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7. Abstract

This study is a summary report that examines and evaluates the feasibility of consolidating irradiated fuel and sludge currently in KE Basin with that in the KW Basin. This study was conducted in support of TPA Milestone (target date) M-34-00-T03.

The report summarizes three supporting engineering studies involving: 1) spent fuel consolidation into the single basin, 2) transport of the encapsulated fuel between KE AND KW Basins, and 3) dispositioning contaminated water remaining in KE Basin. From the three reports, and preferred storage method, transfer method and water disposition method were defined. These consolidation methods were then evaluated against the no action alternative of continued storage using both KE and KW Basins.

The report concluded that the fuel and sludge currently store in KE Basin not be consolidated in the KW Basin, primarily due to increased cost and radiation exposure required to consolidate the fuel and sludge. Consolidation is more attractive for storage periods beyond the year 2002, which is the study period of the report.

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105KE AND 105KW BASINS FUEL AND SLUDGE CONSOLIDATION STUDY

WHC-SD-SNF-ES-003
REV. 0

SUMMARY REPORT

Prepared for:
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September 20, 1994

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1.0 OBJECTIVES

1.1 PURPOSE AND NEED

This report contains a summary of three engineering studies performed to evaluate 100K Area Fuel Consolidation and KE Water Disposition. This report is prepared in support of efforts to meet a Hanford Federal Facility Agreement and Consent Order (TPA) milestone, TPA Milestone M-34-00-T03. This Summary Report presents the results of:

- Spent Fuel Consolidation in the 105KW Building Fuel Storage Basin - WHC-SD-N040-ES-001 (Consolidation Study), prepared by ICF-Kaiser Hanford Company for Westinghouse Hanford Company (Westinghouse Hanford);

- 105KE to 105KW Basin Fuel and Sludge Transfer Engineering Study - WHC-SD-SNF-ES-002 (Transfer Study), prepared by Columbia Energy and Environmental Services, Inc, for Westinghouse Hanford; and

- KE Basin Water Disposition Engineering Study - WHC-SD-SNF-ES-001 (Water Disposition Study), prepared by Westinghouse Hanford.

In addition to summarizing the three engineering studies, the preferred options are compared with the continued use of two basins, conclusions and recommendations are presented with respect to the feasibility, cost effectiveness, advantages and disadvantages of moving and temporarily storing the encapsulated fuel and sludge from the 105KE Fuel Storage Basin in the 105KW Fuel Storage Basin.

1.2 BACKGROUND

In the 1950s the 100KE and 100KW reactors were constructed. The 105KE Fuel Storage Basin (KE Basin) and 105KW Fuel Storage Basin (KW Basin) were originally constructed to receive the spent fuel from these reactors. The spent fuel was temporarily stored in the basins until it could be processed. The reactors were shut down and the basins taken out of service in 1970-1971. Between the mid-1970s and early 1980s the basins were upgraded to temporarily store irradiated fuel from the N Reactor prior to processing at PUREX.

With the shutdown of PUREX in the late 1980s and the subsequent shutdown and defueling of the N Reactor, the 100K Area basins have become the storage facility for N Reactor fuel. There are currently 961 metric tons of N Reactor fuel in sealed Mark II canisters stored in the KW Basin. There are currently 1,150 metric tons of irradiated N Reactor fuel stored in 3,671 open canisters in the KE Basin, as well as 0.1 tonnes in KW and 0.4 tonnes in KE of single pass reactor fuel. The radioactivity in the water as well as cladding damage to a portion of the fuel has resulted in the accumulation of a radioactively contaminated sediments on the floor of the basin. This sediment is referred to in this report as a sludge.

In 1977 the KE Basin experienced a leak. This leak was measured at approximately 13.5 gal/min (51 L/min). The source of this leak was found and repaired

and by 1980 the rate of leakage had been reduced to approximately 2-3 gal/hr (7.5-11 L/hr). A measurement in February 1993 indicated a water-loss rate of approximately 60 gal/hr (227 L/hr). The basin water temperature was raised in response to a correlation between water temperature and leak rate, and since June 1993 there has been no measurable leakage. These leaks have raised concern among the public, DOE, state, and other Federal officials. This has led to the establishment of TPA Target Milestone M-34-00-T03 to submit an engineering study to determine the feasibility of consolidating all the encapsulated KE Basin fuel and sludge and KW Basin fuel in the KW Basin. Target Milestone M-34-00-T04 was established to submit a schedule for disposition of the contaminated KE Basin water, and Target Milestone M-34-00-T08 was established to remove all fuel and sludge from the K Basins in the year 2002, which is used as the basis for feasibility determination.

