DOE/EA-1528

ENVIRONMENTAL ASSESSMENT FOR THE STORAGE OF TRITIUM-PRODUCING BURNABLE ABSORBER RODS IN K-AREA TRANSFER BAY AT THE SAVANNAH RIVER SITE

JUNE 2005

U. S. DEPARTMENT OF ENERGY
SAVANNAH RIVER OPERATIONS OFFICE
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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ABBREVIATIONS/ACRONYMS

The following is an alphabetized list of the abbreviations and acronyms found within the text of this document:

ASCE	-	American Society of Civil Engineers
CEQ	-	Council on Environmental Quality
CFR	-	Code of Federal Regulations
Ci	-	Curie
DOE	-	U.S. Department of Energy
EA	-	environmental assessment
EIS	-	environmental impact statement
FONSI	-	finding of no significant impact
HNUS	-	Halliburton NUS
ISO	-	International Standards Organization
lbs		Pounds
kW		Kilowatt
LWT	-	Legal Weight Truck
mrem	-	1/1000 roentgen equivalent man
NAC	-	NAC International, Inc.
NEPA	-	National Environmental Policy Act
NNSA	-	National Nuclear Security Administration
psi		Pounds per square inch
RadCon	-	Radiological Contamination
RBOF	-	Receiving Basin for Offsite Fuels
SAR	-	Safety Analysis Report
SRS	-	Savannah River Site
TEF	-	Tritium Extraction Facility
TIDs	-	tamper indicating devices
TPBARs	-	Tritium-Producing Burnable Absorber Rods
TVA	-	Tennessee Valley Authority

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1.0 INTRODUCTION

The U.S. Department of Energy (DOE) Savannah River Operations Office (SR) and the National Nuclear Security Administration (NNSA) Savannah River Site (SRS) Office prepared this environmental assessment (EA) to analyze the potential environmental impacts of the temporary dry storage of a cask containing Tritium-Producing Burnable Absorber Rods (TPBARs) in the Transfer Bay in K Area, at SRS, located near Aiken, South Carolina (Figure 1-1). The Tennessee Valley Authority (TVA) Watts Bar Nuclear Generating Station (Watts Bar) is providing TPBARs to the DOE facilities at SRS. The Tritium Extraction Facility (TEF) at SRS would process the TPBARs to recover tritium. Watts Bar would need to ship the TPBARs approximately one year before TEF is ready to receive the material, due to the TEF construction and startup schedule.

The proposed action is to store a Watts Bar cask containing irradiated TPBARs in the K-Area Transfer Bay until the TEF is ready to receive and process the material. The Transfer Bay is a dry storage location which was used for loading trailers with reactor material casks, including tritium-producing targets and poison rods. The TPBARs would be transported to SRS and stored in a shipping cask in accordance with a U.S. Nuclear Regulatory Commission Certificate of Compliance. DOE did not anticipate the need for this temporary storage in the original the National Environmental Policy Act (NEPA) of 1969, as amended; review for TEF [Final *Environmental Impact Statement for the Construction and Operation of a Tritium Extraction Facility at the Savannah River Site*, DOE/EIS-0271 (DOE 1999a)]. Transportation of the TPBARs to SRS was evaluated in the Final *Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reacto*r, DOE/EIS-0288 (DOE 1999b).

This document was prepared in compliance with NEPA the requirements of the Council on Environmental Quality (CEQ) Regulations for Implementing NEPA (40 CFR Parts 1500-1508); and the DOE Regulations for implementing NEPA (10 CFR Part 1021). NEPA requires the assessment of environmental consequences of Federal actions that may affect the quality of the human environment. Based on the potential for impacts described herein, DOE would either publish a finding of no significant impact (FONSI) or prepare an environmental impact statement (EIS).

1.1 Background

The need to store irradiated TPBARs at SRS is dictated by a Memorandum of Agreement between the NNSA and TVA that TPBARs, after completion of the irradiation cycle, would not be stored in TVA's spent fuel pool. The planned TPBAR storage location at SRS, the TEF, would not be ready to accept the TPBARs for about one year due to the construction and startup schedule.

