.388.o	3.88	0.5895	0.004	0.008	0.5975
cr-500.582.o	5.82	0.629	0.0047	0.0094	0.6384
cr-500.873.o	8.73	0.6676	0.0045	0.009	0.6766
cr-500.136.o	13.6	0.6849	0.005	0.01	0.6949
cr-500.233.o	23.3	0.6913	0.0045	0.009	0.7003
cr-500.471.o	47.1	0.6285	0.004	0.008	0.6365
cr-500.524.o	52.4	0.6173	0.0043	0.0086	0.6259
cr-500.588.o	58.8	0.6008	0.0042	0.0084	0.6092
cr-500.773.o	77.3	0.5612	0.0038	0.0076	0.5688
cr-500.110.o	110.6	0.485	0.0032	0.0064	0.4914
cr-500.188.o	188.2	0.3747	0.0024	0.0048	0.3795

Figure 4.4.2-7. Two 5.00" ID x 24" Tall Cylinders of UF_4 and Oil Next to a Wall

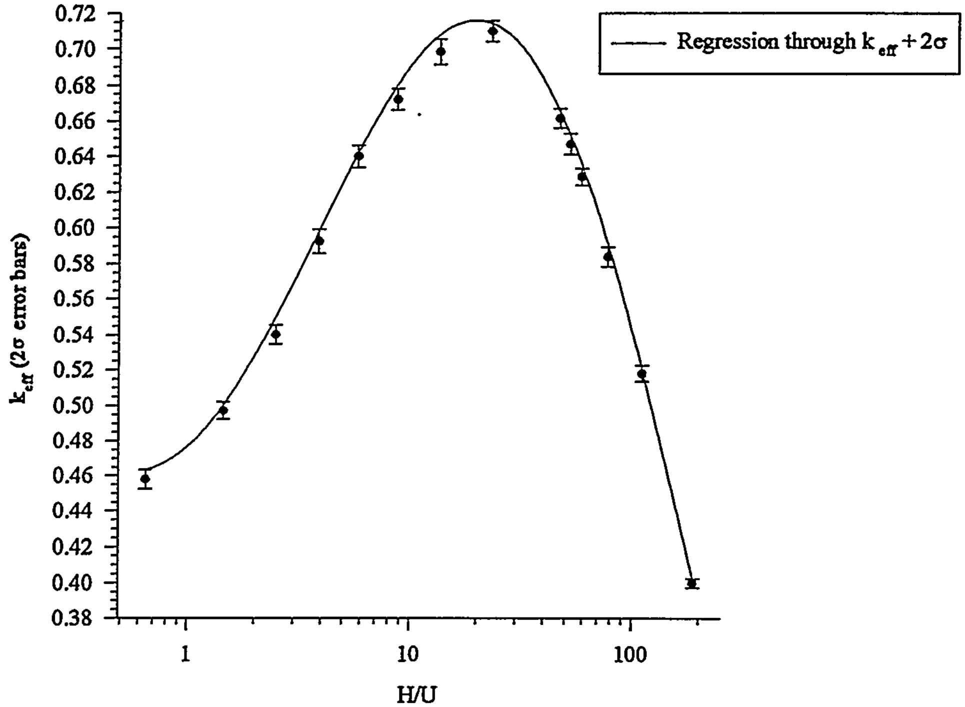
10% enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 5.0 in. Diameter Poly. Containers Adjacent to Concrete Wall for 10% Enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
d00n-500.p65	0.65	0.5669	0.00291	0.00582	0.57272
d00n-500.145	1.45	0.6155	0.00308	0.00616	0.62166
d00n-500.249	2.49	0.6637	0.00295	0.0059	0.6696
d00n-500.388	3.88	0.7043	0.00332	0.00664	0.71094
d00n-500.582	5.82	0.7587	0.00304	0.00608	0.76478
d00n-500.873	8.73	0.7915	0.0033	0.0066	0.7981
d00n-500.136	13.6	0.817	0.0035	0.007	0.824
d00n-500.233	23.3	0.8211	0.00342	0.00684	0.82794
d00n-500.471	47.1	0.7555	0.00351	0.00702	0.76252
d00n-500.524	52.4	0.74	0.00304	0.00608	0.74608
d00n-500.588	58.8	0.7158	0.00321	0.00642	0.72222
d00n-500.773	77.3	0.6666	0.00267	0.00534	0.67194
d00n-500.110	110.6	0.5864	0.00232	0.00464	0.59104
d00n-500.188	188.2	0.4569	0.00179	0.00358	0.46048

Figure 4.4.2-8. Two 5.00" ID x 24" Tall Cylinders of UF_4 and Oil One Foot from a Wall

10% enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 5.0 in. Diameter Poly. Containers 1' from Concrete Wall					
for 10% Enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
d12n-500.p65	0.65	0.4579	0.00265	0.0053	0.4632
d12n-500.145	1.45	0.4972	0.00245	0.0049	0.5021
d12n-500.249	2.49	0.5399	0.00275	0.0055	0.5454
d12n-500.388	3.88	0.5924	0.00336	0.00672	0.59912
d12n-500.582	5.82	0.6396	0.00303	0.00606	0.64566
d12n-500.873	8.73	0.6718	0.00299	0.00598	0.67778
d12n-500.136	13.6	0.6979	0.00355	0.0071	0.705
d12n-500.233	23.3	0.7092	0.00299	0.00598	0.71518
d12n-500.471	47.1	0.661	0.00273	0.00546	0.66646
d12n-500.524	52.4	0.6464	0.00303	0.00606	0.65246
d12n-500.588	58.8	0.628	0.00242	0.00484	0.63284
d12n-500.773	77.3	0.5834	0.00272	0.00544	0.58884
d12n-500.110	110.6	0.5177	0.00217	0.00434	0.52204
d12n-500.188	188.2	0.3999	0.001184	0.002368	0.402268

4.4.3 5.0-inch-Diameter Case (UF_4+Oil)

The UF_4+oil is more reactive than UO_2F_2. To approve the 5.0-inch container for use with UO_2F_2 only, the container must be shown to be safe when filled with the more reactive material (UF_4+oil). The model consists of a single container reflected by 1 inch of close-fitting water on the top and sides and 24 inches of concrete on the bottom. The data for these calculations are presented in Table and Figure 4.4.3-1. The calculated results fall within the safety criterion.

4.5 5.25-inch-Diameter by 24-inch-Tall Tin-Plated Steel Container

This section presents results of calculations designed to model the F-Can and Z-Can containers described in Table 1.0-1.

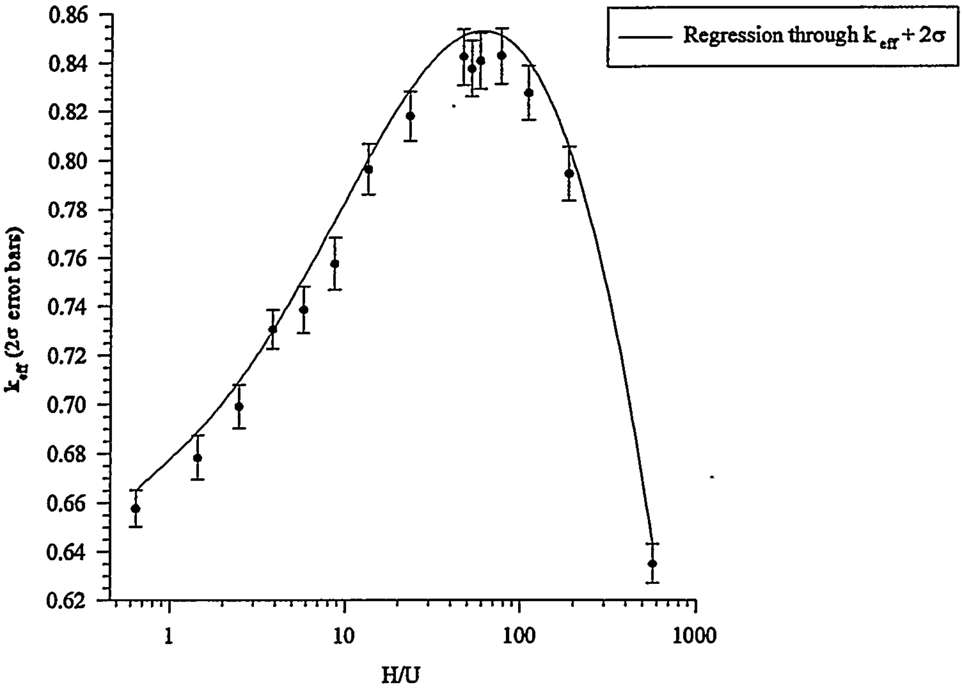
4.5.1 100% Enriched UO_2F_2+H_2O and UF_4+Oil

Limiting the uranium density for H/U values less than 4.0 was not done for this container type, because a second k_{eff} peak greater than the approval criterion occurred at H/U values greater than 4.0. Table 4.5.1-0 gives the figure and table numbers that contain the result data for this container with various geometry models and fuel materials. The geometry model designators are explained in Table 4.1-1.

The standard arrays were not analyzed because the single container and two container case results fell outside the safety criterion. Container thickness was not included in the models tested because single container full reflection results fell outside the safety criterion for both UO_2F_2+H_2O and UF_4+oil.

Figure 4.4.3-1. Single 5.00" ID x 24" Tall Cylinder of UF_4 and Oil

100% enrichment, .195" container, 1" close fit water reflector on all other sides, 12" ceiling 10' above



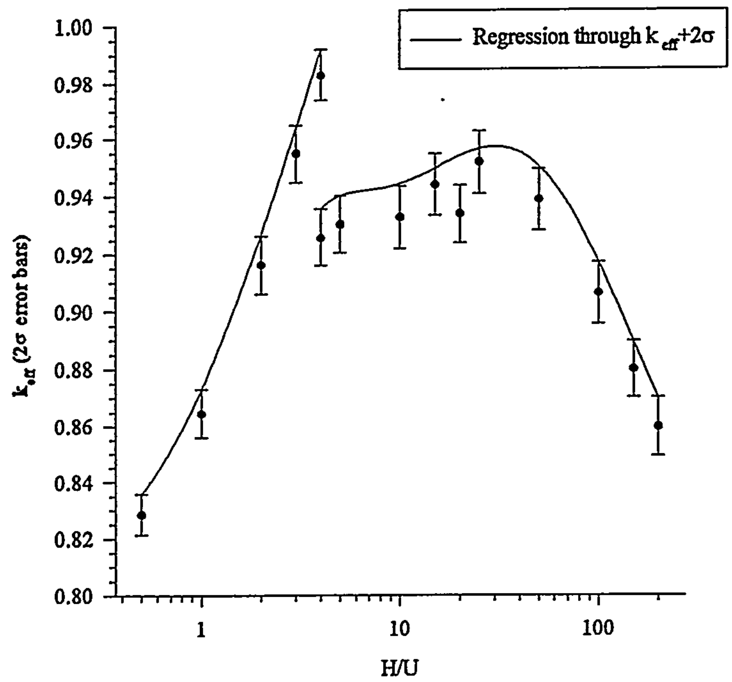
Single 5.00-in. Container w/ 1" Water Reflection (.195" Container)					
For 100% Enriched UF4+Oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
cye01n-c	0.64	0.6578	0.0038	0.0076	0.6654
cye02n-c	1.44	0.6784	0.0045	0.009	0.6874
cye03n-c	2.47	0.6992	0.0044	0.0088	0.708
cye04n-c	3.84	0.7306	0.004	0.008	0.7386
cye05n-c	5.76	0.7385	0.0047	0.0094	0.7479
cye06n-c	8.64	0.7575	0.0054	0.0108	0.7683
cye07n-c	13.4	0.7963	0.0051	0.0102	0.8065
cye08n-c	23.1	0.8178	0.005	0.01	0.8278
cye09n-c	46.6	0.8421	0.0057	0.0114	0.8535
cye10n-c	51.9	0.8373	0.0057	0.0114	0.8487
cye11n-c	58.2	0.8404	0.0057	0.0114	0.8518
cye12n-c	76.6	0.8424	0.0057	0.0114	0.8538
cye13n-c	109.5	0.8272	0.0056	0.0112	0.8384
cye14n-c	186.4	0.7944	0.0054	0.0108	0.8052
cye15n-c	570.6	0.6351	0.004	0.008	0.6431

Table 4.5.1-0. Summary of References for F-Can Results for 100% Enrichment

Geometry Model	Material	Figure/Table Number
SFR	UO_2F_2+H_2O	4.5.1-1
SCC	UO_2F_2+H_2O	4.5.1-2
TACW	UO_2F_2+H_2O	4.5.1-3
TSCW	UO_2F_2+H_2O	4.5.1-4
SFR	UF_4+oil	4.5.1-5
SCC	UF_4+oil	4.5.1-6
TACW	UF_4+oil	4.5.1-7
TSCW	UF_4+oil	4.5.1-8
SMRC	UF_4+oil	4.5.1-9

Figure 4.5.1-1. Single Fully Reflected 5.25" ID x 24" Tall Cylinder of UO_2F_2

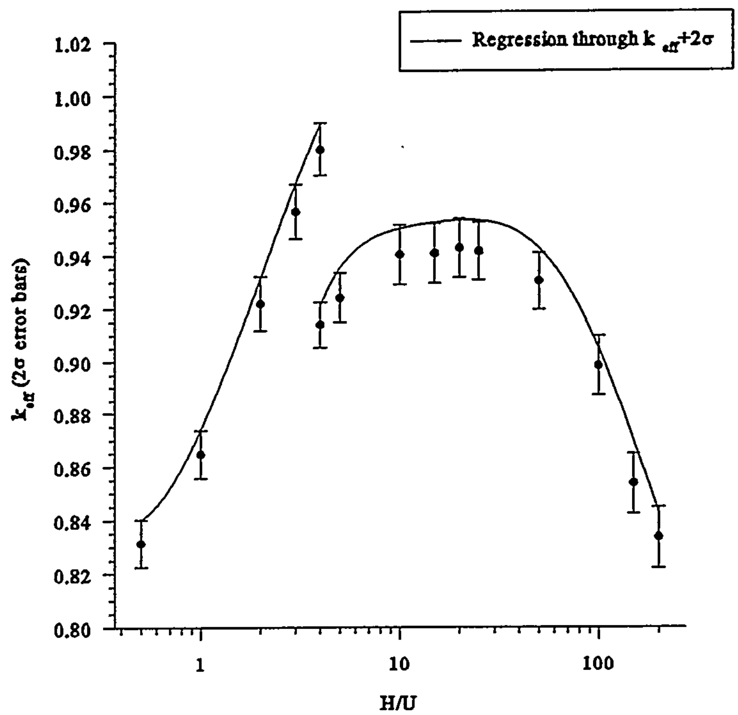
100% enrichment, 24" concrete floor, 12" (minimum) water reflector on all other sides



Single 5.25 in. Diameter Tin Plated Steel Container w/ Full Reflection for 100% Enriched UO2F2+H2O					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
frc001n.o	0.5	0.8285	0.0036	0.0072	0.8357
frc002n.o	1	0.8645	0.0043	0.0086	0.8731
frc003n.o	2	0.9161	0.0051	0.0102	0.9263
frc004n.o	3	0.9548	0.005	0.01	0.9648
frc005n.o	3.99	0.9828	0.0045	0.009	0.9918
frc006n.o	4	0.9256	0.0049	0.0098	0.9354
frc007n.o	5	0.9302	0.0049	0.0098	0.94
frc008n.o	10	0.9326	0.0054	0.0108	0.9434
frc009n.o	15	0.9439	0.0053	0.0106	0.9545
frc010n.o	20	0.9337	0.005	0.01	0.9437
frc011n.o	25	0.9516	0.0055	0.011	0.9626
frc012n.o	50	0.9387	0.0053	0.0106	0.9493
frc013n.o	100	0.9062	0.0054	0.0108	0.917
frc014n.o	150	0.8798	0.0048	0.0096	0.8894
frc015n.o	200	0.8596	0.0052	0.0104	0.87

Figure 4.5.1-2. Single 5.25" ID x 24" Tall Cylinder of UO_2F_2 in a Concrete Corner

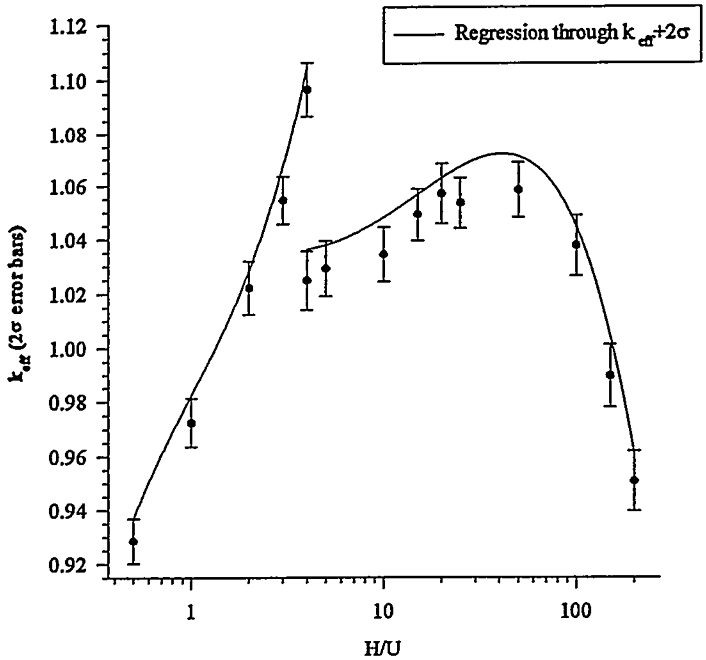
100% enrichment, 24" concrete floor, 12" concrete walls and ceiling, ~100 kg water reflector simulating a person



Single 5.25 in. Diameter Tin Plated Steel Container in a Corner for 100% Enriched UO2F2+H2O					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
cpc001n.o	0.5	0.8314	0.0044	0.0088	0.8402
cpc002n.o	1	0.8647	0.0045	0.009	0.8737
cpc003n.o	2	0.9218	0.0051	0.0102	0.932
cpc004n.o	3	0.9563	0.0051	0.0102	0.9665
cpc005n.o	3.99	0.9799	0.005	0.01	0.9899
cpc006n.o	4	0.9138	0.0043	0.0086	0.9224
cpc007n.o	5	0.9239	0.0046	0.0092	0.9331
cpc008n.o	10	0.94	0.0056	0.0112	0.9512
cpc009n.o	15	0.9405	0.0056	0.0112	0.9517
cpc010n.o	20	0.9425	0.0055	0.011	0.9535
cpc011n.o	25	0.9413	0.0054	0.0108	0.9521
cpc012n.o	50	0.9301	0.0053	0.0106	0.9407
cpc013n.o	100	0.8982	0.0056	0.0112	0.9094
cpc014n.o	150	0.8537	0.0056	0.0112	0.8649
cpc015n.o	200	0.8335	0.0057	0.0114	0.8449