1.3 SCOPE

The scope of the Summary Report is limited to the information provided in the three engineering studies performed for fuel consolidation. The scope of these reports is the following:

- The Consolidation Study examined the facility upgrades associated with the consolidated storage of fuel in the KW Basin. The study addressed methods of handling the anticipated increase in heat loading and water treatment at the KW Basin as well as examining possible modification and reconfiguration requirements needed for existing support systems, instruments, and controls.

- The Transfer Study evaluated methods for transferring encapsulated fuel and sludge from the KE Basin to the KW Basin. The study addressed possible alternatives in transport method as well as options in the containers used for transport.

- The Water Disposition Study examined options for the disposal or treatment of the KE Basin water to comply with TPA milestones. The study addressed possible alternatives for water treatment and disposal option.

2.0 RECOMMENDATIONS AND CONCLUSIONS

The recommendations and conclusions described in this section are derived from the recommendations and conclusion stated in the respective reports.

2.1 RECOMMENDATIONS

It is recommended that the fuel and sludge currently stored in KE Basin not be consolidated into the KW Basin. This recommendation is based primarily on the increased costs and radiation exposure needed to consolidate the fuel and sludge. While cost and radiation exposure clearly favor continued use of two basins, the less quantifiable factors such as risk and schedule favor consolidation in KW.

The recommendation not to consolidate fuel into KW is schedule sensitive, and consolidation becomes a more attractive choice if storage of fuel at the Basins extends beyond the year 2002. Sections 2.1.1 through 2.1.3 provide a brief discussion of the recommended consolidation methods, if consolidation was to be completed.

2.1.1 Consolidation

A system of floor-mounted steel racks is the preferred storage method based on flexibility of design and arrangement. This system allows for accessibility for maintenance and surveillance once the fuel is consolidated. The actual number of canisters to be stored will dictate the most effective rack construction arrangement. The preferred alternative for basin water cooling requires the relocation of the 60-ton air-cooled condenser and the associated evaporator presently at KE. Water treatment in KW can be accomplished using the existing system.

2.1.2 Transfer

If the fuel consolidation project is implemented there are a number of options for transferring fuel between the KE Basin and the KW Basin. Preliminary analysis indicates that fuel heat loads have reduced, and transfer of fuel may be possible without cooling. It is recommended that consideration be given to transferring fuel without cooling water to minimize the potential impact to the environment. If the transfer can be completed without the use of cooling water, the recommended alternative is for Westinghouse Hanford to utilize the existing trailer trucks with K Area casks. Well car with K Area casks transfer without cooling water is also possible, and this alternative is also recommended for consideration. If the transfer cannot be completed without cooling water, the only viable option is to use the well cars with K Area casks.

2.1.3 Water Disposition

KE Basin water treated for disposal through the NPDES Outfall 004 was identified as the preferred option. This had the lowest cost, and had the highest overall score in the Water Disposition Study. Because the treatment method examined in the Water Disposition Study was the same for all disposal methods, it is recommended that permitting schedules be developed for surface water, ground water, and air disposal pathways.

2.2 CONCLUSIONS

2.2.1 Consolidation

Three storage alternatives were evaluated for consolidating fuel in KW Basin. The most efficient and practical method is the addition of multi-tiered storage racks. The actual number of canisters will ultimately dictate the tier arrangement. The racks can be fabricated off-site in accordance with the basin's required specifications and, once installed, allow accessibility for maintenance and surveillance. A 60-ton air-cooled condenser will be relocated from KE to KW in order to provide adequate basin water cooling. Water treatment will be performed using the existing treatment system.

2.2.2 Transfer

Six alternatives were evaluated and were rated with respect to the criteria identified in the Transport Study. Each alternative was scored for each of the evaluation criteria on a scale of 0 for unacceptable, to 5 for the highest rating. The study showed that the highest rating was to transfer the KE Basin fuel and sludge to the KW Basin using drained K Area casks and trailer trucks. The next best alternative was transfer using the K Area casks and the well cars drained of water. These options scored higher than wet transfer using the K Area casks and well cars, or developing a new shielded cask for transferring the fuel. The study determined if water cooling is required, the only viable option is wet transfer using the K Area casks and well cars.

2.2.3 Water Disposition

The treatment of the KE Basin water is feasible for the removal of inorganics and radionuclides to an acceptable level for disposal. There are three disposal alternatives reviewed in the Water Disposition Study. The time needed to implement the disposal system is two years. There is currently no permitted discharge at the Hanford Site, for KE Basin water. The estimated times for obtaining a discharge permit are 36 months for river discharge, 18 months for ground water discharge, and 24 months for air permitting a solar evaporation pond.

