

**Mixed Oxide Fuel Fabrication Facility
Evaluation Pursuant to 10 CFR §70.22(i)(1)(i) –
Emergency Plan Assessment**

November 2006

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1. INTRODUCTION

Title 10 of the Code of Federal Regulations (CFR) §70.22(i)(1) requires an emergency plan for the Mixed Oxide (MOX) Fuel Fabrication Facility (MFFF) to be submitted to the U.S. Nuclear Regulatory Commission (NRC) if the maximum dose to a member of the offsite public due to a release of radioactive materials exceeds 1 rem effective dose equivalent, or exceeds an intake of 2 mg of soluble uranium. If an evaluation demonstrates that those values are not exceeded, then the licensee can submit such an evaluation in lieu of an emergency plan.

DCS has performed Integrated Safety Analyses (ISA) for the MFFF, and, under separate cover, provided the NRC with the ISA Summary (ISAS). The ISA evaluated accident types (i.e., Loss of Confinement, Fire, Load Handling, Explosion, Criticality, Natural Phenomena, External Man-Made Events, External Radiation Exposure, and Chemical Release).

DCS has determined that the most significant intake of soluble uranium would occur during a release of uranyl nitrate from the Secured Warehouse Building (BSW). DCS has also determined that the most significant radiological exposure would occur as a result of a criticality event. A release of uranyl nitrate would be visually detected. A criticality would be detected by observation and/or the Nuclear Incident Monitoring System.

DCS has developed chemical and dose consequences for potential hazard events. This evaluation is submitted in accordance with 10 CFR §70.22(i)(1)(i) and bounds the potential release pathways and conservatively considers any mitigating factors. It is based on exposure to the Individual Outside the Controlled Area Boundary (IOC), which is a more conservative assumption than dose to “a member of the public offsite.”

This evaluation contains or refers to the License Application (LA) and/or ISAS for the following:

- A description of the facility and proposed licensed activities. An overview description of the facility and processes is given in Chapter 1 of the LA (provided under separate cover). Proposed licensed activities are specified in Section 1.2 of the LA. More detailed descriptions of the facility and processes are given in Chapters 3 and 4 of the ISAS.
- Types of materials used, including both radioactive material and hazardous chemicals are described in Section 1.2 and Chapter 8 of the LA, and Chapter 4 of the ISAS.
- Types of accidents are described in Section 5.3 of the ISAS. The bounding accidents for this evaluation are provided above.
- Detection of accidents for the bounding accidents is provided above.
- Site-specific information used to support the evaluation is provided in Chapters 3 and 4 of the ISAS.
- An evaluation of the consequences, both onsite and offsite, for the bounding accidents noted above are provided below.
- One or more of the considerations provided in 10 CFR §70.22(i)(2) are provided in Section 2.2 below.

1.1 PURPOSE

The purpose of this evaluation is to demonstrate that an emergency plan is not required to be submitted to the NRC per 10 CFR §70.22(i)(1).

2. APPROACH

Hazard events for the MFFF are established as a part of the ISA process. A hazard assessment is performed to identify and evaluate the hazards posed by the MFFF and its associated support facilities. The assessment identifies facility hazards, which include the locations and quantities of hazardous materials (chemical and radioactive). Hazard evaluation is the process of linking the hazards that were identified during the hazard identification process with postulated causes to produce event scenarios. Event scenarios are postulated as general events or system failures that could lead to an event. Process hazards analyses (PrHAs) are performed for each process unit or workshop to identify specific event scenarios in detail, including causes of the events, and associated prevention and mitigation features (items relied on for safety [IROFS]) at the component level. In this evaluation, the bounding hazard event consequences are established by considering the worst combination of hazard, cause, and material-at-risk (MAR) in a process area that produces the worst consequences.

