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7. Abstract <p>This document provides an evaluation of five alternatives for the disposition of 3.4 metric tons of irradiated fuel from PUREX to support facility turnover following deactivation. The alternatives for disposition of the fuel include transfer to the K Basins, transfer to T Plant, passivation and dry vault storage, and dissolution and underground tank storage. The five alternatives were compared and it was determined that the fuel should be transferred from PUREX to the K Basins where it would be placed into pool storage.</p>		
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ALTERNATIVES FOR THE DISPOSITION OF FUEL STORED IN THE PUREX FACILITY

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January, 1995

EXECUTIVE SUMMARY

The PUREX plant is in the process of deactivation with the ultimate goal to turn over the facility to EM-40 which would provide surveillance and maintenance until Decontamination and Decommissioning activities can take place. There is presently 2.9 metric tons of irradiated Single Pass Reactor (SPR) fuel and 0.5 metric tons of N Reactor fuel stored in the PUREX facility. Proper fuel disposition is necessary to meet the end point criteria for turnover of the facility to EM-40 following facility transition. This document evaluates the feasible fuel disposition alternatives and determines the alternative which best supports PUREX transition.

The five alternatives which were considered are: 1) Interim Storage in PUREX; 2) Pool Storage at K Basins; 3) Pool Storage at T Plant; 4) Dry Vault Storage Following Passivation at PUREX; 5) Underground Tank Storage Following Dissolution at PUREX. Each alternative was evaluated against four primary objectives: 1) Protect public and environment from hazards; 2) Preserve worker health and safety; 3) Consider cost and schedule; and 4) Gain public acceptance.

The transfer of the fuel to the 105 K Basins was determined to best meet the objectives. This alternative could be completed within the PUREX Deactivation schedule and budget, with a low impact to worker health and safety, and a negligible effect to the hazards to the public and environment. This alternative would initially require the recovery and packaging of the N Reactor fuel from the process cell floors. Both the N Reactor and SPR fuel would then be loaded into irradiated fuel cask cars and transferred to the 105 K Basins. The fuel would then be unloaded and placed into storage with the 2100 metric tons of N Reactor and SPR fuel already being stored in the K Basins. Final fuel disposition would take place along with the K Basin fuel as determined by the programmatic environmental impact statement.

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1.0 INTRODUCTION

The PUREX facility is being deactivated for turnover from the Office of Facility Transition and Management (EM-60) to the Office of Environmental Restoration (EM-40). EM-40 will take over surveillance and maintenance (S&M) at a reduced level and eventually perform Decontamination and Decommissioning (D&D) activities. During deactivation, the building will be placed in a benign state requiring minimum surveillance and maintenance. Approximately 3.4 metric tons of irradiated fuel must be dealt with during PUREX facility deactivation. Fuel disposition is necessary prior to facility turnover. This document evaluates the five feasible alternatives for fuel disposition, and determines which is the best choice.

1.1 Background

The PUREX facility presently contains approximately 3.4 metric tons of irradiated fuel. There is both aluminum clad Single Pass Reactor (SPR) fuel and zircalloy clad N Reactor fuel stored in the PUREX plant. The 2.9 metric tons of SPR fuel is stored under water in the slug storage basin (SSB) at the east end of the PUREX canyon. Approximately 0.5 metric tons of fuel, mostly N reactor elements with at least one SPR element, is located on the PUREX plant head end process cell floors exposed to the cell atmosphere.

The SPR fuel was shipped to PUREX in 1972 where it was placed in the slug storage basin for temporary storage to await processing. However, the PUREX plant was modified to process zirconium clad fuel in 1972, prior to processing the SPR fuel, and the fuel has remained under water in the SSB since that time. The fuel differs from normal K reactor irradiated fuel processed at PUREX as it contains a very low U^{235} content (0.06%) and a very high Pu^{240} content (26%) (See ref. 1). The SPR fuel consists of 779 pieces packaged approximately into four buckets which are sitting on the floor of the SSB. The most recent visual inspection (1990) of this fuel indicates that the cladding on the visible top layer is intact but some foreign material was observed on the surface of the fuel (See figure 1). The SSB does not contain a water treatment system and has been operated as a stagnant storage pool with makeup water added as needed to maintain the level. Samples obtained of the basin water in 1993 were very low in activity indicating little degradation to the fuel (See table 1).

