Environmental Assessment

Relocation and Storage of TRIGA Reactor Fuel, Hanford Site,
Richland, Washington

U.S. Department of Energy
Richland, Washington

August 1995

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**ENVIRONMENTAL ASSESSMENT
RELOCATION AND STORAGE OF
TRIGA® REACTOR FUEL**

**U.S. DEPARTMENT OF ENERGY
RICHLAND, WASHINGTON**

August 1995

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Summary

This Environmental Assessment (EA) evaluates the proposed action to relocate nuclear fuel assemblies (101 irradiated and three unirradiated) from the 308 Building's Neutron Radiography Facility (NRF) Mark I TRIGA^{®1} Reactor (TRIGA[®] Reactor) storage pool, which is located in the 300 Area of the Hanford Site, near Richland, Washington. The irradiated fuel assemblies would be stored in casks at the Interim Storage Area (ISA) in the 400 Area of the Hanford Site. The three unirradiated fuel assemblies would be transferred to another TRIGA[®] Reactor operated by the U.S. Geological Survey, a part of the U.S. Department of Interior (DOI) in Denver, Colorado, or if necessary, would be stored in one of the existing storage areas at the Plutonium Finishing Plant (PFP), 200 West Area, Hanford Site until they could be transferred to another reactor. Relocation of all the fuel assemblies would allow the shutdown of the 308 Building, which is no longer needed for the fabrication of fuel and test assemblies for the Fast Flux Test Facility (FFTF). Some of the irradiated fuel assemblies may be shipped to other TRIGA[®] Reactors that are not operated by the U.S. Department of Energy (DOE). Relocation of these irradiated fuel assemblies to other reactors is not within the scope of this EA.

Most of the fuel assemblies would be packaged in six DOE-approved NRF TRIGA[®] casks (TRIGA[®] cask) which have been designed and would be procured for onsite transportation. Two of the irradiated fuel assemblies, fuel-followed control rods, are longer than the other assemblies. These fuel-followed control rods would be packaged, transported, and stored in two U.S. Department of Transportation (DOT) Specification 6M containers (DOT-6M).

The loading operation for the TRIGA[®] casks and the DOT-6M containers would consist of: (1) lowering a fuel assembly basket into the storage pool, (2) placing the fuel assemblies into the basket, (3) hoisting the loaded basket out of the storage pool and suspending it in the shielded area directly above the pool to allow the basket and the assemblies to dry,

¹ TRIGA is a registered trademark of General Atomics.

(4) transferring and placing the basket into each TRIGA® cask or DOT-6M container, (5) sealing each TRIGA® cask or DOT-6M container by securing lids, (6) testing the seal on each closed TRIGA® cask or DOT-6M container, and (7) moving each TRIGA® cask or DOT-6M container to a staging area within the 308 Building to await transport. The unirradiated fuel assemblies would be removed individually, dried, and placed in appropriate containers.

Transportation and storage operations would consist of moving up to two TRIGA® casks or DOT-6M containers, out of the 308 Building for each shipment; placing each TRIGA® cask in an overpack (the DOT-6M containers would not require an overpack); placing each TRIGA® cask or DOT-6M container, onto the transport vehicle; verifying that the TRIGA® casks and the DOT-6M containers meet all of the applicable requirements; transporting the TRIGA® casks and the DOT-6M containers to the storage facility; unloading each TRIGA® cask or DOT-6M container from the vehicle; removing the overpack from each TRIGA® cask, and placing each TRIGA® cask or DOT-6M container in a storage module at the storage location; installing the lid on the storage module; and monitoring and managing the stored TRIGA® casks and DOT-6M containers.

The irradiated fuel assemblies would be stored at the 400 Area ISA along with Spent Nuclear Fuel (SNF) from the Fast Flux Test Facility. During storage, the TRIGA® casks and the DOT-6M containers would be managed as spent nuclear fuel. The near-term relocation of the fuel is consistent with the Record of Decision for the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Environmental Impact Statement*.

Several alternatives to the proposed action were evaluated. Common to all of the alternatives, the fuel assemblies may be shipped to other offsite TRIGA® Reactors prior to completion of the alternative.

- **No-Action Alternative.** DOE would continue to store the fuel assemblies in the storage pool until the Record of Decision for the SNF-PEIS is implemented.
- **Store the Fuel Assemblies in an existing Hanford Site Waste Storage Facility.** Under this alternative, the fuel assemblies would be stored in an existing Hanford Site Waste Storage Facility, such as the Hanford Central Waste Complex.
- **Ship the Fuel Assemblies to the Idaho National Engineering Laboratory for Storage.** Under this alternative, the fuel assemblies would be shipped directly to the Idaho National Engineering Laboratory for storage.
- **Ship the Fuel Assemblies to Another Existing Fuel Storage Basin on the Hanford Site.** This alternative would relocate the fuel assemblies to another existing wet-storage facility on the Hanford Site.
- **Rail Transport.** This alternative would utilize rail transport to relocate the fuel assemblies to the ISA.

Impacts from relocation of the fuel assemblies would include worker radiation exposure and vehicle emissions. The TRIGA® casks and DOT-6M containers are designed to minimize the impact of transportation and storage operations. The maximum radiological exposure to the workers from the relocation of the fuel assemblies is estimated to be 1.6 person-rem. Storage of the casks would result in an estimated yearly dose of 0.022 person-rem for the workers. Radiation exposures to the workers, from relocation or 50-year storage, are not expected to result in any latent cancer fatalities (LCF).

Transportation of three unirradiated fuel assemblies to Denver would have very minor impacts. Storage of the three fuel assemblies in PFP would result in minor impacts.

Materials utilized, such as stainless steel, lead, and concrete, represent a long-term commitment of nonrenewable resources. Minor socioeconomic and no environmental justice

impacts are anticipated. No sensitive cultural resources in the fuel storage areas have been identified, and none are anticipated. The proposed action would not affect a wetland; threatened, endangered, or candidate species; prime or unique farmland; or a wild and scenic river.

The offsite exposure from all Hanford Site 300 and 400 Area operations in 1993 was estimated to be 0.07 and 0.003 person-rem respectively. Relocation of the fuel assemblies is not expected to change this estimated dose.

A spectrum of postulated accidents was analyzed. It is most likely that there would be no anticipated fatal cancers to the onsite and offsite populations attributable to these potential radiation exposures from the postulated accidents.

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Glossary

Acronyms and Initialisms

CFR	<i>Code of Federal Regulations</i>
DOE	U.S. Department Of Energy
DOH	State Of Washington Department Of Health
DOI	U.S. Department Of Interior
DOT	U.S. Department Of Transportation
EA	Environmental Assessment
FFTF	Fast Flux Test Facility
HCWC	Hanford Central Waste Complex
HPT	Health Physics Technician
HVAC	heating, ventilation, and air conditioning
INEL	Idaho National Engineering Laboratory
ISA	Interim Storage Area
LCF	Latent Cancer Fatality
NRC	U.S. Nuclear Regulatory Commission
NRF	Neutron Radiography Facility
PFP	Plutonium Finishing Plant
ROD	Record of Decision
SNF	spent nuclear fuel
SNF-PEIS	<i>Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Environmental Impact Statement (DOE 1995a)</i>
WHC	Westinghouse Hanford Company

Definition of Terms

Cladding. The outer metal surface of a fuel assembly. The cladding member is normally made of a tube with welded ends that contains various components, including the fuel pieces.

Dose, Radiation. The amount of energy deposited in body tissue due to radiation exposure. Various technical terms, such as dose equivalent, effective dose equivalent and collective dose, are used to evaluate the amount of radiation an exposed worker receives. These terms are used to describe the differing interactions of radiation with tissue as well as to assist in the management of personnel exposure to radiation.

Some types of radiation, such as neutron and alpha, deposit their energy more densely in affected tissue than gamma radiation thereby causing more damage to tissue. The term **dose equivalent**, measured in units of rem, is used to take into account this difference in tissue damage. Therefore 1 rem from gamma radiation causes damage **equivalent** to 1 rem from alpha radiation. However, it takes one-twentieth as much energy from alpha radiation, as compared with gamma radiation, to produce this 1 rem **dose equivalent**.

Definitions for dose terms necessary for various exposure calculations and recordkeeping purposes include the following:

absorbed dose (D): Energy absorbed by matter from ionizing radiation per unit mass of irradiated material at the place of interest in that material. The absorbed dose is expressed in units of rad (or gray) i.e., 1 rad = 0.01 gray.

collective dose: The sum of the total effective dose equivalent values for all individuals in a specified population. Collective dose is expressed in units of person-rem (or person-sievert) i.e., 1 person-rem = .01 person-sievert.

committed dose equivalent ($H_{T,50}$): The dose equivalent calculated to be received by a tissue or organ over a 50-year period after the intake of a radionuclide into the body. It does not include contributions from radiation sources external to the body. Committed dose equivalent is expressed in units of rem (or sievert) i.e., 1 rem = .01 sievert.

committed effective dose equivalent ($H_{E,50}$): The sum of the committed dose equivalents to various tissues in the body ($H_{T,50}$), each multiplied by the appropriate weighting factor (w_T) - that is $H_{E,50} = \sum w_T H_{T,50}$. Committed effective dose equivalent is expressed in units of rem (or sievert).

cumulative total effective dose equivalent: The sum of the total effective dose equivalents recorded for an individual.

deep dose equivalent: The dose equivalent derived from external radiation at a tissue depth of 1 cm in tissue.

dose equivalent (H): The product of the absorbed dose (D) (in rad or gray) in tissue, a quality factor (Q), and all other modifying factors (N). Dose equivalent is expressed in units of rem (or sievert) (1 rem = 0.01 sievert).

effective dose equivalent (H_E): The summation of the products of the dose equivalent received by specified tissues of the body (H_T) and the appropriate weighting factors (W_T) - that is ($H_E = \sum W_T H_T$). It includes the dose from radiation sources internal and/or external to the body. The effective dose equivalent is expressed in units of rem (or sievert).

external dose or exposure: That portion of the dose equivalent received from radiation sources outside the body (e.g., "external sources").

internal dose or exposure: That portion of the dose equivalent received from radioactive material taken into the body (e.g., "internal sources").

lens of the eye dose equivalent: The external exposure of the lens of the eye and is taken as the dose equivalent at a tissue depth of 0.3 cm.

quality factor: The principal modifying factor used to calculate the dose equivalent from the absorbed dose; the absorbed dose (expressed in rad or gray) is multiplied by the appropriate quality factor (Q).

shallow dose equivalent: The dose equivalent deriving from external radiation at a depth of 0.007 cm in tissue.

total effective dose equivalent (TEDE): The sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures). Deep dose equivalent to the whole body may be used as effective dose equivalent for external exposures.

weighting factor (w_T): The fraction of the overall health risk, resulting from uniform, whole body irradiation, attributable to specific tissue (T). The dose equivalent to the affected tissue, H_T, is multiplied by the appropriate weighting factor to obtain the effective dose equivalent contribution from that tissue.

whole body: For the purposes of external exposure, head, trunk (including male gonads), arms above and including the elbow, or legs above and including the knee.

Fuel-Followed Control Rod. The fuel-followed control rod functions both as a fuel and control rod. Each contains approximately 28 centimeters (11 inches) of borated graphite above the fuel. The rods control the neutron flux when placed into the reactor at varying depths.

Interim storage. Storage of the fuel assemblies for the next 40 years. The ultimate disposition may be implemented by the SNF-PEIS Record of Decision.

Latent cancer fatalities. The number of excess cancer fatalities predicted in a population due to exposure to whole body irradiation.

Spent nuclear fuel. Fuel that has been withdrawn from a nuclear reactor following irradiation, but has not been reprocessed to remove its constituent elements.

TRIGA®. A registered trademark of General Atomics, the manufacturer of the reactor. TRIGA® is an acronym for Test Reactor and Isotope Production, General Atomics.

Units of Measurement

The principal units of measurement used in this EA are SI units, a metric system, accepted by the International Organization for Standardization. SI is the abbreviation for *Système Internationale d'Unités*. In this EA, values given in SI units are followed by values given in common units (sometimes called Imperial units) in parentheses.

Numbers that are very small or very large are often expressed in exponential notation. For example the number 0.000034 may be expressed as 3.4×10^{-5} and 65,000 may be expressed as 6.5×10^4 . A list of multiples and sub-multiples used in this EA are as follows:

Multiplier	Equivalent	Multiplier	Equivalent	Multiplier	Equivalent	Multiplier	Equivalent
10^6	1,000,000	10^2	100	10^{-1}	0.1	10^{-3}	.00001
10^5	100,000	10^1	10	10^{-2}	.01	10^{-6}	.000001
10^4	10,000	10^0	1	10^{-3}	.001	10^{-7}	.0000001
10^3	1,000			10^{-4}	.0001	10^{-8}	.00000001

Metric Conversion Chart

If you know	Multiply by	To get	If you know	Multiply by	To get
Length					
centimeters	0.3937	inches	kilometers	0.6214	miles
meters	3.281	feet			
Area					
square kilometers	0.3861	square miles	square meters	10.76	square feet
Mass (weight)					
grams	0.002205	pounds	grams	0.03528	ounces
kilograms	2.205	pounds			
Volume					
liters	0.2642	gallons (US)	cubic meters	35.31	cubic feet
Temperature			Radiation		
Celsius	multiply by 1.8, then add 32	Fahrenheit	sievert	100	rem

Source: *CRC Handbook of Chemistry and Physics*, Robert C. Weast, Ph.D., definition Ed., 1989-1990, CRC Press, Inc., Boca Raton, Florida.