2.1 ASSUMPTIONS

Most postulated radiological and chemical releases exit via the MOX stack; however, the chemical consequence analysis also considers some releases from the BSW where drums of depleted uranium dioxide powder and drums of uranyl nitrate are stored. The IOC is located 160 meters from the MOX stack, and 68 meters from the BSW.

For both chemical and radiological releases, it is assumed that all applicable material is available for release.

A release of, and IOC exposure to, each chemical (as opposed to a radiological release) is assumed over a one-hour period (i.e., effectively an instantaneous release).

The puddle of a chemical spilled on the ground outside of any confinement is assumed to be one centimeter deep.

The direct radiation contribution from a hypothetical criticality event to the IOC is negligible relative to exposure from airborne radiological releases due to the significant shielding provided by the building and the attenuation resulting from the distance between the IOC and the source. Ingestion, water immersion, and contaminated soil dose pathways are assumed negligible contributors to the total effective dose equivalent (TEDE) resulting from a hypothetical criticality event.

The evaluation of consequences from a hypothetical criticality event is based on 66.3 kg of unpolished Pu, the maximum tank inventory of Pu in solution form.

For a hypothetical criticality event, nonvolatile fission products are considered to contribute negligible dose due to a low Airborne Release Fraction (ARF) relative to noble gases and iodines, and low source term (Ci) and inhalation dose conversion factor (DCF) relative to nonvolatiles present in the reacting solution (e.g., Pu isotopes). The nonvolatiles are filtered by high efficiency particulate air (HEPA) filters, whereas the noble gases are not filtered and the iodines are assumed partially released.

Radiological airborne particulate releases produced as a result of a hypothetical criticality event are assumed to be filtered by two HEPA filters in series prior to release. The direct radiation contribution from a hypothetical criticality event is not assumed to affect filter system post accident operability due to the shielding provided by interceding interior building walls and the distance to filtration system active components.

2.2 10 CFR §70.22(i)(2) CONSIDERATIONS

The following factors listed in 10 CFR §70.22(i)(2) have been credited in this evaluation

- The radioactive material is physically separated so that only a portion could be involved in an accident. Since the warehouse is the location where the largest inventory of uranyl nitrate is stored, and it is the closest distance to the IOC, it is considered the bounding location for the chemical release.
- The solubility of the material released would reduce the dose received. Uranyl nitrate is soluble. No reduction in exposure was taken for its specific solubility.
- Operating restrictions or procedures would prevent a release large enough to cause a member of the public offsite to receive a dose exceeding 1 rem effective dose equivalent. While not specifically credited in this evaluation because it assumes a worst case scenario, the operating restrictions and procedures in place at the MFFF would further limit the dose.

2.3 MATERIAL-AT-RISK, DAMAGE RATIOS, AIRBORNE RELEASE FRACTIONS, RESPIRABLE FRACTIONS, LEAK PATH FACTORS, ATMOSPHERIC DISPERSION FACTORS, AND DOSE CONVERSION FACTORS

To establish applicable, conservative releases, the following items are established: the Materials-At-Risk (MAR), Damage Ratios (DRs), Airborne Release Fractions (ARFs), Respirable Fractions (RFs), Leak Path Factors (LPFs), the atmospheric dispersion factors (χ/Q), and the DCFs.

The atmospheric dispersion factors (χ/Q) for the IOC were determined from Savannah River Site data using the MACCS2 and ARCON96 computer codes. χ/Q for the IOC is $2.50 \times 10^{-4} \text{ s/m}^3$ for a release from the MOX stack, and $1.25 \times 10^{-3} \text{ s/m}^3$ for a release from the BSW. These values correspond to the 95th percentile χ/Q at distances of 160 meters from the MOX stack, and 68 meters from the BSW, respectively. These values are conservative since they are based on a one-hour ground release and worst case historical χ/Q values.

2.4 EVALUATION CRITERIA

If an emergency plan is not submitted to the NRC, then intake exposures must be below the 10 CFR §70.22(i)(1)(i) thresholds.