Three PUREX plant dissolver cells (A, B, and C cells) presently contain approximately 40 elements of N reactor fuel and at least one SPR fuel element. Fuel elements were dropped onto the cell floor during dissolver charging operations, and most were subsequently recovered and charged into the dissolvers. However, the remaining elements are located in positions which require dissolver equipment removal, which was not considered necessary considering the limited amount of fuel remaining on the floor. This fuel would normally have been recovered either during equipment replacement or at the end of the PUREX life cycle.

The N reactor fuel is mostly 25 year old reactor grade ($12\%Pu^{240}$) material with some 12 year old weapons grade ($6\%Pu^{240}$) material. The majority of the fuel is located in B cell from a fuel spill in October, 1971. The fuel was inspected in 1982 using a still camera lowered from the crane, which indicated that the fuel was in fairly good condition with minimal cladding failure at that time (see figure 2). A recent inspection of B cell was conducted in 1993 using a remote camera system. This inspection indicated that the fuel had been exposed to process solutions which may have attacked the cladding and raised questions of the fuel integrity (see figure 3). The inspection also found one SPR element located in a remote area. The source of this fuel piece could not be tracked down but it is expected to be normal K reactor discharge material.

TABLE 1 - SLUG STORAGE BASIN WATER SAMPLE RESULTS			
Analysis	Result	Analysis	Result
Appearance	Clear, <1% solids, No organic	CePr-144	<2.29E-01 $\mu\text{Ci/l}$
pH	8.4	Co-60	<9.32E-03 $\mu\text{Ci/l}$
Total Organic Carbon	Incomplete	Nb-95	<7.1E-03 $\mu\text{Ci/l}$
Uranium	2.99E-03 g/l	Ru-103	<3.86E-02 $\mu\text{Ci/l}$
Alpha Total	4.1E-02 $\mu\text{Ci/l}$	RuRh-106	<4.17E-01 $\mu\text{Ci/l}$
Total Beta	40 $\mu\text{Ci/l}$	Zr-95	<1.25E-02 $\mu\text{Ci/l}$
Over The Top Dose Rate (4 Oz.)	<.5 mrad/hr/open window	Cs-134	<1.69E-02 $\mu\text{Ci/l}$
Pu	4.0E-07 g/l*	Cs-137	16.4 $\mu\text{Ci/l}$
* Conversion of Total Alpha analysis only		Th-228	2.0 $\mu\text{Ci/l}$

Any time fuel is stored in water corrosion can occur. The fuel stored in PUREX has two possible corrosion mechanisms. The aluminum clad SPR fuel is stored in three stainless steel baskets and one carbon steel basket. When two different metals are in contact in water there is the potential for galvanic corrosion. Aluminum is more active than either the carbon or stainless steel of the buckets, so the cladding would be attacked by the corrosion. Degradation to aluminum though galvanic corrosion has been observed in aluminum clad fuel stored in steel containers at other DOE sites (See refs. 4 & 5). In each incident the fuel had been stored in a pool with unfavorable water chemistry or high electrical conductivity. Although the SPR fuel has been stored in water with favorable water chemistry, the potential for galvanic corrosion to the aluminum cladding cannot be ruled out.