Figure 4.5.1-3. Two 5.25" ID x 24" Tall Cylinders of UO_2F_2 Next to a Wall

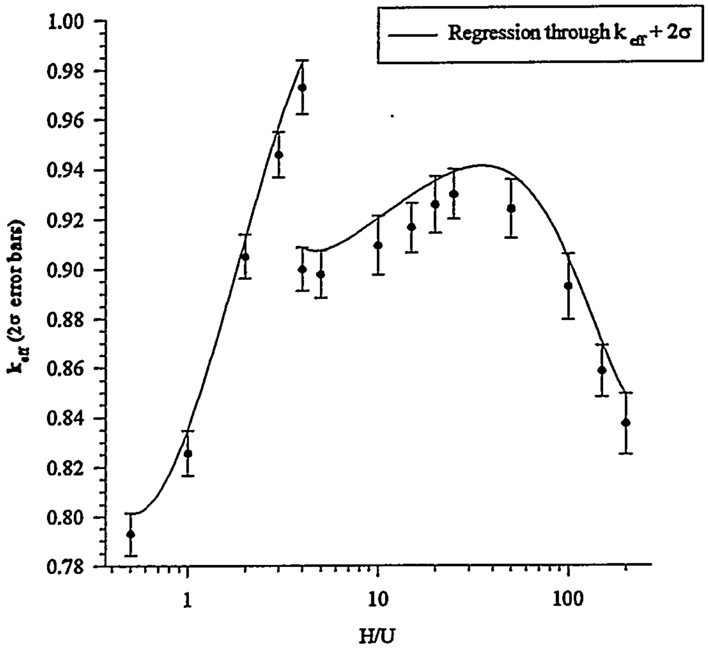
100% enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 5.25 in. Dia. Tin/Steel Containers Adjacent to Concrete Wall for 100% Enriched UO2F2+H2O					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
npc001n.o	0.5	0.9286	0.0042	0.0084	0.937
npc002n.o	1	0.9725	0.0044	0.0088	0.9813
npc003n.o	2	1.0222	0.0049	0.0098	1.032
npc004n.o	3	1.0545	0.0045	0.009	1.0635
npc005n.o	3.99	1.0964	0.0049	0.0098	1.1062
npc006n.o	4	1.0248	0.0054	0.0108	1.0356
npc007n.o	5	1.0291	0.0051	0.0102	1.0393
npc008n.o	10	1.0342	0.005	0.01	1.0442
npc009n.o	15	1.049	0.0048	0.0096	1.0586
npc010n.o	20	1.0569	0.0057	0.0114	1.0683
npc011n.o	25	1.0533	0.0047	0.0094	1.0627
npc012n.o	50	1.0582	0.0052	0.0104	1.0686
npc013n.o	100	1.0375	0.0056	0.0112	1.0487
npc014n.o	150	0.9895	0.0058	0.0116	1.0011
npc015n.o	200	0.9507	0.0056	0.0112	0.9619

Figure 4.5.1-4. Two 5.25" ID x 24" Tall Cylinders of UO_2F_2 One Foot from a Wall

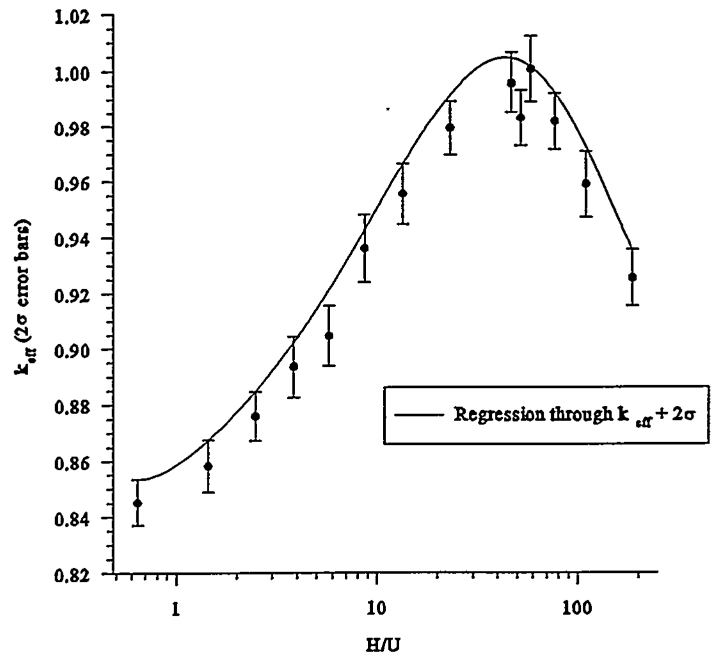
100% enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 5.25 in. Diameter Tin/Steel Containers 1' from Concrete Wall for 100% Enriched UO2F2+H2O					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
apc001n.o	0.5	0.7929	0.0043	0.0086	0.8015
apc002n.o	1	0.8256	0.0045	0.009	0.8346
apc003n.o	2	0.9049	0.0044	0.0088	0.9137
apc004n.o	3	0.9456	0.0046	0.0092	0.9548
apc005n.o	3.99	0.9728	0.0054	0.0108	0.9836
apc006n.o	4	0.8997	0.0044	0.0088	0.9085
apc007n.o	5	0.8976	0.0048	0.0096	0.9072
apc008n.o	10	0.9091	0.0059	0.0118	0.9209
apc009n.o	15	0.9162	0.005	0.01	0.9262
apc010n.o	20	0.9255	0.0057	0.0114	0.9369
apc011n.o	25	0.9296	0.005	0.01	0.9396
apc012n.o	50	0.9237	0.0059	0.0118	0.9355
apc013n.o	100	0.8925	0.0066	0.0132	0.9057
apc014n.o	150	0.8583	0.0052	0.0104	0.8687
apc015n.o	200	0.8371	0.0061	0.0122	0.8493

Figure 4.5.1-5. Single Fully Reflected 5.25" ID x 24" Tall Cylinder of UF_4 and Oil

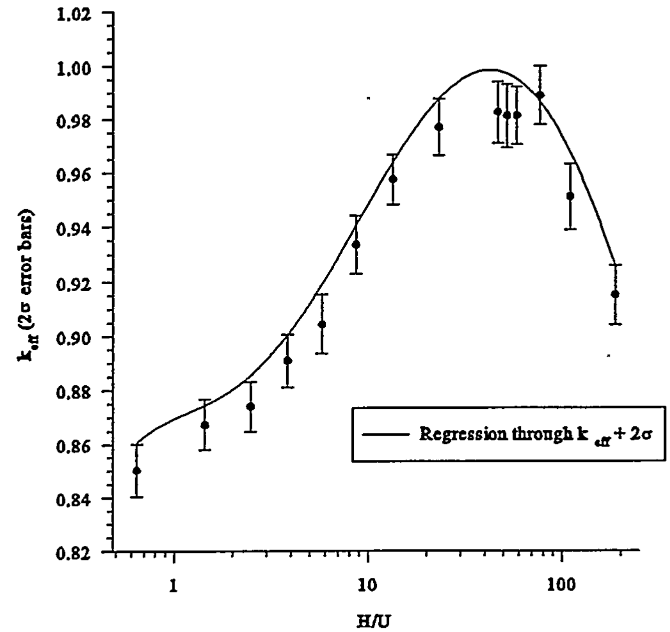
100% enrichment, 24" concrete floor, 12" (minimum) water reflector on all other sides



Single 5.25 in. Diameter Tin/Steel Container w/ Full Reflection for 100% Enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
frf001n.o	0.64	0.8452	0.0041	0.0082	0.8534
frf002n.o	1.44	0.8582	0.0047	0.0094	0.8676
frf003n.o	2.47	0.8759	0.0043	0.0086	0.8845
frf004n.o	3.84	0.8934	0.0054	0.0108	0.9042
frf005n.o	5.76	0.9044	0.0054	0.0108	0.9152
frf006n.o	8.64	0.9358	0.006	0.012	0.9478
frf007n.o	13.4	0.9551	0.0054	0.0108	0.9659
frf008n.o	23.1	0.979	0.0049	0.0098	0.9888
frf009n.o	46.6	0.9952	0.0053	0.0106	1.0058
frf010n.o	51.9	0.9826	0.0051	0.0102	0.9928
frf011n.o	58.2	1.0001	0.0058	0.0116	1.0117
frf012n.o	76.6	0.9813	0.0051	0.0102	0.9915
frf013n.o	109.5	0.9585	0.0059	0.0118	0.9703
frf014n.o	186.4	0.9252	0.0051	0.0102	0.9354

Figure 4.5.1-6. Single 5.25" ID x 24" Tall Cylinder of UF_4 and Oil in a Concrete Corner

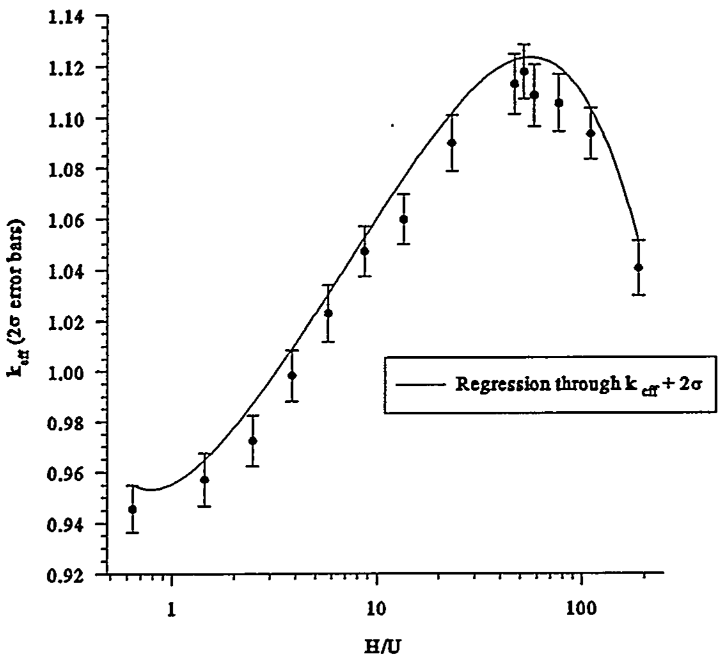
100% enrichment, 24" concrete floor, 12" concrete walls and ceiling, ~100 kg water reflector simulating a person



Single 5.25 in. Diameter Poly. Container in a Corner for 100% Enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
cpe001n.o	0.64	0.819	0.0046	0.0092	0.8282
cpe002n.o	1.44	0.8377	0.0053	0.0106	0.8483
cpe003n.o	2.47	0.8491	0.0049	0.0098	0.8589
cpe004n.o	3.84	0.8667	0.0051	0.0102	0.8769
cpe005n.o	5.76	0.8975	0.0045	0.009	0.9065
cpe006n.o	8.64	0.8952	0.0045	0.009	0.9042
cpe007n.o	13.4	0.9208	0.0051	0.0102	0.931
cpe008n.o	23.1	0.9409	0.0051	0.0102	0.9511
cpe009n.o	46.6	0.9583	0.005	0.01	0.9683
cpe010n.o	51.9	0.9489	0.006	0.012	0.9609
cpe011n.o	58.2	0.9533	0.0052	0.0104	0.9637
cpe012n.o	76.6	0.9445	0.0057	0.0114	0.9559
cpe013n.o	109.5	0.9292	0.0054	0.0108	0.94
cpe014n.o	186.4	0.8803	0.006	0.012	0.8923

Figure 4.5.1-7. Two 5.25" ID x 24" Tall Cylinders of UF_4 and Oil Next to a Wall

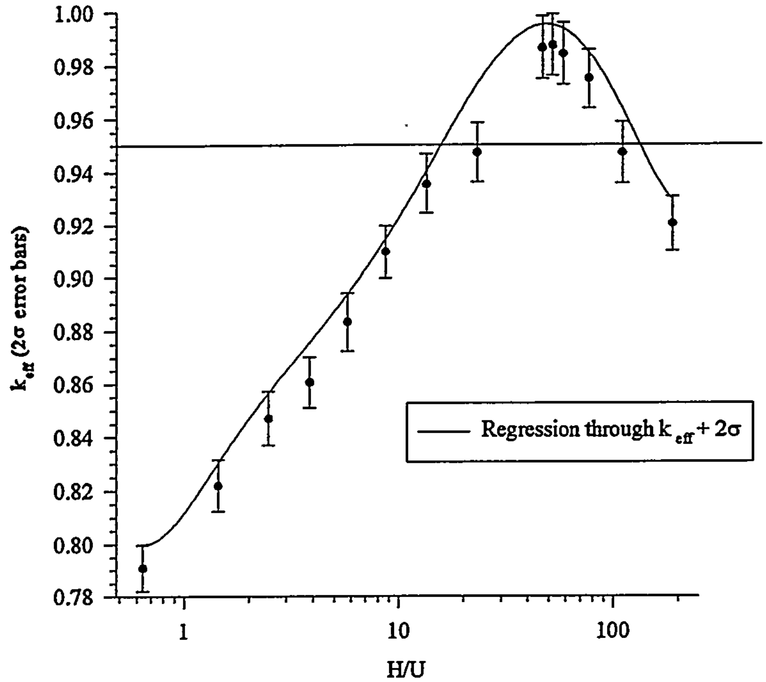
100% enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 5.25 in. Dia. Tin/Steel Containers Adjacent to Concrete Wall for 100% Enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
npf001n.o	0.64	0.9456	0.0046	0.0092	0.9548
npf002n.o	1.44	0.957	0.0052	0.0104	0.9674
npf003n.o	2.47	0.9723	0.005	0.01	0.9823
npf004n.o	3.84	0.9981	0.0051	0.0102	1.0083
npf005n.o	5.76	1.0227	0.0056	0.0112	1.0339
npf006n.o	8.64	1.0469	0.0049	0.0098	1.0567
npf007n.o	13.4	1.0593	0.0049	0.0098	1.0691
npf008n.o	23.1	1.0894	0.0056	0.0112	1.1006
npf009n.o	46.6	1.1124	0.0058	0.0116	1.124
npf010n.o	51.9	1.1171	0.0052	0.0104	1.1275
npf011n.o	58.2	1.108	0.006	0.012	1.12
npf012n.o	76.6	1.105	0.0055	0.011	1.116
npf013n.o	109.5	1.093	0.0051	0.0102	1.1032
npf014n.o	186.4	1.0402	0.0053	0.0106	1.0508

Figure 4.5.1-8. Two 5.25" ID x 24" Tall Cylinders of UF_4 and Oil One Foot from a Wall

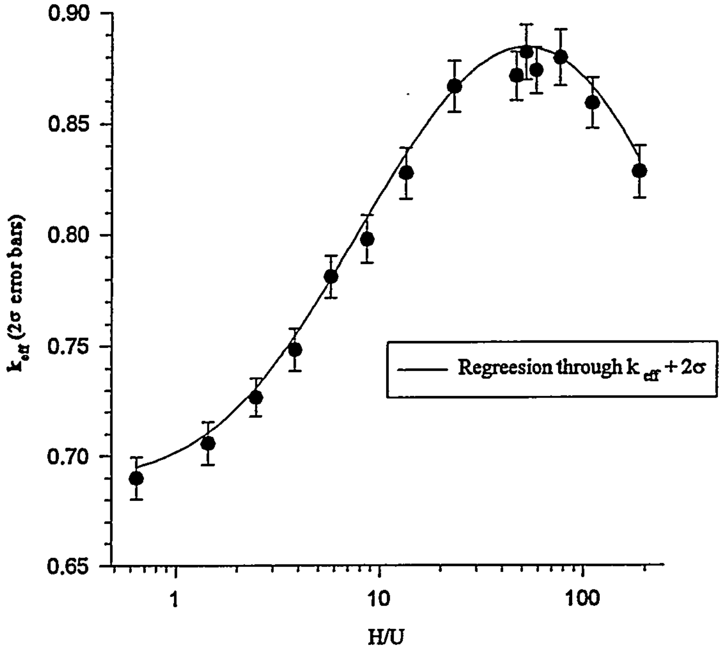
100% enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 5.25 in. Diameter Tin/Steel Containers 1' from Concrete Wall for 100% Enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
apf001n.o	0.64	0.7909	0.0044	0.0088	0.7997
apf002n.o	1.44	0.822	0.0048	0.0096	0.8316
apf003n.o	2.47	0.847	0.005	0.01	0.857
apf004n.o	3.84	0.8606	0.0048	0.0096	0.8702
apf005n.o	5.76	0.8832	0.0054	0.0108	0.894
apf006n.o	8.64	0.9095	0.005	0.01	0.9195
apf007n.o	13.4	0.9354	0.0056	0.0112	0.9466
apf008n.o	23.1	0.9473	0.0055	0.011	0.9583
apf009n.o	46.6	0.9863	0.0059	0.0118	0.9981
apf010n.o	51.9	0.9873	0.0058	0.0116	0.9989
apf011n.o	58.2	0.984	0.0058	0.0116	0.9956
apf012n.o	76.6	0.9747	0.0055	0.011	0.9857
apf013n.o	109.5	0.9471	0.0057	0.0114	0.9585
apf014n.o	186.4	0.9202	0.0052	0.0104	0.9306

Figure 4.5.1-9 Single 5.25" ID x 24" Tall Cylinder of UF_4 and Oil

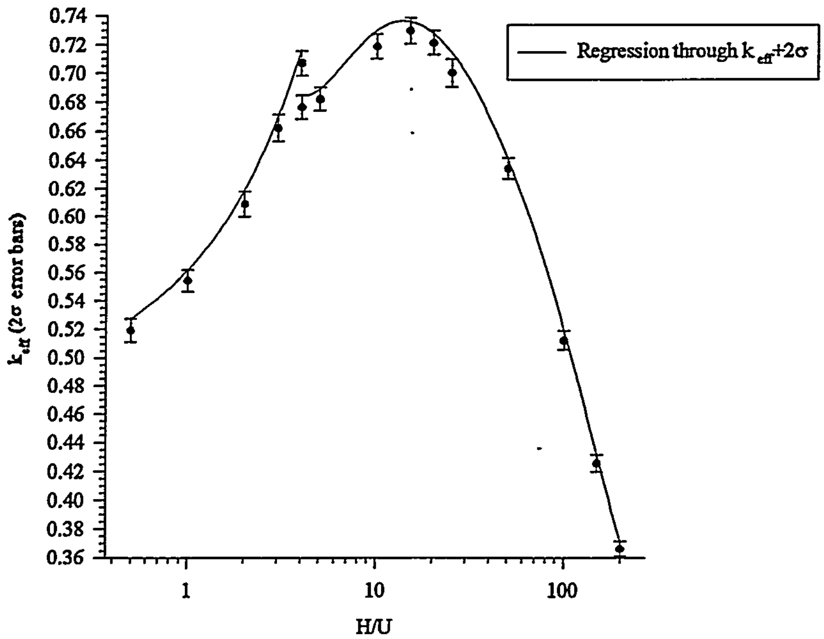
100% Enrichment, 24" concrete floor, 1" close fit water reflector on all other sides, 12" ceiling 10' above



Single 5.25" ID x 24" Tall Cylinder of UF4 and Oil					
100% Enriched, 1" close fit water reflector					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
fullrf-1.0p6	0.64	0.6899	0.0048	0.0096	0.6947
fullrf-1.144	1.44	0.7058	0.0049	0.0098	0.7107
fullrf-1.247	2.47	0.7268	0.00433	0.00866	0.73113
fullrf-1.384	3.84	0.7483	0.00482	0.00964	0.75312
fullrf-1.576	5.76	0.781	0.00471	0.00942	0.78571
fullrf-1.864	8.64	0.7977	0.00528	0.01056	0.80298
fullrf-1.134	13.4	0.8272	0.00572	0.01144	0.83292
fullrf-1.231	23.1	0.8661	0.00578	0.01156	0.87188
fullrf-1.466	46.6	0.8708	0.00547	0.01094	0.87627
fullrf-1.519	51.9	0.8814	0.00621	0.01242	0.88761
fullrf-1.582	58.2	0.8733	0.00517	0.01034	0.87847
fullrf-1.766	76.6	0.879	0.0063	0.0126	0.8853
fullrf-1.109	109.5	0.8587	0.00565	0.0113	0.86435
fullrf-1.186	186.4	0.8278	0.00587	0.01174	0.83367

Figure 4.5.2-1. Single Fully Reflected 5.25" ID x 24" Tall Cylinder of UO_2F_2

10% enrichment, 24" concrete floor, 12" (minimum) water reflector on all other sides



Single 5.25 in. Diameter Tin Plated Steel Container w/ Full Reflection for 10% Enriched UO2F2+H2O					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
frw001n.o	0.5	0.5193	0.004	0.008	0.5273
frw002n.o	1	0.5542	0.0039	0.0078	0.562
frw003n.o	2	0.6088	0.0045	0.009	0.6178
frw004n.o	3	0.6618	0.0047	0.0094	0.6712
frw005n.o	3.99	0.7065	0.0043	0.0086	0.7151
frw006n.o	4	0.6762	0.0041	0.0082	0.6844
frw007n.o	5	0.6816	0.0039	0.0078	0.6894
frw008n.o	10	0.7181	0.0043	0.0086	0.7267
frw009n.o	15	0.7289	0.0044	0.0088	0.7377
frw010n.o	20	0.7205	0.0042	0.0084	0.7289
frw011n.o	25	0.6994	0.0049	0.0098	0.7092
frw012n.o	50	0.6334	0.0036	0.0072	0.6406
frw013n.o	100	0.5117	0.0033	0.0066	0.5183
frw014n.o	150	0.4253	0.003	0.006	0.4313
frw015n.o	200	0.3663	0.0026	0.0052	0.3715

4.5.2 10% Enriched UO_2F_2+H_2O and UF_4+Oil

Table 4.5.2-0 gives the figure and table numbers that contain the results data for this container with various geometry models and fuel materials. The geometry model designators are explained in Table 4.1-1.