3. CALCULATION

3.1 METHOD FOR CALCULATING CHEMICAL CONSEQUENCE

3.1.1 Chemical Hazard Identification

The following is the chemical hazard information for uranyl nitrate:

- Chemical formula – $\text{UO}_2(\text{NO}_3)_2$
- Chemical Abstract System Registry Number (CASRN) – 36478-76-9
- Temperature and state of uranyl nitrate as it will be stored is liquid
- Quantity and location of uranyl nitrate held – Thirty four (34) 55-gallon drums in the Secured Warehouse

3.1.2 Chemical Consequence Analysis Methodology

A chemical consequence analysis was performed in support of the ISA in order to ensure that the performance requirements of 10 CFR §70.61 were satisfied. The computer models used for chemical consequence analysis were either based on an evaporation model, or a release fraction model, or both. Uranyl nitrate in its liquid form fits the release fraction model. The MACCS2 code determined a χ/Q value for the maximum airborne chemical concentration to the IOC. The following parameters were used in calculating the atmospheric dispersion of the release. These parameters, for offsite consequence analysis, are comparable to those parameters suggested in 40 CFR §68.22.

- A wind speed of 2.2 m/sec and F stability class
- A wind direction that transports the puff kernel and/or plume centerline directly over the receptor of concern (in this case, the IOC; conservative), thereby eliminating any crosswind dispersion
- An ambient temperature of 25°C (77°F) and 50% humidity; representative of late-spring to early-autumn conditions
- A ground level release (conservative)
- No mechanical or buoyancy plume rise (conservative)
- A rural (i.e., flat terrain) topography (conservative) (Note: The forest canopy morphology at SRS is more accurately characterized as urban terrain relative to atmospheric turbulence intensity.)

3.1.3 Source Terms for Chemical Release

Uranyl nitrate, which is used as an aqueous solution at MFFF, has a negligible vapor pressure at 25°C (77°F) and a solute concentration less than approximately 50%, with a very low solute

vapor pressure. Because of these properties, uranyl nitrate releases were modeled with a five-factor formula to:

- Establish the quantity of MAR from the facilities materials list [MAR]
- Establish a conservative damage ratio [DR]
- Establish the applicable bounding airborne release fraction [ARF]
- Establish the applicable bounding respirable fraction [RF]
- Establish the applicable bounding leak path factor [LPF].

Source Term [ST] = (MAR)(DR)(ARF)(RF)(LPF)

The source term calculated with the five-factor formula is then used to calculate a release rate. A one-hour release is assumed.

The χ/Q value at 68 meters, calculated by ARCON96, was then multiplied by the release rate to obtain an airborne chemical concentration at the CAB.

3.1.4 Chemical Calculation

The following inputs were used to calculate the release rate and 68 meter air concentration for uranyl nitrate:

- Drums in the Secured Warehouse containing uranyl nitrate have the highest volume available for release
- Molecular Weight – 394.03 kg/kmole
- Quantity evaluated – 200 g(U)/l, 34 55-gallon drums, which equates to a total of 7079 liters (1416 kg mass)
- Airborne Release Fraction – 0.002
- Damage Ratio – 1.0
- Leak Path Factor – 1.0
- Breathing Rate for 8-hour day – 3.47E-04 m³/sec.

An ARF (0.002) and RF (1.0) were used for uranyl nitrate. These ARF and RF values are bounding for leaks and spills and would directly apply in the event of a fire, which boils a noncombustible liquid.

3.1.5 Chemical Consequence Analysis Results for the IOC

The concentration of uranyl nitrate for the IOC (i.e., 68 meters from the Secured Warehouse) due to accidental chemical release is depicted below. The airborne chemical concentration at 68 meters is calculated by multiplying the release rate for uranyl nitrate by the χ/Q value.

The soluble uranium intake for the IOC is less than the performance criteria of 10 CFR §70.22 (2 mg U).