FIGURE 1 - SINGLE PASS REACTOR FUEL IN SLUG STORAGE BASIN (1990)

FIGURE 2 - N REACTOR FUEL IN B DISSOLVER CELL (1980)

FIGURE 3 - N REACTOR FUEL IN B DISSOLVER CELL (1993)

A second method for fuel corrosion involves uranium metal exposed to water. Uranium metal exposed due to cladding failures reacts with water to form uranium oxide and uranium hydride, releasing fission products into the water. Since the uranium oxide is a larger molecule than the uranium metal, the fuel will swell at the corroded surface which peels back the cladding and exposes more fuel for reaction. The oxide coating on the metal surface provides a barrier to continued or constant corrosion. However, this layer is not stable and is easily dislodged providing new surfaces for corrosion, continuing the fuel degradation. The N Reactor fuel is particularly susceptible to this type of corrosion because of cladding failures which occur during the discharge of the fuel from the reactor.

An additional product of the fuel corrosion is uranium hydride, which can be pyrophoric when exposed to an air environment. However, if the uranium hydride is exposed to either water or low levels of oxygen the hydride will convert to a stable uranium oxide. This will occur to most of the hydride generated during corrosion, however, the hydride can form in microcracks in the uranium metal which is then isolated from the oxygen and water by a layer of passive uranium oxide. If the layer of uranium oxide is disturbed upon handling the fuel out of water, the rapid oxidation of uranium hydride releases energy which could initiate a uranium metal fire.

The SPR fuel stored in the basin should not have significant corrosion or hydride generation as indicated by visual examinations and water samples. However, some galvanic corrosion may be occurring which is not visible on the limited number of elements available for inspection. The N reactor fuel stored on the dissolver floor has been exposed to water but has not been stored in water for extended periods. Exposure to process chemicals may have attacked the cladding and some of the fuel. The subsequent years of exposure to air should have allowed for conversion of any hydride to oxide. However, there have been studies which indicate that partial exposure of uranium metal to water allows for generation of higher levels of hydride. All fuel handling operations will need to address both the potential for a hydride oxidation reaction and the release of energy and hydrogen gas. The PUREX deactivation activities will be conducted in a well ventilated operating canyon and the fuel will be submerged in water to preclude potential fuel ignition.

1.2 Purpose

The PUREX plant is in the process of being deactivated with the intent to turn over the facility to EM-40 to continue S&M while awaiting facility D&D work. Spent fuel disposition must be accomplished during deactivation to satisfy the end point criteria for facility turnover. The purpose for this document is to identify and evaluate the PUREX spent fuel alternatives and determine the best alternative for fuel disposition.

1.3 Scope

This evaluation considers the impacts of activities necessary to disposition the 3.4 MTU of fuel presently stored in the PUREX facility. The activities vary for each alternative and include process development, process operation, facility modification, fuel transportation and several types of interim storage. Future fuel disposition activities have not been defined for fuel on the Hanford site and therefore were not included in this evaluation.

Due to the similarity in handling considerations for the two types of fuel, SPR and N Reactor, a parallel disposition path will be evaluated. Storage of the fuel in an irradiated fuel cask car was not considered feasible because a transport cask is not an approved container for storage of fuel. Transport of the fuel offsite was not an alternative due to lack of both an approved container for offsite shipping and an offsite facility capable of receiving the fuel. The special nuclear materials (SNM) in the fuel are no longer of value, and therefore the fuel will not be processed for recovery of SNM, however it may be processed to stabilize it for storage.

2.0 SUMMARY

The purpose of this document is to determine the best method for disposition of the irradiated fuel presently stored in the PUREX facility. A list of general requirements were determined and used to identify five feasible alternatives which are described and evaluated in the following sections. The alternatives are:

- 1) Interim Storage in PUREX Canyon
- 2) Pool Storage at K Basins
- 3) Pool Storage at T Plant
- 4) Dry Vault Storage Following Passivation at PUREX
- 5) Underground Tank Storage Following Dissolution at PUREX

Four primary objectives were defined for the disposition of the fuel. In determining the proper disposition alternative it is important to:

- 1) Protect public and environment from hazards
- 2) Preserve worker health and safety
- 3) Consider cost and schedule
- 4) Gain public acceptance

Each alternative was evaluated against the objectives listed above to determine the best method for fuel disposition. The results of the evaluation indicate that the fuel should be transferred to the K basins and placed with the existing 2100 MTU of fuel in pool storage. This alternative was chosen since it could be completed within the PUREX Deactivation schedule and budget, with a low impact to worker health and safety, and a negligible effect to the hazards to the public and environment.