1.0 Purpose and Need for Agency Action

The U.S. Department of Energy (DOE) needs to relocate the irradiated and unirradiated nuclear fuel assemblies from the Mark I TRIGA¹ Reactor storage pool in order to complete the shutdown of the 308 Building, in the 300 Area on the Hanford Site, Richland, Washington. Shutdown of the 308 Building would place the building in a minimum surveillance condition prior to decommissioning activities, saving an estimated \$600,000 per year.

The Hanford Site's Mark I TRIGA[®] Reactor was used for research and development and as a neutron source for the Neutron Radiography Facility (NRF) which supported the fabrication of removable core components and test assemblies for use in the Fast Flux Test Facility (FFTF). The DOE has decided to shutdown both the FFTF and the 308 Building. Removal of the fuel assemblies stored in TRIGA[®] Reactor storage pool is the last action necessary to complete the shutdown of the 308 Building.

¹ TRIGA is a Registered Trademark of General Atomic.

2.0 Description of the Proposed Action

The DOE proposes to relocate nuclear fuel assemblies (101 irradiated and three unirradiated) from the 308 Building storage pool in the 300 Area of the Hanford Site (Figures 1 and 2). Relocation of these fuel assemblies would allow the shutdown of the 308 Building, which is no longer needed for the fabrication of fuel assemblies and test assemblies for the FFTF.

The irradiated fuel assemblies would be placed in six NRF TRIGA® casks (TRIGA® casks) and two U.S. Department of Transportation (DOT) Specification 6M (DOT-6M) containers for transportation and storage in the Interim Storage Area (ISA) to be constructed in the 400 Area of the Hanford Site. The three unirradiated fuel assemblies would be transferred to another TRIGA® Reactor operated by U.S. Geological Survey a part of the U.S. Department of Interior (DOI) in Denver, Colorado. If the three fuel assemblies could not be transferred to Denver, they may be stored at the Plutonium Finishing Plant (PFP) in the 200 West Area until they can be transferred to another reactor. All, or some, of the irradiated fuel assemblies may be shipped to other TRIGA® Reactors before or after the relocation of the fuel assemblies has occurred. Relocation of any irradiated fuel assemblies to other reactors is not covered within the scope of this Environmental Assessment (EA).

During storage, the fuel assemblies in the TRIGA® casks and DOT-6M containers would be managed as spent nuclear fuel. The near-term relocation of the fuel is consistent with the Record of Decision (ROD) for the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Environmental Impact Statement* (SNF-PEIS) (DOE 1995a).

The current annual cost for surveillance and maintenance of the 308 Building is about \$900,000. It is anticipated this annual expense would be incurred as long as the TRIGA fuel remains in 308 Building. If the TRIGA fuel were removed and that portion of the 308 Building were shutdown, the annual operation and surveillance cost would be about \$300,000. The additional cost to relocate the TRIGA fuel and shutdown that portion of the 308 Building would be about \$1.7 million. This includes the engineering and procurement of the TRIGA® casks and DOT-6M containers, about \$750,000.

Figure 1.
Hanford Site.

Figure 2.
Hanford Site 300 Area.

2.1 The Neutron Radiography Facility's Mark I TRIGA® Reactor Storage Pool

The fuel assemblies are currently stored in the storage pool for the TRIGA® Reactor in 308 Building. The storage pool is approximately 3 meters (9 feet) in diameter, and 6 meters (20 feet) deep (Figure 3). The fuel assemblies, which were removed from the TRIGA® Reactor's core, are stored in racks in the storage pool. Each DOT-6M container (Figure 4) or TRIGA® cask (Figure 5) would be located near the storage pool. The shielding blocks over the storage pool would be removed, and the shielding block walls would remain in place. The shielding door would be opened to allow movement of the fuel assemblies to each TRIGA® cask or DOT-6M container. The radiation field located vertically above the fuel assemblies is reduced inherently by the configuration of several inches of reflector

material in the top portion of each individual fuel assembly, in addition to the shielding provided by the water. The room air passes through high efficiency particulate air filters before it is exhausted from the building.

Figure 3.
Neutron Radiography Facility.

Figure 4.
DOT-6M Leak Testable 110 Gallon Configuration.

Figure 5.
Neutron Radiography Facility TRIGA® cask.

The TRIGA® Reactor was operated in the 308 Building for 13 years, from 1976 until 1989. To protect and maintain the integrity of the currently stored fuel assemblies, storage pool maintenance and monitoring activities will continue until the fuel assemblies are removed. These activities include operation of the storage pool's water purification system; maintenance of the storage pool's water level and water level alarm; addition of makeup water to the storage pool; chemical analysis of the storage pool's water for pH, conductivity and gamma ray spectroscopic analysis content; continuous air monitoring for radiation in the reactor hall; calibration of radiation detection instruments; maintenance of the reactor hall ventilation; calibration of heating, ventilation, and air conditioning (HVAC) monitoring system's alarm; training and recertification of personnel; and safeguards and material accountability of fuel assemblies.

2.2 Fuel Assemblies

The 104 fuel assemblies consist of TRIGA® fuel assemblies, fuel-followed control rods, and a thermocouple instrumented fuel assembly. The fuel assemblies have various cladding materials and irradiation histories. They have been obtained from various sources before most were used in the NRF TRIGA® Reactor. The fuel assemblies are all in good condition and have not leaked.

The fuel columns in all of the fuel assemblies are ceramic zirconium hydride of which 8 to 8.5 percent is low-enriched uranium. The uranium portion of each fuel assembly is made up of less than 20 percent uranium-235 dispersed throughout the hydride. The original nominal uranium-235 content of each fuel assembly before irradiation was 37 to 38 grams. Each of the 104 fuel assemblies has one of two types of cladding material: 66 fuel assemblies have aluminum cladding, and 38 fuel assemblies (including four fuel-followed control rods and one thermocouple instrumented fuel assembly) have stainless-steel cladding. A radiological analysis based on historical operating history and physical measurements has been performed to verify the estimated radiation fields of the fuel assemblies.

2.2.1 Irradiated Fuel Assemblies

The irradiated assemblies have limited burnup; the uranium-235 burnup is probably less than one percent (30 to 35 grams) of the total grams of U-235 in all of the fuel assemblies. This low burnup has produced only a small amount of fission products resulting in a lower radiation exposure rate than a similar amount of fuel, with a higher burnup rate. The TRIGA® Reactor has not operated since 1989 which has allowed most of the high-activity, short-lived fission products to decay, further lowering the radiation exposure rate. Each irradiated fuel assembly is estimated to contain a maximum of 9.0 curies (150 rem per hour, unshielded) of radioactive material, including less than 3 grams of plutonium (WHC 1994b). The fuel assemblies are 72 centimeters (28.37 inches) long.

2.2.2 Irradiated Fuel-Followed Control Rods

Two irradiated fuel-followed control rods have less than one percent burnup and they were last irradiated in 1976 which has allowed most of the high-activity, short-lived fission products to decay, which has further lowered the radiation exposure rate. The fuel-followed control rods are 116 centimeters (45.75 inches) long compared to 72 centimeters (28.37 inches) for all the other fuel assemblies.

2.2.3 Unirradiated Assemblies

The three unirradiated assemblies consist of two fuel-followed control rods and one thermocouple instrumented fuel assembly. These three unirradiated fuel assemblies have a much weaker radiation field, 0.01 mrem per hour (unshielded, at the fuel assembly surface),

than irradiated fuel assemblies; therefore, they would not require remote handling or extensive shielding.

2.3 Transportation and Storage Packaging

The irradiated fuel assemblies would be placed in six TRIGA® casks and two DOT-6M containers for transportation and storage. The 99 shorter fuel assemblies would be placed in the TRIGA® casks, and the two longer irradiated fuel-followed control rods would be placed in the DOT-6M containers. The three unirradiated assemblies would be packed and transported in a DOE or DOT approved container (see 2.3.3).

2.3.1 Neutron Radiography Facility TRIGA® Cask

Six TRIGA® casks have been designed and would be built specifically for the proposed action. These TRIGA® casks would be approved for use onsite, in accordance with applicable regulations and orders, including *Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes*, DOE Order 5480.3 (DOE 1985), and DOE-RL Order 5480.1A (DOE-RL 1988).

The TRIGA® casks have been designed and built to meet the criteria necessary for future U.S. Nuclear Regulatory Commission (NRC) and/or DOT approval for offsite transportation in accordance with 49 *Code of Federal Regulations* (CFR) 173, *Shippers - General Requirements for Shipments and Packagings*, and *Packaging and Transportation of Radioactive Material* (10 CFR 71). Safety of the transfers has been demonstrated by analysis, using NRC performance standards, and Hanford Site packaging safety acceptance criteria. The TRIGA® casks have been analyzed and evaluated for their thermal stability, containment, shielding, and nuclear subcriticality for normal conditions, and hypothetical accident conditions, during transportation (WHC 1994a).

The TRIGA® casks and overpacks have been designed as reusable, single-containment transportation packages. Each TRIGA® cask would contain two individual components (the inner cask and the outer cask). The inner cask would provide confinement, and the outer cask would provide containment. The TRIGA® casks would be top loaded (i.e., the fuel assemblies would be loaded into the inner casks through a lid opening). After the basket containing the fuel assemblies is placed in the inner cask, the lids on the inner and outer casks would be sealed. During shipment, the transportation package would consist of the TRIGA® cask placed in the overpack for protection.

The outer cask materials and seal have been designed of a material that can meet a storage life of at least 50 years in a climatically (Hanford Site) uncontrolled environment. The TRIGA® cask is designed to have an allowable accessible surface dose rate of 100 millirem per hour or less. The additional DOT dose rate requirements of 10 millirem per hour or less at 2 meters (6.56 feet) from the accessible surface of the cask, and 2 millirem per hour or less in the transporter cab would be met during transport. Relocation is expected to be completed in 1996.

2.3.2 The DOT-6M Container

The four fuel-followed control rods are approximately 43 centimeters (17 inches) longer than the remaining fuel assemblies. It would not be cost effective to design the TRIGA® casks to accommodate both lengths of fuel assemblies. The two irradiated fuel-followed control rods would be placed in two DOT-6M containers for transportation and storage.

Each DOT-6M container would be fabricated from a 110-gallon drum (Figure 4). An inner containment vessel would be fabricated from a stainless steel 13-centimeter (5-inch) diameter pipe. A 1.3-centimeter (0.5-inch) thick stainless steel plate would be welded to the bottom of the pipe. The top of the pipe would be sealed by a bolted flange assembly. The containment vessel would have the necessary connections to test the seal to verify it would be leak tight. The inner containment vessel would be supported within the outer vessel.

2.3.3 Unirradiated Fuel Assembly Container

The three unirradiated fuel assemblies would be shipped off the Hanford Site in a DOT approved container. If necessary, the three fuel assemblies would be relocated to storage on the Hanford Site in DOE-approved containers (DOE 1985, DOE-RL 1988). The three assemblies would be stored at PFP in one of the existing materials storage areas until they could be relocated off the Hanford Site.

2.4 Retrieval and Packaging of the Fuel Assemblies

Procedures for the retrieval and packaging of each fuel assembly have been developed for both the irradiated and unirradiated fuel assemblies.

2.4.1 Retrieval and Packaging of the Irradiated Fuel Assemblies

Operators working in the area located directly over the storage pool would place a maximum of 18 fuel assemblies into a fuel basket for each TRIGA® cask through remote mechanical means. The fuel basket would have divided storage locations and a handling bail on top. In a similar manner, a fuel-followed control rod would be placed in a DOT-6M fuel basket. After the basket is loaded, the operators would leave the area directly over the storage pool.

An operator and a Health Physics Technician (HPT), would stand in the shielded area of the reactor hall and operate the overhead bridge crane to raise the fuel basket out of the storage pool (Figures 2 and 6). Mirrors and cameras would be installed to help the operators control the movement of the basket. An observer, an HPT, and possibly a supervisor would stand further away, in the unshielded area in room 158, to assist the hoist operator (Figure 6).

Figure 6.
Mark I TRIGA® Reactor Location
in the 308 Building.

The fuel basket would be raised out of the water and suspended in the shielded loadout area, located over the storage pool, until the fuel basket and the assemblies are dry. If necessary, fans would be used to circulate the air and speed up the drying of the fuel basket and the assemblies. It may take up to one hour to dry the fuel basket and assemblies.

After the fuel basket and the assemblies are dry, they would be lifted out of the drying area, transferred and lowered into the TRIGA® cask or DOT-6M container, and disengaged from the crane hook. This process could take up to 10 minutes. The lids on the inner and outer casks would be sealed. The TRIGA® cask or DOT-6M container then would be surveyed for surface contamination, and the seal would be tested.

After the fuel assemblies are placed into each TRIGA® cask or DOT-6M container, the shielding door would be closed until another transfer is ready. This transfer process would be repeated until all of the irradiated fuel assemblies have been removed from the storage pool.

After each TRIGA® cask or DOT-6M container is loaded and sealed, it would be moved to a staging area in the room adjacent to the TRIGA® Reactor until it is transported to the 400 Area ISA.

2.4.2 Retrieval and Packaging of Unirradiated Fuel Assemblies

The three unirradiated fuel assemblies would be removed from the storage pool individually, dried, and placed in the appropriate container. This container would then be closed and staged until it is transported.

2.5 Transportation and Storage

The TRIGA® irradiated fuel assemblies would be stored in the 400 Area ISA. The ISA would also store irradiated fuel assemblies and fueled components removed from the FFTF as described in the *Environmental Assessment: Shutdown of the Fast Flux Test Facility, Hanford Site, Richland, Washington, May 1995* (DOE 1995b).