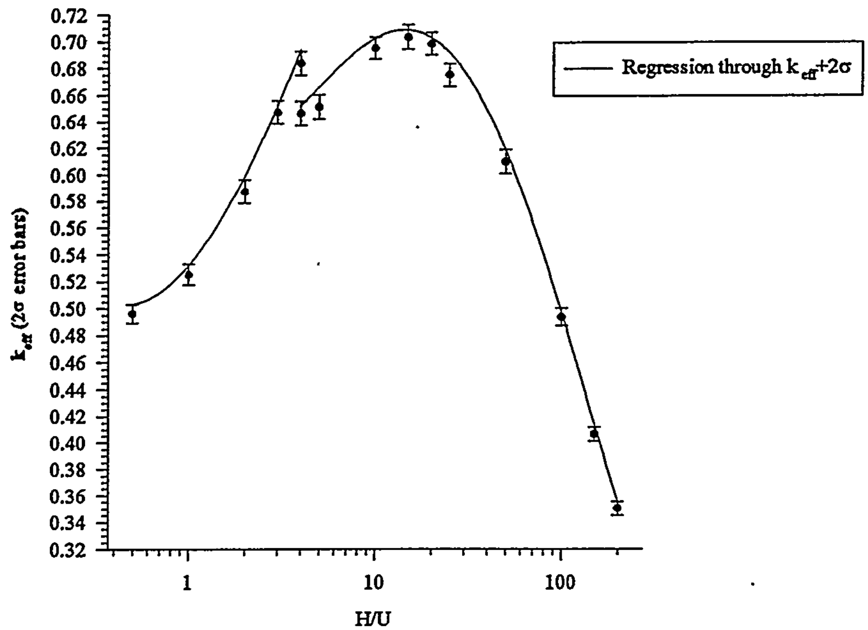
The three standard array cases were not analyzed because the 100% enriched standard array cases fell within the safety criterion. The maximum container poly thickness was considered in the TACW and TSCW cases for both UO_2F_2+H_2O and UF_4+oil. Polyethylene was used to model the F-Cans (constructed of steel coated with tin) in the TACW and TSCW cases to provide a measure of conservatism and to bound the smaller diameter containers with the analysis.

Table 4.5.2-0. Summary of References for F-Can Results for 10% Enrichment

Geometry Model	Material	Figure/Table Number
SFR	UO_2F_2+H_2O	4.5.2-1
SCC	UO_2F_2+H_2O	4.5.2-2
TACW	UO_2F_2+H_2O	4.5.2-3
TSCW	UO_2F_2+H_2O	4.5.2-4
SFR	UF_4+oil	4.5.2-5
SCC	UF_4+oil	4.5.2-6
TACW	UF_4+oil	4.5.2-7
TSCW	UF_4+oil	4.5.2-8

Figure 4.5.2-2. Single 5.25" ID x 24" Tall Cylinder of UO_2F_2 in a Concrete Corner

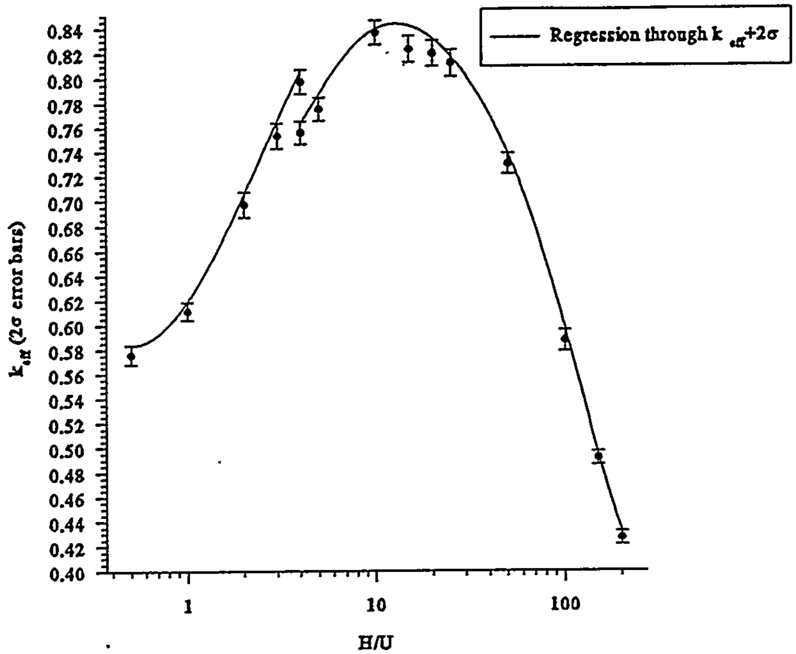
10% enrichment, 24" concrete floor, 12" concrete walls and ceiling, ~100 kg water reflector simulating a person



Single 5.25 in. Diameter Tin Plated Steel Container in a Corner for 10% Enriched UO2F2+H2O					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
cpw001n.o	0.5	0.4961	0.0035	0.007	0.5031
cpw002n.o	1	0.5252	0.0039	0.0078	0.533
cpw003n.o	2	0.5872	0.0044	0.0088	0.596
cpw004n.o	3	0.6469	0.0043	0.0086	0.6555
cpw005n.o	3.99	0.6834	0.0045	0.009	0.6924
cpw006n.o	4	0.6462	0.0046	0.0092	0.6554
cpw007n.o	5	0.651	0.0046	0.0092	0.6602
cpw008n.o	10	0.6945	0.0041	0.0082	0.7027
cpw009n.o	15	0.7027	0.0046	0.0092	0.7119
cpw010n.o	20	0.6976	0.0042	0.0084	0.706
cpw011n.o	25	0.6744	0.0042	0.0084	0.6828
cpw012n.o	50	0.6088	0.0044	0.0088	0.6176
cpw013n.o	100	0.4931	0.0032	0.0064	0.4995
cpw014n.o	150	0.4061	0.0026	0.0052	0.4113
cpw015n.o	200	0.3501	0.0026	0.0052	0.3553

Figure 4.5.2-3. Two 5.25" ID x 24" Tall Cylinders of UO $_2$F$_2$ Next to a Wall

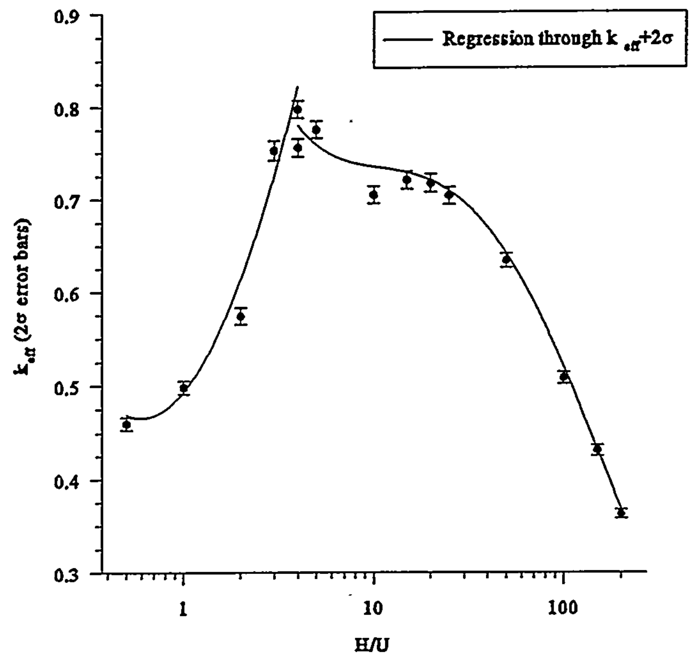
10% enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 5.25 in. Dia. Tin/Steel Containers Adjacent to Concrete Wall for 10% Enriched UO2F2+H2O					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
d00n-525.0p5	0.5	0.5757	0.0038	0.0076	0.5833
d00n-525.1	1	0.6112	0.00365	0.0073	0.6185
d00n-525.2	2	0.6968	0.00505	0.0101	0.7069
d00n-525.3	3	0.7526	0.00523	0.01046	0.76306
d00n-525.3p9	3.99	0.7968	0.00483	0.00966	0.80646
d00n-525.4	4	0.755	0.00478	0.00956	0.76456
d00n-525.5	5	0.7746	0.00462	0.00924	0.78384
d00n-525.10	10	0.8359	0.00486	0.00972	0.84562
d00n-525.15	15	0.8228	0.00518	0.01036	0.83316
d00n-525.20	20	0.8193	0.00505	0.0101	0.8294
d00n-525.25	25	0.8115	0.0053	0.0106	0.8221
d00n-525.50	50	0.7294	0.00422	0.00844	0.73784
d00n-525.100	100	0.5865	0.00436	0.00872	0.59522
d00n-525.150	150	0.4913	0.00268	0.00536	0.49666
d00n-525.200	200	0.4266	0.00265	0.0053	0.4319

Figure 4.5.2-4. Two 5.25" ID x 24" Tall Cylinders of UO_2F_2 One Foot from a Wall

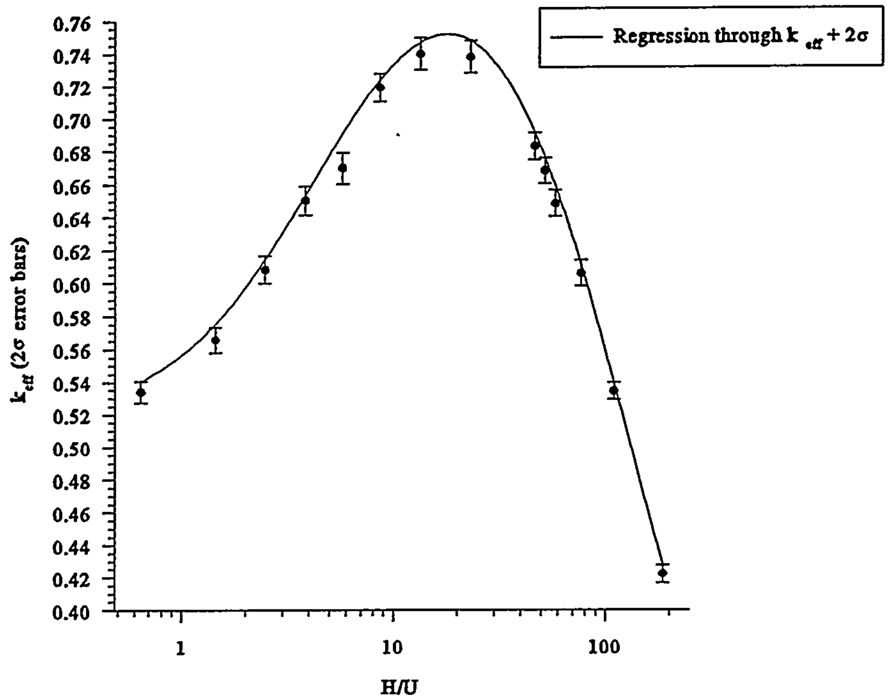
10% enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 5.25 in. Diameter Tin/Steel Containers 1' from Concrete Wall					
for 10% Enriched UO2F2+H2O					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
d12n-525.0p5	0.5	0.4603	0.00342	0.00684	0.46714
d12n-525.1	1	0.4982	0.00347	0.00694	0.50514
d12n-525.2	2	0.5735	0.00444	0.00888	0.58238
d12n-525.3	3	0.7518	0.00523	0.01046	0.76226
d12n-525.3p9	3.99	0.7968	0.00483	0.00966	0.80646
d12n-525.4	4	0.755	0.00478	0.00956	0.76456
d12n-525.5	5	0.7746	0.00462	0.00924	0.78384
d12n-525.10	10	0.704	0.00478	0.00956	0.71356
d12n-525.15	15	0.7201	0.00472	0.00944	0.72954
d12n-525.20	20	0.7167	0.0049	0.0098	0.7265
d12n-525.25	25	0.7034	0.00456	0.00912	0.71252
d12n-525.50	50	0.6332	0.00383	0.00766	0.64086
d12n-525.100	100	0.5078	0.00304	0.00608	0.51388
d12n-525.150	150	0.4309	0.00293	0.00586	0.43676
d12n-525.200	200	0.3623	0.00236	0.00472	0.36702

Figure 4.5.2-5. Single Fully Reflected 5.25" ID x 24" Tall Cylinder of UF $_4$ and Oil

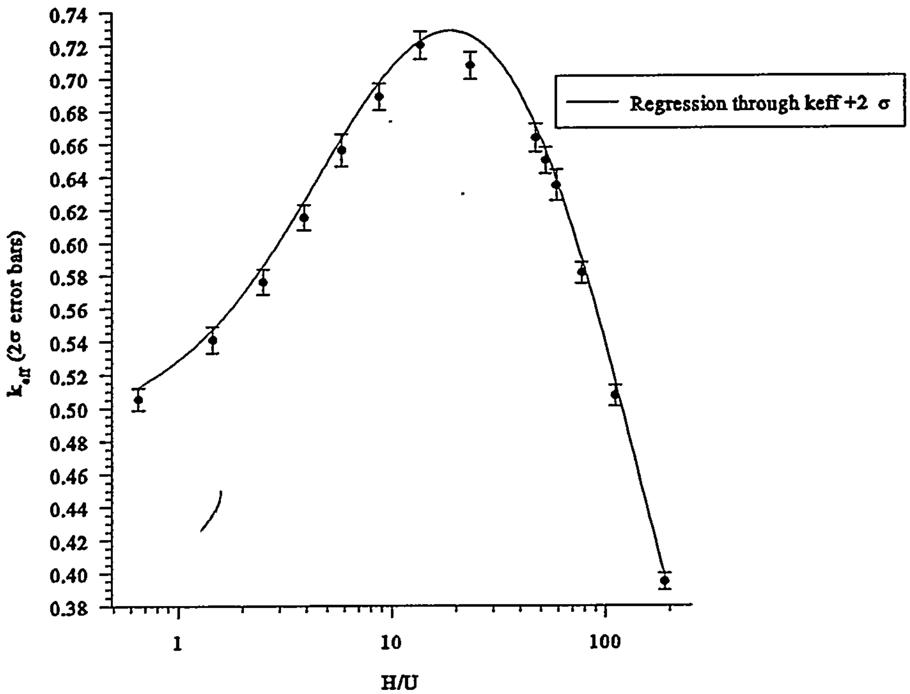
10% enrichment, 24" concrete floor, 12" (minimum) water reflector on all other sides



Single 5.25 in. Diameter Tin/Steel Container w/ Full Reflection for 10% Enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
fr-525.p65.o	0.65	0.5344	0.004	0.008	0.5424
fr-525.145.o	1.45	0.57	0.0041	0.0082	0.5782
fr-525.249.o	2.49	0.6011	0.0043	0.0086	0.6097
fr-525.388.o	3.88	0.6436	0.0041	0.0082	0.6518
fr-525.582.o	5.82	0.6722	0.0046	0.0092	0.6814
fr-525.873.o	8.73	0.7216	0.0049	0.0098	0.7314
fr-525.136.o	13.6	0.7472	0.0045	0.009	0.7562
fr-525.233.o	23.3	0.7388	0.0042	0.0084	0.7472
fr-525.471.o	47.1	0.6783	0.004	0.008	0.6863
fr-525.524.o	52.4	0.6699	0.0037	0.0074	0.6773
fr-525.588.o	58.8	0.6621	0.0039	0.0078	0.6699
fr-525.773.o	77.3	0.6152	0.0038	0.0076	0.6228
fr-525.110.o	110.6	0.529	0.0033	0.0066	0.5356
fr-525.188.o	188.2	0.4163	0.0024	0.0048	0.4211

Figure 4.5.2-6. Single 5.25" ID x 24" Tall Cylinder of UF_4 and Oil in a Concrete Corner

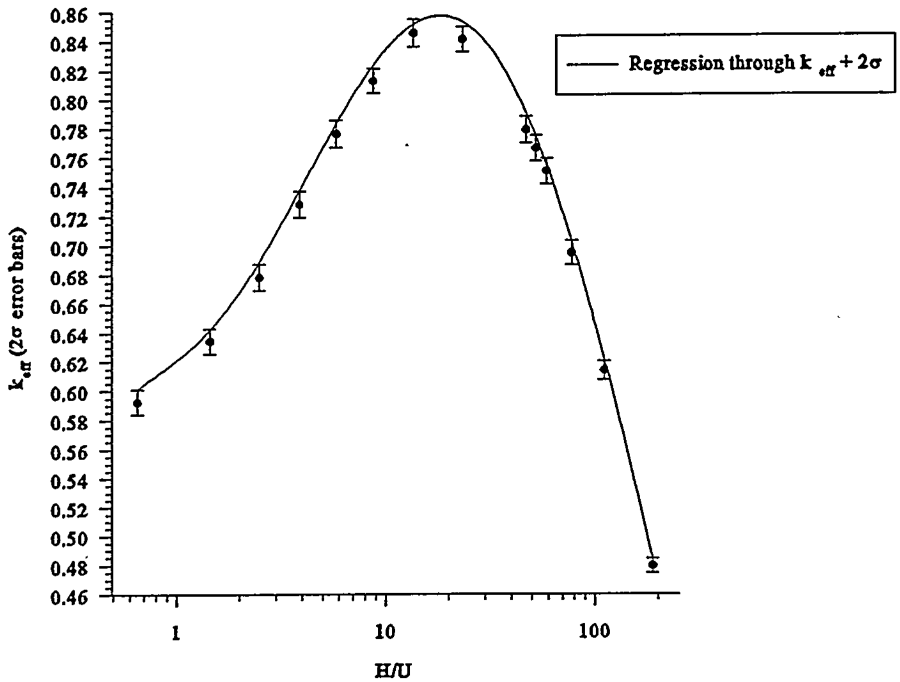
10% enrichment, 24" concrete floor, 12" concrete walls and ceiling, ~100 kg water reflector simulating a person