3.0 UNCERTAINTIES AND ASSUMPTIONS

3.1 UNCERTAINTIES

In completing these studies, it was recognized that there were many uncertainties with respect to consolidation, fuel transfer, and subsequent water disposition at the KE and KW basins. These uncertainties have the ability to impact existing Tri Party Agreement Milestones and have to be considered in the planning of future engineering work. The following uncertainties are summarized from the three studies

3.1.1 Operations Uncertainties

- Since the KE Basin and KW Basin are over 40 years old aging effects could develop with either or both basins, causing uncertainty as to the exact period of time that the basin may be able to provide for safe storage of fuel without additional improvements;

- The volume of KE sludge and the resulting number of sludge canisters is not accurately known;

- The location, methods, cost, and schedule for disposal of contaminated storage racks, following KW Basin modification, has yet to be determined;

- Disposal method and location for the displaced water from the additional canisters is not yet defined;

- The time and radiation exposure required for canister surveillance for fuel inventory purposes is an uncertainty with respect to multi-tiered storage;

- It is not clear whether the existing 200-ton water-cooled chiller can be used during the construction period and fuel transfer. Further, it is uncertain if the existing 200-ton water-cooled chillers have a remaining useful life to 2002;

- Presently, the safety analysis report and operations safety requirements for the KE and KW Basins limit the west bay to storage of low enrichment material (LEM) only and prohibits hanging storage in the west bay. This creates uncertainty with respect to the logistics of rearranging fuel during installation of the new racks;

- The condition of the railroad shipping cars, railroad engines, and casks used in the past to transport fuel canisters, as well as the state of readiness of this equipment and the resources to bring them to current standards is not known. Although dose rate criteria are known to be satisfied by the well car and K Area cask combination. It is uncertain if the combination will meet other DOT equivalency criteria such as leakage of radioactivity;

- Existing commercial fuel shipping container cannot be placed into the loadout pits. Therefore, a shielded transfer basket to place the canisters into and remove them out of the shipping container would need to be developed. Uncertainties exist with respect to the cost and schedule of this development;

- Effluent treatment performance and treated effluent characteristics are based on vendor reported decontamination factors and not on site-specific testing; and

- Encapsulation activities will cause the resuspension of a great deal of particulates, which would increase the loading of the treatment system. There is some uncertainty to the operational characteristics of the filter treatment system under heavy particulate loading.

3.1.2 Unreviewed Safety Questions Uncertainties

- The effects of the steel storage racks, full of canisters, on the KW Basin epoxy coating will require further investigation;

- New safety requirements that would evolve from consolidation have an uncertainty as to their overall impact with respect to required facility/equipment modifications and associated costs and schedules to resolve safety concerns;

- These safety issues also have various approval levels of authority within DOE and Westinghouse Hanford, creating uncertainty with timely resolution emerging safety concerns; and

- It is uncertain if the use of a non-DOT certified fuel shipping cask will be allowed. If allowed, an equivalency evaluation similar to the existing well car must be performed.

3.1.3 Radiation Exposure Uncertainties

- The dose rates estimates for the tiered racks containing the canisters of irradiated fuel are based on computer models. This creates some uncertainty with respect to handling fuel canisters above three tiered rack sections;

- Uncertainties exist with respect to the assignment of administrative exposure limits set by Westinghouse Hanford. This creates significant uncertainty with resect to cost and schedule;

- The radiation exposure estimates for KE water disposition are rough estimates based on current exposure usage. Additional uncertainty is created by the inability to predict radionuclide buildup on the water treatment system during and after fuel and sludge encapsulation; and

- The microfilter/ultrafilter unit being considered is a commercial unshielded unit, and will require additional ALARA design considerations. This also creates additional cost and schedule uncertainties.

3.1.4 Environmental Uncertainties

- Environmental uncertainties exist with respect to the development of and time required to obtain a "Record of Decision" for an Environmental Assessment and satisfy any additional National Environmental Policy (NEPA) requirements; and

- Schedule uncertainties exist with respect to obtaining regulatory authorization for effluents and wastes that may be generated by the transfer of irradiated fuel/sludge from the KE Basin to the KW Basin.

3.1.5 Waste Management Uncertainties

- It is uncertain if any of wastes generated by the consolidation will require management as transuranic wastes as defined by DOE 5820.2A (DOE 1988);

- If transportation of hazardous, transuranic and/or mixed wastes is required, new packaging for shipping and disposal may need to be obtained. Design, approval and procurement for new packages have not been considered in this study, but would have factored into cost and schedule;

- Since there are no preestablished water quality criteria for the discharge of radionuclides (except tritium and strontium), the proposed reduction factors for the radionuclide contaminants in the discharge may not be acceptable to permitting agencies;

- It is uncertain if that the use of a river mixing zone to achieve Tritium levels below Drinking Water Standards will be deemed acceptable for obtaining a discharge permit; and

- There is uncertainty if spent resins and filter media can kept below TRU concentrations.