A TPBAR is be a welded closed stainless steel clad rod coated with an aluminide coating to minimize tritium diffusion. The TPBARs would be contained in a consolidation canister which is secured and maintained in the appropriate transport position within the cask cavity by the TPBARs basket assembly. The TPBARs would be shipped and stored in an NAC International, Inc. (NAC) Legal Weight Truck (NAC-LWT) cask (Figure 2-1). The NAC-LWT is a cask designed for the safe transport of Type B fissile and other radioactive materials. The major components of the LWT cask are the cask body, the closure lid secured by bolting, and the transport impact limiters installed to the front and rear of the cask body. The containment vessel for the radioactive material contents consists of a stainless steel shell, bottom plate and closure lid. This cask would be positioned on an International Standards Organization (ISO) shipping container fitted with a cask support structure which would be mounted on a trailer. Aluminum honeycomb impact limiters cover and protect the containment boundary openings from impact conditions of transport. Jack stands and jacking plates would be used to support the trailer during storage. The cask would not be opened at any time.

The general activities in K-Area Transfer Bay include the following. The trailer and ISO container with the NAC-LWT cask would be inspected immediately outside the K-Area Transfer Bay. SRS Radiological Contamination (RadCon) personnel would then open the ISO container, monitor the outside of the cask to determine the level of contamination, and close the ISO container. The cask would be new and DOE does not expect contamination to be present. There would be appropriate tamper indicating devices (TIDs) placed on the ISO container, and the trailer would be backed into the Transfer Bay. The jack stands would be positioned and flame-resistant tarps would be placed over the NAC-LWT cask (the tarp will not affect heat load calculations per NAC). Periodically it would be confirmed that the TIDs remain in place. When TEF is ready to receive the NAC-LWT cask, the trailer would be moved out of the Transfer Bay (Figure 3-1), SRS RadCon personnel would open the ISO container and monitor the outside of the cask prior to shipment to TEF. TEF has a "clean" receiving bay and it would be necessary to know contamination levels of the outside of the cask.

1.2 Purpose and Need for Action

The purpose of the proposed action is to provide safe and secure storage of irradiated TPBARs until the TEF is ready to receive and process the material. DOE needs to implement this action to comply with the Memorandum of Agreement between DOE and TVA which does not allow storage of irradiated TPBARs at Watts Bar. Conforming to the Memorandum of Agreement will help insure that DOE meets its national security commitment to the U.S. Department of Defense to develop a new source of tritium production to support the nuclear weapons stockpile.

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 Proposed Action

The proposed action is to implement the storage of TPBARs in the K-Area dry storage Transfer Bay for a period of up to two years. The Transfer Bay is proposed for the storage of TPBARs in a 10 CFR 71-certified shipping package that offers a high degree of protection for the tritiated rods. The incremental estimated cost for storage of the TPBARs is approximately $110,000. This cost does not include vehicle or trailer rental, etc. The shipping cask, its outer ISO container packaging, and the trailer portion of the tractor-trailer transporter would be parked in the Transfer Bay.

The NAC-LWT package, U.S. Nuclear Regulatory Commission Certificate of Compliance No. 9225, has been evaluated and certification is being requested for the safe transport of up to 300 TPBARs. The TPBAR contents would be positioned in the LWT cavity in the TPBAR basket assembly and contained in a consolidation canister supplied by TVA. Upon arrival of the NAC-LWT cask with the TPBAR contents at SRS, the trailer, the ISO container, and the cask would be inspected for any shipping damage and surveyed for radiation and removable contamination levels. After determining the condition of the cask, the ISO container and trailer would be placed into storage.

The cask would remain in its assembled transport condition inside a closed ISO container for the duration of interim storage. The K-Area Transfer Bay has been de-inventoried and has been effectively retired (U.S. NRC 2003). There is no power directly into the Transfer Bay but some energized lines traverse the Transfer Bay. The ventilation system has been deenergized. The bay has been cleared of all unnecessary combustible materials. The TPBARs LWT cask would be placed on and covered with fire resistant canvas as a housekeeping measure for storage.

2.2 Alternatives to the Proposed Action

In accordance with NEPA regulations, DOE examined the following alternative to the proposed action:

- No action: TPBARs would be stored at TVA's Watts Bar location

In addition, DOE considered but did not evaluate several alternative locations for temporary storage of TPBARs.