Single 5.25 in. Diameter Tin/Steel Container in a Corner for 10% Enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
cr-525.p65.o	0.65	0.5053	0.0033	0.0066	0.5119
cr-525.145.o	1.45	0.5409	0.0039	0.0078	0.5487
cr-525.249.o	2.49	0.5758	0.0039	0.0078	0.5836
cr-525.388.o	3.88	0.6153	0.0038	0.0076	0.6229
cr-525.582.o	5.82	0.6557	0.0049	0.0098	0.6655
cr-525.873.o	8.73	0.6882	0.0041	0.0082	0.6964
cr-525.136.o	13.6	0.7197	0.0042	0.0084	0.7281
cr-525.233.o	23.3	0.7072	0.0042	0.0084	0.7156
cr-525.471.o	47.1	0.6628	0.0043	0.0086	0.6714
cr-525.524.o	52.4	0.649	0.0039	0.0078	0.6568
cr-525.588.o	58.8	0.6343	0.0046	0.0092	0.6435
cr-525.773.o	77.3	0.581	0.0032	0.0064	0.5874
cr-525.110.o	110.6	0.507	0.0031	0.0062	0.5132
cr-525.188.o	188.2	0.3945	0.0025	0.005	0.3995

Figure 4.5.2-7. Two 5.25" ID x 24" Tall Cylinders of UF_4 and Oil Next to a Wall

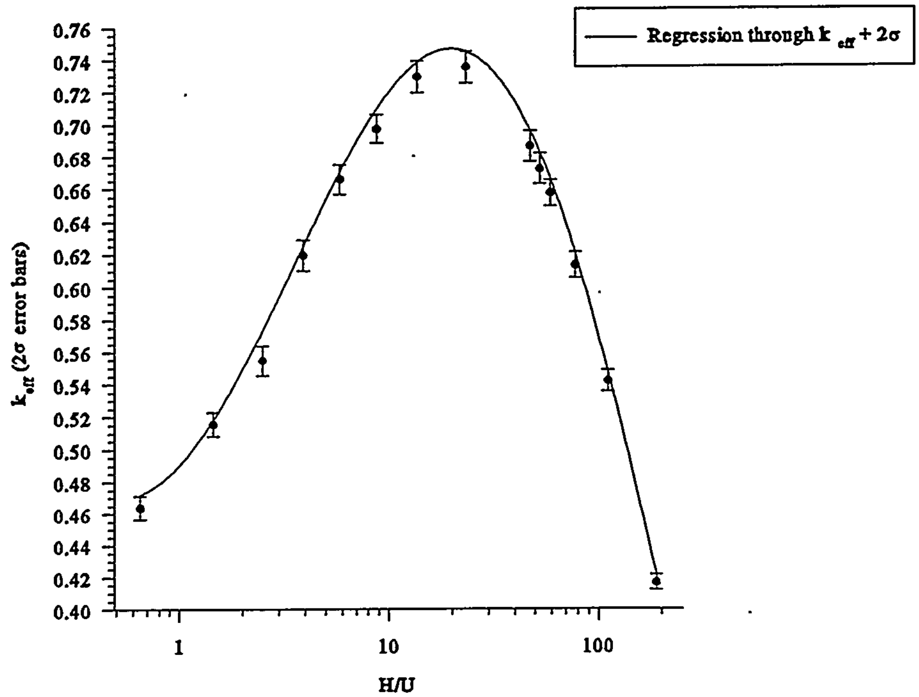
10% enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 5.25 in. Dia. Tin/Steel Containers Adjacent to Concrete Wall for 10% Enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
d00n-525.p65	0.65	0.5923	0.00429	0.00858	0.60088
d00n-525.145	1.45	0.6342	0.00453	0.00906	0.64326
d00n-525.249	2.49	0.6783	0.00453	0.00906	0.68736
d00n-525.388	3.88	0.728	0.0044	0.0088	0.7368
d00n-525.582	5.82	0.7761	0.0046	0.0092	0.7853
d00n-525.873	8.73	0.8123	0.00416	0.00832	0.82062
d00n-525.136	13.6	0.8448	0.0048	0.0096	0.8544
d00n-525.233	23.3	0.8404	0.00427	0.00854	0.84894
d00n-525.471	47.1	0.7785	0.0045	0.009	0.7875
d00n-525.524	52.4	0.766	0.00438	0.00876	0.77476
d00n-525.588	58.8	0.7499	0.00439	0.00878	0.75868
d00n-525.773	77.3	0.6946	0.00402	0.00804	0.70264
d00n-525.110	110.6	0.6133	0.00318	0.00636	0.61966
d00n-525.188	188.2	0.4796	0.00239	0.00478	0.48438

Figure 4.5.2-8. Two 5.25" ID x 24" Tall Cylinders of UF_4 and Oil One Foot from a Wall

10% enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 5.25 in. Diameter Tin/Steel Containers 1' from Concrete Wall					
for 10% Enriched UF4+oil					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
d12n-525.p65	0.65	0.4639	0.00372	0.00744	0.47134
d12n-525.145	1.45	0.5156	0.0036	0.0072	0.5228
d12n-525.249	2.49	0.5547	0.00468	0.00936	0.56406
d12n-525.388	3.88	0.6193	0.00466	0.00932	0.62862
d12n-525.582	5.82	0.6657	0.0045	0.009	0.6747
d12n-525.873	8.73	0.697	0.00441	0.00882	0.70582
d12n-525.136	13.6	0.7292	0.00483	0.00966	0.73886
d12n-525.233	23.3	0.7352	0.00489	0.00978	0.74498
d12n-525.471	47.1	0.6861	0.00477	0.00954	0.69564
d12n-525.524	52.4	0.6719	0.00475	0.0095	0.6814
d12n-525.588	58.8	0.6569	0.004	0.008	0.6649
d12n-525.773	77.3	0.6134	0.00396	0.00792	0.62132
d12n-525.110	110.6	0.5417	0.00328	0.00656	0.54826
d12n-525.188	188.2	0.4167	0.00243	0.00486	0.42156

4.6 5.25-inch-Diameter by 15-inch Tin Can

This section presents results of calculations designed to model the Z-Can containers described in Table 1.0-1. Table 4.6-0 gives the figure and table numbers that contain the geometry models and fuel materials. The results of the SFR cases with UO_2F_2 and U_3O_8, demonstrates that U_3O_8 is only slightly more reactive. For this reason, the full range of geometry models is only analyzed for the U_3O_8 cases. The array in the each of the array models is moved to 1-foot from the concrete wall enclosure to support a less restrictive array position. The geometry model designators are explained in Table 4.1-1.

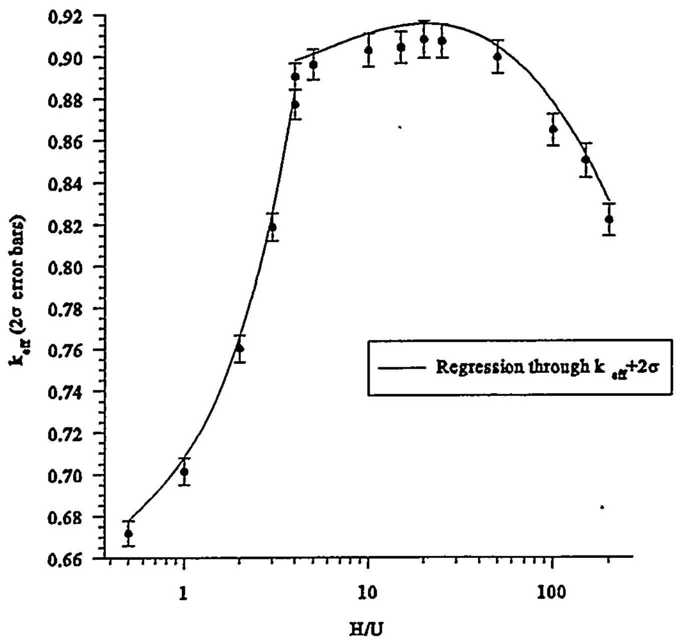
Table 4.6-0. Summary of References for Z-Can Results

Geometry Model	Material	Figure/Table Number
SFR	UO_2F_2	4.6-1
SFR	UF_4 +oil	4.6-2
TSCW	UO_2F_2	4.6-3
SMRC	UF_4 +oil	4.6-4
SFR	U_3O_8	4.6-5
SCC	U_3O_8	4.6-6
TACW	U_3O_8	4.6-7
TSCW	U_3O_8	4.6-8
ACE*	U_3O_8	4.6-9
AI*	U_3O_8	4.6-10
AOSP*	U_3O_8	4.6-11

* Array positioned 1-foot from concrete enclosure.

Figure 4.6-1. Single Fully Reflected 5.25" ID x 15" Tall Cylinder of UO_2F_2

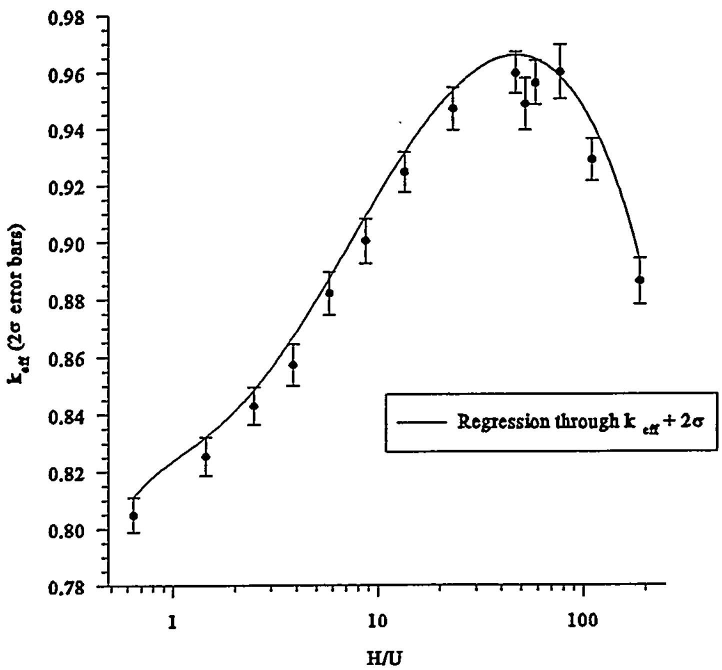
100% enrichment, ρ_s=3.2 for H/U<4, 24" concrete floor, 12" (minimum) water reflector on all other sides



Single Fully Reflected 5.25-in. by 15-in. Tall Cylinder of UO2F2					
For 100% Enrichment					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
fr-zcan01n.o	0.5	0.6718	0.0029	0.0058	0.6776
fr-zcan02n.o	1	0.7013	0.0032	0.0064	0.7077
fr-zcan03n.o	2	0.7599	0.0032	0.0064	0.7663
fr-zcan04n.o	3	0.8185	0.0032	0.0064	0.8249
fr-zcan05n.o	3.99	0.877	0.0035	0.007	0.884
fr-zcan06n.o	4	0.8902	0.0032	0.0064	0.8966
fr-zcan07n.o	5	0.8959	0.0036	0.0072	0.9031
fr-zcan08n.o	10	0.9026	0.0039	0.0078	0.9104
fr-zcan09n.o	15	0.9039	0.0037	0.0074	0.9113
fr-zcan10n.o	20	0.9075	0.0043	0.0086	0.9161
fr-zcan11n.o	25	0.9067	0.0039	0.0078	0.9145
fr-zcan12n.o	50	0.8992	0.0039	0.0078	0.907
fr-zcan13n.o	100	0.8643	0.0039	0.0078	0.8721
fr-zcan14n.o	150	0.8495	0.004	0.008	0.8575
fr-zcan15n.o	200	0.8214	0.0037	0.0074	0.8288

Figure 4.6-2. Single Fully Reflected 5.25" ID x 15" Tall Cylinder of UF $_4$ and Oil

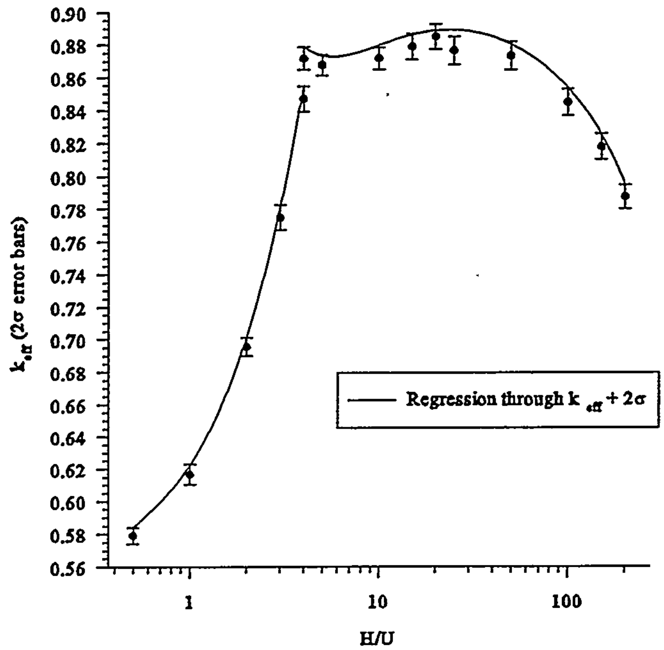
100% enrichment, 24" concrete floor, 12" (minimum) water reflector on all other sides



Single 5.25-in. ID by 15-in. Tall Cylinder of UF4+oil					
Full reflection, 100% Enrichment					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
fr-zcan16n.o	0.64	0.8049	0.0031	0.0062	0.8111
fr-zcan17n.o	1.44	0.8253	0.0034	0.0068	0.8321
fr-zcan18n.o	2.47	0.8429	0.0033	0.0066	0.8495
fr-zcan19n.o	3.84	0.8571	0.0036	0.0072	0.8643
fr-zcan20n.o	5.76	0.882	0.0037	0.0074	0.8894
fr-zcan21n.o	8.64	0.9002	0.0039	0.0078	0.908
fr-zcan22n.o	13.4	0.9243	0.0036	0.0072	0.9315
fr-zcan23n.o	23.1	0.9467	0.0038	0.0076	0.9543
fr-zcan24n.o	46.6	0.9593	0.0036	0.0072	0.9665
fr-zcan25n.o	51.9	0.9483	0.0046	0.0092	0.9575
fr-zcan26n.o	58.2	0.9559	0.0039	0.0078	0.9637
fr-zcan27n.o	76.6	0.9596	0.0047	0.0094	0.969
fr-zcan28n.o	109.5	0.9285	0.0037	0.0074	0.9359
fr-zcan29n.o	186.4	0.886	0.004	0.008	0.894

Figure 4.6-3. Two 5.25" ID x 15" Tall Cylinders of UO_2F_2 One Foot from a Wall

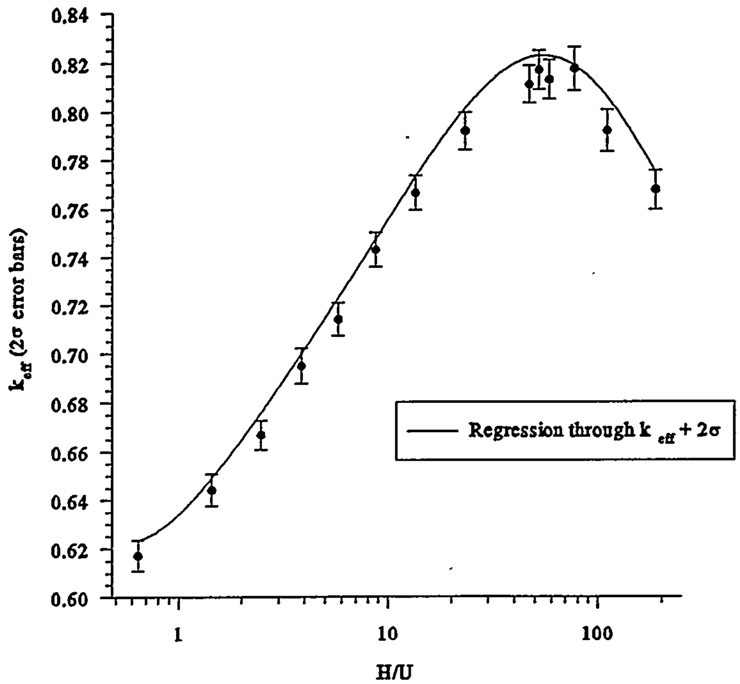
100% enrichment, ρ_u=3.2 for H/U<4, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 5.25-in. ID by 15-in. Tall Cylinders of UO2F2 1' from a Wall For 100% Enrichment					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
ap-zcan01n.o	0.5	0.5792	0.0024	0.0048	0.584
ap-zcan02n.o	1	0.6168	0.0031	0.0062	0.623
ap-zcan03n.o	2	0.6953	0.0027	0.0054	0.7007
ap-zcan04n.o	3	0.7745	0.0038	0.0076	0.7821
ap-zcan05n.o	3.99	0.8464	0.0038	0.0076	0.854
ap-zcan06n.o	4	0.8711	0.0035	0.007	0.8781
ap-zcan07n.o	5	0.8671	0.0032	0.0064	0.8735
ap-zcan08n.o	10	0.8711	0.0033	0.0066	0.8777
ap-zcan09n.o	15	0.8782	0.0039	0.0078	0.886
ap-zcan10n.o	20	0.8843	0.0038	0.0076	0.8919
ap-zcan11n.o	25	0.8756	0.0042	0.0084	0.884
ap-zcan12n.o	50	0.8723	0.0042	0.0084	0.8807
ap-zcan13n.o	100	0.844	0.0041	0.0082	0.8522
ap-zcan14n.o	150	0.8171	0.0039	0.0078	0.8249
ap-zcan15n.o	200	0.7869	0.0036	0.0072	0.7941