3.1.6 Cost and Schedule Uncertainties

- DOE budgetary line items require the approval of DOE Headquarters and Congress. There is, therefore, a degree of uncertainty that DOE and Congress will give their approvals in the fiscal year they are expected. This uncertainty affects the start of all work. If the capital cost of selected options require more than $2 million, the budget may become a line item, requiring 18 to 36 months. Obviously, the higher the cost, the higher the probability of budgetary delay, final disposition, or non-approval;

- The integration of roof repairs and other facility improvements with fuel consolidation activities has potential for impacting timely completion of fuel consolidation;

- New safety requirements that would evolve from consolidation have an uncertainty as to their overall impact with respect to required facility/equipment modifications and associated costs and schedules to resolve safety concerns; and

- These safety issues also have various approval levels of authority within DOE and Westinghouse Hanford, creating uncertainty with timely resolution emerging safety concerns.

3.2 ASSUMPTIONS

A large number of assumptions were used in completing the three studies. The following assumptions are summarized from the three studies.

3.2.1 Operations Assumptions

- All the fuel transferred to the KW Basin will be encapsulated in MK-II canisters using existing encapsulation methods and technologies;

- The fuel currently stored in the KW Basin will remain in their current MK-I or MK-II canisters;

- The minimum number of sludge canisters is 1,000;

- The KE Basin grating floor has the capacity for normal construction loads, but not for hanging new storage structures;

- The well cars are capable of transporting the fuel canisters and casks without major modification and repairs;

- The 100K Area can be isolated from general public and nonessential personnel as required for transfer of fuel and the controlled area can be enlarged to fully control the area where the transfer will be performed;

- An average of 2,000,000 gal (7,570,000 L) of contaminated basin water will be treated and disposed of annually, in keeping with TPA Milestone M 34-01;

- Water treatment will be performed in a campaign mode, collecting sufficient volume for disposal;

- The polishing IXM will have a 99.9% efficiency (1000 DF) for the removal of radionuclides except tritium;

- Selection of the water treatment process was based in a large part on the BAT studies previously performed for the N Reactor, and ETF;

- Sand filter and microfilter/ultrafilter backwash will be discharged to the basin in a manner comparable to the sand filter backwash;
- Performance testing of equipment will be done prior to completion of final design; and
- The hydrogen buildup question pertaining to the filters and ion exchange media has been satisfactorily resolved .

3.2.2 Unreviewed Safety Question Assumptions

- Mechanical anchorage of the storage structure to the basin is not allowed;
- The KW Basin is structurally qualified for the storage system and the epoxy finish will withstand the loadings imposed on it by the storage system used;
- That SNM inventories required by DOE Order 5633.3A will be performed using statistical samples, and DOE is willing to approve a deviation to the bimonthly weighing requirement;
- This study assumes that any USQs that would be identified have been satisfactorily resolved prior to the transfer of irradiated fuel from the KE Basin to the KW Basin;
- Alternative mechanisms developed to transfer fuel and sludge will be within the authorization basis envelope established by the existing SAR and its referenced documentation;
- The K Area cask in combination with either the well car or tractor trailer satisfies DOT equivalency criteria; and
- Use of commercial DOT certified shipping casks or other DOT casks will be allowed by DOE for certain alternatives assessed.

3.2.3 Radiation Exposure Assumptions

- KW dose rates in the three-tiered configuration are sufficiently low to support fuel movement and inspection.
- It is assumed that a comprehensive ALARA plan, meeting the requirements of DOE Orders and Westinghouse Hanford Administrative Control Manual requirements, has been developed, approved and implemented prior to starting consolidation.
- Irradiated fuel and sludge will be put into fully enclosed containers, thereby reducing the KE Basin water source term over time;

- Work crews will be scheduled for two shifts. Our analyses show that this is the most effective use of personnel with respect to radiation exposure;

- It was assumed that respiratory protection is not required during transfer activities.

- Dose rates for loading fuel canisters into the K Area casks and well cars are assumed to be as described in the Fuel Encapsulation ALARA Report, and dose rates for transporting the canisters in the well cars are assumed effectively reduced after decontamination.

- Water treatment equipment will have adequate shielding for ALARA considerations;

3.2.4 Environmental Assumptions

- It is assumed that NEPA Environmental Assessment requirements and all permitting requirements will be completed in a timely manner.

- It is assumed that no new DOE, the State of Washington, and Westinghouse Hanford environmental requirements are encountered with respect to installing new racks in KW.