Results:

$$\begin{aligned} \text{ST} &= 200 \text{ g(U)/l} \cdot 1 \text{ kg/1000g} \cdot 208 \text{ liters/drum} \cdot 34 \text{ drums} \cdot 1 \cdot 2 \times 10^{-3} \cdot 1 \cdot 1 \\ &= 2.83 \text{ kg/hr} - \text{Uranium Release Rate (over 1 hr period)} \end{aligned}$$

$$\begin{aligned} \text{IOC Conc}_{68\text{m}} &= 2.83 \text{ kg/hr} \cdot 1 \times 10^6 \text{ mg/kg} \cdot 1.25 \times 10^{-3} \text{ sec/m}^3 \cdot 1 \text{ hr/3600sec} \\ &= 0.98 \text{ mg/m}^3 - \text{Uranium Airborne Concentration at CAB} \end{aligned}$$

$$\begin{aligned} \text{IOC Uptake}_{68\text{m}} &= 0.98 \text{ mg/m}^3 \cdot 3.47 \times 10^{-4} \text{ m}^3/\text{sec} \cdot 3600 \text{ sec/hr} \\ &= 1.3 \text{ mg U} - \text{One Hour Uranium uptake at CAB} \end{aligned}$$

3.2 METHOD FOR CALCULATING RADIOLOGICAL CONSEQUENCE

3.2.1 Radiological Hazard Identification

Although criticality events at the MFFF are highly unlikely, a generic hypothetical criticality event is evaluated. A bounding source term produced by 10^{19} fissions in solution occurring over 8 hours is evaluated consistent with guidance provided in Regulatory Guide 3.71 and NUREG/CR-6410. Airborne releases and direct radiation result from the criticality. The direct radiation contribution is negligible due to the shielding provided by the building and the distance to the IOC. Airborne releases are calculated consistent with the guidance of Regulatory Guide 3.35.

The dose to the IOC is the sum of the contributions from the release of entrained solution resulting from the boiling of solution due to the fission burst and the release of fission products. The dose contribution of semi-volatile fission products (e.g., cesium and strontium) resulting from the criticality event is assumed to be negligible due to the relatively low quantity of the fission products compared to the fissile material in solution, the low DCF of the semi-volatile fission products compared to the fissile material, and the effectiveness of HEPA filtration in removing these fission products compared to gaseous fission products.

The dose consequences of a hypothetical criticality event are the sum of the TEDE for the fission products and the release of solution. The tank with the largest potential release contains the isotopes listed in Table 1. The release of material in solution is modeled as a boiling event with DR of 0.25 as discussed in the *Nuclear Fuel Cycle Facility Accident Analysis Handbook*. An LPF of 1×10^{-4} is applied for the mitigated release.

Table 1. Radionuclide Composition of Potentially Released Oxides		
Isotope	Conservative mix $\left(\frac{\text{mass isotope}}{\text{total Pu + Am mass}} \right)$	Mass fraction in PuO₂ $\left(\frac{\text{mass isotope}}{\text{mass oxide}} \right)$
²³⁶ Pu	1.00E-09	8.82E-10
²³⁸ Pu	0.0005	0.00044
²³⁹ Pu	0.9	0.794
²⁴⁰ Pu	0.0815	0.0719
²⁴¹ Pu	0.00908	0.00801
²⁴² Pu	0.001	0.00088
²⁴¹ Am	0.007916	0.00698
Isotope	Conservative mix $\left(\frac{\text{mass isotope}}{\text{total U mass}} \right)$	Mass fraction in UO₂ $\left(\frac{\text{mass isotope}}{\text{mass oxide}} \right)$
²³⁵ U	0.01	0.00882
²³⁸ U	0.99	0.873

3.2.2 Criticality Consequence Analysis Modeling

The inhalation dose to the IOC from each individual radioisotope that composes the source term can be calculated through the following process:

- Establish the radionuclides present in the MAR that can be assumed released as a result of the evaluated hazard event and contribute a significant fraction of the total dose¹
- Establish the quantity or weight percent of the radionuclide X in the MAR, MAR_X or w_X
- Establish the applicable effective inhalation dose conversion factor (in Sv/Bq) for the specified radionuclide, X, DCF_X
- Establish the value for χ/Q (in s/m³) that is applicable to the IOC (I), χ/Q

For the release of entrained solution, the inhalation dose is calculated as follows:

$$\text{Inhalation Dose} = \sum_{x=1}^N BR \cdot C_{ave_x} \cdot t_e \cdot DCF_x$$

Where:

- *Inhalation Dose* is the committed effective inhalation dose to the receptor (rem)
- *BR* is the breathing rate (3.47×10⁻⁴ m³/s)
- *C_{avex}* is the average concentration of the material in air at the receptor location during the time of exposure (kg/m³)

¹ A “significant fraction of the total dose” is considered to be 0.1% of the total dose for this calculation.

- t_e is the time of exposure (s)
- DCF_x is the committed inhalation dose conversion factor of each material (rem/kg)
- x represents one material
- N represents the total number of materials

The product of the χ/Q value and the amount of airborne respirable material, ST_x , is equal to the quantity $C_{avex} \cdot t_e$ in the above equation. Substituting:

$$Inhalation\ Dose = \sum_{x=1}^N BR \cdot \frac{\chi}{Q} \cdot ST_x \cdot DCF_x$$

Where:

- $\frac{\chi}{Q}$ is the relative concentration factor for the receptor (s/m^3), and
- ST_x is the respirable source term of an individual material (kg).

For the fission product release, the inhalation dose is calculated as follows:

$$Inhalation\ Dose = C \cdot \sum_{x=1}^N BR \cdot \chi / Q \cdot ST_{crit, x} \cdot DCF_x$$

where N is the total number of dose contributing radionuclides involved in the evaluated hazard event.

Doses to the IOC (I) are calculated for inhalation pathways consistent with the methodology described above. Dose contribution from air submersion is also evaluated for the hypothetical criticality event since the source term includes significant amounts of short-lived noble gas releases. Air submersion dose is calculated by summing all the submersion dose contributions for each radionuclide in the event source term as follows:

$$Submersion\ Dose = \chi / Q \cdot C \cdot \sum_{x=1}^N ST_{crit, X} \cdot DCAS_X$$

where C is a conversion factor (3.7×10^{12} rem-Bq/Sv-Ci), N is the total number of dose contributing radionuclides involved in the source term, $ST_{crit, X}$ is the source term for radionuclide X produced over 8 hours of hypothetical criticality event duration (Ci), and $DCAS_X$ is the effective dose coefficient for air submersion for radionuclide X ($Sv \cdot m^3/Bq \cdot sec$).

Since direct radiation, ingestion, water immersion, and contaminated soil dose pathways are assumed negligible contributors to TEDE, the total effective dose equivalent to the IOC (I) is

equivalent to the TEDE that is:

$$TEDE = Inhalation \ Dose + Submersion \ Dose$$

3.2.3 Source Terms for Radiological Release

Using the type and form of the MAR, the source term for each hazard event can then be established by the use of the five-factor formula:

$$ST_{critX} = MAR_{critX} \cdot DR \cdot ARF \cdot LPF$$

Where:

- MAR_{critX} is the 0 to 8 hr noble gas and iodine fission product activity produced from the postulated criticality event
- DR is the damage ratio, which is assumed to be one (i.e., all material is at risk)
- ARF is the airborne release fraction, assumed to be one for iodine and noble gases and 2×10^{-3} for non-volatiles
- LPF is the leak path factor, which is assumed to be one (i.e., no credit for mitigation) for noble gases and 0.25 for iodines and 1×10^{-4} for particulate species

The χ/Q value at 160 meters calculated by ARCON96 is then multiplied by the release rate to obtain an airborne chemical concentration at 160 meters.