Figure 4.6-4. Single 5.25" ID x 15" Tall Cylinder of UF_4 and Oil

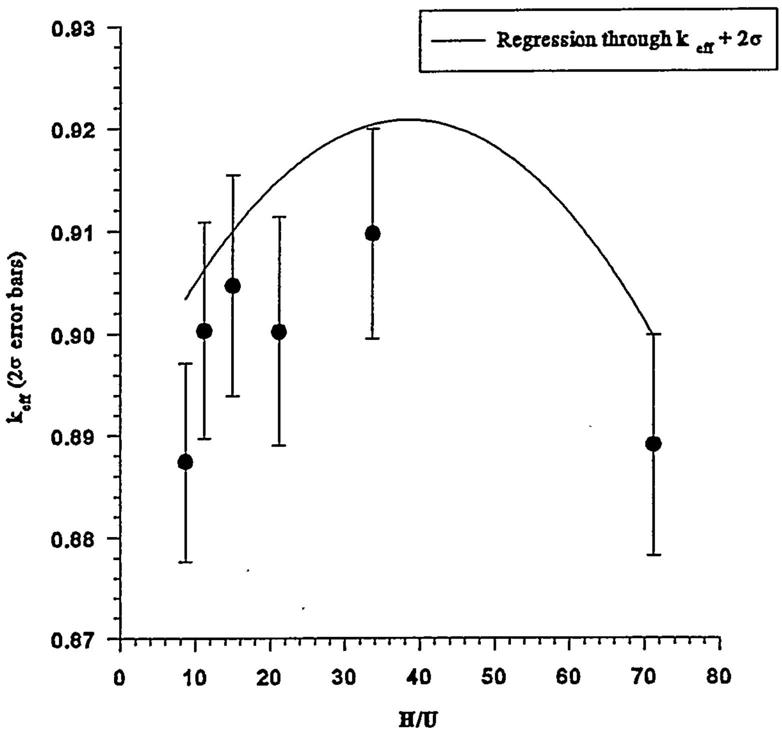
100% enrichment, 24" concrete floor, 1" close fit water reflector on all other sides, 12" ceiling 10' above



Single 5.25-in. ID by 15-in. Tall Cylinder of UF4+Oil 1" water reflector					
For 100% Enrichment					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
cyzcan01n.o	0.64	0.6171	0.0031	0.0062	0.6233
cyzcan02n.o	1.44	0.6442	0.0032	0.0064	0.6506
cyzcan03n.o	2.47	0.6668	0.003	0.006	0.6728
cyzcan04n.o	3.84	0.6948	0.0036	0.0072	0.702
cyzcan05n.o	5.76	0.7139	0.0034	0.0068	0.7207
cyzcan06n.o	8.64	0.7427	0.0035	0.007	0.7497
cyzcan07n.o	13.4	0.7661	0.0035	0.007	0.7731
cyzcan08n.o	23.1	0.7917	0.0038	0.0076	0.7993
cyzcan09n.o	46.6	0.8109	0.0038	0.0076	0.8185
cyzcan10n.o	51.9	0.8168	0.0039	0.0078	0.8246
cyzcan11n.o	58.2	0.8129	0.004	0.008	0.8209
cyzcan12n.o	76.6	0.8172	0.0044	0.0088	0.826
cyzcan13n.o	109.5	0.7918	0.0043	0.0086	0.8004
cyzcan14n.o	186.4	0.7674	0.004	0.008	0.7754

Figure 4.6-5. Single Fully Reflected 5.25" ID x 15" Tall Cylinder of U_3O_8

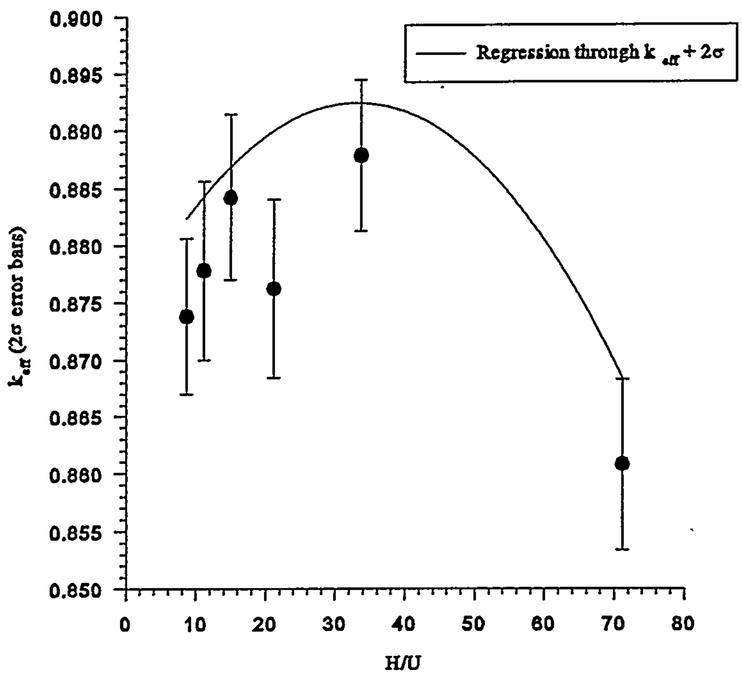
100% Enrichment, 24" concrete floor, 12" (minimum) water reflector on all other sides



Single 5.25" by 15" Container with Full Reflection					
for 100% Enriched U3O8 and water					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
fr-t05.out	71.2	0.889	0.0054	0.0108	0.8998
fr-t10.out	33.7	0.9097	0.0051	0.0102	0.9199
fr-t15.out	21.2	0.9002	0.0056	0.0112	0.9114
fr-t20.out	15	0.9047	0.0054	0.0108	0.9155
fr-t25.out	11.2	0.9003	0.0053	0.0106	0.9109
fr-t30.out	8.7	0.8874	0.0049	0.0098	0.8972

Figure 4.6-6. Single 5.25" ID x 15" Tall Cylinder of U_3O_8 in a Concrete Corner

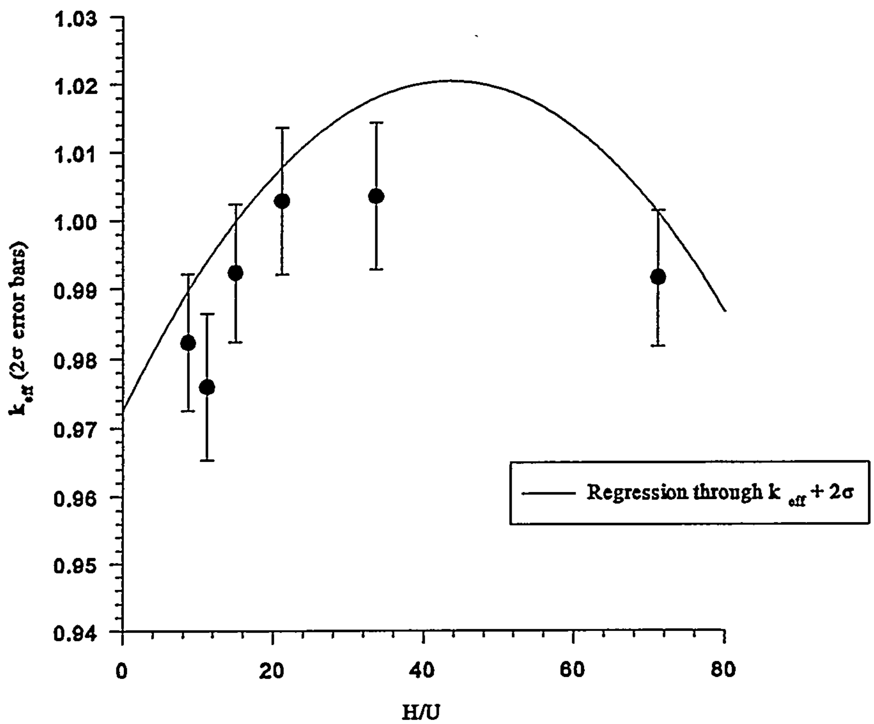
100% Enrichment, 24" concrete floor, 12" concrete walls and ceiling, ~100 kg water reflector simulating a person



Single 5.25" by 15" Container in a Concrete Corner					
for 100% Enriched U3O8 and water					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
crnrz05.out	71.2	0.8608	0.0037	0.0074	0.8682
crnrz10.out	33.7	0.8878	0.0033	0.0066	0.8944
crnrz15.out	21.2	0.8762	0.0039	0.0078	0.884
crnrz20.out	15	0.8842	0.0036	0.0072	0.8914
crnrz25.out	11.2	0.8778	0.0039	0.0078	0.8856
crnrz30.out	8.7	0.8738	0.0034	0.0068	0.8806

Figure 4.6-7. Two 5.25" ID x 15" Tall Cylinders of U_3O_8 Next to a Wall

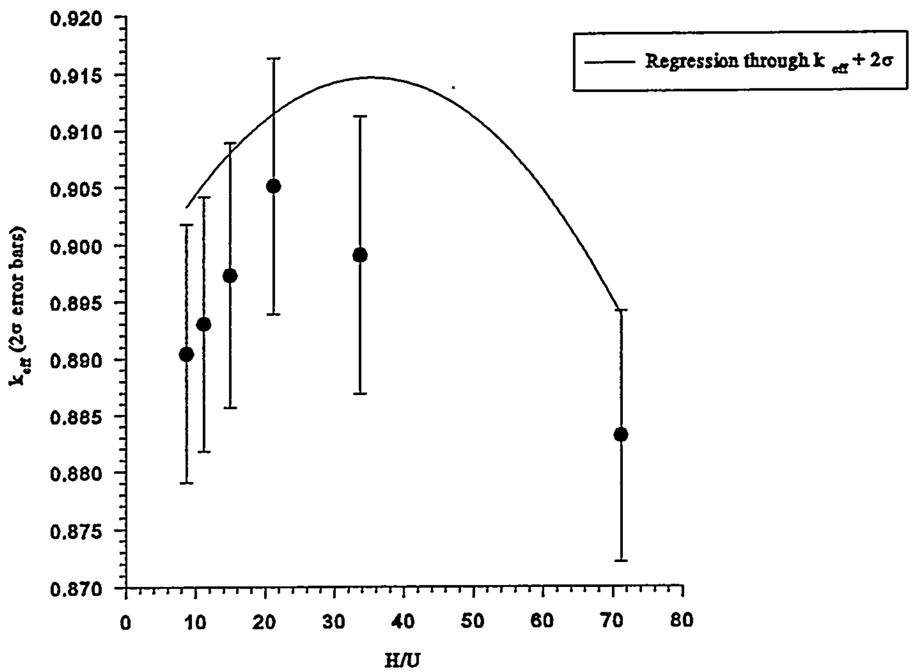
100% Enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 5.25" by 15" Tall Containers Adjacent to a Concrete Wall					
for 100% Enriched U3O8 and water					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
d00nz05.out	71.2	0.9914	0.0049	0.0098	1.0012
d00nz10.out	33.7	1.0034	0.0054	0.0108	1.0142
d00nz15.out	21.2	1.0028	0.0054	0.0108	1.0136
d00nz20.out	15	0.9923	0.005	0.01	1.0023
d00nz25.out	11.2	0.9759	0.0053	0.0106	0.9865
d00nz30.out	8.7	0.9823	0.0049	0.0098	0.9921

Figure 4.6-8. Two 5.25" ID x 15" Tall Cylinders of U_3O_8 One Foot from a Wall

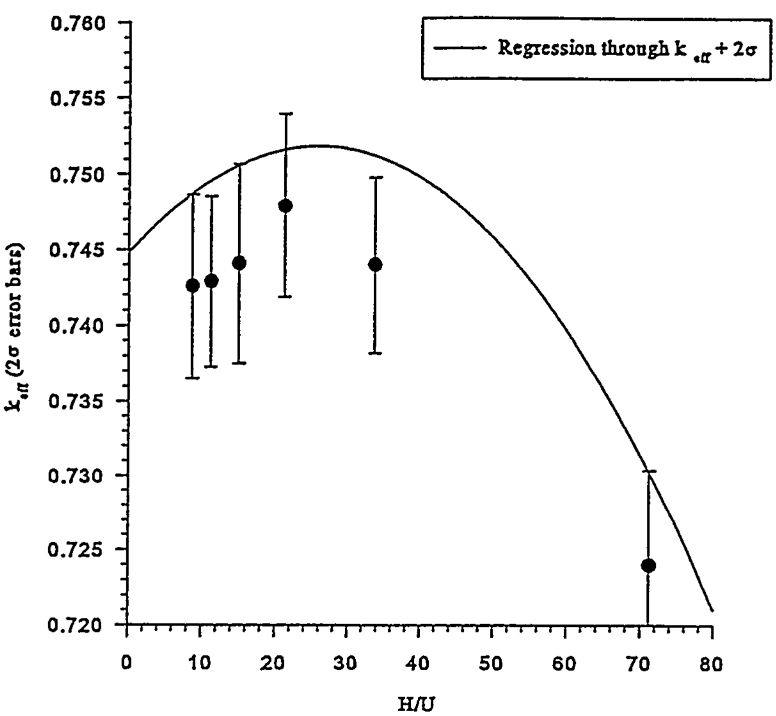
100% Enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 5.25" by 15" Tall Containers One Foot from a Concrete Wall					
for 100% Enriched U3O8 and water					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
d12n-cz.05	71.2	0.8831	0.00549	0.01098	0.89408
d12n-cz.10	33.7	0.899	0.00607	0.01214	0.91114
d12n-cz.15	21.2	0.9051	0.00561	0.01122	0.91632
d12n-cz.20	15	0.8973	0.00579	0.01158	0.90888
d12n-cz.25	11.2	0.893	0.0056	0.0112	0.9042
d12n-cz.30	8.7	0.8904	0.00569	0.01138	0.90178

Figure 4.6-9. An Array of 5.25" ID x 15" Tall Cylinders of U_3O_8

100% Enrichment, 0.015" thick tin/steel containers, 24" concrete floor, 12" concrete walls and ceiling, 6' spacing between row sets, 23" spacing between containers, 1' spacing from walls



An Array of 5.25" x 15" Tin/Steel Containers of U3O8					
For 100% Enrichment					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
array-z.05.o	71.2	0.724	0.00318	0.00636	0.73036
array-z.10.o	33.7	0.744	0.0029	0.0058	0.7498
array-z.15.o	21.2	0.7479	0.00302	0.00604	0.75394
array-z.20.o	15	0.7441	0.003295	0.00659	0.75069
array-z.25.o	11.2	0.7429	0.00282	0.00564	0.74854
array-z.30.o	8.7	0.7426	0.00303	0.00606	0.74866

Figure 4.6-10. The Effects of Interstitial Water Volume Fraction on k_{eff}

Standard array geometry with 5.25" ID x 15" tall containers of U_3O_8 with 0.015" thick tin/steel walls

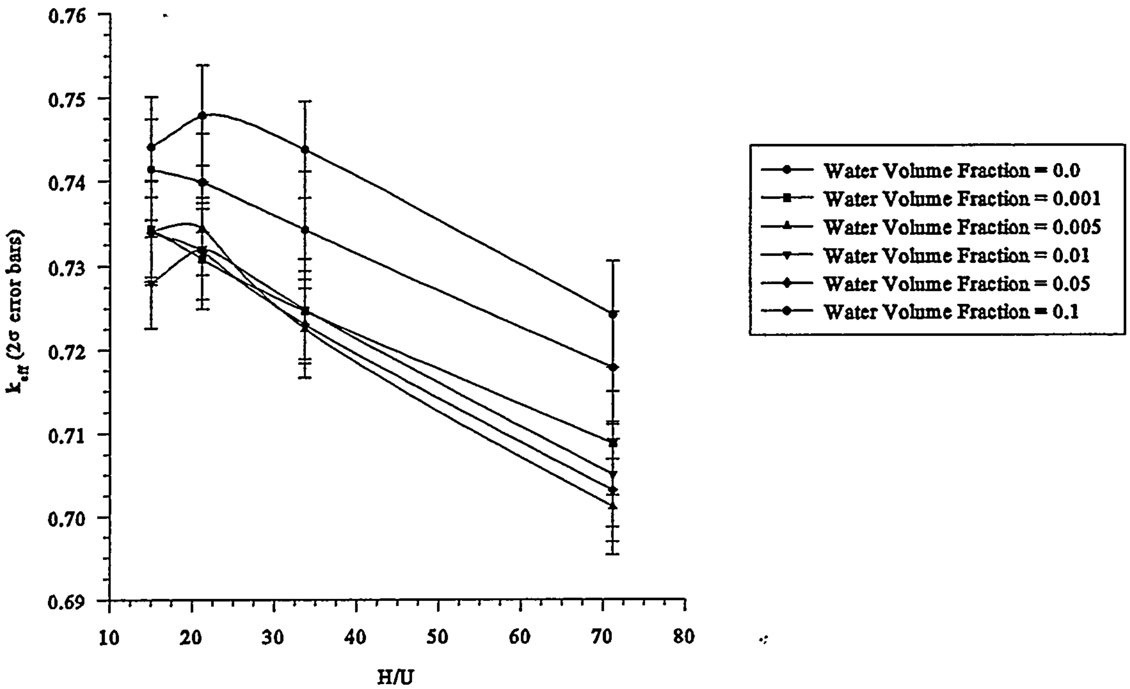


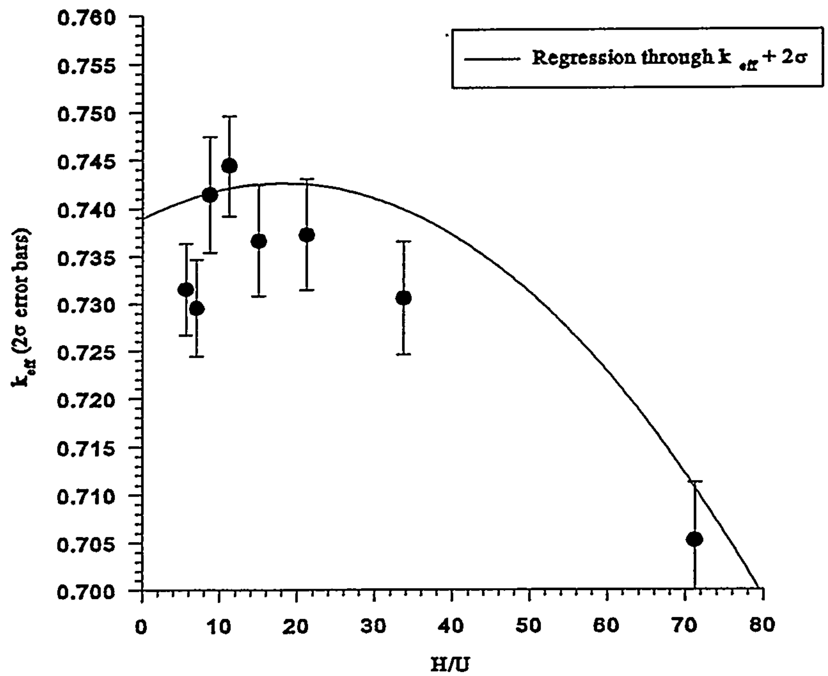
Figure 4.6-10a. The Effects of Interstitial Water Volume Fraction on k_{eff}

Standard array geometry with 5.25" ID x 15" tall containers of U_3O_8 with 0.015" thick tin/steel walls