The TRIGA® casks and DOT-6M containers would be placed in a storage module. The proposed storage module would be a reinforced concrete module. A possible configuration is shown in Figure 8. It would provide additional radiation shielding, cask and container weather protection, and adequate security. There would be gaskets or seals between the concrete cover and module body to help prevent rain and dust infiltration into the module. The module would be placed in the ISA, the casks and containers placed in the module, then the cover placed on the module body. Only a portion of the storage module will be used in storing all of the TRIGA® irradiated fuel assemblies.

Figure 7.
400 Area Storage Location.

Figure 8.
Example Storage Module Configuration.

2.5.1 Loading the Transportation Packages and the DOT-6M Containers

The transportation package for each TRIGA® cask would consist of the cask placed in an overpack for protection. Each DOT-6M container would also be a transportation package. Up to two packages may be loaded and transported on the truck at the same time. The transportation packages would be secured onto the truck, and transported to the storage location.

2.5.2 Transportation Route

The TRIGA® casks and the DOT-6M containers would be transported approximately 13 kilometers (8 miles). The driver, and possibly an assistant, would be in the cab of the truck during transport. The road from the 300 Area to the 400 Area, normally accessible to the public, would be closed to traffic during transport. To reach the 400 Area, the transport vehicle would follow Route 4S north to Kentucky Boulevard to the 400 Area (Figure 1). The transportation route would be evaluated for traffic conditions and safety before departure. Total transportation time, including all inspections, should not exceed two hours. The "rolling closure" concept would be used providing for short term closure of the route to traffic on the sections of the route being used until the transport has passed those sections. The shipments would be made during periods of off-peak traffic.

2.5.3 Unloading and Unpackaging

When the transport vehicle arrives at the 400 Area ISA, the transportation packages would be unloaded. Each TRIGA® cask would be removed from the overpack. Each TRIGA® cask or DOT-6M container would then be placed in the storage module. After all the TRIGA® casks and DOT-6M containers have been placed in the storage module, a cover would be installed on the storage module.

2.5.4 Storage and Maintenance

Because the TRIGA® casks and DOT-6M containers would be sealed, no air emissions should occur during storage. The storage module, TRIGA® casks, and the DOT-6M containers may be inspected to verify integrity; an inventory of the material content and possibly the retrieval of a gas samples might be conducted periodically. This inspection process, using two operators, could require up to 60 minutes every year. The exterior of the storage module may also be periodically inspected. The inspection could require approximately five minutes every month. If necessary, the storage module, TRIGA® casks, and DOT-6M containers could be relocated within the storage area in the future.

2.5.5 Transportation and Storage of the Unirradiated Fuel Assemblies

The three unirradiated fuel assemblies would be transported from 308 Building to the DOI TRIGA® Reactor in Denver, Colorado. The route for the transport would be similar to the route analyzed in the *Environmental Assessment: Return of Isotope Capsules to the Waste Encapsulation and Storage Facility* (DOE 1994a). If necessary, the three fuel assemblies would be transported to PFP in the 200 West Area (Figure 1) for storage. The fuel assemblies are sealed so no air emissions could occur during transportation or storage. If stored at PFP, the unirradiated fuel assemblies would be stored and managed in existing material storage areas. No modifications to the PFP would be required to store the three fuel assemblies. The unirradiated fuel assemblies would be included in routine periodic material inspections and inventories. Eventually they could be repackaged in the appropriate container for transportation to another TRIGA® reactor.

2.6 Interim Storage

When interim storage for all of the SNF on the Hanford Site is determined, the TRIGA® casks and DOT-6M containers may be retrieved from storage and relocated. The TRIGA® casks and DOT-6M containers may be reviewed and possibly approved by NRC and/or DOT for offsite shipment or could be placed in other existing approved casks for offsite shipment. If necessary, the fuel could be retrieved and repackaged as appropriate.

2.7 Shutdown of the 308 Building

After all the fuel assemblies are removed from the 308 Building, any remaining salvageable components, such as storage racks, monitoring equipment, cooling system, and purification system, would be removed and, if possible, sent to another reactor or user for reuse. Those components that are not relocated would either be stored or disposed of as appropriate. The water also would be drained from the storage pool. Samples of the water, and smears of equipment removed from the storage pool, have shown no contamination in the water. Following verification sampling, the water would be either disposed of or recycled for other industrial uses, such as makeup water for other fuel storage pools on the Hanford Site. Finally, the electrical connections to the TRIGA® Reactor would be locked off, and water and ventilation systems would be shut down. The 308 Building would then be completely shutdown.

3.0 Alternatives to the Proposed Action

3.1 No-Action Alternative

Under the No-Action Alternative, the fuel assemblies would continue to be stored in the 308 Building's storage pool. To protect and maintain the integrity of the fuel assemblies, this alternative would require continued monitoring, ventilation, and surveillance.

Maintenance and monitoring activities include operation of the storage pool's water purification system; maintenance of the storage pool's water level and level alarm; the addition of makeup water to the storage pool; chemical analysis of storage pool water's pH, conductivity and gamma ray spectroscopic analysis content; continuous air monitoring for radiation in the reactor hall; calibration of radiation detection instruments; maintenance of reactor hall ventilation; calibration of the HVAC monitoring system's alarm; training and recertification of personnel; and safeguards and material accountability of fuel assemblies. This alternative does not meet the agency need and was not analyzed further.

3.2 Store the Fuel Assemblies in an existing Waste Storage Facility

Relocation of the fuel assemblies to an existing Hanford Site waste storage facility, such as the Hanford Central Waste Complex (HCWC) in the 200 West Area which presently stores hazardous waste, was evaluated. The waste storage facilities operate in compliance with federal and state waste regulations, including the *Resource Conservation and Recovery Act of 1976*, and the State of Washington Department of Ecology *Dangerous Waste Regulations, Washington Administrative Code 173-303*. Dangerous waste permit application documentation was submitted for the HCWC on October 31, 1991 (DOE/RL-91-17). The fuel assemblies could be managed as spent nuclear fuel while stored in the waste storage facility. The lead shielding in the TRIGA® casks could be considered waste by regulatory agencies, possibly resulting in requiring compliance with waste storage regulations. Management of the fuel assemblies stored in the TRIGA® casks and DOT-6M containers as a waste is technically viable. This would unduly complicate management activities, requiring more frequent inspections of the casks and containers with a corresponding increase in worker radiation dose.

3.3 Ship the Fuel Assemblies to the Idaho National Engineering Laboratory for Storage

The fuel assemblies could be shipped to the Idaho National Engineering Laboratory's (INEL) fuel storage facility. This facility currently stores irradiated TRIGA® Reactor fuel assemblies. However, the INEL is not able to receive nuclear shipments at this time. The fuel assemblies would remain in the storage pool until the SNF-PEIS's ROD is implemented. Implementation of the record of decision would relocate the fuel assemblies to the INEL. However, this alternative would not meet the need to remove the fuel assemblies from 308

Building in a timely manner. Implementation of the proposed action would not preclude shipment of the fuel assemblies to INEL in the future.

3.4 Ship the Fuel Assemblies to Another Existing Fuel Storage Basin on the Hanford Site

Other existing fuel storage basins are located on the Hanford Site. The 105-KE and 105-KW Reactor fuel storage basins (K Basins), along with the T Plant fuel storage basins, could store the fuel assemblies. In all of these locations, the operational safety requirements or technical specifications would have to be revised and approved. The 20 percent enriched uranium-235 fuel assemblies exceed the two facility's operational safety requirement of five percent maximum enriched material. Transportation packaging and supporting equipment would be required, and facility modifications could be required in order to store the fuel assemblies. This alternative does not meet the agency need and was not analyzed further.

3.5 Rail Transport

The irradiated fuel assemblies could be transported to the 400 Area ISA via rail. However, in order to reach the rail line, the casks and containers would have to be loaded onto a truck, transferred to the railcar, transferred to a truck, then offloaded at the ISA. The extra handling of the casks and containers would unnecessarily complicate the transportation, and therefore was not analyzed further.

4.0 Affected Environment

This section provides an overview of environmental characteristics of the Hanford Site and site-specific characteristics of the 300 and 400 Areas, where the proposed action would occur. Detailed environmental information concerning the Hanford Site is provided in various documents (DOE 1983, DOE 1987, PNL 1994a).

4.1 Location and Regional Population

Nearly all activities would take place on the Hanford Site, approximately 1,450 square kilometers (560 square miles), located in the south-central portion of the State of Washington (Figure 1). The fuel assemblies are presently stored in the 308 Building, located in the 300 Area of the Hanford Site. The proposed storage locations are in the 400 Area (Figure 7) and possibly the 200 West Area of the Hanford Site. The 308 Building is located approximately 460 meters (1,500 feet) west of the Columbia River. The proposed storage location in the 400 Area is located approximately 7 kilometers (4.5 miles) west of the Columbia River. Possible storage could also be located at PFP in the 200 West Area, approximately 11 kilometers (7 miles) south of the Columbia River. All of the sites are located outside the projected 100-year Columbia River floodplain and the 100-year floodplain of Cold Creek, an ephemeral stream in the southwest portion of the Hanford Site. The 308 Building, the 400 Area storage, and the PFP are not within the Hanford Reach (DOI 1994).

The City of Richland (population 33,500), the nearest population center, adjoins the southernmost portion of the Hanford Site boundary, and is approximately 40 kilometers (25 miles) from the PFP, 19 kilometers (12 miles) from the 400 Area, and 1.6 kilometers (1 mile) from the 308 Building. The 1990 population within an 81-kilometer (50-mile) radius of the Hanford Site was estimated to be 420,000. The 1990 Census indicates that, in Benton and Franklin counties, individuals of Hispanic origin represent a higher proportion of the population (13.3 percent, PNL 1994a), than in the whole State of Washington (4.4 percent).

The major Hanford Site roadways are shown in Figure 1. The transportation routes include some roads with public access. For example, the transportation route from the 300 Area to the 400 Area has public access. The roads within each area are private DOE roads.

Three unirradiated fuel assemblies would be transported approximately 1800 kilometers (1100 miles) to the DOI at the Federal Center in Denver, Colorado, or approximately 40 kilometers (25 miles) on the Hanford Site to the PFP. The route would be similar to that described in the *Environmental Assessment: Return of Isotope Capsules to the Waste Encapsulation and Storage Facility* (DOE 1994a).

4.2 Physical Environment

The Columbia River, the dominant river in the region, flows through the northern part of the Hanford Site and along the eastern boundary. Grade level at the 308 Building is 123 meters (404 feet) above sea level, which is 2.4 meters (8 feet) above the projected 100-year flood. The 400 Area is about 165 meters (550 feet) above sea level, and above the projected 100 or 500 year flood. The PFP is about 206 meters (676 feet) above sea level, and also above the projected 100 or 500 year flood. The depth to groundwater at the proposed 400 Area is more than 30 meters (100 feet), approximately 80 meters (260 feet) at PFP, and approximately 19 meters (62 feet) at 308 Building.

The storage location in the PFP would be in an existing building currently in use. A biological review (Appendix A) found that extensive 400 Area site development around the storage location has removed all of the native vegetative cover. The proposed action would not affect a wetland; threatened, endangered, or candidate species; prime or unique farmland; or wild and scenic river.

A Cultural Resources Review for historic, archeological, or architectural significance of the 400 Area storage location has been completed. The 400 Area has been previously disturbed over the past 30 years. No sensitive cultural resources in the area of the reactor complex have been identified, or are anticipated (Appendix B).

5.0 Environmental Impacts of the Proposed Action

Impacts of construction, relocation, and routine operations (storage) aspects of the proposed action are discussed in the following sections. If the fuel is not relocated, the 308 Building cannot be shutdown and the annual cost of about \$900,000 would continue until the fuel assemblies could be removed from the storage pool. While none of the fuel assemblies have leaked, to date, and the storage pool does not currently leak, there is risk in storing the fuel assemblies in a water storage pool approximately 450 meters (1,500 feet) from the Columbia River.

5.1 Construction and Fabrication Impacts

The TRIGA® casks would be fabricated primarily with stainless steel and lead. As much as 6,000 kilograms (13,000 pounds) of stainless steel and lead could be used in the fabrication of the casks and containers. No environmental impacts are anticipated from the fabrication process.

Materials utilized, such as steel, lead, and concrete, represent a long-term commitment of nonrenewable resources. None of these resources would be used in large quantities when compared to resources previously committed to structures and facilities on the Hanford Site. Minor amounts of waste may be generated during fabrication.

If expansion of the 400 Area storage pad is required, a small amount of concrete and steel would be committed. The associated excavation would not impact any known cultural resources or habitat for any federal or state threatened, endangered, candidate or monitor species (Appendices A and B). Minor amounts of dust may be generated for a short time during construction, and a small amount of construction associated waste would be disposed of in existing Hanford Site waste disposal facilities.

5.2 Transportation Impacts

Impacts of relocation of the irradiated fuel assemblies would occur in three stages: (1) placing the fuel assemblies into the casks and containers, (2) transporting the casks and containers to the 400 Area, and (3) offloading and placing the casks and containers in a storage module. The workers would be exposed to radiation fields during each of these phases. The impacts of transporting the three unirradiated fuel assemblies to Denver or storage at PFP would be less than similar actions previously analyzed (DOE 1994a, DOE 1992). No impacts are anticipated from the transportation of salvageable components, such as storage racks and monitoring equipment, to another TRIGA® reactor for reuse.

It is difficult to precisely determine the actual personnel exposure at this time since the detailed operating procedures, local shielding, and the corresponding detailed worker dose assessments have not been finalized. Appropriate administrative and engineering controls

would limit individual personnel exposure as low as reasonably achievable and below the maximum allowed by DOE order (5 rem per year). A worst-case estimate of possible radiological exposure is presented in this section. For this analysis, it is assumed that all personnel would remain in the maximum radiation field for the maximum duration without the aid of additional shielding.