- NEPA requirements, DOE Orders, and all permitting requirements will be met prior to starting an activity;

- A discharge permit will be issued based on using the a river mixing zone to achieve acceptable tritium levels; and

3.2.5 Waste Management Assumptions

- The existing water treatment system at the KW Basin is assumed to be capable of providing adequate water quality; and

- Spent IXMs would remain non-TRU for disposal;

- KE Basin sludge will be treated as spent fuel;

- It is assumed the transfer wastes may contain some mixed wastes.

3.2.6 Cost and Schedule Assumptions

- The material condition of the KW Basin and associated systems can be maintained over its intended life;

- All fuel/sludge will be removed from the KW Basin prior to December 2002, and the KW Basin will remain operational through the 2002.

- Fuel canister displacement during new rack installation can be managed as not to impact the schedule.

- Cost and schedule for transferring fuel by tractor trailer are based on purchasing new trucks and trailers.

- Water treatment costs are based on a treatment capacity of 2,000,000 gal (7,570,800 L) of water per year, and will be proportional to the volume of required treatment;

- Since practical tritium removal methods do not currently exist for water treatment, the costs and schedule for KE water disposition do not include tritium removal. Costs and schedule duration would increase should tritium treatment technology become available.

- The schedule for water treatment equipment installation is assumed independent of encapsulation and consolidation activities. The start of water treatment is assumed dependent on the decision as to whether KE Basin fuel/sludge will be consolidated at KW.

4.0 DESCRIPTION OF CONSOLIDATION METHODS

The various consolidation methods are described in this section. In addition, continued operation of both basins and not consolidating encapsulated KE fuel and sludge in the KW Basin is also discussed as a "No Action " alternative. Consolidation of the encapsulated fuel/sludge from the KE Basin with the existing fuel in KW Basin may be considered a three phase action. Phase one is to modify the KW Basin in order to accommodate all of the canisters of fuel and encapsulated sludge. The second phase is to transfer the encapsulated fuel and sludge canisters from the KE Basin to the KW Basin. Phase three occurs after all the canisters have been removed from KE and consists of treating and disposing of KE Basin water. Each of these phases are discussed below.

4.1 105-KW BASIN MODIFICATION OPTIONS

The Consolidation Study evaluates the KW Basin modifications necessary to store the repackaged fuel and encapsulated sludge from the KE Basin along with the fuel already stored in the KW Basin. The study covers the adequacy of the current fuel storage configuration, the current basin water cooling system, the current water treatment system, and the current instrumentation and inventory control system. The capabilities of the current systems were evaluated against the anticipated requirements of the basin after consolidation.

4.1.1 Preferred KW Basin Modifications

The preferred option is to use floor supported multi-tier steel racks, with the current KW 60-ton air-cooled water chiller and water treatment system. Once fuel consolidation is completed KE's 60 ton air-cooled water chiller would also be relocated to KW.

4.1.2 Fuel Storage Option

Currently the storage capacity of the KW Basin is not enough to hold the canisters to be transferred from the KE Basin. Three storage alternatives were evaluated based on the following factors: maximum and minimum storage requirements, constructability, cost and scheduling, water shielding requirements, impacts to existing facilities, structural design, and serviceability of racks. The three alternatives are floor-mounted steel racks, evaluating three different rack configurations, superstructure/ monorail supported canister hangers, and three boron concrete cubicles currently in the N Reactor basin (N Basin). All three methods provide access to retrieve canisters for repair or replacement; these configurations will meet the inventory and canister integrity surveillance requirements; and maintain adequate separation of canisters to prevent criticality. These configurations are also designed to restrain the canisters to prevent damage to the canisters and basin during a design basis earthquake.

The floor-mounted steel rack configurations evaluated by the Consolidation Study include: two layers in two bays, and three layers in one bay (2 bay/2 tier-1 bay/3 tier); three layers in three bays (3 bay /3 tier); and the existing one layer in one bay, and three layers in two bays (1 bay/1 tier-2 bay /3 tier). All of these configurations meet the

minimum storage requirement for number of canisters, the basin is structurally adequate for this storage system; and the racks themselves are adequate for canister storage. Additionally, the 3 bay/3 tier option would accommodate the maximum number of canisters currently anticipated. The only disadvantage is that the existing layer of storage racks for the 1 bay/1 tier-2 bay /3 tier option would have to be studied for structural adequacy as well as compatibility with the rack systems to be constructed.

The second method for storage uses a combination of steel racks on the floor of the basin along with superstructure/monorail supported hanging storage. This requires installation of two layers of floor storage in three of the bays and one layer of hanging storage in two of the bays. This method was examined for comparison purposes only. The storage capacity of this method is more than 200 canisters short of the minimum projected need. In addition, the superstructure/monorail supported hanging system will need qualification in order to use this method.