The Effects of Interstitial Water Volume Fraction for a Standard					
Array of 5.25" ID x 15" Tin/Steel Containers of U3O8					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
Interstitial	Water =	0			
array-z.05.o	71.2	0.7241	0.0032	0.0064	0.7305
array-z.10.o	33.7	0.7437	0.0029	0.0058	0.7495
array-z.15.o	21.2	0.7478	0.003	0.006	0.7538
array-z.20.o	15	0.7441	0.003	0.006	0.7501
Interstitial	Water =	0.001			
arr~z~w1.05.o	71.2	0.7087	0.00308	0.00616	0.71486
arr~z~w1.10.o	33.7	0.7246	0.00314	0.00628	0.73088
arr~z~w1.15.o	21.2	0.7308	0.00295	0.0059	0.7367
arr~z~w1.20.o	15	0.7343	0.0028	0.0056	0.7399
Interstitial	Water =	0.005			
arr~z~w2.05.o	71.2	0.7011	0.00288	0.00576	0.70686
arr~z~w2.10.o	33.7	0.7225	0.00296	0.00592	0.72842
arr~z~w2.15.o	21.2	0.7344	0.00274	0.00548	0.73988
arr~z~w2.20.o	15	0.7341	0.00296	0.00592	0.74002
Interstitial	Water =	0.01			
arr~z~w3.05.o	71.2	0.705	0.00315	0.0063	0.7113
arr~z~w3.10.o	33.7	0.7248	0.00298	0.00596	0.73076
arr~z~w3.15.o	21.2	0.732	0.003	0.006	0.738
arr~z~w3.20.o	15	0.728	0.00272	0.00544	0.73344
Interstitial	Water =	0.05			
arr~z~w4.05.o	71.2	0.7031	0.00307	0.00614	0.70924
arr~z~w4.10.o	33.7	0.723	0.0032	0.0064	0.7294
arr~z~w4.15.o	21.2	0.7317	0.00284	0.00568	0.73738
arr~z~w4.20.o	15	0.7339	0.00307	0.00614	0.74004
Interstitial	Water =	0.1			
arr~z~w5.05.o	71.2	0.7177	0.00336	0.00672	0.72442
arr~z~w5.10.o	33.7	0.7342	0.00343	0.00686	0.74106
arr~z~w5.15.o	21.2	0.7398	0.00293	0.00586	0.74566
arr~z~w5.20.o	15	0.7414	0.003	0.006	0.7474

Figure 4.6.11 -- An Array of 5.25" ID x 15" Tall Cylinders of U_3O_8

100% Enrichment, 0.015" thick tin/steel containers, 24" concrete floor, 12" concrete walls and ceiling, 6' spacing between row sets, 23" spacing between containers, 1' spacing from walls



An Array of 5.25" x 15" Tin/Steel Containers of U3O8					
For 100% Enrichment, Overloaded Storage Position					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
arrzcon.05.o	71.2	0.7052	0.003	0.006	0.7112
arrzcon.10.o	33.7	0.7305	0.003	0.006	0.7365
arrzcon.15.o	21.2	0.7372	0.0029	0.0058	0.743
arrzcon.20.o	15	0.7366	0.0029	0.0058	0.7424
arrzcon.25.o	11.2	0.7444	0.0026	0.0052	0.7496
arrzcon.30.o	8.7	0.7414	0.003	0.006	0.7474
arrzcon.35.o	6.96	0.7295	0.00257	0.00514	0.73464
arrzcon.40.o	5.62	0.7315	0.00242	0.00484	0.73634

4.7 5.0-inch by 9.0-inch Polybottle (CO-4)

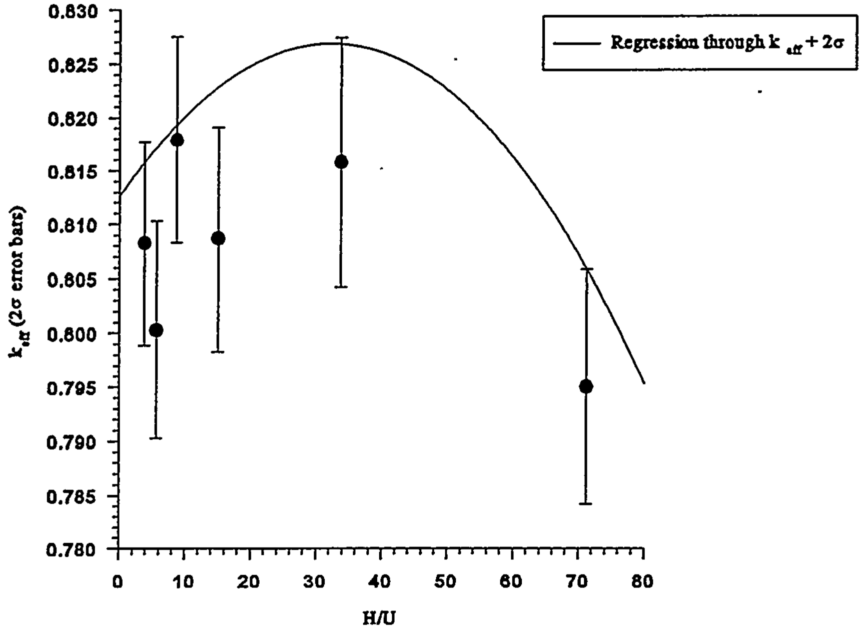
This section presents results of calculations designed to model the CO-4 polybottles described in Table 1.0-1. Table 4.7-0 gives the figure and table numbers that contain the geometry models and fuel materials. Standard array cases are bounded by the analysis performed for the more reactive material UO_2F_2 in 5.0-inch by 24-inch polybottles. The reactivity of U_3O_8 and UO2F2 is not significantly different as shown by a comparison of Figures 4.7-5 and 4.4.1-1. Note, the U_3O_8 cases presented in this section do not include the polybottle container in the model. However, the additional reactivity that is expected is not significant as discussed in Section 4.1.2; therefore, either material could be used for this container analysis. The results of this study validate bounding the 5.0-inch by 9.0-inch array case using the UO_2F_2 results. The geometry model designators are explained in Table 4.1-1.

Table 4.7-0. Summary of References for CO-4 Polybottles

Geometry Model	Material	Figure/Table Number
SFR	U_3O_8	4.7-1
SCC	U_3O_8	4.7-2
TACW	U_3O_8	4.7-3
TSCW	U_3O_8	4.7-4

Figure 4.7-1. Single Fully Reflected 5.00" ID x 9" Poly. Container of U_3O_8

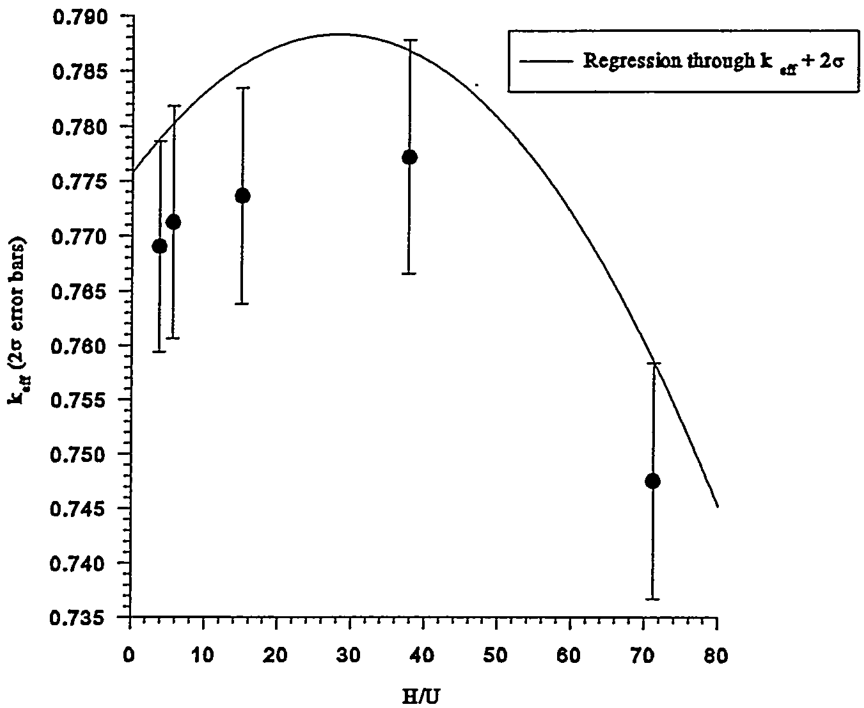
100% Enrichment, 24" concrete floor, 12" (minimum) water reflector on all other sides



Single Fully Relected 5.0" by 9" Poly. Container for 100% Enriched U3O8 and water					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
frco405.out	71.2	0.795	0.0054	0.0108	0.8058
frco41.out	33.75	0.8158	0.0058	0.0116	0.8274
frco42.out	15	0.8087	0.0052	0.0104	0.8191
frco43.out	8.7	0.8179	0.0048	0.0096	0.8275
frco44.out	5.62	0.8003	0.005	0.01	0.8103
frco45.out	3.8	0.8083	0.0047	0.0094	0.8177

Figure 4.7-2. Single 5.00" ID x 9" Tall Cylinder of U_3O_8 in a Concrete Corner

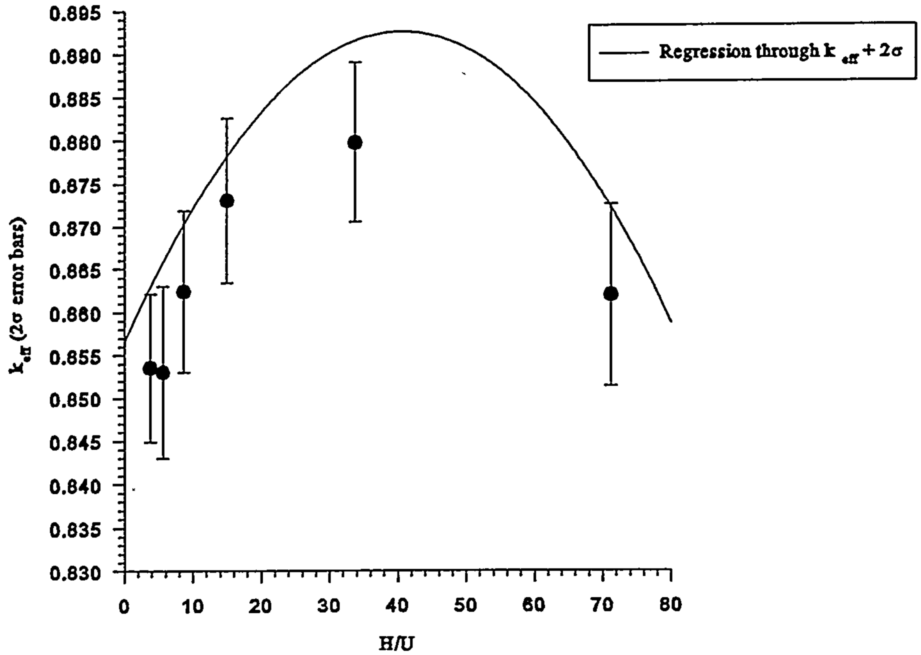
100% Enrichment, 24" concrete floor, 12" concrete walls and ceiling, ~100 kg water reflector simulating a person



Single 5.0 in. Poly. Container in a Concrete Corner for 100% Enriched U3O8 and water					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
crnco405.out	71.2	0.7475	0.0054	0.0108	0.7583
crnco41.out	33.75	0.7771	0.0053	0.0106	0.7877
crnco42.out	15	0.7736	0.0049	0.0098	0.7834
crnco43.out	8.7	0.7712	0.0053	0.0106	0.7818
crnco44.out	5.62	0.769	0.0048	0.0096	0.7786

Figure 4.7-3. Two 5.00" ID x 9" Tall Cylinders of U_3O_8 Next to a Wall

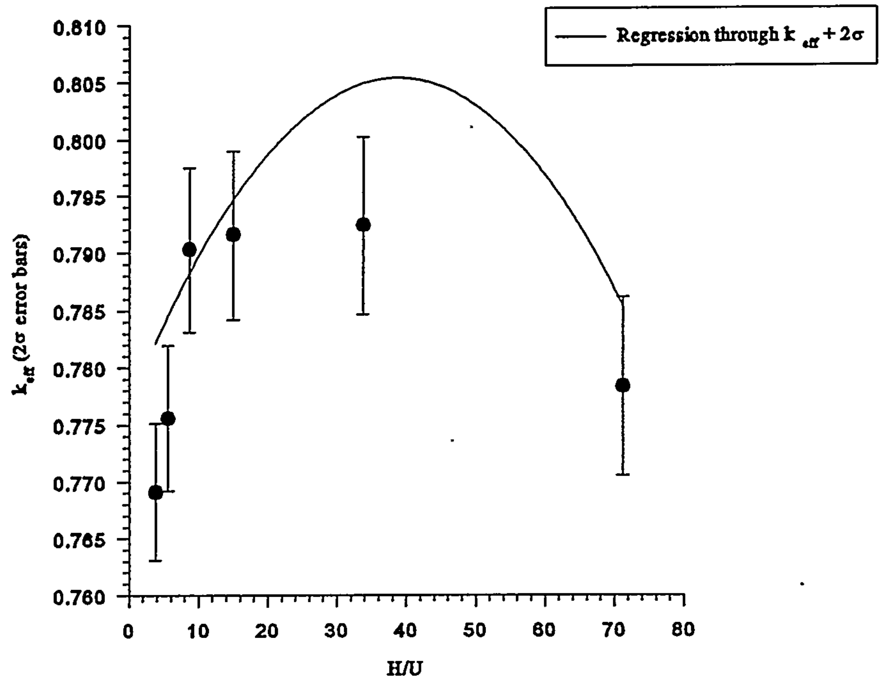
100% Enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 5.0 in. Poly. Containers Adjacent to a Wall					
for 100% Enriched U3O8 and water					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
d00n05.out	71.2	0.8619	0.0053	0.0106	0.8725
d00n1.out	33.75	0.8797	0.0046	0.0092	0.8889
d00n2.out	15	0.873	0.0048	0.0096	0.8826
d00n3.out	8.7	0.8624	0.0047	0.0094	0.8718
d00n4.out	5.62	0.853	0.005	0.01	0.863
d00n5.out	3.8	0.8535	0.0043	0.0086	0.8621

Figure 4.7-4. Two 5.00" ID x 9" Tall Cylinders of U_3O_8 One Foot from a Wall

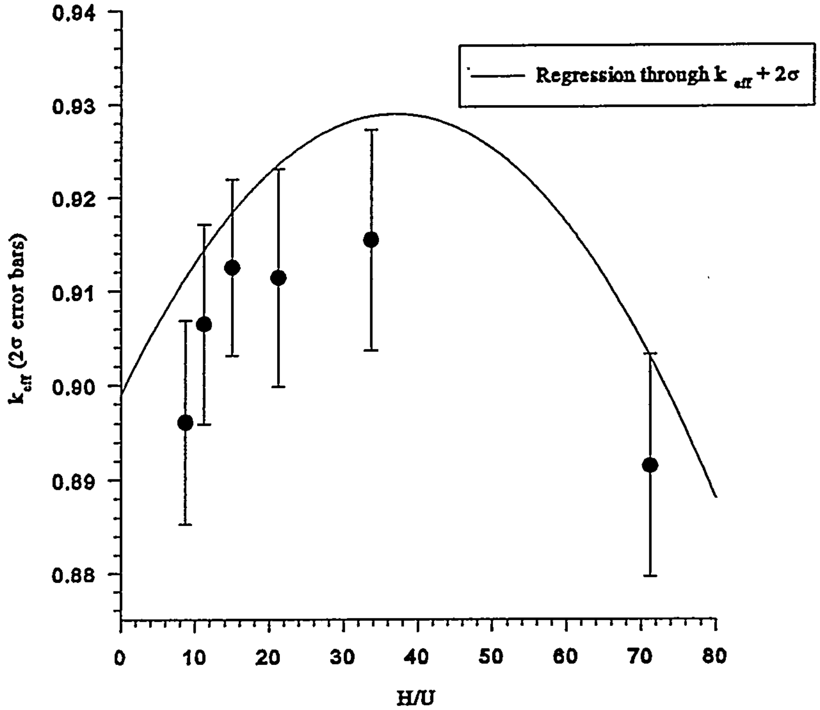
100% Enrichment, 24" concrete floor, 12" concrete wall and ceiling, ~100 kg water reflector simulating a person



Two 5.0 in. Poly. Containers 1' from Concrete Wall					
for 100% Enriched U3O8 and water					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
d2nco405.out	71.2	0.7783	0.0039	0.0078	0.7861
d2nco41.out	33.7	0.7924	0.0039	0.0078	0.8002
d2nco42.out	21.2	0.7916	0.0037	0.0074	0.799
d2nco43.out	15	0.7903	0.0036	0.0072	0.7975
d2nco44.out	11.2	0.7756	0.0032	0.0064	0.782
d2nco45.out	8.1	0.7691	0.003	0.006	0.7751

Figure 4.7-5. Single Fully Reflected 5.00" ID x 24" Tall Cylinder of U $_3O_8$

100% Enrichment, 24" concrete floor, 12" (minimum) water reflector on all other sides



Single Fully Relected 5.0" by 24" Poly. Container for 100% Enriched U3O8 and Water					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
fr24-05.out	71.2	0.8914	0.0059	0.0118	0.9032
fr24-10.out	33.7	0.9154	0.0059	0.0118	0.9272
fr24-15.out	21.2	0.9114	0.0058	0.0116	0.923
fr24-20.out	15	0.9125	0.0047	0.0094	0.9219
fr24-25.out	11.2	0.9065	0.0053	0.0106	0.9171
fr24-30.out	8.7	0.8961	0.0054	0.0108	0.9069

4.8 Supplemental UF_4+Oil Array Cases

The most reactive array of those performed for the 100% enriched cases are 5.00" ID x 24" tall polyethylene containers filled with UF_4+oil (Figure 4.4.1-10). The position of this array was moved to 1-foot from all surrounding reflecting concrete walls. The results are shown in Figure 4.8-5. Based on this result, all arrays considered in this analysis fall within the safety criteria when moved to within 1-foot from surrounding concrete walls.

The 1-foot spacing limit is not required for 10% enriched material based on additional array analysis presented herein using no separation from the concrete walls. The study uses UF_4+oil which was shown previously to be more reactive than UO_2F_2+H_2O and U_3O_8; therefore, UF_4+oil was used as the bounding material for this analysis. Each of the container sizes was evaluated using the standard array model with no separation from the surrounding concrete walls to show the effects of surrounding the array with a close fitting concrete enclosure.

Figure 4.8-1	4.32" ID x 50.4" standard array with no separation from concrete walls (UF_4+oil).
Figure 4.8-2	5.0" ID x 24.0" standard array with no separation from concrete walls (UF_4+oil).
Figure 4.8-3	5.25" ID x 24.0" standard array with no separation for concrete walls (UF_4+oil).

The most reactive of the contingency cases is overloading a storage position, as shown by comparing Figures 4.3.1-10, 4.3.1-12, and 4.3.1-14. The most reactive container in an array (5.25" ID x 24" tall containers) was shown to meet the safety criteria by modeling two containers side by side with full water reflection. The results are shown in Figure 4.8-4. For less than 10% enriched materials, polyethylene was used as the container material for all of the can types.