Fig. 4 PUREX FUEL DISPOSITION ALTERNATIVES

FIGURE 4 - PUREX FUEL REMOVAL ALTERNATIVES

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3.0 CRITERIA

3.1 General Requirements

The following general requirements were used to identify the alternatives:

- The fuel must be maintained in a configuration in compliance with security requirements.
- Fuel must be placed into a storage configuration such that it can be removed for future long term storage.
- The PUREX plant fuel vulnerabilities must be resolved prior to the end of Deactivation (See ref. 2).
- The fuel must be handled in such a way to avoid an unfavorable uranium hydride oxidation reaction.

3.2 Primary Objectives

The following objectives will be used to evaluate the alternatives. The evaluation will analyze all impacts from the recovery, processing, packaging, transfer and interim storage of the fuel until it is consolidated with similar materials for processing or storage.

Protect public and environment from hazards - The public and environment should be protected from contamination from radioactive and other hazardous materials. It is important to consider:

- Routine releases of radioactive and/or hazardous materials during normal operations
- Potential for releases of radioactive and/or hazardous materials during accident conditions
- Consequences to the public and environment from releases

Preserve worker health and safety - It is important to keep personnel exposure to radiation and other potential hazards As Low As Reasonably Achievable.

Potential hazards include:

- Personnel radiation exposure during normal operations
- Personnel radiation exposure during accident conditions
- Industrial injuries to personnel.

Consider cost and schedule - A cost effective and expeditious disposition of the fuel is necessary to ensure a timely completion of the alternative. Cost and schedule impacts include:

- Costs for fuel processing, packaging and transport, as necessary
- Cost for interim storage of the fuel
- Delays to the PUREX Deactivation schedule (Cost of \$100K per day)

Gain public acceptance - The method chosen for fuel disposition from PUREX must be acceptable by public interest groups. Issues which affect public acceptance include:

- Location of fuel storage
- Stability of the fuel storage configuration
- Potential contamination of additional facilities
- Impacts to the PUREX Deactivation schedule
- The use of PUREX processing equipment and the introduction and use of new equipment
- Consequences of potential accidents

4.0 FUEL TRANSFER ALTERNATIVES

Considering the general requirements outlined above and the scope of the evaluation, five alternatives were determined to be feasible for the disposition of the fuel presently stored in PUREX. These alternatives are:

- 1) Interim Storage in PUREX Canyon
- 2) Pool Storage at K Basins
- 3) Pool Storage at T Plant
- 4) Dry Vault Storage Following Passivation at PUREX
- 5) Underground Tank Storage at Tank Farms Following Dissolution at PUREX

The following sections provide a concise description of each alternative, followed by a breakdown of cost and schedule. These costs, estimated using engineering judgement, are to be used for order of magnitude comparisons only. Evaluation of the alternatives is based on how well they fulfill the objectives for fuel disposition. Each alternative has been rated based on whether it exceeds (+), satisfies (0) or fails to accomplish (-) the objectives. The evaluations are followed by a list of issues not addressed in the evaluations which may assist in selection or elimination of an alternative.

4.1 Interim Storage in PUREX Canyon

4.1.1 Description

This alternative involves the minimum actions necessary to resolve the fuel vulnerabilities without removing the fuel from PUREX. The fuel would be placed into a safe storage configuration which facilitates future fuel removal from PUREX. The activities for this alternative would be conducted during PUREX deactivation, however increased S&M would remain following deactivation.