5.2.1 Placing the Fuel Assemblies Into the Six Neutron Radiography Facility TRIGA® casks.

Workers moving the fuel assemblies into the basket would be exposed to a very small radiation field above the storage pool, and no radiation health effect is anticipated. The estimated radiation dose rate for workers in the reactor hall that operate the hoist to lift the loaded basket would be 0.02 rem per hour while the fuel assemblies are drying. An hour of drying time may be required; however, the workers would only be in the radiation field approximately 10 minutes while the fuel assemblies are drying. The dose rate increases to 0.1 rem per hour for up to 10 minutes while the basket is lifted, maneuvered, and placed into the cask. The workers 15 meters (50 feet) away in Room 158 would receive 0.03 rem per hour. The observers would be in this field for approximately 10 minutes during fuel assembly drying and approximately 10 minutes during loading. The estimated radiation dose to the workers during the entire drying and loading operation assumes the two workers (an operator and an HPT) remain at the hoist controls in the reactor hall, and two workers and possibly a supervisor remain at the 15-meter (50-foot) observation point in Room 158.

The cask would then be sealed, vacuum dried, filled with inert gas, leak-checked, surveyed, moved to a staging area, and inspected. During the sealing operations, two workers would receive a radiation dose rate of 0.1 rem per hour maximum at the surface of the loaded cask for about 10 minutes. During the remaining operations, the workers would be 1 meter (3.3 feet) from the surface of the cask in an estimated radiation field of 0.01 rem per hour or less for about 45 minutes. The doses for placing the fuel assemblies in the cask and staging the cask are summarized in Table 1.

Table 1.
Estimated Worker Dose Loading TRIGA® Casks.

Operation	Location	Number of Workers	Time in Field (minutes)	Dose Rate (rem/hr)	Dose for Workers (person-rem)
Drying per cask	Reactor Hall	2	10	0.02	0.007
	Observers	3	10	0.03	0.015
Lifting into a cask	Reactor Hall	2	10	0.1	0.03
	Observers	3	10	0.03	0.015
Sealing a cask	Cask Surface	2	10	0.1	0.033
Miscellaneous operations for a cask	1 meter (3.3 feet) from the cask	2	45	0.01	0.015
Total each cask					0.12
Total 6 casks					0.72

The workers would receive a direct exposure of 0.72 person-rem while placing the fuel assemblies into and staging all six TRIGA® casks.

5.2.2 Placing the Fuel-Followed Control Rods Into DOT-6M Containers.

The estimated radiation dose rate that the workers would receive while loading the DOT-6M containers is summarized in Table 2. The sequence of operations is nearly the same as those for the TRIGA® cask. The radiation dose rate is lower because there would be fewer assemblies with lower activity in the basket.

Table 2.
Estimated Worker Dose DOT-6M Containers.

Operation	Location	Number of Workers	Time in Field (minutes)	Dose Rate (rem/hr)	Dose for Workers (person-rem)
Drying	Reactor Hall	2	20	0.002	0.0014
	Observers	3	20	0.003	0.003
Lifting into container	Reactor Hall	2	20	0.01	0.0066
	Observers	3	20	0.003	0.003
Sealing the container	Cask surface	2	20	0.1	0.066
Miscellaneous sealed container operations	1 meter (3.3 feet) from the cask	2	90	0.01	0.03
Total					0.12

The total estimated worker dose to load all of the fuel assemblies into the appropriate casks and containers for transportation and storage is estimated to be 0.84 person-rem.

5.2.3 Transporting the Packages

The transportation packages would consist of the casks and overpacks, or DOT-6M containers. Four members of the crew that would load the packages onto the transport vehicle would be exposed to a radiation dose. These four members could be two riggers, an HPT, and an inspector. Additional workers may be involved in the activity; however, no radiation dose is expected for those workers. Loading each transportation package onto the vehicle would expose two workers to a radiation field of 0.1 rem per hour for approximately 10 minutes at the surface of the package, two workers to a radiation field of 0.01 rem per hour for approximately 10 minutes at 1 meter (3.3 feet) from the package. This would result in 0.29 person-rem exposure for eight packages.

The transportation route would be on public roads to the 400 Area and on DOE private roads thereafter. The public roads would be closed to the public during transport of the fuel, so no radiation dose to the public would be expected. During transportation of the packages to the 400 Area, the radiation field in the cab of the transport vehicle would correspond to a dose rate of 0.002 rem per hour maximum. Assuming both DOT 6-M containers would be transported in one shipment (they may be shipped with two TRIGA casks, which would require fewer shipments) there would be seven shipments of a two-hour duration each. The resultant estimated maximum worker dose to the driver and occupant would be 0.056 person-rem. It would be anticipated that the rolling road closure for each shipment would be scheduled for off-peak traffic flow times and would last no longer than 30 minutes.

5.2.4 Offloading the Packages

Offloading the casks at the storage location would result in 0.29 person-rem; the same as the dose from loading the casks onto the transport vehicle. At the storage location, additional worker exposure (0.08 person-rem) would occur during placement of the casks and containers in the storage module. This would result in 0.37 person-rem exposure for the six casks and two containers.

5.2.5 Total Transportation Radiation Impact

Relocation of the fuel assemblies to interim storage would result in a total radiation exposure workers of approximately 1.6 person-rem (Table 3). While it is highly speculative to estimate health effects of low levels of radiation exposure, the number of latent cancer fatalities (LCF) that might occur as a result of radiation exposure may be estimated using the factor of 4×10^{-4} LCF per person-rem (ICRP 1991). This would result in an estimated 6×10^{-4} LCFs among the workers for fuel assembly relocation, or no anticipated LCFs. As a perspective, if a workforce of approximately 75,000 were exposed to the same radiation fields, an LCF might occur.

Table 3.
Total Estimated Worker Radiation
Exposure for Relocation.

Operation	Radiation Exposure (person-rem)
Placing the fuel assemblies into the casks and containers	0.84
Loading the casks and containers	0.29
Transporting the casks and containers	0.056
Offloading the casks and containers	0.37
Total	1.6

5.2.6 Unirradiated Fuel Assemblies Impacts

The impacts of transporting the three unirradiated fuel assemblies to the DOI TRIGA® Reactor in Denver, Colorado, can be compared to the similar action of transporting isotope capsules from the Denver suburb of Northglenn to Hanford. The DOE issued a Finding of No Significant Impact on May 11, 1994 for the *Environmental Assessment: Return of Isotope Capsules to the Waste Encapsulation and Storage Facility, Hanford Site, Richland, Washington* (DOE 1994a). The action analyzed in the EA included 20 shipments of 309 cesium capsules with a total radioactivity of nearly 14 million curies was estimated to result in 0.00255 and 0.000134 LCFs for the public and workers respectively. The cesium capsule shipment impacts are much greater than the potential impacts from the proposed single shipment of three fuel assemblies to Denver with a total radioactivity of less than .00004 curies.

If the three fuel assemblies are relocated to the PFP for storage, the impacts can be compared to previous actions. The DOE issued a Finding of No Significant Impact on January 9, 1992 on the *Environmental Assessment: Storage of Fast Flux Test Facility Unirradiated Fuel in the Plutonium Finishing Plant Complex* (DOE 1992). The action analyzed in the EA included nine shipments of over 12,000 unirradiated fuel pins containing mostly mixed plutonium and uranium oxide fuel, from 308 Building to PFP for storage. The impacts of the proposed action of shipping three unirradiated uranium fuel assemblies to PFP would not be as great as the impacts analyzed in that EA.

5.3 Impacts from Fuel Assembly Storage

No air or liquid emissions from storage of the fuel assemblies in the PFP or the ISA are expected.

Potential radiation exposure would be minimized by shielding features in the design of the casks. Shielding of the casks and the low activity of the fuel assemblies would reduce personnel radiation dose rates to as low as reasonably achievable in accordance with 10 CFR 835 "Occupational Radiation Protection" and *Hanford Site Radiological Control Manual, Revision 2* (DOE 1994b). The maximum dose rate at the surface of the loaded NRF TRIGA® cask would be 0.1 rem per hour in the storage module.

The most conservative estimate of personnel radiation exposure during the inventory of the material content and possibly the retrieval of cask and container gas samples would assume two workers would annually require 60 minutes or less in a radiation field of 0.01 rem per hour or less. The radiation exposure to workers during annual surveillance of the storage module would be estimated to be 0.02 person-rem. Inspection of the storage module exterior would expose two workers to a radiation field of 0.001 rem per hour as often as five minutes every month. This would result in an annual dose of 0.002 person-rem. These combined doses would result in an estimated 9×10^{-6} LCF over the 40-year storage life of the cask.

The relocation and storage of the fuel assemblies could result in a reduction of workforce of up to four workers. These workers would be reassigned to other positions, if available. The socioeconomic impact of possible workforce reduction is unknown at this time because of uncertainties associated with the future Hanford Site budgets.

No sensitive cultural resources in the storage areas have been identified, or are anticipated. Extensive site development around the proposed storage locations have removed most of the native vegetative cover (Appendix A). The proposed action would not affect a wetland; threatened, endangered, or candidate species; prime or unique farmland; or wild and scenic river.

A minor amount of low-level radioactive and non-radioactive waste would be generated during the fuel relocation. All of the waste would be disposed in existing waste management facilities on the Hanford Site.

5.4 Impacts from Accident Scenarios

5.4.1 Neutron Radiography Facility TRIGA® Cask Loading

The Interim Safety Basis for the 308 Building (WHC 1994b) evaluates unplanned releases that might occur from accidents, including accidents during loading of the fuel assemblies into the TRIGA® casks. Several types of accidents were considered including

mechanical failure, human error, and natural forces (i.e., earthquake, high wind, flood, and ashfall). A safety analysis report for NRF TRIGA packaging (WHC 1994a) has been prepared for transportation of the fuel assemblies in the casks, and evaluates the cask integrity when exposed to all applicable accident scenarios. Accidents could occur during storage of the casks; these accidents would be analyzed in the appropriate facility specific safety analysis.

A postulated accident scenario would involve the rupture of 18 fuel assemblies that are to be loaded into the cask. This is a highly improbable situation (annual probability of less than 3×10^{-7}) because the assemblies are protected by the basket during this operation, and drop distances are minimal. The primary impact of the rupture would be the possible release of gaseous krypton-85 from all 18 fuel assemblies. If the ventilation system were not operating, the krypton-85 would accumulate in the room resulting in a dose to the workers in the reactor hall. If the ventilation system were operating, the dose to the workers would be reduced; however, there would be a higher dose to the onsite and offsite populations. Krypton-85 is an inert gas that would dissipate and not collect on HEPA filters. The consequences of the postulated accident have been estimated in Appendix C and are summarized in Table 4.

Table 4.
Impacts Resulting from the Accidental
Rupture of 18 Fuel Assemblies.

Receptor Location	Dose Consequences		Health Effects	
	No HVAC	HVAC	No HVAC	HVAC
Facility Worker	21 millirem	15 millirem	8.4×10^{-6} LCF	6.0×10^{-6} LCF
Maximum Onsite Individual (100 m N)	0	0.17 millirem	0	6.8×10^{-8} LCF
Maximum Site-Boundary Individual (510 m ESE)	0	0.028 millirem	0	1.5×10^{-8} LCF
Maximum Onsite Population (E, pop=314)	0	39 person-millirem	0	1.2×10^{-5} LCF
Maximum Offsite 50-mile Population (S, pop=57,116)	0	1.8 person-millirem	0	9.0×10^{-7} LCF

Another highly improbable accident scenario that could result in a greater dose consequence to the directly involved worker would be the dropping of the 18 fuel assemblies so that the workers are exposed to direct radiation. It is assumed that the fuel assemblies do not rupture, but the workers would still be exposed to direct radiation. The analysis of the potential dose consequences of this accident also is included in Appendix C. The maximum exposed worker could receive 25 millirem. This would correspond to 1.0×10^{-5} probability

that the worker would become an LCF. The consequences of this postulated accident are summarized in Table 5.

Table 5.
Impacts Resulting from the Accidental
Dropping of 18 Fuel Assemblies.

Receptor Location	Dose Consequences		Health Effects	
	No HVAC	HVAC	No HVAC	HVAC
Facility Worker	25 millirem	25 millirem	1.0×10^{-5} LCF	1.0×10^{-5} LCF

Worker radiation exposure would be anticipated during the cleanup from the postulated accident. Extensive use of shielding, robotics, and remote handling equipment would minimize the worker radiation exposure as the fuel assemblies are gathered and placed in a shielded cask. It is estimated that four workers would receive 0.5 person-rem during accident cleanup, which would correspond to 2×10^{-4} probability that the workers would have a LCF.

5.4.2 Fuel Assembly Relocation Accidents

The cask, overpack, and engineered tie-down system or container would secure the fuel assemblies during postulated transportation accident conditions. In an unlikely (3×10^{-10} annual probability) postulated accident scenario of a collision resulting in a secondary fire of the transport vehicle, no breach of the cask or container is anticipated with no resultant release of fissile material (WHC 1994a).

5.4.3 Fuel Assembly Storage Accident

A potential accident scenario that has been postulated and analyzed for the storage of the TRIGA fuel assemblies. In the unlikely event (.003 annual probability) that the boom of the crane is placing the FFTF fuel storage casks were to fail, allowing a cask to fall on the storage module containing the TRIGA fuel assemblies, it is postulated that the storage module would fail and some of the contained fuel would be crushed. Some of the crushed fuel could be released to the atmosphere. Conservatively, assuming that 10 percent of the fuel is crushed and 1 percent of the crushed fuel is lofted into the air and becomes respirable, the potential accident effects have been estimated. The directly involved worker could be injured by a falling boom or cask. Nearby workers not involved in the fuel storage activities could be exposed to radiation exposure from the release. The maximum exposed individual at 100 meters (330 feet) could receive 3.3 rem, which would result in an estimated annual probability of a fatal cancer induced by the radiation of 0.001. Approximately 210 workers in the 400 Area south southwest of the accident would receive 78 person-rem resulting in an

estimated .03 LCFs induced by the exposure. The offsite population of 78,700 south southeast of the accident could receive 6.6 person-rem, resulting in an estimated 0.003 LCFs induced by the exposure. It is most likely that there would be no fatal cancers attributable to this potential exposure at the 400 Area storage pad.