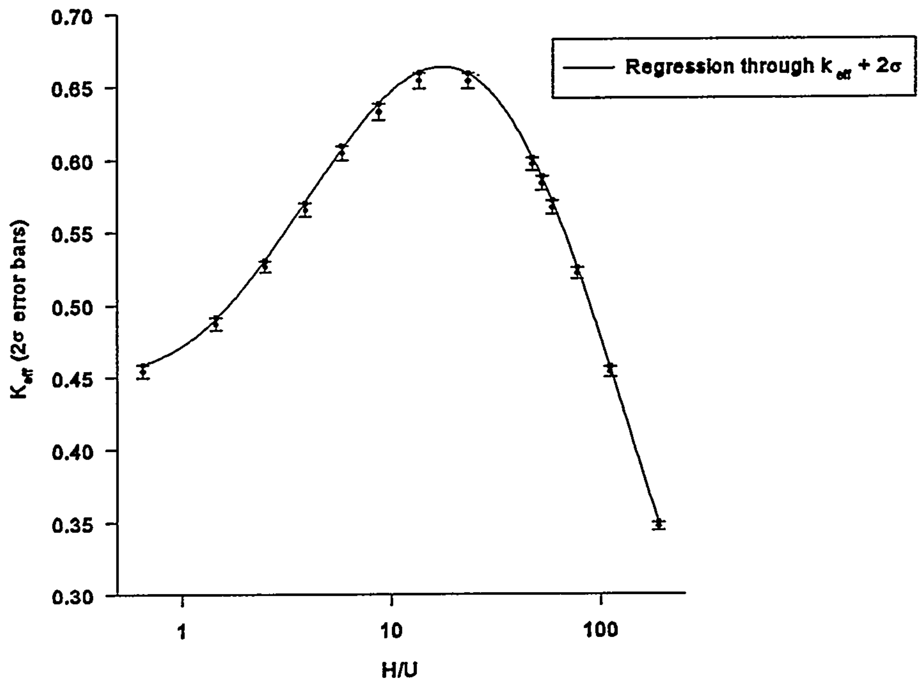
An additional set of cases was run for an overloaded storage position in an array with 5.25"

ID x 24" containers, 10% enriched UF_4+oil, assuming the containers are 0.195" polyethylene, and next to a 12" thick concrete wall on all sides of the array. The results are shown in Figure 4.8-6.

Figure 4.8-1 An Array of 4.32" ID x 50" Tall Cylinders of UF_4+oil

10% enriched, 0.195" thick poly containers, 24" concrete floors and ceiling,

6" spacing between rows, 23" spacing between containers, adjacent to walls

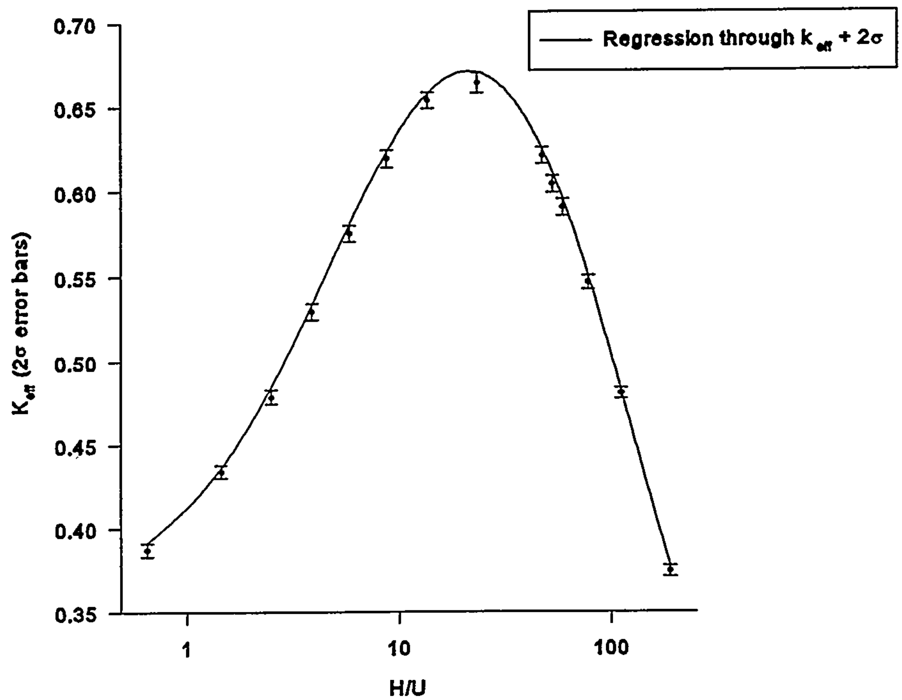


An Array of 4.32" x 50" Cylinders of UF4+oil Next to a Wall					
10% Enrichment, 0.195" thick Poly Container					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
arrdwall.p65.o	0.65	0.45435	0.00218	0.00436	0.45871
arrdwall.145.o	1.45	0.48723	0.00217	0.00434	0.49157
arrdwall.249.o	2.49	0.52622	0.00198	0.00396	0.53018
arrdwall.388.o	3.88	0.56517	0.00229	0.00458	0.56975
arrdwall.582.o	5.82	0.60455	0.00241	0.00482	0.60937
arrdwall.873.o	8.73	0.63218	0.00275	0.0055	0.63768
arrdwall.136.o	13.6	0.65324	0.00259	0.00518	0.65842
arrdwall.233.o	23.3	0.65294	0.00253	0.00506	0.658
arrdwall.471.o	47.1	0.59607	0.00218	0.00436	0.60043
arrdwall.524.o	52.4	0.58259	0.00241	0.00482	0.58741
arrdwall.588.o	58.8	0.56608	0.00233	0.00466	0.57074
arrdwall.773.o	77.3	0.52093	0.00186	0.00372	0.52465
arrdwall.110.o	110.6	0.45301	0.00178	0.00356	0.45657
arrdwall.188.o	188.2	0.34707	0.00141	0.00282	0.34989

Figure 4.8-2 An Array of 5.25" ID x 24" Tall Cylinders of UF_4+oil

10% enriched, 0.195" thick poly containers, 24" concrete floors and ceiling,

6" spacing between rows, 23" spacing between containers, adjacent to walls

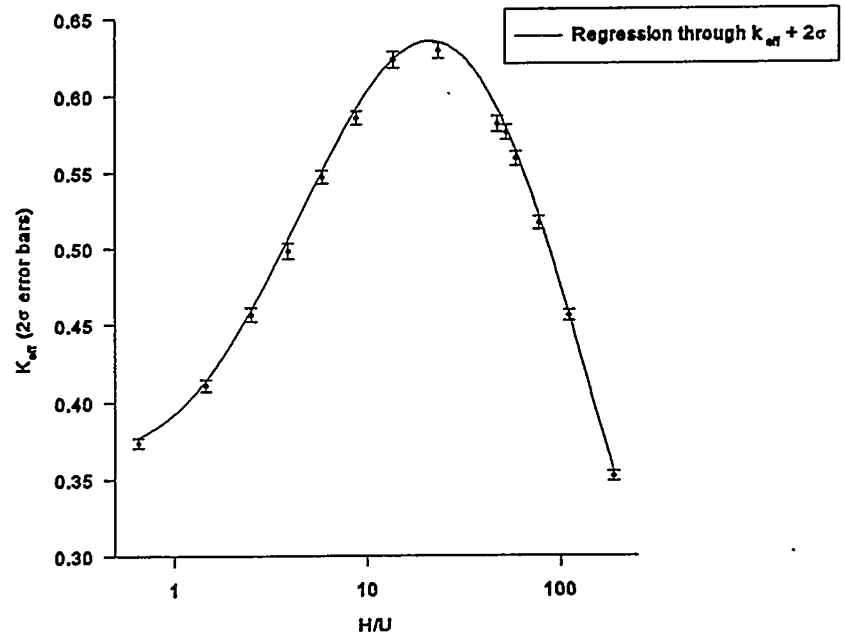


An Array 5.25 x 24" Cylinders of UF4+oil Next to a Wall					
10% Enrichment, 0.195" thick Poly Container					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
arrfwall.p65.o	0.65	0.3872	0.00197	0.00394	0.39114
arrfwall.145.o	1.45	0.43395	0.00194	0.00388	0.43783
arrfwall.249.o	2.49	0.4785	0.00208	0.00416	0.48266
arrfwall.388.o	3.88	0.52936	0.00234	0.00468	0.53404
arrfwall.582.o	5.82	0.57481	0.00237	0.00474	0.57955
arrfwall.873.o	8.73	0.61912	0.00255	0.0051	0.62422
arrfwall.136.o	13.6	0.65311	0.00241	0.00482	0.65793
arrfwall.233.o	23.3	0.66334	0.00293	0.00586	0.6692
arrfwall.471.o	47.1	0.6206	0.00242	0.00484	0.62544
arrfwall.524.o	52.4	0.60363	0.00257	0.00514	0.60877
arrfwall.588.o	58.8	0.58993	0.00249	0.00498	0.59491
arrfwall.773.o	77.3	0.54611	0.00202	0.00404	0.55015
arrfwall.110.o	110.6	0.48038	0.00173	0.00346	0.48384
arrfwall.188.o	188.2	0.37425	0.0016	0.0032	0.37745

Figure 4.8-3 An Array of 5.00" ID x 24" Tall Cylinders of UF_4+oil

10% enriched, 0.195" thick poly containers, 24" concrete floors and ceiling,

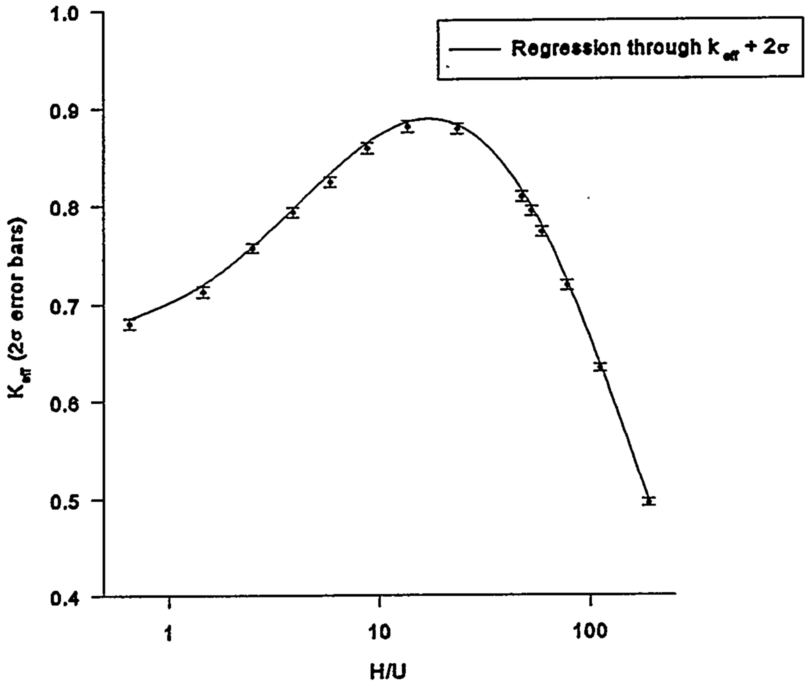
6" spacing between rows, 23" spacing between containers, adjacent to walls



An Array 5.00" x 24" Cylinders of UF4+oil Next to a Wall					
10% Enrichment, 0.195" thick Poly Container					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
arrewall.p65.o	0.65	0.37361	0.00159	0.00318	0.37679
arrewall.145.o	1.45	0.41063	0.0019	0.0038	0.41443
arrewall.249.o	2.49	0.45636	0.00229	0.00458	0.46094
arrewall.388.o	3.88	0.49817	0.00261	0.00522	0.50339
arrewall.582.o	5.82	0.54685	0.00223	0.00446	0.55131
arrewall.873.o	8.73	0.58513	0.00221	0.00442	0.58955
arrewall.136.o	13.6	0.62269	0.00269	0.00538	0.62807
arrewall.233.o	23.3	0.62854	0.00247	0.00494	0.63348
arrewall.471.o	47.1	0.5809	0.00257	0.00514	0.58604
arrewall.524.o	52.4	0.57528	0.00239	0.00478	0.58006
arrewall.588.o	58.8	0.55855	0.00229	0.00458	0.56313
arrewall.773.o	77.3	0.51596	0.00204	0.00408	0.52004
arrewall.110.o	110.6	0.45537	0.00175	0.0035	0.45887
arrewall.188.o	188.2	0.35183	0.00159	0.00318	0.35501

Figure 4.8-4 Two 5.25" ID x 24" Tall Cylinders of UF_4+oil Side by Side Fully Reflected

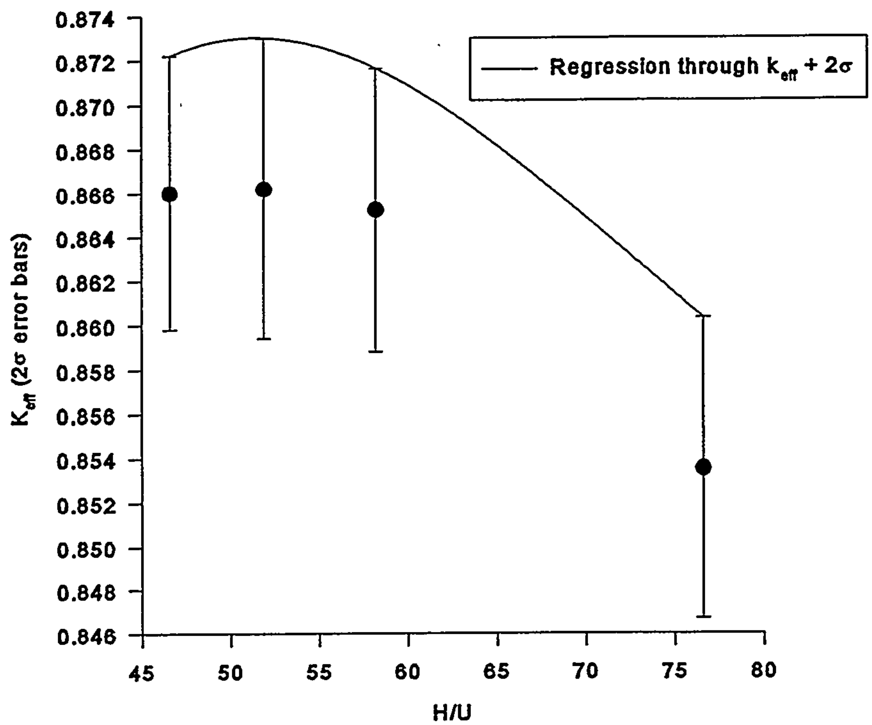
10% enriched, 0.195" thick poly containers, 12" of water reflection, 24" concrete floors



Two Containers Side by Side Fully Reflected UF4+oil 10% Enriched					
Case	H/U	Keff	K_sig	2*K_sig	Keff+2*K_sig
fc2-fr.p65	0.65	0.67985	0.0026	0.0052	0.68505
fc2-fr.145.o	1.45	0.71256	0.00274	0.00548	0.71804
fc2-fr.249.o	2.49	0.7563	0.0024	0.0048	0.7611
fc2-fr.388.o	3.88	0.79243	0.00243	0.00486	0.79729
fc2-fr.582.o	5.82	0.82354	0.00272	0.00544	0.82898
fc2-fr.873.o	8.73	0.85821	0.00273	0.00546	0.86367
fc2-fr.136.o	13.6	0.88026	0.00288	0.00576	0.88602
fc2-fr.233.o	23.3	0.87757	0.00267	0.00534	0.88291
fc2-fr.471.o	47.1	0.80784	0.0025	0.005	0.81284
fc2-fr.524.o	52.4	0.7932	0.0024	0.0048	0.798
fc2-fr.588.o	58.8	0.77183	0.00243	0.00486	0.77669
fc2-fr.773.o	77.3	0.71813	0.00249	0.00498	0.72311
fc2-fr.110.o	110.6	0.633185	0.0021	0.0042	0.637385
fc2-fr.188.o	188.2	0.49561	0.00182	0.00364	0.49925

Figure 4.8-5. An Array of 5.0" ID x 24" Tall Cylinders of UF_4+oil

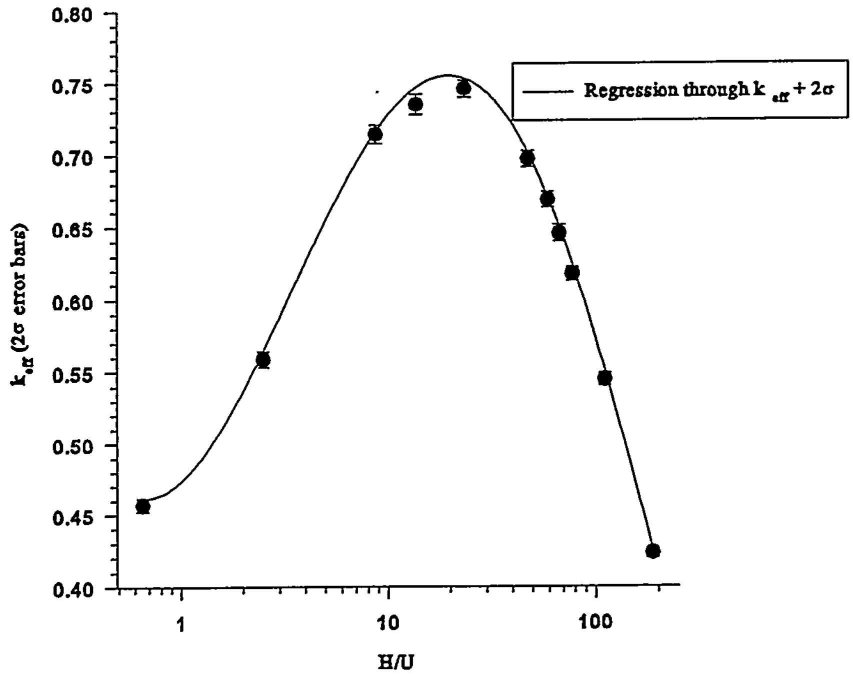
100% Enriched, 0.185" thick poly containers, 24" concrete floor, 12" concrete walls and ceiling, 6' spacing between row sets, 23" spacing between containers, 1' spacing between walls



An array of 5.0" x 24" Tall Containers of UF4+oil 100% Enrichment					
Spaced 1' from Wall					
Case	H/U	Keff	Sigma	2 Sigma	Keff+2Sigma
arr12_1.o	46.6	0.866	0.0031	0.0062	0.8722
arr12_2.o	51.9	0.8662	0.0034	0.0068	0.873
arr12_3.o	58.2	0.8652	0.0032	0.0064	0.8716
arr12_4.o	76.6	0.8535	0.0034	0.0068	0.8603

Figure 4.8-6 An Array of 5.25" ID x 24" Tall Cylinder of UF_4 and Oil Adjacent to Concrete Walls

10% Enrichment, 24" concrete floor, 12" thick concrete walls, One overloaded storage portion



5.25" Cans, .0195" Poly Containers, Overloaded Storage Position in an Array, Adjacent to Concrete Walls					
H/U	Case	Keff	K_sig	2*sig	Keff+2sig
0.65	arrfcn1.o	0.4569	0.0023	0.0046	0.4615
2.5	arrfcn2.o	0.5588	0.0027	0.0054	0.5642
8.7	arrfcn3.o	0.7138	0.0032	0.0064	0.7202
13.6	arrfcn4.o	0.7344	0.0036	0.0072	0.7416
23.3	arrfcn5.o	0.7455	0.003	0.006	0.7515
47.1	arrfcn6.o	0.6966	0.0028	0.0056	0.7022
58.8	arrfcn7.o	0.6687	0.0026	0.0052	0.6739
66.9	arrfcn8.o	0.6452	0.0029	0.0058	0.651
77.3	arrfcn9.o	0.6173	0.0025	0.005	0.6223
110.6	arrfcn10.o	0.5446	0.0021	0.0042	0.5488
188.2	arrfcn11.o	0.423	0.0016	0.0032	0.4262

4.9 Summary of Results

Table 4.8-1 is a summary of the results for the 100% enrichment cases for each of the container types tested with UO_2F_2+H_2O, UF_4+oil, and U_3O_8 for the various reflection models tested. The standard geometry models are described in Table 4.1-1. All 10% enriched cases met the criteria $k_{eff} + 2\sigma \leq 0.95$ with the exception of one TACW case.