A fuel storage location would be identified in the PUREX canyon, and the necessary equipment would be removed from the cell for installation of a storage tank. Fuel storage racks, remote surveillance and water level monitoring equipment and a water addition line would be installed. Also, water level monitoring and a water removal system would be installed in the surrounding sump. Upon completion of the storage area, the SPR fuel would be removed from the SSB and placed into the tank. The N Reactor fuel would be recovered from the headend cell floors, packaged into canisters and placed into the tank. The water would then be removed from the SSB, and the fuel would be stored in a much smaller amount of water with double containment.

At some point in the future, the fuel could be retrieved from the PUREX canyon and combined with the other SPR and N Reactor fuel at the proposed Staging and Storage Facility (if built) to handle the fuel at K Basins (See ref. 6). As a minimum this would require reactivation of the canyon crane, and an increase in the ventilation system. The transfer of the fuel from PUREX would be done using either the irradiated fuel cask car or a cask and rail car of a new design. Once the fuel was removed, the canyon crane and ventilation system would be deactivated once more.

The hazards to public and environment and worker safety will not be evaluated for future transfers of fuel, because the packaging system and transport mechanisms are unknown at this time. It is assumed that the safety of the public, environment and onsite workers will be ensured to a similar degree for any future fuel transfer. The cost of obtaining the packaging system will not be evaluated because it is assumed that a new packaging system will be designed for transfer of the N Reactor and SPR fuel from K Basins which would also be used for this fuel transfer.

4.1.2 Cost And Schedule Impacts

The cost and schedule impacts for this alternative would be separated into three time periods. The first time period would involve those activities conducted within three years to prepare for storage of the fuel in a new storage tank. The second time period would involve the S&M activities necessary to ensure that the water level in the tank is maintained. The third time period would involve those actions incurred to recover and transfer the fuel to the Hanford site fuel storage complex. The following costs are estimated for this alternative.

- The cost of installing a tank and level indication instrumentation, preparing the water addition connections and removing additional equipment will be \$200K.
- The cost of recovering and packaging the N Reactor fuel will be \$200K.
- The cost of the necessary security and the S&M to monitor and maintain the tank water level as well as the surrounding sump level will be \$250K per year for <10 years.
- The cost of temporarily reactivating the crane and ventilation and transferring the fuel to the new facility will be \$2M.

The preparation of the canyon for interim storage will require one year to complete.

Total cost: \$4.9M

Scheduled completion: 1 Year (to storage in PUREX)

4.1.3 Evaluation Against Performance Measures

Protect Public & Environment from Hazards	+	Fuel stored in water in a HEPA filtered facility on 200 Area plateau (+); Double containment of contaminated water (+); Recovery from emergency condition difficult due to limited resources of a partially deactivated facility (-)
Preserve Worker Safety	0	Future reactivation of PUREX crane and ventilation done by workers not familiar with facility (-); Fuel preparation and loading for transport done by non-PUREX workers (-); Work done remotely from crane (+); Fuel condition may require new packaging (-)
Consider Cost & Schedule	-	Initial deactivation costs minimal (+); PUREX cannot be turned over to EM-40 (-); S&M and security must be maintained until fuel is removed (-)
Gain Public Acceptance	0	Fuel placed in stable storage location on 200 Area plateau (+); Hanford fuel remains at separate locations (-); PUREX turnover to EM-40 delayed (-);

4.1.4 Other Issues

- Future handling of the fuel will be complicated by ongoing fuel degradation during water storage.
- At the time of the fuel recovery, the equipment will be over 50 years old and will have been deactivated for over 10 years.

4.2 Interim Storage at Onsite Facility

Two Hanford Facilities currently have the ability to store N Reactor and SPR fuel. The 105 K Basins and T Plant have water basins with water treatment processes which are compatible with SPR and N Reactor fuel. Both facilities allow easy access to the fuel for later transfer to the Staging and Storage Facility presently being proposed for storage of all the Hanford Fuel (See ref. 6).