3.2.4 Radiological Calculation

To calculate unmitigated consequences to the IOC for these hazard events, the MAR, the ARF and RF, the DR, the χ/Q , the breathing rate (BR), the DCFs, and the radionuclide composition and properties of the MAR are established. Then, to calculate the mitigated consequences to the IOC the safety strategy employed for a group of hazard events (bounded by a bounding event [BE]) is interpreted into a LPF. For example, if a hazard event is prevented, then a LPF of zero is implied, or if the safety strategy credits a HEPA filter for a hazard event, then a LPF related to the efficiency of the filter is applied to the unmitigated consequences.

- Airborne Release Fraction – 1.0 for noble gases and iodines, and 2×10^{-3} for non-volatiles
- Damage Ratio – 1.0 (all material at risk)
- Leak Path Factor – 1.0 (no credit for mitigation) and .25 for iodines and 1×10^{-4} for particulates

The inhalation DCF of an isotope is dependent in part on its chemical form. This dependence is accounted for by the lung clearance class (D – daily, W – weekly, Y – yearly) used to evaluate the DCF of a given isotope. Some isotopes have only one lung clearance class, others have multiple lung clearance classes. For isotopes with multiple lung clearance classes, the most applicable lung clearance class will be used. In this calculation, all releases are assumed to be in the form of oxides of unpolished plutonium, polished plutonium, and depleted uranium. Table 2

lists the effective exposure-to-dose conversion factors and the lung clearance classes associated with the DCFs for inhalation used in this analysis.

Material	DCF (rem/kg of material)
Pu (U) in solution	5.504E+10
Uranium in solution	4.203E+04

3.2.5 Radiological Consequence Analysis Results for the IOC

The MFFF processes are designed to preclude a criticality event through the use of reliable engineered features and administrative controls. Adherence to the double contingency principle, as specified in ANSI/ANS-8.1, is employed. Simultaneous failure of the criticality controls is highly unlikely.

Doses to the IOC are calculated (Table 3 – TEDE from Fission Products of Hypothetical Criticality Event and Table 4 – TEDE from Release of Pu Solution due to Hypothetical Criticality Event) for inhalation pathways and from air submersion for the hypothetical criticality event since the source term includes significant amounts of short-lived noble gas releases. Since direct radiation, ingestion, water immersion, and contaminated soil dose pathways are assumed negligible contributors to TEDE, the total effective dose equivalent to the IOC is equivalent to the summation of the total inhalation dose and the total submersion dose).

Results:

A criticality event resulting in 10^{19} fissions associated with a solution of PuO_2 will result in less than 0.9 rem TEDE

4. SUMMARY AND RECOMMENDATIONS

The resulting chemical (< 1.3 mg U) and radiological (< 0.9 rem) consequences from bounding releases are below the thresholds in 10 CFR §70.22. An emergency plan for MFFF is not required to be submitted to the NRC.