2.2.1 No Action, TVA's Watts Bar to Store TPBARs

The No Action alternative would consist of TVA having to store irradiated TPBARs either in their Spent Fuel Pool or in the NAC-LWT cask within their security area at Watts Bar. This alternative would not be in accordance with the Memorandum of Agreement with DOE which does not allow for storage at TVA facilities. Further, TVA could pass along to DOE the cost of storage of the TPBARs. In addition, TVA would likely cease TPBAR irradiation, and as a result DOE would not be able to meet its national security commitment to the U.S. Department of Defense to develop a new source of tritium production to support the nuclear weapons stockpile.

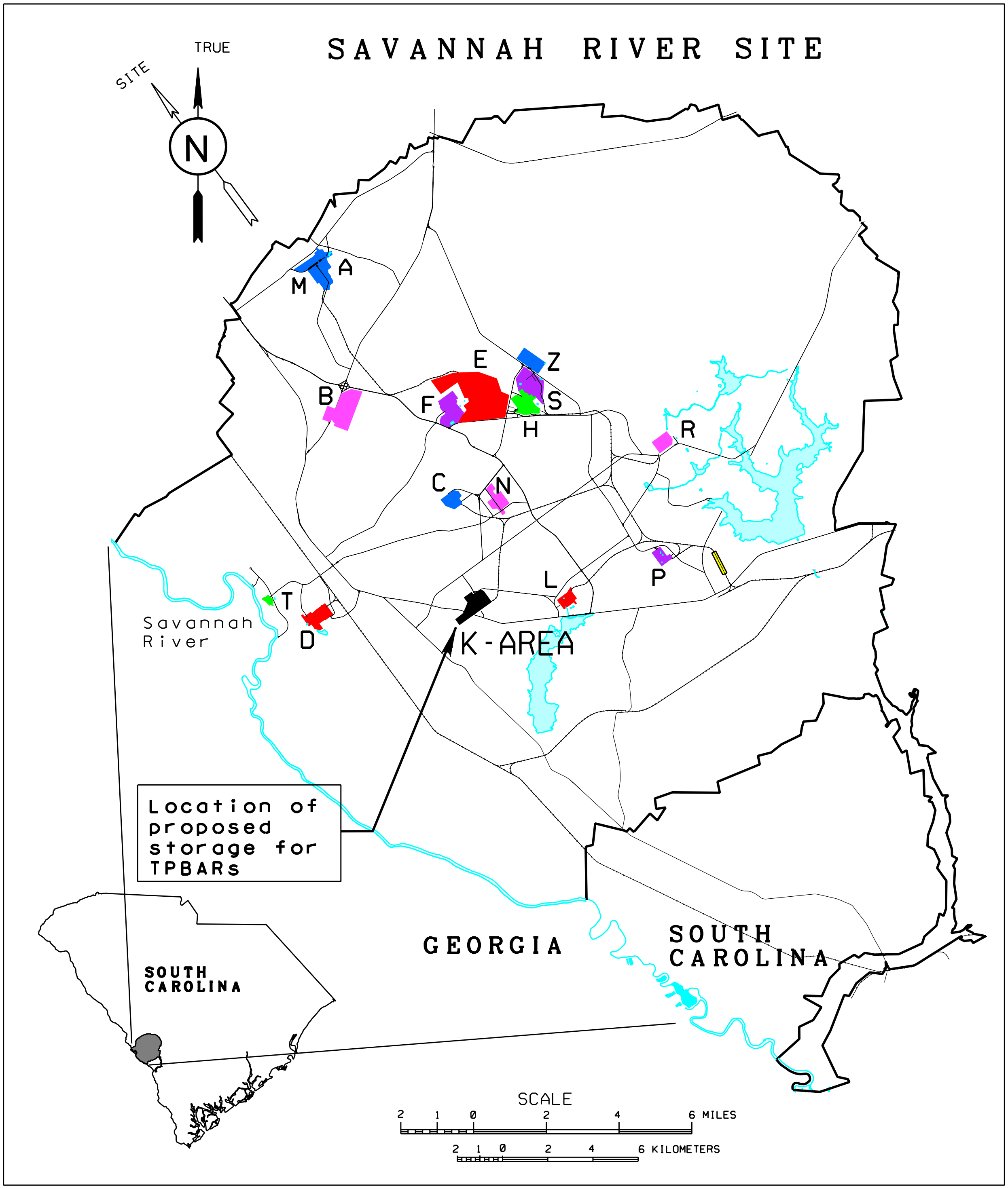

Figure 1-1. Location of the Proposed Storage Area for the TPBARs at the Savannah River Site, SC.