A suitable transfer container must be identified in order to adequately evaluate the alternative impact. A review of the presently available transfer systems was conducted (See ref. 9). Each system was evaluated for compatibility with the fuel and facilities, container capacity and cost effectiveness. The Irradiated Fuel Cask Car was identified as the transfer system to use for the fuel shipments.

4.2.1 Pool Storage at K Basins

4.2.1.1 Description

This alternative involves transferring the SPR and N Reactor fuel into the 105 K Basins. Preliminary activities include recovery and packaging of each type of fuel, preparation of three cask cars and completion of regulatory and safety documentation. Each type of fuel would be packaged into containers which hold water and then be placed into the rail cask cars. The cask cars would be transferred to the K basins where the fuel would be unloaded and placed into storage. Due to storage requirements, the SPR fuel would be placed in KE Basin, and the N Reactor fuel would be placed in KW Basin. Once in the basin, the fuel would be handled along with the existing SPR and N Reactor fuel.

4.2.1.2 Costs and Scheduling Impacts

The costs involved with this alternative are documented in the PUREX/UO₃ Deactivation Project Management Plan (See ref. 7). The costs can be broken down into three main areas and include:

- Preparation of required documentation, \$200K.
- Preparatory activities to support transfer, \$300K.
- Transfer of the fuel to the K basins, \$100K.

Total cost: \$600K

Schedule completion: 1 year (to storage in K Basins)

4.2.1.3 Evaluation Against Performance Measures

Protect Public & Environment from Hazards	0	Addition of fuel to K Basins would not increase the probability of an accident (+); Fuel moved closer to Columbia River (-); Potential release during accident conditions and normal operations increased by less than 0.2% (+)
Preserve Worker Safety	+	Both PUREX and K basins workers experienced in fuel handling activities (+); Activities would be conducted in either a shielded facility or in shielding water (+)
Consider Cost & Schedule	+	Fuel disposition would occur within deactivation schedule (+); Cost for fuel transfer minimal (+)
Gain Public Acceptance	0	Fuel consolidated in one location (+); Fuel moved closer to Columbia River (-); Turnover to EM-40 on schedule (+)

4.2.4 Other Issues

- Future handling of the fuel will be complicated by ongoing fuel degradation during water storage which must be addressed for all fuel.

4.2.2 Pool Storage at T Plant

4.2.2.1 Description

This alternative involves the transfer of the fuel to T Plant and pool storage until the Hanford Staging and Storage Facility is ready to accept the fuel. T Plant is presently storing Shippingport Reactor fuel in a pool cell, and has water level monitoring and water purification equipment. All of the fuel at PUREX would fit into the pool along with the Shippingport fuel. There is little contamination in the water since the Shippingport fuel has no exposed uranium to degrade. Continued degradation of the N Reactor and SPR fuel could contaminate the pool cell as well as the Shippingport fuel unless the water circulation and purification systems are modified. The transfer of fuel to T Plant would be very similar to the transfer of fuel to the K Basins, except the N Reactor and SPR fuel would be packaged into containers compatible with T Plant and stored together. The fuel would remain in the T Plant pool cell until a new fuel storage facility is built, where it would be transferred.

4.2.2.2 Cost And Scheduling Impacts

The costs of this alternative are from preparation of the T Plant to accept and store the fuel. There are also impacts on T plant operation for the time frame until the new Hanford Fuels Staging and Storage Facility is operational. The costs associated with PUREX deactivation are already known and would not change significantly by transfer to T plant instead of to 105 K basins. The costs associated with this alternative are:

- The cost associated with the fuel transfer out of PUREX equivalent to PUREX deactivation plans (See ref. 7), \$600K.
- Additional monitoring and operating requirements while the fuel is stored in T plant, \$100K per year for 10 years.
- The costs involved with modifying T plant canyon (upgrade ion exchange system and install pool cell isolation barriers) and preparing appropriate regulatory paperwork for fuel storage, \$5M.