5.5 Environmental Justice Impacts

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires that Federal agencies identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of their programs and activities on minority and low income populations. DOE is in the process of developing official guidance on the implementation of the Executive Order. The analysis in this EA indicates that there would be minimal impacts to both the offsite population and potential workforce as a result of relocation of the fuel assemblies, under both routine and accident conditions, with the exception of social and economic impacts which are unknown. It is not expected that there would be any disproportionate impacts to any minority or low-income portion of the community.

5.6 Cumulative and Collocation Impacts

The existing and planned future facilities at the Hanford Site were reviewed to determine any near-term cumulative or synergistic impacts that could result from the proposed relocation of fuel assemblies to the 400 Area.

The existing areas that contribute to the cumulative impact include the following:

- Waste Management activities, including 177 waste storage tanks
- Plutonium-Uranium Extraction Plant
- PFP
- K Basins
- FFTF Deactivation

The personnel that would periodically survey the storage containers also would perform other duties at the 400 Area storage pad. The additional radiation exposure to these workers would be very small. The offsite exposure from Hanford Site 300 and 400 Area operations in 1993 was estimated to be 0.07 and 0.003 person-rem respectively (PNL 1994b). Relocation of the fuel assemblies is not expected to change this estimated dose.

The risks associated with routine transport of the unirradiated fuel assemblies to Denver are very small, and the radiation exposure to workers and members of the public is extremely low (far less than natural background radiation).

The reduction of four workers after relocation of the fuel assemblies is completed represents approximately 0.03 percent of the 1995 Hanford Site workforce. Social and economic impacts cannot be quantified at this time because of uncertainties associated with the future Hanford Site budgets. However, the analysis in this EA indicates that there would be minimal impacts to both the offsite population and potential workforce as a result of relocation of the fuel assemblies under both routine and accident conditions.

6.0 Regulatory Provisions Considered

It is the policy of the DOE to carry out its operations in compliance with all applicable federal, state, and local laws and regulations. The relocation of the fuel assemblies would not be regulated under solid waste regulations. The State of Washington Department of Health (DOH) has stated that the relocation of the fuel assemblies does not require *Clean Air Act of 1977* permitting (Appendix D).

Fugitive emissions (especially dust) from construction/operational activities associated with the 400 Area storage pad would be controlled in accordance with normal practices, as per Benton-Franklin County Clean Air Authority rules. An example of such a control would be wetting ground surfaces.

Any radioactive solid waste that would be generated would be subject to the requirements of DOE Order 5820.2A, *Radioactive Waste Management* (DOE 1988a, 10 CFR 835). Disposal of solid, low-level mixed waste would be subject to DOE Order 5820.2A and the additional requirements of *Resource Conservation and Recovery Act of 1976*, and *Washington Administrative Code* 173-303, "Dangerous Waste Regulations."

The storage of the irradiated fuel assemblies as spent nuclear fuel at the 400 Area storage location would meet applicable requirements of DOE Order 6430.1A, *General Design Criteria* (DOE 1989), *Hanford Site Radiological Control Manual, Revision 2* (DOE 1994b), DOE Order 5820.2A, *Radioactive Waste Management* (DOE 1988a) and "Occupational Radiation Protection," 10 CFR 835. The storage location would meet the intent of "Licensing Requirements for Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste," 10 CFR 72.

Fuel assembly transportation, including to the 200 West Area and 400 Area, would be in accordance with applicable regulations and orders, including DOE Order 5480.3 and the *Hanford Site Radiological Control Manual, Revision 2*. In addition, applicable requirements promulgated by DOT and NRC would be followed, including 10 CFR Part 71 and 49 CFR Parts 171 through 178.

7.0 Consultation and Coordination

The DOH was consulted on *Clean Air Act of 1977* requirements for the proposed action. The meeting minutes are attached in Appendix D.

Prior to DOE approval of this EA, it was provided to the Yakama Indian Nation, the Confederated Tribes of the Umatilla Indian Reservation, the Nez Perce Tribe, the Wanapum People, The U.S. Environmental Protection Agency (EPA), and the State of Washington for review. Comments were received from EPA and the State of Washington and these comments were considered in the preparation of the final EA. The comments and the DOE responses to these comments are provided in Appendix E.

8.0 References

- 10 CFR 71, "Packaging & Transportation of Radioactive Material," *Code of Federal Regulations*, as amended.
- 10 CFR 72, "Licensing Requirements for Independent Storage of Spent Nuclear Fuel and High-Level Waste," *Code of Federal Regulations*, as amended.
- 10 CFR 835, "Occupational Radiation Protection," *Code of Federal Regulations*, as amended.
- 49 CFR 173, "Shippers - General Requirements for Shipments and Packagings," *Code of Federal Regulations*, as amended.
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Washington.

Appendix A

Biological Review

Battelle

Pacific Northwest Laboratories
Battelle Boulevard
P.O. Box 999
Richland, Washington 99352
Telephone (509) 376-5345

May 23, 1994

Ms. Debbie Nielsen N2-53
Westinghouse Hanford Company
Facility Operations
Richland, WA 99352

Dear Ms. Nielsen

BIOLOGICAL REVIEW OF THE F027-IEM CELL ENHANCEMENTS/INTERIM STORAGE AREA, THE SODIUM STORAGE FACILITY AND THE SODIUM REACTION FACILITY (FFTF SHUTDOWN PROJECT) #94-WHC-140 AND #94-WHC-154.

This report summarizes the results of the biological review for the above-referenced projects. The Interim Storage Area entails installing a fence around an existing 90 foot by 120 foot concrete pad. The fence dimensions will be 190 foot by 220 foot, with a depth of six inches. The Sodium Storage Facility entails the construction of 107 foot by 163 foot by 28 foot tall metal sided building. The Sodium Reaction Facility entails the construction of a 57 foot by 65 foot by 25 foot tall metal sided building. All projects are located inside the fenced area at FFTF. A biological survey of the sites proposed for the installation of these facilities was conducted on May 20, 1994 by G. L. Fortner, R. Zufelt, and C. Mackinnon.. The pedestrian survey focused on plant and animal species protected under the Endangered Species Act, candidates for such protection, and plant and animal species listed as threatened, endangered, candidate, sensitive, or monitor by the State of Washington.

The proposed projects are located in an area that is highly disturbed by previous construction. Substrate at this site consists primarily of pavement and packed gravel which is herbicided annually. There is no vegetation on the subject area. Western Kingbird (*Tyrannus verticalis*), Western Meadowlark (*Sturnella neglecta*), European Starling (*Sturnus vulgaris*), American Kestrel (*Falco sparverius*), and Barn Swallow (*Hirundo rustica*) were observed in the vicinity of the proposed project. However, it is unlikely that the proposed projects would negatively impact any of the above mentioned species.

No species protected under the endangered species act, candidates for such protection, or species listed as threatened, endangered, candidate, sensitive, or monitor by the Washington State government were observed during this survey. Consequently, no adverse impacts to such species would occur from the proposed action.

Sincerely,

C. A. Brandt, Ph.D.
Project Manager
Ecological Compliance Assessment

cc: RH Engelmann
PF Dunigan
RD Hildebrand
File
LB

Appendix B

Cultural Resources Review

Battelle

Pacific Northwest Laboratory
Battelle Boulevard
P.O. Box 999
Richland, Washington 99352
Telephone (509) 372-1791

June 23, 1994

No Known Affected Historic Properties

Ms. Debbie Nielsen
Westinghouse Hanford Company
Facility Operations
P. O. Box 1970/N2-53
Richland, WA 99352

Dear Debbie:

**CULTURAL RESOURCES REVIEW OF THE FFTF SHUTDOWN PROJECT.
HCRC #94-400-008.**

In response to your request received May 9, 1994, staff of the Hanford Cultural Resources Laboratory (HCRL) conducted a cultural resources review of the subject project, located in the 400 Area of the Hanford Site. According to the information that you supplied, the project entails the deactivation of FFTF and four related sub-projects. The sub-projects involve utilizing and fencing an existing concrete pad near FFTF, modifying the PFP existing fuel storage area, and constructing new sodium storage and sodium reaction facilities near FFTF. The current deactivation activities will involve defueling the reactor, dry cask storage of the fuel, sodium drain and reaction, accommodation of sodium residuals, and shutdown of the auxiliary systems.

Our literature and records review shows that FFTF has not been evaluated for eligibility for the National Register of Historic Places (NRHP). However, if the facility is found to be eligible in the future, the current project entails minor modifications only which will not affect any characteristics of the facility which would make it eligible for the NRHP. A new cultural resources review request must be submitted for any additional work pertaining to the FFTF shutdown.

Our review also shows that the project area has been highly disturbed by building, road, and utility construction. It is very unlikely that any archaeological materials exist in such disturbed ground. Survey and monitoring by an archaeologist are not necessary. The workers, however, must be directed to watch for cultural materials (e.g., bones, artifacts) during all work activities. If any are encountered, work in the vicinity of the discovery must stop until an HCRL archaeologist has been notified, assessed the significance of the find, and, if necessary, arranged for mitigation of the impacts to the find. The HCRL must be notified if any changes to project location or scope are anticipated. This is a Class III case, defined as a project which involves new construction in a disturbed, low-sensitivity area, and a Class VI case, a project which involves the demolition or remodeling of an existing structure.

A copy of this letter has been sent to Charles Pasternak, DOE, Richland Operations Office, as official documentation. If you have any questions, please call me at 372-1791. Please use the HCRC# above for any future correspondence concerning this project.

Very truly yours,

M. E. Crist
Technical Specialist
Cultural Resources Project

Concurrence:

P. R. Nickens, Project Manager
Cultural Resources Project

cc: C. R. Pasternak, RL (3)
T. Clark
File/LB

Appendix C

Accident Analysis Summary

Accident Analysis Summary

INTRODUCTION

This appendix provides radiological dose and health effect estimates for the postulated bounding accident condition for the transfer of fuel from the 308 Building's Mark I TRIGA® Reactor storage pool. The bounding accident is a breach of 18 fuel assemblies. The current design of the Neutron Radiography Facility (NRF) TRIGA® Reactor cask contains 18 fuel assemblies in each cask.

It is anticipated that four personnel will be directly involved in the transfer operation. A crane operator and Health Physics Technician (HPT) will be located behind the sliding shield block and the fixed reactor shielding. Two large mirrors will assist the crane operator in making the lifts out of the storage pool and into the shipping cask. A second technician and HPT will be located at the far end of room 158 with binoculars or real time video cameras and monitors to aid the crane operator in handling operations.

This analysis evaluates the potential accidental dose consequences and health effects both to the operators and to onsite personnel. The following two scenarios are evaluated:

1. The simultaneous breaching of the 18 peak burnup fuel elements contained in the fuel basket and exposure due to release of radioactive fission product gases.
2. The dropping of all 18 fuel elements contained in the fuel basket onto the reactor building floor. This accident potentially exposes the operating personnel in the reactor building to both gamma-ray shine and direct unshielded radiation, but no radioactive fission product gases, as they exit the reactor building.

ASSUMPTIONS

Source Term

Due to the low power level of the assembly (0.029 watts after five years of decay), it is not possible for the cladding to fail as a result of internal heat generation, even when air cooled. Due to the low power (and temperature) of the fuel assemblies, the only fission product readily releasable is the noble gas krypton-85 ($T_{1/2} = 10.72$ yr). Since krypton-85 is an inert gas and beta decays to stable rubidium-85, the internal irradiation of the body from its absorption can be disregarded. Any krypton-85 released into the reactor hall will quickly mix with the surrounding air volume. This assumption is fairly accurate due to the small quantity of krypton-85 available for release and the high reactor hall ventilation rate of 8 air volumes per hour vented directly to atmosphere through one of two High-Efficiency Particulate Air filter trains (Plum 1975).

The krypton-85 is uniformly mixed within the reactor hall (room 158).

The ORIGEN2 computer code was used to determine a peak fuel element krypton-85 inventory (Leach 1993). The calculation conservatively uses the power history of the peak fuel element to yield 0.1706 curies of krypton-85 after five years of decay. A slightly modified ORIGEN2 input file was used to determine the thermal power of the peak fuel element after five years decay.

Atmospheric Transport

1. The bounding atmospheric condition is defined as that condition which causes a health effect which is exceeded only by a small fraction of time due to weather fluctuations. The U.S. Nuclear Regulatory Commission's (NRC) *Atmospheric Dispersion Models for Potential Accident Consequences Assessment at Nuclear Power Plants*, 1.145 (NRC 1982) defines this fraction as 0.5 percent for each sector or 5 percent for the overall site, whichever is greater. For simplicity, this bounding condition is referred to as a maximum condition throughout the text.
2. Use of an elevated plume release model is not recommended unless the release stack is at least twice the height of adjacent solid structures. Plumes released in such situations have a tendency to become trapped in the wake of the adjacent structure. This situation should be treated as a ground level release (NRC 1982). However, credit is taken for the mixing and dilution of the plume due to building wake effects. Since the 308 Building does not have a stack that meets the above requirements, only the building wake influences atmospheric transport. The 308 Building annex has a floor area of 870 square meters (9,400 square feet). The width and height is assumed to be 29 and 6.1 meters (95 and 20 feet), respectively (Plum 1975). The atmospheric dispersion model is implemented in the GXQ computer code. This code is described in more detail in the *GXQ Users' Manual* and the *GXQ Program Verification and Validation* (Hey 1993a, Hey 1993b).
3. For the releases considered here, the onsite individual with maximum exposure is assumed to remain at 100 meters (330 feet) as the plume meanders over him for eight hours (i.e., one shift).
4. The maximum offsite individual is assumed to be standing at the Hanford Site boundary or near the bank of the Columbia River. He is assumed to remain at the site boundary for the entire passage of the plume.
5. The onsite population distribution is based on up-to-date records of Hanford Site phone numbers. Previous experience has shown that it is not necessary to account for all site personnel, but only those closest to the release point. The onsite population at risk here are those persons located in the 300 Area. The 300 Area personnel count are based on major buildings located in the 300 Area. The onsite population weighted X/Q calculated later in this analysis is adjusted upwards by a factor of 1.5 to account for trailers and individuals without phones.