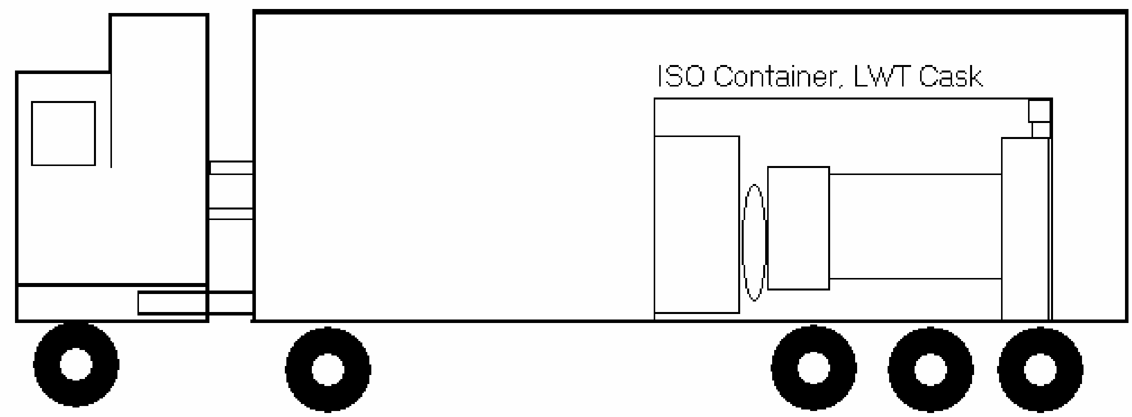

Figure 2-1
NAC-LWT Transport Unit

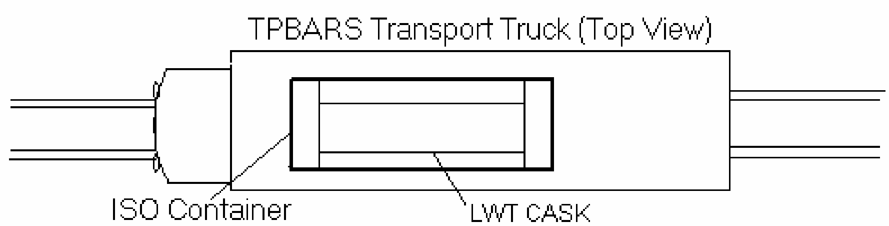

Figure 3-1
TPBARs Storage in K-Area Transfer Bay

2.2.2 Alternatives Considered but Not Analyzed

The following alternative locations at SRS were considered but not analyzed as they were determined to be inadequate for potential storage areas due to one or a combination of spacing, ongoing mission, and protection from weathering, cost, or security controls:

<u>Receiving Basin for Offsite Fuels (RBOF)</u>

This facility is transitioning to a shutdown condition and there are no plans for future missions. As a result of the shutdown condition, the security posture is inadequate for the storage of the TPBARs. In addition, the historic mission for this facility was wet storage and the TPBARs require dry storage in a transportation cask. RBOF does not have a location with the appropriate weather protection and security available for up to two years for the storage of a tractor trailer and cask. Identification and modifications for a new material storage area are not cost effective.

<u>L Area</u>

L Area facilities are used for the wet storage of spent nuclear material. Wet storage is not appropriate for the TPBARs because it will remain in the cask and requires dry storage. In addition, the L-Area Transfer Bay can not be considered because it is being used for railcar material shipment. The Transfer Bay is not being managed as a material storage area. Finally, L Area does not have a location with the appropriate weather protection and security available for up to two years for the storage of a tractor trailer and cask. Identification and modifications for a new material storage area are not cost effective.

<u>H Area</u>

H Area does not have an available holding bay with the appropriate weather protection and security for two years storage of a tractor trailer and cask. Identification and modifications for a new material storage area are not cost effective.

3.0 AFFECTED ENVIRONMENT

SRS occupies an area of approximately 310 square miles in southwestern South Carolina (Figure 1-1). The site borders the Savannah River for about 17 miles near Augusta, Georgia, and Aiken and Barnwell, South Carolina. SRS contains five non-operational nuclear production reactor areas, two chemical separations facilities, waste treatment, storage and disposal facilities, and various supporting facilities. The SRS High-Level Waste Tank Closure Final EIS (DOE 2002) and the most recent socioeconomic survey of the six-county SRS area of influence (HNUS 1997) contain additional information on SRS facilities and the areas surrounding the site.