The transfer of fuel to T plant should incur no scheduling impacts. If necessary, the fuel could be transferred to the T Plant railroad tunnel during PUREX deactivation to await completion of physical modifications and regulatory approval and safety documentation.

Total cost: \$6.6M

Scheduled completion: 2 years (to storage in T Plant)

4.2.2.3 Evaluation Against Performance Measures

Protect Public & Environment from Hazards	0	Fuel would be stored in water with only single containment (-); Facility is filtered (+); Water purified by ion exchangers (+)
Preserve Worker Safety	0	All fuel handling activities at PUREX and T Plant done remotely from crane (+); T Plant modifications would involve canyon work (-)
Consider Cost & Schedule	0	Fuel disposition would occur within deactivation schedule (+); Modifications to T Plant moderately costly (-)
Gain Public Acceptance	0	Fuel remains on 200 Area plateau (+); Fuel consolidated with other fuel (+); Potential exists to contaminate Shippingport Fuel stored at T Plant (-)

4.2.2.4 Other Issues

- Future handling of the fuel will be complicated by ongoing fuel degradation during water storage.

4.3 Dry Vault Storage Following Passivation at PUREX

4.3.1 Description

This alternative involves the installation of a fuel stabilization process in the PUREX plant which would prepare the fuel for dry storage. The SPR fuel would remain in the SSB and the N Reactor fuel would be recovered, packaged and stored on the canyon deck until the process could be readied for operation. The process to stabilize the fuel has not been determined, however initial selection of the most viable method has been done by an Independent Technical Assessment Team (See ref. 3).

The dry storage process would need to be identified and tested via a pilot test elsewhere using sample specimens. The process design would then be developed and the equipment installed in PUREX. The fuel would be stabilized and sealed in dry storage containers. The fuel would then be transferred to storage vaults which would be built on the 200 Area plateau. The process used for the stabilization of this fuel could be later used for the stabilization of SPR and N reactor fuel at K Basins and elsewhere on the Hanford site.

4.3.2 Cost And Schedule Impacts

The cost involved with this alternative are very difficult to establish since the process has not yet been identified.

- The PUREX plant would continue to operate for at least years 2 beyond presently planned deactivation adding \$10M per year of minimum operating costs.
- Obtaining required regulatory approvals would require \$1M.
- The installation and startup of the process would require \$3M in R&D funds.
- New containers, a storage vault and shielded transfer device would need to be designed and tested at \$500K and then fabricated at \$5M.
- Operation of the plant to convert the fuel would take approximately 1 year at an operating cost of \$10M to \$20M.
- Deactivation of this process would follow at a cost of \$1M.

Total cost: \$50M

Schedule completion: 5 years (to storage in dry vault)

4.3.3 Evaluation Against Performance Measures

Protect Public & Environment from Hazards	+	Process is contained within filtered facility (+); Storage systems will isolate fuel from environment (+)
Preserve Worker Safety	0	Most operations conducted remotely (+); May require entry into contaminated area for maintenance (-)
Consider Cost & Schedule	-	PUREX Deactivation delayed (-); High cost for new process (-); PUREX turnover to EM-40 delayed (-)
Gain Public Acceptance	-	Requires startup of a new process inside PUREX (-); Deactivation time increased (-); Technology transferrable to other fuel (+)

4.3.4 Other Issues

- The process for fuel stabilization is not complete and further engineering is necessary without assured process identification.
- This would be considered a new PUREX process requiring development of all new Environmental Impact Statements and Safety Analysis Report.

4.4 Underground Tank Storage Following Dissolution in PUREX

4.4.1 Description

The PUREX plant head end processes would be utilized to dissolve the fuel using a modification of the existing flowsheet operations. The SPR fuel would be stored in the SSB and the N Reactor fuel would be recovered and stored on the canyon deck until the process and necessary regulatory and safety documentation are prepared. The elements would then be sheared in one or more places using the jumper cutter, or a similar cutting device, and charged to the dissolver. The uranium metal would be dissolved in nitric acid slowly at a low temperature.