The third method for storage evaluates the possibility of relocating and installing the 1,000 boron concrete cubicles from the N Basin to the KW Basin. Along with the boron concrete cubicles, new steel racks would be installed. The cubicles are modular arrays formed by boron concrete posts and sidewall panels. They provided three-layer storage at N-Basin with interior dimensions of 24-in x 14-in x 108-in. The advantages of this option are that the cubicles meet the minimum anticipated storage capacity and the reuse of the cubicles limits additional radwaste. The disadvantages of this option include: the cubicles add significant weight and seismic loading to the basin, limiting storage to two layers; and transfer of the cubicles would involve significant labor, exposure, and decontamination efforts to remove them from the N Basin.

4.1.3 Cooling of Basin Water Options

Cooling the basin water is used to remove the decay heat generated by the stored fuel and also the additional heat generated from the operation of equipment. It has been shown that variations in water temperature can affect the concentration levels of various radionuclides in the water, and cooling the basin water helps minimize radionuclide concentrations in the basin water. The capacity of the cooling system is based on two factors. The first factor is the capability of the cooling system to remove the heat from the fuel and sludge canisters and operations activities. This heat load has been estimated to be approximately 406,700 Btu/hr from the fuel and sludge and 154,200 Btu/hr from the operation of equipment. The second factor in cooling system design is the capability to transient cooling, which is needed to lower basin water temperature in the event of cooling system shutdown, large heat gain from the surrounding soil, or other thermal transient event. The capacity designed for will provide the capability to reduce the basin temperature by 1°F/day.

One of the options is the relocation of a 60-ton condenser and evaporator from the KE Basin to the KW Basin. This option offers the advantages of using existing equipment and removing the need to dispose of the contaminated unit, thereby saving disposal costs. The disadvantages include the fact that the fuel must be completely transferred before the unit can be moved, also by the time the unit is installed at the KW Basin it will be approximately 10 years old. This is approximately half its life expectancy.

Another option is the purchase and installation of a new air-cooled condenser and evaporator. The new unit would provide 37 tons of cooling. The new unit would be installed in parallel with the current air-cooled condenser system. This option would use no river water, removing the need for the water supply system to be maintained. The disadvantages include the need to purchase all new equipment, and that this option would only meet the very minimum of the transient cooling requirements.

A third option for cooling the basin water is to continue the use of the 200-ton water-cooled chiller which is currently in place. The advantages of this include that the equipment already exists and only requires minimal retrofit to the controls, the capacity of the unit is well above the minimum required, the chiller was made for heavy-duty industrial use and is very reliable, and with this large cooling capacity, the chiller only needs to operate on an intermittent basis. The disadvantages for this option include: the need for river water to cool the condenser, requiring the operation and maintenance of the river water supply system; at low basin water temperatures, the discharge from the chiller may be close to freezing; the system requires dedicated power; and the refrigerant used by the system is a CFC which may no longer be available. Life expectancy is also uncertain.

4.1.4 Water Filtration and Treatment Options

The existing water filtration capability at the KW Basin was evaluated as adequate to meet the needs of the basin after the addition of the repackaged fuel and encapsulated sludge. Therefore no other options were evaluated. Postulated increases in filtration needs can be addressed through simultaneous operation of the primary filters currently being operated separately. The current sand filter is anticipated to be capable of continuing to remove floating solids from the basin water. The level of solids is not anticipated to increase significantly with the addition of the repackaged fuel and encapsulated sludge. The majority of solids in the water is from sources dependent on factors other than canister numbers.

The addition of the repackaged KE Basin fuel and encapsulated sludge will not introduce any new types of contaminants to the KW Basin. The canisters from the KE Basin may contribute some solids to the KW Basin water as a result of external contamination. However, this contribution from the contamination will be of short duration and of a very low amount.

4.1.5 Instrumentation and Inventory Control Option

Some new instrumentation will be required in the KW Basin. This instrumentation will have to be installed due to modifications of systems and of equipment discussed earlier. These modifications include installation of a new chiller.

The inventory control requirements for the fuel to be stored in the KW Basin are complex. In order to comply with DOE Order 5633.3A, a ten percent sample of the stored canisters in the facility must be taken every two months. This would mean that as many as 1,150 canisters would have to be removed for physical inventory verification. This level of effort would require approximately 380 manhours to complete. Along with

the amount of time needed to perform the inventory, a significant increase in dose to operations personnel would also result due to lifting the canisters out of the racks to a level leaving only two to six feet of shielding water above the canisters as they are moved.