3.1 Land Use

The K-Area Transfer Bay is located within a previously developed area. The K Reactor at SRS was initially constructed and operated as a material production reactor in the 1950s. The facility design provided for the safe production of weapons materials. The function did not change until the early 1990s when the K Reactor was shut down. The mission for this facility has changed to safe storage of nuclear materials.

3.2 Meteorology and Climatology

The SRS region has a temperate climate with mild winters and long summers. The average annual rainfall at SRS is about 49.5 inches and the average annual relative humidity is 70 percent (DOE 2002). Tornadoes have been observed during every month of the year in the area encompassing SRS, but occur most frequently in the spring (Bauer et al. 1989). Only a few instances of slight to moderate tornado damage to support facilities have been documented for the site to date. Bauer et al. (1989) contains additional information on SRS meteorology and climatology. The general meteorological and climatological data for SRS would be representative of that for the K Area location.

3.3 Geology and Seismology

SRS is located in the Aiken Plateau physiographic region of the upper Atlantic Coastal Plain approximately 25 miles southeast of the Fall Line which separates the Piedmont Plateau from the Atlantic Coastal Plain. The topographic surface of the coastal plain slopes gently seaward and is underlain by a wedge of seaward-dipping unconsolidated and semiconsolidated sediments from the Fall Line to the coast of South Carolina. The Atlantic Coastal Plain tectonic province in which SRS is located is characterized by generally low seismic activity that is expected to remain subdued (Haselow et al. 1989).

No faults are located within the proposed project area. The most active seismic zones in the southeastern United States are all located over 100 miles away from the site. A recent EIS (DOE 2002) contains information on SRS fault location and earthquake occurrences.

3.4 Accident Analysis and Storage Conditions

The K-Area Transfer Bay is a dry storage location which was used for loading trailers with reactor material casks, including tritium producing targets and poison rods. The TPBARs would be transported to SRS and stored in their shipping cask in accordance with a U.S. Nuclear Regulatory Commission Certificate of Compliance. In the aftermath of September 11, 2001, DOE continues to consider measures to minimize the risk and consequences of potential terrorist attacks. Both the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996) and the *Surplus Plutonium Disposition Final Environmental Impact Statement* (DOE 1999) acknowledge that a threat could be presented by sabotage or terrorism, and concluded that adequate safeguards are in place to meet such a threat. There is the potential for attempts at acts of sabotage or terrorist attacks during transport. The likelihood of an attempted act of sabotage or terrorism occurring is not precisely knowable. However, the transport methods employed by DOE in the shipment are specifically designed to afford security against sabotage or terrorism, as well as safety in the event of an accident.

3.4.1 TPBARs Cask and Expected Storage Conditions

The NAC-LWT packaging is a cask designed for the safe transport of Type B fissile and other radioactive materials. Safety features of transportation casks that provide containment, shielding, and thermal protection also provide protection against sabotage. The NAC International, Inc. (2004b), presenting the safety analyses and results for the structural, thermal, shielding, and containment evaluations, concludes that the NAC-LWT cask containing TPBARs meets the applicable requirements of 10 CFR 71.

The loaded cask and trailer weighs approximately 80,000 pounds when assembled for transport and is designed and approved for road, rail, or ocean transport. The major components of the LWT cask are the basket assembly, cask body, the closure lid secured by bolting, and the transport impact limiters installed at the front and rear of the cask body. The containment vessel for the radioactive material contents is provided by a stainless steel shell, bottom plate, and closure lid. The closure lid, and the vent and drain port covers, are sealed by metallic seals installed by bolting. The NAC-LWT cask is certified (U.S. NRC 2005) for the transport of up to 300 TPBARs contained in a consolidation canister and having a total heat load of less than 1 Kilowatt (kW).