Frequency

1. The International Commission on Radiological Protection has determined that the nominal cancer fatality rate for workers for low dose, low dose-rate whole body irradiation is approximately 4×10^{-4} latent cancer fatality (LCF) per person-rem effective dose equivalent (EDE).
2. The nominal cancer fatality rate for a population of all ages for low dose, low dose-rate whole body irradiation is approximately 5×10^{-4} LCF per person-rem EDE (ICRP 1991).
3. The National Safety Council has estimated the total annual death rate from all types of cancer per 100,000 persons of all ages is 200 (NSC 1992). Thus, the nominal risk of an LCF is 0.002 year^{-1} .

ATMOSPHERIC DISPERSION

The onsite population distribution used in this analysis is based on up-to-date records of Hanford site phone numbers. Previous experience has shown that it is not necessary to account for all site populations but only those reasonably close to the release point. The onsite population at risk here are those persons located in the 300 Area. The onsite population weighted X/Q calculated later in this analysis is adjusted upwards by a factor of 1.5 to account for trailers and individuals without phones.

The atmospheric dispersion coefficients (X/Q') are calculated according to *Atmospheric Dispersion Models for Potential Accident Consequences Assessment at Nuclear Power Plants, 1.145 methodology* (NRC 1982), commonly referred to as 99.5 percentile. The latest Hanford Site meteorological data, the average over 1983 through 1991, are used. The GXQ computer program (Hey 1993a, Hey 1993b) Version 3.1 is utilized to calculate the X/Qs.

Credit for additional dilution due to the effect of building wake is taken. The building wake model is based on the assumption discussed in Atmospheric Transport Assumption #2 (Hey 1993a).

The maximum onsite population and 80-kilometer (50-mile) offsite population, weighted X/Q, also is calculated. In addition to the maximum values calculated, the X/Q for the annual average onsite and offsite individual is calculated for use in determining the annual risk to the individual.

ACCIDENT ANALYSIS

Scenario 1 - Undetected Breach of up to 18 Fuel Assemblies

During the Mark I TRIGA® Reactor fuel transfer operation, it is assumed that all of the fuel assemblies contained within the fuel transfer basket, up to 18 assemblies, are breached. Since considerable force would be needed to breach the cladding on all of the assemblies simultaneously, it is anticipated that the operators present would be aware of what was

happening and take steps to evacuate the reactor hall. It is assumed that 100 percent of the krypton-85 escapes the 18 assemblies which have a power history equivalent to the peak assembly. In reality, only a small fraction of the noble gas would be released since most of this gas is bound up in the uranium zirconium hydride fuel matrix. It is further assumed that the operators vacate the reactor hall five minutes after the incident.

Two variations are considered. The first, which is the worst case for the operators, assumes no ventilation. This means that all of the krypton-85 released remains in the reactor hall. It also is assumed that no alarms or detectors alert the operators as to its presence. Since krypton-85 is primarily a beta emitter, a semi-infinite submersion plume is assumed with little error. Since all of the krypton-85 is contained in the reactor hall, there is no dose to persons located outside the building.

Outside the building, the krypton-85 concentration is further reduced due to the dispersion afforded by atmospheric turbulence. The time necessary to release 95 percent of the krypton-85 from the building is calculated to be $3/\lambda$ or 0.38 hours. Since this is a relatively short time frame, no credit is taken for the effects of changing wind direction (i.e., plume meander). Also, the effects of building wake, which could further reduce the concentration of krypton-85 downwind is neglected.

The reactor hall ventilation flow rate is approximately 0.8 cubic meters per second (1,620 cubic feet per minute). The air concentration at 100 meters (330 feet) in the worst direction (95 percentile) was calculated using the computer program GXQ, Version 3.1 (Hey 1993).

Table 1.
Dose Consequences from Accident Scenario 1.
(100 percent krypton-85 from 18 Fuel Elements, evacuation within 5 minutes,
100 percent exposure to personnel located outside Building 308).

Receptor Location	Without HVAC	With HVAC
Facility Worker	21 millirem	15 millirem
Maximum Onsite Individual (100 meters north)	0	0.17 millirem
Maximum Site-Boundary Individual (510 meters east-southeast)	0	0.028 millirem
Maximum Onsite Population (E, pop=314)	0	39 person-millirem
Maximum Offsite 50-mile Population (S, pop=57,116)	0	1.8 person-millirem

Table 2.
Health Effect Consequences from Accident Scenario 1
(100 percent krypton-85 from 18 Fuel Elements, evacuation within 5 minutes,
100 percent exposure to personnel located outside Building 308).

Receptor Location	Without HVAC	With HVAC
Facility Worker	8.4×10^{-6} LCF	6.0×10^{-6} LCF
Maximum Onsite Individual (100 meters north)	0	6.8×10^{-8} LCF
Maximum Site-Boundary Individual (510 meters east-southeast)	0	1.5×10^{-8} LCF
Maximum Onsite Population (E, pop=314)	0	1.2×10^{-5} LCF
Maximum Offsite 50-mile Population (S, pop=57,116)	0	9.0×10^{-7} LCF

This scenario has the worst population health effect consequence of the scenarios evaluated. However, the effect is quite small. Based on national cancer statistics (see Frequency Assumption #3), the onsite population is over 50,000 times more likely to suffer a cancer fatality from other causes than from this potential accident, not taking into account the accident frequency.

Scenario 2 - Inadvertent Removal of Fuel From Transfer Basket

During the Mark I TRIGA® Reactor fuel transfer operation, it is assumed that the fuel transfer basket, containing 18 fuel assemblies, detaches from the bridge crane hook, tips over, and spills the fuel assemblies out on the reactor hall floor. The fuel element cladding is assumed to remain intact. If the cladding were breached, then the additional doses calculated in Scenario 1 of the Accident Analysis from krypton-85 could potentially occur.

The crane operator and the HPT are protected from direct gamma-ray exposure by the sliding shield block on the south face. However, they are still exposed indirectly by backscatter from the reactor hall ceiling and concrete walls. It is assumed for this analysis that the workers escape from the reactor hall through the south door which leads into room 158. The path from behind the sliding shield block through the south door could potentially expose personnel to direct gamma-ray radiation from the unshielded fuel assemblies lying on the reactor hall floor.

This portion of the analysis uses the MCNP computer code (Carter 1991) to model the potential doses to the crane operator and HPT resulting from the above described incident. The gamma-ray source spectrum was calculated using the same ORIGEN2 input file discussed above.

The MCNP computer code is used to model one fuel assembly on the floor of the reactor hall. Since the dose rate is a strong function of distance and location, it is necessary to make some assumptions regarding the motion of the crane operator and HPT exiting the reactor hall. The following assumptions are made to estimate a reasonable, yet conservative dose.

1. After dropping the fuel elements onto the reactor hall floor, the crane operator and HPT remain behind the 0.609-meter by 15.24-centimeter (2-foot by 6-inch) sliding shield block for 5 minutes (until they make their exit).
2. The crane operator and HPT walk past (step over) the 18 fuel elements and experience a varying dose rate at 0.305, 0.914, 3.05, and 6.10 meters (1, 3, 10 and 20 feet) for 1, 2, 3 and 4 seconds, respectively.
3. The HPT and technician in room 158 assisting the fuel transfer, experience a dose rate from the 18 fuel elements at 6.096 meters (20 feet) for 5 minutes and 10 seconds.
4. All four personnel leave the area and are not exposed further.

Due to the shielding and distance afforded by the building walls, there is negligible dose to persons located outside the 308 Building; the dose is due to fixed source gamma radiation, there is no effect due to operation of the building ventilation system.

Table 3.
Dose Consequences from Accident Scenario 2
(Gamma-ray dose due to dropping 18 fuel elements on floor,
evacuation of workers in 5 minutes 10 seconds).

Receptor Location	Without HVAC	With HVAC
Facility Worker	25 millirem	25 millirem

Table 4.
Health Effect Consequences from Accident Scenario 2
(Gamma-ray dose due to dropping 18 fuel elements on floor,
evacuation of workers in 5 minutes 10 seconds).

Receptor Location	Without HVAC	With HVAC
Facility Worker	1.0×10^{-5} LCF	1.0×10^{-5} LCF

Appendix D
State of Washington Department of Health
Meeting Minutes, December 1, 1992

88300-93-008

Page 1 of 2

MEETING MINUTES

Subject: ROUTINE MEETING WITH THE STATE OF WASHINGTON
DEPARTMENT OF HEALTH

TO: DISTRIBUTION

BUILDING: 740 Stevens Center

FROM: C. E. Sowa

CHAIRMAN: J. A. Bates

Dept-Operation-Component	Area	Shift	Meeting Date	Number Attending
Regulatory Support	RCHN	Day	December 1, 1992	13

Distribution:

J. A. Bates	H6-22*
A. W. Conklin	DOH*
J. O. Dittmer	L4-30*
M. J. Hall	H6-21*
S. E. Knaus	H6-26*
G. L. Laws	H6-25*
R. B. McCord	L4-30*
J. M. Nickels	H6-22*
C. R. Richins	A6-55
J. M. Ring	H6-25*
C. M. Smith	H6-21*
C. E. Sowa	H6-25*
S. D. Stites	A5-15*
S. R. Tift	H6-26*
EPIC	H6-08
CES/File/LB	H6-25
*Attendees	

The State of Washington Department of Health (DOH) was provided information on two topics at a meeting held December 1, 1992. Each topic discussed is addressed below:

308 Building

DOH was provided a heads-up regarding activities associated with the shutting down of the Training & Testing, Research, Isotope Production, General Atomics (TRIGA®) Reactor in the 308 Building in the Hanford Site 300 Area. Currently, 104 fuel assemblies (100 fuel elements and 4 fuel-followed control rods associated with the TRIGA® Reactor) are stored in a 9 foot diameter by 20 foot deep reactor pool in the 308 Building. These materials will be removed from the reactor pool and shipped as appropriate (i.e., in approved shipping and storage casks) to other TRIGA® Reactors offsite and/or to interim storage in the Hanford Site 200 Areas.

The fuel assembly storage area is vented to the atmosphere through the 308 Building's TRIGA® Reactor Exhaust (ID #097-097), which is registered with DOH. The vented emissions are controlled by High-Efficiency Particulate Air filtration. None of the fuel assemblies have failed and

88300-93-008

Page 2 of 2

the water in the storage pool is clean. The proposed activity is not expected to increase emissions to the atmosphere. However, the action was considered significant enough to warrant informal notification of DOH.

Following a description of the proposed project, Mr. A. W. Conklin stated that he considered the fuel assemblies to be sealed sources. Mr. Conklin approved the project based upon the description provided in the meeting and given the use of filtered, registered exhaust points and approved shipping and storage casks.

241 SY Tank Farm

DOH has previously provided approval for the installation of a mixer pump in Tank 241-SY-101. In the event that the mixer pump can only be installed partially in the tank, and hence becomes contaminated, a storage pad with shielded walls has been proposed to store the pump. The storage pad would also be used if the pump is removed from the tank, either due to the end of the test or because the pump fails. The pump will be placed inside a cask when it is placed on the storage pad. A new cask is being designed for that purpose. If the pad is not used for the mixer pump, it may be used to store other items that are currently stored inside the tank farm fenceline.

Mr. Conklin provided approval to proceed with the construction of the storage pad and requested that more details on the storage cask be provided at a future meeting. Nothing further was required in writing at this time. Additionally, the approval to construct is not to be considered an approval to store equipment on the storage pad that is not normally stored in tank farms.

Concurrence:

A. W. Conklin, DOH

1/20/93
Date

S. D. Stites, RL

1-20-93
Date

C. E. Sowa, WHC

1/20/93
Date

Appendix E

EA Comments and Responses

DON'T SAY IT --- Write It!

DATE: May 30, 1995

TO: Doug Chapin, TPD

N2-36

FROM: Paul F. X. Dunigan, Jr.
RL NEPA Compliance Officer

Telephone: 376-6667

SUBJECT: Preapproval Review Comments from D. Sherwood, EPA-X, on Draft Triga Fuel EA

Doug Sherwood of EPA Region X's Richland office gave me the following comments by telephone on May 18, 1995:

- If the data don't show that the liquids in the reactor tank are clean, don't state that they are. Include the data in the EA.
- Re: Storage in the 400 Area for up to 40 years. Need to be sure the discussion, including the period of interim storage, is consistent with the TPA.

He had other comments, but they were answered in the course of our conversation. He indicated no written comments would be sent by his office.

Please consider these comments in the preparation of the final EA, and discuss the resolution of the comments with Mr. Sherwood prior to preparation of our response letter.