Table 3. TEDE from Fission Products of Hypothetical Criticality Event

Nuclide	Release 0-0.5 hr (Ci)	Release 0.5-8.0 hr (Ci)	MAR _{exit} (Ci)	LPF	ST _{exit} (Ci)	Inhalation DCF (Sv/Bq)	Submersion DCF (Sv-m ³ /Bq-sec)	SW Inhalation Dose (rem)	SW Submersion Dose (rem)	SW TEDE (rem)	IOC Inhalation Dose (rem)	IOC Submersion Dose (rem)	IOC TEDE (rem)
Kr-83m	1.50E+01	9.50E+01	1.10E+02	1.0	1.10E+02	---	1.50E-18	---	3.72E-07	3.72E-07	---	1.53E-07	1.53E-07
Kr-85m	9.90E+00	6.10E+01	7.09E+01	1.0	7.09E+01	---	7.48E-15	---	1.19E-03	1.19E-03	---	4.91E-04	4.91E-04
Kr-85	1.20E-04	7.20E-04	8.40E-04	1.0	8.40E-04	---	1.19E-16	---	2.25E-10	2.25E-10	---	9.25E-11	9.25E-11
Kr-87	6.00E+01	3.70E+02	4.30E+02	1.0	4.30E+02	---	4.12E-14	---	3.99E-02	3.99E-02	---	1.64E-02	1.64E-02
Kr-88	3.20E+01	2.00E+02	2.32E+02	1.0	2.32E+02	---	1.02E-13	---	5.33E-02	5.33E-02	---	2.19E-02	2.19E-02
Kr-89	1.80E+03	1.10E+04	1.28E+04	1.0	1.28E+04	---	0.00E+00	---	0.00E+00	0.00E+00	---	0.00E+00	0.00E+00
Xe-131m	1.40E-02	8.60E-02	1.00E-01	1.0	1.00E-01	---	3.89E-16	---	8.77E-08	8.77E-08	---	3.60E-08	3.60E-08
Xe-133m	3.10E-01	1.90E+00	2.21E+00	1.0	2.21E+00	---	1.37E-15	---	6.82E-06	6.82E-06	---	2.80E-06	2.80E-06
Xe-133	3.80E+00	2.30E+01	2.68E+01	1.0	2.68E+01	---	1.56E-15	---	9.42E-05	9.42E-05	---	3.87E-05	3.87E-05
Xe-135m	4.60E+02	2.80E+03	3.26E+03	1.0	3.26E+03	---	2.04E-15	---	1.50E-02	1.50E-02	---	6.15E-03	6.15E-03
Xe-135	5.70E+01	3.50E+02	4.07E+02	1.0	4.07E+02	---	1.19E-14	---	1.09E-02	1.09E-02	---	4.48E-03	4.48E-03
Xe-137	6.90E+03	4.20E+04	4.89E+04	1.0	4.89E+04	---	0.00E+00	---	0.00E+00	0.00E+00	---	0.00E+00	0.00E+00
Xe-138	1.50E+03	9.50E+03	1.10E+04	1.0	1.10E+04	---	5.77E-14	---	1.43E+00	1.43E+00	---	5.87E-01	5.87E-01
I-131	1.50E+00	9.50E+00	1.10E+01	0.25	2.75E+00	8.89E-09	1.82E-14	1.91E-02	1.13E-04	1.92E-02	7.85E-03	4.63E-05	7.89E-03
I-132	1.70E+02	1.00E+03	1.17E+03	0.25	2.93E+02	1.03E-10	1.12E-13	2.36E-02	7.38E-02	9.74E-02	9.67E-03	3.03E-02	4.00E-02
I-133	2.20E+01	1.40E+02	1.62E+02	0.25	4.05E+01	1.58E-09	2.94E-14	5.00E-02	2.68E-03	5.27E-02	2.05E-02	1.10E-03	2.16E-02
I-134	6.00E+02	3.70E+03	4.30E+03	0.25	1.08E+03	3.55E-11	1.30E-13	2.98E-02	3.15E-01	3.45E-01	1.22E-02	1.29E-01	1.42E-01
I-135	6.30E+01	3.90E+02	4.53E+02	0.25	1.13E+02	3.32E-10	7.98E-14	2.94E-02	2.04E-02	4.98E-02	1.21E-02	8.36E-03	2.04E-02
TOTAL									2.11E+00	2.11E+00			8.68E-01

Table 4. TEDE from Release of Pu Solution due to Hypothetical Criticality Event

Unit	Tank	Material	Form	Release Mechanism	Mass, kg	ARF	RF	DR	DCF (rem/kg)	SW TEDE (rem)	IOC TEDE (rem)
KPA	TK 9500	Pu (U)	solution	boil	6.63E+01	2.0E-03	1	0.25	5.5E+10	3.86E-02	1.58E-02