During storage, the NAC-LWT cask would be exposed to essentially static storage loading conditions (i.e., cask in horizontal position supported by the transport frame). As a result of the assumptions required for transport certification of the TPBAR contents, it is assumed that all of the 300 TPBARs have failed under normal transport conditions and their retained gases are released to the cavity. The pressure loading of the gases would increase over time as the radioactive materials of the TPBARs decay, which results in helium build-up. The normal condition of transport pressure loading of 289 pounds per square inch (psi) on the cavity (i.e., containment vessel) was evaluated in the Safety Analysis Report (SAR) (NAC International, Inc. 2004b) and was shown to meet American Society of Civil Engineers (ASCE) Code criteria. As identical ASCE Code acceptance criteria are utilized to evaluate normal storage conditions, the maximum pressure evaluated for transport (i.e., 289 psi) would bound the pressure loadings during storage. Due to the thermal decay of the radioactive materials, the stresses on the containment vessel resulting from internal pressure would decrease over the storage period. Evaluation of a payload of 300 TPBARs stored in the NAC-LWT cask over a period of two years indicates that the pressure of 300 psi used in the structural evaluation would be reached near the end of the two-year period. Further analysis would be required if storage of 300 TPBARs is anticipated to exceed the above time period.

Safe storage of the TPBARs cask is enhanced by the storage in the Transfer Bay and the cask remaining in its NAC ISO container for the duration of the storage period. The ISO container provides some added protection from radiant heat exposure and general isolation from elevated temperatures. The ISO container can be entered for receipt inspection, if needed. DOE anticipates that the material could be stored for up to two years with no routine maintenance or inspections. The Transfer Bay would be locked after receipt and placement and inspected per security procedures until the planned shipment to TEF.

3.4.2 Accident Analysis

The postulated TPBARs design basis fire is similar in severity and duration to the 10 CFR 71 evaluation fire used in U.S. NRC (2003) evaluations. This fire in the Transfer Bay would result in damage in the immediate area; however the 10 CFR 71 Department of Transportation Type B NAC-LWT cask would protect the material from any impacts. Furthermore, the Fire Protection Program (limiting combustibles) and operating procedures reduce any likelihood of fire occurrence (Burch 2005) [Note: Burch (2005) represents a preliminary analysis. Prior to TPBARs storage in K Area, the analysis would be finalized via an approved safety Authorization Basis].

With regard to gas generation and build-up and the possibility of explosion from damaged TPBARs, where a mixture of free hydrogen and helium occur, generation of hydrogen would be less than 1 percent of total helium gas content. This would be well below the flammability limit. Shipment preparations taken to preclude potential gas generation would involve physical measures such as draining water, vacuum drying, and backfilling with helium. Additionally, the 10 CFR 71 required Material Receipt and Shipping Program, and limited two year storage, add administrative controls for accident mitigation (Burch 2005).

Natural events such as earthquakes, tornados, flooding, etc. have consequences that DOE has demonstrated to be negligible to offsite receptors when mitigating factors are applied. These mitigating factors include building design, cask design, other engineered controls, and administrative controls (Burch 2005).

3.4.3 Health and Human Effects

There may be a potential for tritium permeation through the closure seals of the containment vessel during both transport and storage conditions (NAC International, Inc. 2004). As shown in the SAR (NAC International, Inc. 2004b), the total radioactive material release per week under accident conditions is approximately 5 Curies (Ci)/week, which is significantly less than the allowable accident release rate. Therefore, even assuming an increase of tritium available due to the longer storage period evaluated (i.e., two years versus one year for transport) of 100 percent, the total radioactive material which could permeate past the metallic seals would be less than 10 Ci/week, or less than 1 percent of the allowable accident rate. Under normal storage conditions, where the gas temperature and seal temperature are significantly below the accident temperature used in the SAR, the permeation rate would be significantly less. A seal permeation evaluation was performed based on an accident condition with a tritium partial pressure of 0.15 atmospheres. Because the tritium concentration decreases with time due to radioactive decay, the tritium leakage due to seal permeation of 5 Ci/week remains bounding for long-term storage. The seal permeation evaluation is very conservative. The analysis assumes failure of 298 rods as the result of an initiating event and two pre-failed rods.

Tritium permeation is also possible through the cask body. An evaluation crediting only the cask inner shell (the SAR-defined containment boundary) and applying a temperature of 222°F and 100 percent failed rod inventory yields a permeation rate of ~0.1 Ci/week. Actual release rates are expected to be significantly lower because DOE does not anticipate 100 percent failure of the TPBARs and the actual cask radial design is a multi-walled steel/lead/steel configuration. In conclusion, it has been shown that the containment boundary of the NAC-LWT cask closed with metallic O-ring seals is capable of providing the required confinement of the TPBAR radioactive material contents for the evaluated onsite storage duration of two years. Therefore, the NAC-LWT package can be safely stored on SRS with up to 300 TPBARs (NAC International, Inc. 2004).