Table 4.9-1. Summary of Results for 100 % Enriched Material

Container Type/Material	Model	Container Model Description	$k_{eff} + 2\sigma \leq 0.95$
4.32" x 50.4" Poly/UO_2F_2	SFR	Single, Full Reflection	Yes
	SCC	Single, in Corner	Yes
	TACW	Two, Adjacent to Wall	No
	TSCW	Two, One Foot from Wall	Yes
	ACE	Array, Standard	Yes
	AI	Array, Interstitial Water	Yes
	AOSP	Array, Overloaded Storage Position	Yes
4.32" x 50.4" Poly/UF_4+oil	SFR	Single, Full Reflection	Yes
	SCC	Single, in Corner	Yes
	TACW	Two, Adjacent to Wall	No
	TSCW	Two, One Foot from Wall	Yes
	ACE	Array, Standard	Yes
	AI	Array, Interstitial Water	Yes
	AOSP	Array, Overloaded Storage Position	Yes

Container Type/Material	Model	Container Model Description	$k_{eff} + 2\sigma \leq 0.95$
5.0"x 24" Poly/UO_2F_2	SFR	Single, Full Reflection - U density limited to 3.2g/cc for H/U < 4.0	Yes
	SCC	Single, in Corner - U density limited to 3.2g/cc for H/U < 4.0	Yes
	TACW	Two, Adjacent to Wall	No
	TSCW	Two, One Foot from Wall	Yes
	ACE	Array, Standard	Yes
	AI	Array, Interstitial Water	Yes
	AOSP	Array, Overloaded Storage Position	Yes
5.0"x 24" Poly/UF_4+oil	SFR	Single, Full Reflection - Container Material Ignored	No
	SCC	Single, in Corner	No
	TACW	Two, Adjacent to Wall	No
	TSCW	Two, One Foot from Wall	No
	ACE	Array, Standard	Yes
	SMRC	Single, More Reactive Material	Yes
5.25"x 24"/UO_2F_2	SFR	Single, Full Reflection - Container Material Ignored	No
	SCC	Single, in Corner	No
	TACW	Two, Adjacent to Wall	No
5.25"x 24"/UO_2F_2	TSCW	Two, One Foot from Wall	No
5.25"x 24"/UF_4+oil	SFR	Single, Full Reflection - Container Material Ignored	No

Container Type/Material	Model	Container Model Description	$k_{eff} + 2\sigma \leq 0.95$
5.25" x 24"/UF_4+oil	SCC	Single, in Corner	No
	TACW	Two, Adjacent to Wall	No
	TSCW	Two, One Foot from Wall	No
5.25" x 15"/UO_2F_2	SFR	Single, Full Reflection - U density to 3.2g/cc for H/U < 4	Yes
	TSCW	Two, One Foot from Wall - U density to 3.2g/cc for H/U < 4	Yes
5.25" x 15"/UF_4+oil	SFR	Single, Full Reflection	No
	SMRC	Single, More Reactive Material	Yes
5.25" x 15"/U_3O_8	SFR	Single, Full Reflection	Yes
	SCC	Single, in Corner	Yes
	TACW	Two, Adjacent to Wall	No
	TSCW	Two, One Foot from Wall	Yes
	ACE	Array, Standard	Yes
	AI	Array, Interstitial Water	Yes
	AOSP	Array, Overloaded Storage Position	Yes
5.0" x 9"/U_3O_8	SFR	Single, Full Reflection	Yes
	SCC	Single, in Corner	Yes
	TACW	Two, Adjacent to Wall	Yes
	TSCW	Two, One Foot from Wall	Yes

5.0 REFERENCES

1.0 Plant Drawing DX-761-2340-M, "X-744G Polybottle," March 1990.

2.0 Plant Drawing BX-761-M373, "24" Polybottle," November 1965.

3.0 Plant Drawing DX-761-2586-M, "Plastic Storage Container," June 1993.

4.0 Plant Drawing DX-761-M-981, "Container," September 1975.

5.0 Plant Drawing DX-761-2331-M, "5" x 15" Tin Container," March 1990.

6.0 Validation of the CSAS25 Calculation Sequence in Scale--4.2 and the 27 Energy Group ENDF/B-IV Cross Sections on the Battelle Process Safety and Risk Management IBM RS/6000 Workstation.

7.0 Conditional Validation of CSAS25 on Battelle Process Safety and Risk Management RS/6000 (Battelle 1994).

8.0 Configuration Control Plan for Process Safety and Risk Management Nuclear Safety Software & Hardware Systems (IBM/RS6000) (Battelle, August 1994).

9.0 Personal Correspondence, R. Tayloe to D. D'Aquila, June 2, 1995, "Standards for Analysis of Small Containers at the Portsmouth Plant," 1995.

10.0 K/ETO-143, Barber E.J. "Reaction of Uranium Hexafluoride with Hydrocarbon Oil," Enrichment Technical Support Department, August 1994.

11.0 KY/L-1699, Russell R.G. "Investigation of Hygroscopic Properties of Uranyl Fluoride," Paducah Gaseous Diffusion Plant, November 1994.

12.0 POEF-T-3545, Tayloe, R.W. "Calculating Atomic Number Densities For Uranium Compounds," Battelle Memorial Institute, January 1993.

13.0 LA-1086-MS, Paxton, H.C. and Pruvost, N.L. "Criticality Dimensions of Systems Containing U235, Pu-239, and U-233 - 1986 Revision," Los Alamos National Laboratory, July 1987.

14.0 Perry, Robert H. and Cecil H. Chilton, *Chemical Engineers' Handbook*, 5th ed., McGraw-Hill Book Co.

15.0 SCALE 4.1 Manual, March 1992.

REFERENCES (Continued)

16.0 ANSI/ANS - 8.1, American National Standard for Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors, American Nuclear Society, October 1983.

17.0 GAT - 225, Rev. 4, Nuclear Criticality Safety Guide for the Portsmouth Gaseous Diffusion Plant.

18.0 Benedict M., Pigford T., Levi H. W. "Nuclear Chemical Engineering 2nd." MHBC, 1989.

6.0 APPENDIX

KENO Geometry Data File for Single Fully Reflected Container (SFR)

```
H2O          +2 END
REG-CONCRETE  3 END
POLY(H2O)     4 END
END COMP
FULLY REFLECTED 4.32" ID x 50" TALL CYLINDER
' 4.32" ID x 50" TALL CYLINDER OF MATERIAL #1 (FISSILE),
' 0.1" THICK CONTAINER (MATERIAL #4) ON ALL SIDES OF FISSILE MATERIAL,
' 12" (MINIMUM) WATER REFLECTOR ON TOP & SIDES, 24" CONCRETE PAD
READ PARAM  NUB=YES  FDN=YES  END PARAM
READ GEOM
ZCYLINDER 1 1 5.4864     127.00  0.0
ZCYLINDER 4 1 5.7404     127.254 -0.254
CUBOID   2 1 4P36.2204  157.734 -0.254
CUBOID   3 1 4P36.2204  157.734 -61.214
END GEOM
END DATA
END
```

KENO Geometry Data File for a Single Container in a Corner (SCC)

```
H2O          2 END
REG-CONCRETE  3 END
END COMP
4.32" ID x 50" TALL CYLINDER IN A CORNER
' 4.32" ID x 50" TALL CYLINDER OF MATERIAL #1 (FISSILE), 24" CONCRETE PAD,
' 12" CONCRETE WALLS AND CEILING, 100 kg L-SHAPED WATER REFLECTOR
' SIMULATING A PERSON, NO CONTAINER MODELED
READ PARAM  NUB=YES  FDN=YES  END PARAM
READ GEOM
ZCYLINDER 1 1 5.49   127.00  0.0
CUBOID   0 1 4P5.49 127.00  0.0
CUBOID   2 1 24.65  -5.49 24.65  -5.49 127.00  0.0
CUBOID   0 1 66.45  -5.49 66.45  -5.49 304.80  0.0
CUBOID   3 1 66.45 -35.97 66.45 -35.97 335.28 -60.96
END GEOM
END DATA
END
```

KENO Geometry Data File for Two Cylinders Adjacent to a Wall (TACW)

```
H2O          2 END
REG-CONCRETE  3 END
END COMP
TWO 4.32" ID x 50" TALL CYLINDERS NEXT TO A WALL
' TWO 4.32" ID x 50" TALL CYLINDERS OF MATERIAL #1 (FISSILE),
' 24" CONCRETE PAD, 12" CONCRETE WALLS AND CEILING, ~100 kg WATER
' REFLECTOR SIMULATING A PERSON (18" wide x 7" deep x 50" tall)
READ PARAM  NUB=YES  FDN=YES  END PARAM
READ GEOM
UNIT 1
ZCYLINDER 1 1 5.49   127.00   0.0
CUBOID    0 1 4P5.49 127.00   0.0
CUBOID    2 1 5.49 -8.03  5.49   -5.49 127.00 0.0
CUBOID    0 1 5.49 -17.37 5.49   -5.49 127.00 0.0
CUBOID    2 1 5.49 -17.37 23.27  -5.49 127.00 0.0
CUBOID    0 1 5.49 -85.95 66.45  -5.49 304.80 0.0
CUBOID    3 1 5.49 -85.95 66.45 -35.97 335.28 -60.96
UNIT 2
ZCYLINDER 1 1 5.49   127.00   0.0
CUBOID    0 1 4P5.49 127.00   0.0
CUBOID    2 1 8.03  -5.49 5.49   -5.49 127.00 0.0
CUBOID    0 1 17.37 -5.49 5.49   -5.49 127.00 0.0
CUBOID    2 1 17.37 -5.49 23.27  -5.49 127.00 0.0
CUBOID    0 1 85.95 -5.49 66.45  -5.49 304.80 0.0
CUBOID    3 1 85.95 -5.49 66.45 -35.97 335.28 -60.96
END GEOM
READ ARRAY  NUX=2  NUY=1  NUZ=1  FILL  1  2  END FILL  END ARRAY
END DATA

END
```

KENO Geometry Data File for Two Cylinders One Foot from a Wall (TSCW)

```
H2O         2 END
REG-CONCRETE  3 END
POLY(H2O)    4 END
END COMP
TWO 4.32" ID x 50" TALL CYLINDERS 12" FROM A WALL
' TWO 4.32" ID x 50" TALL CYLINDERS OF MATERIAL #1 (FISSILE),
' 0.195" THICK CONTAINER (MATERIAL #4) AROUND EACH CYLINDER OF FISSILE
' MATERIAL, 24" CONCRETE PAD, 12" CONCRETE WALLS AND CEILING, ~100 kg
' WATER REFLECTOR SIMULATING A PERSON (18" wide x 7" deep x 50" tall)
READ PARAM  NUB=YES  FDN=YES  NPG=600  END PARAM
READ GEOM
UNIT 1
ZCYLINDER 4 1 5.49   0.50  0.0
ZCYLINDER 1 1 5.49  127.50  0.0
ZCYLINDER 4 1 5.99  128.00  0.0
CUBOID   0 1 4P5.99  128.00  0.0
CUBOID   2 1 5.99  -8.53   5.99  -5.99  128.00   0.0
CUBOID   0 1 5.99  -16.87  5.99  -5.99  128.00   0.0
CUBOID   2 1 5.99  -16.87  23.77  -5.99  128.00   0.0
CUBOID   0 1 5.99  -85.45  66.95  -36.47  304.80   0.0
CUBOID   3 1 5.99  -85.45  66.95  -66.95  335.28  -60.96
UNIT 2
ZCYLINDER 4 1 5.49   0.50  0.0
ZCYLINDER 1 1 5.49  127.50  0.0
ZCYLINDER 4 1 5.99  128.00  0.0
CUBOID   0 1 4P5.99  128.00  0.0
CUBOID   2 1 8.53  -5.99   5.99  -5.99  128.00   0.0
CUBOID   0 1 16.87  -5.99   5.99  -5.99  128.00   0.0
CUBOID   2 1 16.87  -5.99  23.77  -5.99  128.00   0.0
CUBOID   0 1 85.45  -5.99  66.95  -36.47  304.80   0.0
CUBOID   3 1 85.45  -5.99  66.95  -66.95  335.28  -60.96
END GEOM
READ ARRAY  NUX=2  NUY=1  NUZ=1  FILL  1  2  END FILL  END ARRAY
END DATA
END
```

KENO Geometry Data File for a Standard Array of Containers (ACE)

```
H2O        2 0.001  END
REG-CONCRETE  3 END
POLY(H2O)    4 END
END COMP
ARRAY OF CONTAINERS WITH FISSILE MATERIAL #1
' 4.32" ID x 50" TALL CYLINDERS OF MATERIAL #1 (FISSILE),
' 0.195" THICK CONTAINER (MATERIAL #4) AROUND EACH CYLINDER OF FISSILE
' MATERIAL, 24" CONCRETE PAD, 12" CONCRETE WALLS AND CEILING
READ PARAM  NPG=600  GEN=153  MKP=YES  MKU=YES
      MKA=YES  NUB=YES  FDN=YES  END PARAM
READ GEOM
' UNIT 1 IS A 23"x23"x10' TALL CUBOID CONTAINING THE FISSILE CYLINDER
UNIT 1
ZCYLINDER  4  1  5.49    0.50  0.0
ZCYLINDER  1  1  5.49  127.50  0.0
ZCYLINDER  4  1  5.99  128.00  0.0
CUBOID    2  1  4P29.21  304.80  0.0
' UNIT 2 IS A CUBOID NEEDED TO PUT 6' OF SPACE BETWEEN THE ROW SETS
UNIT 2
CUBOID    2  1  58.42  0.0  124.46  0.0  304.80  0.0
' UNIT 3 IS A CUBOID NEEDED TO PUT 3' OF SPACE BETWEEN THE TOP ROW
' AND THE MIRROR ALBEDO ON THE +Y BOUNDARY
UNIT 3
CUBOID    2  1  58.42  0.0  62.23  0.0  304.80  0.0
' GLOBAL UNIT 8 IS AN ARRAY OF FISSILE UNITS AND SPACING UNITS
' SURROUNDED BY A CUBOID OF SPACE TO SET THE DISTANCE FROM THE WALLS
' TO THE NEAREST CONTAINER, AND A CUBOID OF REG-CONCRETE TO MAKE UP
' THE WALLS, CEILING, AND FLOOR
GLOBAL UNIT 8
ARRAY 1  0.0  0.0  0.0
CUBOID  2  1  1168.4  -31.75  420.37  -31.75  304.80    0.0
CUBOID  3  1  1168.4  -62.23  420.37  -62.23  335.28  -60.96
END GEOM
READ ARRAY  ARA=1  NUX=20  NUY=6  NUZ=1   FILL
   1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
   1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
   2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
   1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
   1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
   3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
END FILL  END ARRAY
READ BOUNDS  +XB=MIRROR  +YB=MIRROR  END BOUNDS
END DATA
```

KENO Geometry Data File for a Contingency Case for a Standard Array of Containers (AOSP)

```
H2O          2 END
REG-CONCRETE  3 END
POLY(H2O)     4 END
END COMP
CONTINGENCY CASE FOR ARRAY OF CONTAINERS WITH FISSILE MATERIAL #1
' 4.32" ID x 50" TALL CYLINDERS OF MATERIAL #1 (FISSILE),
' 0.195" THICK CONTAINER (MATERIAL #4) AROUND EACH CYLINDER OF FISSILE
' MATERIAL, 24" CONCRETE PAD, 12" CONCRETE WALLS AND CEILING
READ PARAM  NPG=600  GEN=153  MKP=YES  MKU=YES
        MKA=YES  NUB=YES  FDN=YES  END PARAM
READ GEOM
' UNIT 1 IS A 23"x23"x10' TALL CUBOID CONTAINING THE FISSILE CYLINDER
UNIT 1
ZCYLINDER  4  1  5.49    0.50  0.0
ZCYLINDER  1  1  5.49  127.50  0.0
ZCYLINDER  4  1  5.99  128.00  0.0
CUBOID     0  1  4P29.21  304.80  0.0
' UNIT 2 IS A CUBOID NEEDED TO PUT 6' OF SPACE BETWEEN THE ROW SETS
UNIT 2
CUBOID     0  1  58.42  0.0  124.46  0.0  304.80  0.0
' UNIT 3 IS A CUBOID NEEDED TO PUT 3' OF SPACE BETWEEN THE TOP ROW
' AND THE MIRROR ALBEDO ON THE +Y BOUNDARY
UNIT 3
CUBOID     0  1  58.42  0.0  62.23  0.0  304.80  0.0
' UNIT 4 IS A 23"x23"x10' TALL CUBOID CONTAINING THE FISSILE CYLINDER
' AND CONTINGENCY FISSILE CYLINDER.  THIS UNIT IS PLACED IN THE CORNER
' OF THE ARRAY CLOSEST TO THE TWO WALLS
UNIT 4
ZCYLINDER  4  1  5.49    0.50  0.0
ZCYLINDER  1  1  5.49  127.50  0.0
ZCYLINDER  4  1  5.99  128.00  0.0
CUBOID     0  1  29.21 -22.03  29.21  -22.03  128.00  0.0
HOLE       5    8.48    8.48  0.0
CUBOID     2  1  4P29.21  128.00  0.0
CUBOID     0  1  4P29.21  304.80  0.0
UNIT 5
ZCYLINDER  4  1  5.49    0.50  0.0
ZCYLINDER  1  1  5.49  127.50  0.0
ZCYLINDER  4  1  5.99  128.00  0.0
' GLOBAL UNIT 8 IS AN ARRAY OF FISSILE UNITS AND SPACING UNITS
' SURROUNDED BY A CUBOID OF SPACE TO SET THE DISTANCE FROM THE WALLS
' TO THE NEAREST CONTAINER, AND A CUBOID OF REG-CONCRETE TO MAKE UP
```

```
' THE WALLS, CEILING, AND FLOOR
GLOBAL UNIT 8
ARRAY 1 0.0 0.0 0.0
CUBOID 0 1 1168.4 -31.75 420.37 -31.75 304.80  0.0
CUBOID 3 1 1168.4 -62.23 420.37 -62.23 335.28 -60.96
END GEOM
READ ARRAY ARA=1 NUX=20 NUY=6 NUZ=1  FILL
   4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
   1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
   2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
   1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
   1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
   3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
END FILL  END ARRAY
READ BOUNDS  +XB=MIRROR  +YB=MIRROR  END BOUNDS
END DATA
END
```