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

P.O. Box 47600 • Olympia, Washington 98504-7600
(360) 407-6000 • TDD Only (Hearing Impaired) (360) 407-6006

June 15, 1995

Mr. Paul F. X. Dunigan Jr.
Dept. of Energy
PO Box 550
Richland WA 99352

Dear Mr. Dunigan:

Thank you for the opportunity to comment on the draft environmental assessment for the relocation and storage of TRIGA reactor irradiated fuel, at the Hanford Site, Richland, Benton County. We reviewed the environmental assessment and have the following concerns.

1. The draft document only referenced the TRIGA cask as a transport cask once. Other spent nuclear fuel casks projected for use as storage casks undergo a lengthy licensing process certifying them as appropriate for that use. In light of the fact that an inert gas is proposed to be sealed within the cask, this certification would seem a true necessity. Has the TRIGA cask been certified/licensed as a storage cask?
2. 2.8.1 (p. 2-8), TRIGA Cask -- The assessment should indicate whether there is any financial risk incurred by not seeking certification at this time, considering that the fuel will again be transported at some future date.
3. 2.5.2 (p. 2-14) and 5.2.2 (p. 5-4), Transporting the Package -- The required road closure is due to the lack of USDOT/NRC certification of the transport package. While the number of shipments involved in this action is not large, the road closures must be anticipated to have some economic impact. They are also cumulative with other shipments, e.g., samples of spent fuel from K-basins. The cumulative road closure impacts need to be considered.
4. Table 4 describes a calculated dose to workers as a result of five minute exposure following rupture of fuel assemblies and escape of ⁸⁵Kr. It would seem that the dose should have another component, either to workers as a result of changing air filtration filters or otherwise rectifying the accident and/or to the population as a result of eventual escape of the gas to the environment.

Mr. Paul F. X. Dunigan Jr.
June 15, 1995
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5. 3.2, Store the Fuel Assemblies in an Existing Waste Storage Facility (Hanford Central Waste Complex) -- If this storage proposal requires an expansion of the HCWC, funds will be needed in the FY97 Budget to accomplish the expansion. The current proposal is to cut funding for the HCWC expansion.
6. We feel that Alternatives 3.3 and 3.4 were not adequately addressed. Section 3.3, shipping the fuel to the Idaho National Engineering Lab (INEL), should be identified as being feasible. It is not as though that possibility is off in the distant future. The PEIS which includes INEL's future options is scheduled to be completed and the record of decision rendered about the time this EA is complete.
7. 3.4, Ship the Fuel Assemblies to Another Existing Fuel Storage Basin in the Hanford Site -- Our preference is to find a central storage location in a secure area off-site, such as Nevada's Yucca Mountain. Presently, we appear to be moving spent nuclear fuel from one site at Hanford to another site on Hanford, with no permanent storage in the near future.
8. Overall we like the proposed interim storage of open fuel at a central location at Hanford. This is only until a permanent storage vault, such as Yucca Mountain in Nevada, can be found. As stated before, in the interim, we prefer the spent nuclear fuel be removed from all locations, such as the Fast Flux Test Facility.

If you have any questions, please call Mr. Ron Effland with the Nuclear and Mixed Waste Program at (509) 736-3008.

Sincerely,

M. Vernice Santee
Environmental Review Section

MVS:
95-3785

cc: Ron Effland, Kennewick
Max Power, NM
Bob Cordts, NM

Department of Energy

Richland Operations Office
P.O. Box 550
Richland, Washington 99352

95-FFTF-068

Ms. M. Vernice Santee
Environmental Review Section
State of Washington Department of Ecology
P. O. Box 47600
Olympia, Washington 98504-7600

Dear Ms. Santee:

RESPONSE TO THE STATE OF WASHINGTON DEPARTMENT OF ECOLOGY JUNE 15, 1995,
LETTER COMMENTS ON THE MAY 1995, DRAFT NATIONAL ENVIRONMENTAL POLICY ACT
(NEPA) ENVIRONMENTAL ASSESSMENT (EA) - RELOCATION AND STORAGE OF TRIGA®
REACTOR FUEL, HANFORD SITE, RICHLAND, WASHINGTON, (DOE/EA-0985).

Thank you for reviewing the subject NEPA EA document. Your comments contained in your June 15, 1995, letter addressed to me were helpful in identifying areas of the EA which required additional information or clarification. For clarity, each of your June 15th letter comments or questions is repeated below, followed with our responses.

1. The draft document only referenced the TRIGA® cask as a transport cask once. Other spent nuclear fuel casks projected for use as storage casks undergo a lengthy licensing process certifying them as appropriate for that use. In light of the fact that an inert gas is proposed to be sealed within the cask, this certification would seem a true necessity. Has the TRIGA® cask been certified/licensed as a storage cask?

Response: The 308 Building's Neutron Radiography Facility (NRF) TRIGA® Packaging has not been licensed by the U.S. Department of Transportation (DOT) or the Nuclear Regulatory Commission (NRC) because their regulations do not apply. However, the packaging has been certified under the U.S. Department of Energy (DOE) Order 5480.3 and the DOE Richland Operations Office (RL) Order 5480.1 Chapter III and their referenced documents. These two orders direct DOE contractors like the Westinghouse Hanford Company (WHC), to develop and implement programs that ensure hazardous materials are prepared, packaged, and transported in a safe manner that will not present health and safety hazards to plant personnel or the public. WHC has such a program and thus developed the NRF TRIGA® Packaging for Hanford on-site shipping and handling of irradiated TRIGA® fuel. The transportation and storage of the NRF TRIGA® Packaging was designed to meet the intent of Title 10, Code of Federal Regulations, Parts 71 and 72. In addition, a Safety Analysis Report for Packaging (SARP) for the NRF TRIGA® Package was approved by WHC. This approval allows for packaging, shipment, and storage of the NRF TRIGA® irradiated fuel on the Hanford Site. The NRF

M. Vernica Santee, Ecology
95-FFFTF-068

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TRIGA® Cask (without the overpack) will meet the current irradiated fuel storage requirements for the 400 Area Interim Storage Area (ISA) or a proposed 200 Area ISA if a decision is made in the future to send the NRF TRIGA® irradiated fuel to the latter area. The casks were designed with potential licensing in mind and could be licensed later in case another federal or university TRIGA® reactor would desire the fuel or to facilitate future off-site disposal options, i.e., the Idaho National Engineering Laboratory (INEL) in Idaho Falls, Idaho.

2. 2.3.1 (p. 2-8), TRIGA® Cask -- The assessment should indicate whether there is any financial risk incurred by not seeking certification at this time, considering that the fuel will again be transported at some future date.

Response: No financial risks are anticipated at this time because the casks were designed with licensing considerations and can be licensed or can easily be inserted into larger existing licensed casks if a future decision is made to ship the spent fuel to INEL.

3. 2.5.2 (p. 2-14) and 5.2.2 (p. 5-4), Transporting the Package -- The required road closure is due to the lack of DOT/NRC certification of the transport package. While the number of shipments involved in this action is not large, the road closures must be anticipated to have some economic impact. They are also cumulative with other shipments, e.g., samples of spent fuel from K-basins. The cumulative road closure impacts need to be considered.

Response: Shipments would be truck-hauled from the 300 Area to the 400 Area (approximately eight miles) using rolling road closures on a public transportation route during non-peak hours of traffic. The closures provide for short-term closure of the transportation route to public traffic on those sections of the route being used until transport has passed those sections. Total time per shipment, including all inspections, should be less than two hours, with the actual total time of a road closure likely not exceeding one-half hour. Besides the personnel required for a shipment, approximately five members of the Hanford Patrol would be required for about one hour to support a rolling road closure. Thus, economic and cumulative impacts of the road closures are not considered substantial.

4. Table 4 describes a calculated dose to workers as a result of five minute exposure following rupture of fuel assemblies and escape of ⁸⁵Kr. It would seem that the dose should have another component, either to workers as a result of changing air filtration filters or otherwise rectifying the accident, and/or to the population as a result of eventual escape of the gas to the environment.

M. Vernice Santee, Ecology
95-FFTF-068

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Response: ^{85}Kr is an inert gas that will dissipate and will not collect on HEPA air filters. No significant secondary clean up exposures are likely. Population impacts were assessed in the EA and represented in Table 4.

5. 3.2, Store the Fuel Assemblies in an Existing Waste Storage Facility (Hanford Central Waste Complex) -- If this storage proposal requires an expansion of the HCWC, funds will be needed in the FY97 Budget to accomplish the expansion. The current proposal is to cut funding for the HCWC expansion.

Response: At this time, no expansion of the HCWC to store spent nuclear fuel is planned. Moreover, RL's established, current policy decision is to not store irradiated fuel in the HCWC.

6. We feel that Alternatives 3.3 and 3.4 were not adequately addressed. Section 3.3, shipping the fuel to the Idaho National Engineering Lab (INEL), should be identified as being feasible. It is not as though that possibility is off in the distant future. The PEIS which includes INEL's future options is scheduled to be completed and the record of decision rendered about the time this EA is complete.

Response: The chosen option (interim storage) supports either alternative. Alternative 3.3 has been revised to reflect the DOE's Record of Decision (ROD) issued June 1, 1995 on the "U.S. Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final (NEPA) Environmental Impact Statement." The ROD does not preclude the possibility of future shipment of spent fuel to INEL for interim storage.

7. 3.4, Ship the Fuel Assemblies to Another Existing Fuel Storage Basin in the Hanford Site -- Our preference is to find a central storage location in a secure area off-site, such as Nevada's Yucca Mountain. Presently, we appear to be moving spent nuclear fuel from one site at Hanford to another site on Hanford, with no permanent storage in the near future.

Response: No "secure area off-site," such as Yucca Mountain, Nevada, is accepting spent nuclear fuel at this time. However, interim storage on the Hanford Site does not preclude final disposition of spent fuel at an off-site permanent repository.

8. Overall, we like the proposed interim storage of open fuel at a central location at Hanford. This is only until a permanent storage vault, such as Yucca Mountain in Nevada, can be found. As stated before, in the interim, we prefer the spent nuclear fuel be removed from all locations, such as the Fast Flux Test Facility.

M. Vernice Santee, Ecology
95-FFTF-068

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Response: If a future decision is made that all spent nuclear fuel at the 400 Area ISA should be relocated to a proposed 200 Area ISA, then the TRIGA® fuel could be readily relocated to that area.

Copies of the final EA will be provided to your office when it is completed. If you need further information about this EA, please contact Mr. D. H. Chapin, the RL 308 Facilities NEPA Document Manager, on (509) 376-9396, or myself, on (509) 376-6667.

Sincerely,

Paul F. X. Dunigan, Jr.

Paul F. X. Dunigan, Jr.
NEPA Compliance Officer

TPD:DHC

cc: B. E. Cordts, Ecology
R. M. Efflund, Ecology
M. E. Power, Ecology
G. T. Tebb, Ecology

FINDING OF NO SIGNIFICANT IMPACT
FOR
RELOCATION AND STORAGE OF
TRIGA® REACTOR IRRADIATED FUEL

U.S. DEPARTMENT OF ENERGY
RICHLAND, WASHINGTON

AUGUST 1995

AGENCY: U.S. Department of Energy

ACTION: Finding of No Significant Impact

SUMMARY: The U.S. Department of Energy (DOE) has prepared an Environmental Assessment (EA), DOE/EA-0985, to assess environmental impacts associated with the relocation of irradiated and unirradiated nuclear fuel assemblies from the 308 Building's Neutron Radiography Facility (NRF) Mark I TRIGA^{®1} Reactor (TRIGA[®] Reactor) storage pool, located in the 300 Area of the Hanford Site, near Richland, Washington. 101 irradiated fuel assemblies will be transported by truck and stored in casks at the Interim Storage Area (ISA) in the 400 Area of the Hanford Site. Three unirradiated fuel assemblies will be transferred to another TRIGA[®] Reactor operated by the U.S. Geological Survey in Denver, Colorado, or if necessary, will be stored in one of the existing storage areas at the Plutonium Finishing Plant (PFP), 200 West Area, Hanford Site until they can be transferred to another reactor.

Alternatives considered in the review process were: The No-Action alternative; Store the Fuel assemblies in an existing waste storage facility; Ship the fuel assemblies to the Idaho National Engineering Laboratory for storage; Ship the fuel assemblies to another existing fuel storage basin on the Hanford Site; and the proposed action. An alternative to transport the fuel assemblies by rail rather than truck was also considered.

Based on the analysis in the EA, and considering preapproval comments from the State of Washington and the U.S. Environmental Protection Agency, DOE has determined that the proposed action is not a major federal action significantly affecting the quality of the human environment within the meaning of the *National Environmental Policy Act (NEPA)* of 1969. Therefore, the preparation of an Environmental Impact Statement (EIS) is not required.

¹ TRIGA is a registered trademark of General Atomics.

ADDRESSES AND FURTHER INFORMATION:

Single copies of the EA and further project information about the proposed action are available from:

Mr. J. E. Mecca, Director
Transition Program Division
U.S. Department of Energy
Richland Operations Office
Richland, Washington 99352
(509) 376-7471

For further information regarding the DOE NEPA process, contact:

Ms. Carol M. Borgstrom, Director
Office of NEPA Oversight
U.S. Department of Energy
1000 Independence Avenue, S.W.
Washington, D.C. 20685
(202) 586-4600 or (800)-472-2756

PURPOSE AND NEED: DOE needs to take action to relocate the nuclear fuel assemblies from the Mark I TRIGA® Reactor storage pool in order to complete the shutdown of the 308 Building in the 300 Area on the Hanford Site. Shutdown of the 308 Building will place the building in a minimum surveillance condition prior to decommissioning activities, saving an estimated \$600,000 per year.