3.5 Radiation Environment

A person residing in the Central Savannah River Area (within 50 miles of SRS) receives an average annual radiation dose of about 360 mrem; SRS contributes less than 0.05 percent of that total. Natural radiation sources contribute about 300 mrem, medical exposures contribute about 53 mrem, and consumer products contribute about 10 mrem. The most recent SRS annual environmental report (Mamatey 2003) contains more information on the radiation environment.

4.0 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION AND NO ACTION ALTERNATIVE

4.1 Storage Facility Operation

All activities for the proposed action would take place within a previously developed area. The project would utilize approximately 5 workers on an intermittent basis who would be drawn from onsite sources. DOE does not expect any measurable impact on the local economy as a result of the proposed action. The proposed action would not require the development of any new groundwater or surface water resources. Because of the project location is an existing industrial facility, DOE expects no impacts on any SRS ecological, archeological, or environmental resources as a result of the proposed action. Little or no traffic and transportation impacts would result from the implementation of the proposed action.

4.2 Human Health Effects

The Occupational Safety and Health Act (OSHA) regulations (29 CFR Part 1910) require that employers comply with safety and health standards set by the act to provide each employee with a worksite that is free from recognized hazards that are likely to cause death or serious injury. Personal protective clothing and equipment would be used as appropriate. An evaluation of the storage (Section 3.4.1) and potential consequences of an accident (Section 3.4.2) of TPBARs in the NAC-LWT cask shows that it can remain in safe condition for at least two years without adverse impacts. Therefore, human health impacts would be minimal.

4.3 Environmental Consequences of the No Action Alternative

One alternative to the proposed action is to take no action. The no action alternative would have none of the potential or expected impacts associated with the proposed action. Under the no action alternative, TVA would have to store irradiated TPBARs either in their Spent Fuel Pool or in the NAC-LWT cask within their security area. This alternative is not in accordance with their Memorandum of Agreement with DOE which does not allow for storage at TVA facilities. Storage of the TPBARs at Watts Bar would introduce an element of some risk to their operations. In addition, TVA would likely cease TPBAR irradiation, and as a result DOE would not meet its national security commitment to the U.S. Department of Defense to develop a new source of tritium production to support the nuclear weapons stockpile.

4.4 Cumulative Impacts

There would be no measurable impact on the local economy as a result of the proposed action. No adverse impacts to either site surface or groundwater quality would be expected. The proposed action would have no adverse impacts on threatened and endangered species, cultural resources, floodplains, or wetlands on SRS. Impacts to the local air quality would be negligible. The proposed action would not pose any additional potential problems for either public health or safety. Any increases in site traffic accident and fatality rates would be minimal as a result of the proposed action. An evaluation of the storage of TPBARs in the NAC-LWT cask shows that it can remain in safe condition for at least two years without any potential impacts. Therefore, human health impacts would be minimal. The proposed action would not add measurably to the impacts that result from the operation of SRS and surrounding facilities.

5.0 REGULATORY AND PERMITTING PROVISIONS CONSIDERED

DOE policy is to carry out its operations in compliance with all applicable Federal, State, and local laws and regulations, as well as all DOE Orders. This section provides a discussion of the major regulatory permit programs that might be applicable to the proposed action.

5.1 National Environmental Policy Act of 1969 as amended

This EA has been prepared in compliance with the NEPA of 1969, as amended, and the requirements of the CEQ Regulations for Implementing NEPA (40 CFR Parts 1500-1508), and DOE Regulations (10 CFR Part 1021), and DOE Order 451.1B. NEPA, as amended, requires "all agencies of the Federal Government" to prepare a detailed statement on the environmental effects of proposed "major Federal actions significantly affecting the quality of the human environment." This EA has been written to comply with NEPA and analyze the potential environmental impacts of the storage of TPBARs in K-Area Transfer Bay at SRS.

6.0 AGENCIES AND PERSONS CONSULTED

Westinghouse Safety Management Services, Inc. was consulted during the preparation of this EA.

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