There is presently no demand for the special nuclear material contained in either types of fuel. The solution generated would therefore be neutralized and transferred as waste to underground storage tanks at the Tank Farms for later processing through the tank waste vitrification facility. The remaining cladding would be considered waste and would remain in the dissolver to be removed during D&D.

4.4.2 Cost And Scheduling Impacts

The cost associated with the processing of the fuel will be centered around the restart of select head end operations. Material with high plutonium content has already been sent to UGS tanks as part of the PUREX deactivation plan. The costs for this alternative will include the following:

- The PUREX plant would continue to operate for 1 year beyond presently planned deactivation adding \$10M per year of minimum operating costs.
- Preparation of required operating specs., procedures, etc, \$200K.
- Preparation and approval of regulatory approved documentation, \$300K.
- Operation of the head end process and transfer of the solution to underground storage tanks, \$100K.
- Materials for fabrication of new equipment and chemicals for isolation and neutralization \$300K.

The dissolution of fuel elements at PUREX has been conducted in the past and could be restarted with minor retraining. The major impact would be with obtaining approval to restart an operating plant in the existing environment. With an aggressive schedule and DOE support, this alternative could be completed within 4 years.

Total cost: \$11M

Schedule completion: 3 Years (to storage in Tank Farms)

4.4.3 Evaluation Against Performance Measures

Protect Public & Environment from Hazards	0	Process would occur in a filtered facility (+); Waste solution stored in double containment (+); Storage on 200 Area plateau (+); Addition of high levels of plutonium to waste storage tanks (-); Waste stored as a solution (-)
Preserve Worker Safety	+	Work at PUREX done remotely from canyon crane (+); Processing technology well known (+); Solution transfers by pipeline do not affect workers (+)
Consider Cost & Schedule	-	Deactivation schedule and PUREX turnover to EM-40 delayed (-); High cost for process startup (-)
Gain Public Acceptance	-	Requires startup of some PUREX headend processing equipment (-); Deactivation time increased (-)

4.4.4 Other Issues

- The fuel would be placed in a condition from which no further degradation would occur.

5.0 COMPARISON OF ALTERNATIVES

Evaluation of the alternatives is based on how well they fulfill the objectives for fuel disposition. Each alternative has been rated based on whether it exceeds (+), satisfies (0) or fails to accomplish (-) the objectives. These ratings were summed for each alternative to give an evaluator. The more positive the evaluator, the better the alternative is at satisfying the objectives. The most positive evaluator, 2, and therefore best alternative is to transfer the fuel to the 105 K Basins.

TABLE 2 - PUREX FUEL ALTERNATIVE COMPARISON					
ALTERNATIVES	OBJECTIVES				
	Protect Public & Environment from Hazards	Preserve Worker Safety	Consider Cost & Schedule	Gain Public Acceptance	Evaluator
PUREX	+	0	-	0	0
K Basins	0	+	+	0	2
T Plant	0	0	0	0	0
Stabilize/Store Dry	+	0	-	-	-1
Dissolve/Tank Farms	0	+	-	-	-1

The next best or backup alternative, with an evaluator of 0, is to transfer the fuel to T Plant for storage. However, if the fuel transfer to K Basins cannot be accomplished, a new review may be needed since the changes which eliminated the transfer of fuel to K Basins may also impact transfer of the fuel to T Plant.

The temporary storage of the fuel in the PUREX rail tunnel inside the irradiated fuel cask cars could allow time for the receiving facility to prepare the necessary documentation and modifications to safely unload and store the fuel. However, the fuel will continue to degrade while in the cask car. This could add fission products to the water and increase the dose rate from the cars with a potential to increase above allowable shipping parameters. The recovery from this condition in a deactivated PUREX facility would be very difficult and costly and should therefore be avoided.

6.0 REFERENCES

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4. DOE, 1993, *Operating Experience Weekly Summary 93-37*, U.S. Department of Energy, Washington, D.C.
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