BACKGROUND: The Hanford Site's Mark I TRIGA® Reactor was used for research and development and as a neutron source for the Neutron Radiography Facility (NRF) which supported the fabrication of removable core components and test assemblies for use in the Fast Flux Test Facility (FFTF). The TRIGA® Reactor was operated in the 308 Building for 13 years, from 1976 until 1989. The DOE has decided to shutdown both the FFTF and the 308 Building. The fuel assemblies, which were removed from the Reactor's core, are currently stored in racks in the Reactor Storage Pool in the 308 Building. Removal of the fuel assemblies stored in the storage pool is the last action necessary to complete the shutdown of the 308 Building.

The 104 fuel assemblies consist of TRIGA® fuel assemblies, fuel-followed control rods, and a thermocouple instrumented fuel assembly. The fuel assemblies have various cladding materials and irradiation histories. They had been obtained from various sources before most were used in the NRF TRIGA® Reactor. The fuel assemblies are all in good condition and have not leaked. The fuel columns in all of the fuel assemblies are ceramic zirconium hydride of which 8 to 8.5 percent is low-enriched uranium. The uranium portion of each fuel assembly is made up of less than 20 percent uranium-235 dispersed throughout the hydride. The original nominal uranium-235 content of each fuel assembly before irradiation was 37 to 38 grams. Each of the 104 fuel assemblies has one of two types of cladding material: 66 fuel assemblies have aluminum cladding, and 38 fuel assemblies (including four

fuel-followed control rods and one thermocouple instrumented fuel assembly) have stainless-steel cladding.

The irradiated fuel assemblies have limited burnup that has produced only a small amount of fission products resulting in a lower radiation exposure rate than a similar amount of fuel, with a higher burnup rate. The reactor has not operated since 1989 which has allowed most of the high-activity, short-lived fission products to decay, further lowering the radiation exposure rate. Each irradiated fuel assembly is estimated to contain a maximum of 9.0 curies of radioactive material, including less than 3 grams of plutonium.

PROPOSED ACTION: The irradiated fuel assemblies will be placed in six NRF TRIGA® casks (TRIGA® casks) and two U.S. Department of Transportation (DOT) Specification 6M (DOT-6M) containers for transportation and storage in the ISA to be constructed in the 400 Area of the Hanford Site. The three unirradiated fuel assemblies will be transferred to another TRIGA® Reactor operated by the U.S. Geological Survey, an agency of the U.S. Department of Interior (DOI), in Denver, Colorado. If the three fuel assemblies can not be transferred to Denver, they may be stored at the Plutonium Finishing Plant (PFP) in the 200 West Area until they can be transferred to another offsite reactor. All, or some, of the irradiated fuel assemblies may be shipped to other TRIGA® Reactors before or after the relocation of the fuel assemblies has occurred. Relocation of any irradiated fuel assemblies to other reactors was not evaluated.

The irradiated fuel assemblies in the storage pool will be loaded into fuel assembly baskets, hoisted out of the pool, dried, and placed into the TRIGA® casks and the DOT-6M containers. Each cask or container will be sealed and tested and moved to a staging area within the 308 Building to await transport. The unirradiated fuel assemblies will be removed individually, dried, and placed in appropriate containers.

Transportation and storage operations will consist of moving up to two TRIGA® casks or DOT-6M containers out of the 308 Building for each shipment. Each TRIGA® cask will be placed in an overpack. The casks and containers will be loaded onto the transport vehicle and transported to the ISA, a distance of approximately 13 kilometers (8 miles). The road from the 300 Area to the 400 Area, normally accessible to the public, will be closed to traffic during transport. The "rolling closure" concept will be used, providing for short term closure of the route to traffic on the sections of the route being used until the transport has passed those sections. The shipments will be made during periods of off-peak traffic.

At the ISA, the casks and containers will be unloaded, the overpacks removed from each cask, and the casks and containers will be placed in a storage module. Lids will be installed on the storage modules, and the stored casks and containers will be monitored and maintained.

The irradiated fuel assemblies will be stored at the ISA in the 400 Area. During storage, the TRIGA® casks and the DOT-6M containers will be managed as spent nuclear fuel. The near-term relocation of the fuel is consistent with the Record of Decision for the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering*

Laboratory Environmental Restoration and Waste Management Programs Environmental Impact Statement (SNF-PEIS).

ALTERNATIVES CONSIDERED: No-Action Alternative: Under the No-Action Alternative, the fuel assemblies would continue to be stored in the 308 Building's storage pool. To protect and maintain the integrity of the fuel assemblies, this alternative would require continued maintenance, monitoring, ventilation, and surveillance. This alternative does not meet the agency need to achieve cost savings from placing the 308 Building in a minimum surveillance condition.

Store the Fuel Assemblies in an Existing Waste Storage Facility: Relocation of the fuel assemblies to an existing Hanford Site waste storage facility, such as the Hanford Central Waste Complex (HCWC) which presently stores hazardous waste, was evaluated. The waste storage facilities operate in compliance with federal and state waste regulations, including the *Resource Conservation and Recovery Act of 1976*, and the State of Washington Department of Ecology "Dangerous Waste Regulations," *Washington Administrative Code 173-303*. Current DOE policy is to store only waste in waste storage facilities. DOE considers the fuel assemblies to be spent nuclear fuel and not waste; therefore, storage of the fuel assemblies in a waste facility is not in accordance with DOE policy and does not meet the agency need.

Ship the Fuel Assemblies to the Idaho National Engineering Laboratory for Storage: The fuel assemblies could be shipped to the Idaho National Engineering Laboratory's (INEL) fuel storage facility. This facility currently stores irradiated TRIGA® Reactor fuel assemblies. However, the INEL is not able to receive nuclear shipments at this time. The fuel assemblies would remain in the storage pool until the SNF-PEIS's Record of Decision is implemented. Implementation of the record of decision is uncertain at this time and the need to remove the fuel assemblies from 308 Building may not be met.

Ship the Fuel Assemblies to Another Existing Fuel Storage Basin on the Hanford Site: Other existing fuel storage basins are located on the Hanford Site. The 105-KE and 105-KW Reactor fuel storage basins (K Basins), along with the T Plant fuel storage basins, could store the fuel assemblies. In all of these locations, the operational safety requirements or technical specifications would have to be revised and approved. The 20 percent enriched uranium-235 fuel assemblies exceed the two facility's operational safety requirement of five percent maximum enriched material. Transportation packaging and supporting equipment would be required, and facility modifications could be required in order to store the fuel assemblies. This alternative does not meet the agency need.

Rail Transport: The irradiated fuel assemblies could be transported to the ISA via rail. However, in order to reach the rail line, the casks and containers would have to be loaded onto a truck, transferred to the railcar, transferred to a truck, then offloaded at the ISA. The extra handling of the casks and containers would unnecessarily complicate the transportation, and therefore was not analyzed further.

ENVIRONMENTAL IMPACTS: Construction and Fabrication Impacts: The TRIGA® casks will be fabricated primarily with stainless steel and lead. As much as 6,000 kilograms

(13,000 pounds) of stainless steel and lead may be used in the fabrication of the casks and containers and represent a long-term commitment of nonrenewable resources. Minor amounts of waste may be generated during fabrication. If expansion of the 400 Area storage pad is required, a small amount of concrete and steel will be committed. The associated excavation will not impact any known cultural resources or habitat for any federal or state threatened, endangered, candidate or monitor species and the proposed action will not affect a wetland, prime or unique farmland, or wild and scenic river. Minor amounts of dust may be generated for a short time during construction, and a small amount of construction associated waste will be disposed of in existing Hanford Site waste disposal facilities.

Operational Impacts: Impacts of relocation of the irradiated fuel assemblies will occur during three stages: (1) placing the fuel assemblies into the casks and containers, (2) transporting the casks and containers to the 400 Area, and (3) offloading and placing the casks and containers in a storage module. The workers will be exposed to radiation fields during each of these phases. The impacts of transporting the three unirradiated fuel assemblies to Denver or storage at PFP will be less than similar actions previously analyzed. The transportation route will be on public roads to the 400 Area and on DOE private roads thereafter. The public roads will be closed to the public during transport of the fuel, so no radiation dose to the public is expected.

A worst-case estimate of possible radiological exposure to the involved workers was made assuming that all personnel will remain in the maximum radiation fields for the maximum duration without the aid of additional shielding. The total estimated worker dose to load all of the fuel assemblies into the appropriate casks and containers for transportation and storage is estimated to be 0.84 person-rem. Loading the casks and containers on the transport vehicles will result in an estimated dose of 0.29 person-rem. Transporting the casks and containers will result in an estimated dose of 0.056 person-rem. Offloading the casks and containers will result in an estimated dose of 0.37 person-rem.

The total estimated radiation exposure to workers for relocation of the fuel assemblies to interim storage is the sum of the above doses or 1.6 person-rem. This is estimated to result in 6×10^{-4} Latent Cancer Fatalities (LCF), therefore no fatalities are anticipated. As a perspective, if a workforce of approximately 75,000 workers were exposed to the same radiation fields, an LCF might occur.

The most conservative estimate of personnel radiation exposure during the cask storage activities, including inventory of the material content, possibly the retrieval of cask and container gas samples, and surveillance and inspection of the storage module is an annual dose of 0.022 person-rem. This would be expected to result in an estimated 9×10^{-6} LCF over the 40-year storage life of the cask; therefore, no cancer deaths are expected to occur.

Unirradiated Fuel Assemblies Impacts: The impacts of transporting the three unirradiated fuel assemblies to the DOI TRIGA® Reactor in Denver, Colorado, can be compared to the similar action of transporting isotope capsules from the Denver suburb of Northglenn to Hanford. The DOE issued a Finding of No Significant Impact on May 11, 1994 for DOE/EA-0942: *Return of Isotope Capsules to the Waste Encapsulation and Storage Facility, Hanford Site, Richland, Washington*. The action analyzed in the EA included 20 shipments

of 309 cesium capsules with a total radioactivity of nearly 14 million curies and was estimated to result in 0.00255 and 0.000134 LCFs for the public and workers respectively. The cesium capsule shipment impacts are expected to be much greater than the potential impacts from the proposed single shipment of three fuel assemblies to Denver with a total radioactivity of less than .00004 curies.

If the three fuel assemblies are relocated to the PFP for storage, the impacts can be compared to previous actions. The DOE issued a Finding of No Significant Impact on January 9, 1992 for DOE/EA-0534: *Storage of Fast Flux Test Facility Unirradiated Fuel in the Plutonium Finishing Plant Complex*. The action analyzed in the EA included nine shipments of over 12,000 unirradiated fuel pins containing mostly mixed plutonium and uranium oxide fuel, from the 308 Building to PFP for storage. The impacts of the proposed action of shipping three unirradiated uranium fuel assemblies to PFP are not expected to be as great as the impacts analyzed in that EA.

Impacts From Potential Accidents: Several postulated accidents were analyzed for the transfer and storage of the TRIGA fuel assemblies. The upper bounding postulated accident is the failure of the boom of a crane that is placing the FFTF fuel storage casks at the ISA allowing a cask to fall on the storage module containing the TRIGA fuel assemblies. It is postulated that the storage module would be breached and some of the fuel crushed. Some of the crushed fuel could be released to the atmosphere. The annual probability of this accident is estimated to be 0.003.

Directly involved workers could be injured by the falling boom or cask. Nearby workers not involved in the fuel storage activities could be exposed to radiation exposure from the release. The maximum exposed individual at 100 meters (330 feet) could receive 3.3 rem, which would result in an estimated annual probability of a fatal cancer induced by the radiation of 0.001. Approximately 210 workers in the 400 Area south southwest of the accident would receive 78 person-rem resulting in an estimated .03 LCFs induced by the exposure. The offsite population of 78,700 south southeast of the accident could receive 6.6 person-rem, resulting in an estimated 0.003 LCFs induced by the exposure. Therefore, it is unlikely that there would be fatal cancers attributable to this postulated upper bounding accident.

Socioeconomic Impacts: It is estimated that there will be a reduction of four workers at the 308 Building after relocation of the fuel assemblies is completed. This represents approximately 0.03% of the 1995 Hanford Site workforce. Social and economic impacts cannot be quantified at this time because of uncertainties associated with the future Hanford Site budgets.

Environmental Justice: Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires that federal agencies identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of their programs and activities on minority and low-income populations. DOE is in the process of developing official guidance on the implementation of the Executive Order. The analysis in this EA indicates that there would be minimal impacts to both the offsite population and potential workforce as a result of relocation of the fuel

assemblies, under both routine and accident conditions, with the exception of social and economic impacts which are unknown. Therefore, it is not expected that there will be any disproportionate impacts to any minority or low-income portion of the community.

Cumulative Impacts: The existing and planned future facilities at the Hanford Site were reviewed to determine any near-term cumulative or synergistic impacts that might result from the proposed relocation of fuel assemblies to the 400 Area.

The personnel that will periodically survey the storage containers also will perform other duties at the 400 Area storage pad. The additional radiation exposure to these workers will be very small. The offsite exposure from Hanford Site 300 and 400 Area operations in 1993 was estimated to be 0.07 and 0.003 person-rem respectively. Relocation of the fuel assemblies is not expected to change this estimated dose to the offsite public.

The risks associated with routine transport of the unirradiated fuel assemblies to Denver are very small, and the radiation exposure to workers and members of the public is extremely low (far less than natural background radiation).

DETERMINATION: Based on the analysis in the EA, and after considering the preapproval review comments of the State of Washington and the U.S. Environmental Protection Agency, I conclude that the proposed action to relocate and store nuclear fuel assemblies from the 308 Building's Neutron Radiography Facility (NRF) Mark I TRIGA® Reactor on the Hanford Site does not constitute a major federal action significantly affecting the quality of the human environment within the meaning of NEPA. Therefore, an EIS for the proposed action is not required.

Issued at Richland, Washington, this 10th day of August 1995.

John D. Wagoner
Manager
Richland Operations Office