Automation of the inventory sampling process has several advantages over the manual inventory process. However, an automated inventory process was deemed not to be feasible due to cost and maintenance considerations. A waiver relaxing the frequency and percentage of required sampling is currently in effect for the K Basins. A similar type waiver would have to be processed for multi-tiered storage. Approval of this waiver would reduce physical inventory to a yearly requirement.

4.2 105KE TO 105KW FUEL/SLUDGE TRANSFER OPTIONS

Six methods of transferring the fuel and sediment from KE to KW were examined by the Fuel Transfer Study. The six methods can be categorized as either a K Area cask option or new cask option. New cask options were determined to have greater costs and longer schedule duration, Therefore K Area cask alternatives are the more the more preferred alternatives. K Area casks can be transported by truck or rail using existing well cars. The only feasible transfer alternative capable of providing water cooling of the fuel is by well car. However, the energy (watts) of the fuel to be transferred has decayed to approximately four percent of the levels when the fuel was transferred from the 100N to the 100K Area in the 1980s. This relatively low level of thermal energy may allow the encapsulated fuel to be transferred, without cooling water. If dry transfer of fuel is possible, truck transfer or dry transfer using K Area casks and truck or well cars become viable. Variations of transfer by well car and by truck are further described in this section.

4.2.1 Preferred Transfer Option

The preferred method of transferring fuel to KW is to use existing K area casks and either truck or well car.

4.2.2 Well Car Transport Options

The well car transfer system consists of a three barrier arrangement, sealed fuel storage canisters that hold 14 fuel elements, a K Area cask that contains three canisters, and a well car that contains three casks. The K Area casks provide the shielding and accident protection during shipment, while the well car provides cooling water and contamination control.

The three compartment three-well "long cars" are 200-ton capacity railcars, that are 50 ft long and supported by two four-wheel or six-wheel trucks. When loaded the three-well car holds three K Area casks. The car's three rectangular compartments hold cooling water for the fuel casks and are mounted on top of an underslung railroad car. The well cars' doors do not seal tightly against potential water sloshing or spilling. A minor modification of the hinged doors for a better seal on the well cars was assumed for wet well car shipments.

K Area casks are large, heavily shielded containers used to transport canisters between the reactor basins. The K Area cask has three sections to accommodate the placement of three fuel canisters. The outer and inner walls of the cask are assembled from American Society for Testing and Materials (ASTM) A 36 carbon steel. The overall cask envelope measures 59 1/4-in. by 57-in. by 75-in. high. The outer sides and bottom of the cask are 1/2-in.-thick steel plate, encasing a nominal 10-in.-thick lead shielding. The inner walls are a minimum of 3/8-in.-thick plate. The 10-in.-thick lead shielding for the lid is encased in 3/4-in.-thick plate (10, 11). Approximate weights are as follows: lid, 5,700 lbs; cask (empty, without lid), 39,300 lbs; total assembly (empty), 45,000 lbs (9). The lid is locked in place by locking cogs operated by an impact wrench.

Each K Basin has its own load out facility. The three-well cask cars are brought in one at a time and loaded/unloaded inside the transfer area of the building, using the 30-ton overhead crane. Fuel canisters will be loaded into the K Area casks and well cars using the existing process steps for loading encapsulated KE Fuel canisters. The three-well cask car is removed from the building while another car is loaded. The loaded car is then transported to the KW Basin for unloading. Transfer is carefully controlled with the railroad car speed limited to five miles per hour. Unloading follows the reverse steps as loading.

4.2.3 Truck Transport Options

If fuel can be transported without water cooling, it is possible to use a truck to transport the K Area casks. This approach eliminates the need for rail transport and facilitates multi-shift operations, since K Area personnel can drive the trucks. Transfer by truck requires a single truck and two or three 110-ton, three axle low boy trailers, which can carry two or three transfer casks at one time. The height of the doors and height and length of the bays are large enough to accommodate the truck trailer combination. Depending on the payload, two or three trailers are required. However, only one tractor would be required provided a backup tractor was available. Contamination enclosures would have to be installed on the trailers to hold the casks. The K Area casks provide all necessary shielding and structural integrity. The trailer enclosures are similar to the well cars. Therefore, DOT equivalency would have to be demonstrated based on the K Area casks, which is similar to using rail transported dry well cars.

Transfer of fuel from the KE basin to the KW basin by truck is very similar to transfer by rail car. The fuel is moved over a short distance, approximately 0.5 mile, in an entirely fenced and controlled site except when switching from one track to another. The route between the KE Basin and the KW basin is relatively straight with one major turn on each end, and a large concrete pad area to allow lining up the truck trailer with the basin entrance. The route does not cross any roads used by the public and there is very little vehicular traffic on the site and all traffic can be controlled. Computer shielding calculations using the Isoshield code indicate that dose rates external to the K Area casks would be low and no radiation areas would be created during the transfer. Modifications to the road at the turning point where a 90 degree turn would allow a more moderate turn. It is possible that the existing road may need upgrading to handle the 110-ton low boy trailers which would make approximately 300 round trips during a six month time period.

4.3 105KE WATER DISPOSITION OPTIONS

The removal of the water from the KE Basin is a TPA Milestone Item. Milestone M-34-1, states that should the fuel and the encapsulated sludge from KE Basin be consolidated into the KW Basin, the removal and disposal of the basin water shall be completed by September 2000. A complete analysis of KE Water treatment and disposition alternatives is contained in the Westinghouse Hanford study of the water disposal options, Water Disposition Study. Three different alternatives were evaluated for disposition of the treated KE Basin water. These were discharge to the river via NPDES approved effluent discharge, solar evaporation using a permitted on-site evaporation pond, and a discharge to the ground through the Effluent Treatment Facility (ETF) and effluent Disposal facility. Additional details on disposition alternatives are provided in below.

4.3.1 Preferred Water Disposition Option

The preferred method of KE water disposition is to treat the water and discharge via an NPDES liquid effluent permit. The preferred treatment is composed of the current water treatment equipment augmented by adding micro/ultra filters and a final polishing ion exchange module after the water is treated. The preferred discharge is by batch mode release via the K Area 004 discharge point.

4.3.2 Basin Water Treatment

Only one water treatment method was identified. Each of the alternatives uses the same treatment methodology of the current basin water treatment system along with additional treatment to enhance the overall removal efficiency. In the current system a skimmer pump removes water from the basin. The water is passed through a sandfilter for the removal of larger particulates (>100 microns). The stream is then passed through a pair of ion exchange modules (IXMs) situated in parallel. The additional treatment systems will be placed downstream of the IXMs. The additional treatment system will treat a 25 gpm portion of the stream. The new system will use a new Microfiltration/Ultrafiltration system to remove the very small particulates (sub-micron) followed by a polishing ion exchange system using another IXM module. The outflow from this IXM would be collected in two discharge tanks. The pH of the water in the tanks will be adjusted prior to discharge. This combined treatment is effective for all radionuclides except tritium to satisfactorily low levels. However, no cost effective method for the removal of tritium from the water exists. Additional descriptions and details of the treatment system are provided in Water Disposition Study.

4.3.3 Disposal to Columbia River.

Discharges to the river would be routed from the discharge tanks through Outfall 004 discharge point via the 8 inch CW-A-2 chiller piping. The advantages of this option include modifying the existing NPDES permit modification will take less time than obtaining a new permit; less equipment and facility modifications are needed; 100-K Area Operations will have full control of water disposal; lower levels of operating cost and worker exposure; and less D&D after disposal of basin water. The disadvantages of

this option include possible negative public perception of tritium being discharged to the Columbia River, permit approval may require extensive testing of river biota, and long term monitoring of the river.

4.3.4 Disposal to ETF (C018).

Ground disposal via the Effluent Treatment Facility (ETF) requires 5000 gallons of treated water be transported per operating shift from the KE Basin to the ETF in the 200 Area. Radioactivity levels in treated water are low enough to allow transport in tanker trucks. This option is approximately 2 to 3 times more costly than discharge NPDES discharge, has a higher potential for accidental spillage during truck shipments, and places an additional burden on ETF operations due to the two million gallons a year of additional water makes this option less feasible than NPDES discharge. The advantage of this option is infiltration of tritiated water to the soil and groundwater system at C018 allowing tritium levels to diminish through the radioactive decay before reaching Columbia River. The disadvantages of this option include higher worker exposure, more D&D work for disposal of equipment, large amount of handling and transportation creating greater statistical potential for accidents and spills, increased cost, and the schedule may be impacted due to C018 priority conflicts.

4.3.5 Disposal by Way of Solar Evaporator.

Solar evaporation using on-site evaporation pond was evaluated. This option avoids having to transport the water by truck, and eliminates the need for an NPDES liquid discharge. Solar evaporation does require an air permit which will require processing of the water to meet air emissions standards prior to evaporation. A solar evaporation pond would have to be sized properly which requires a large volume (2,000,000 gallons) and have large surface area (90,000 ft^2). The pond would be double lined to prevent leakage. This results in significant costs to build the pond, and, upon completion of evaporation, the pond would have to be dismantled and disposed as radwaste. Solar evaporation costs are over twice the cost of an NPDES permitted discharge. In addition, the time required to design and construct a solar pond does not satisfy the TPA milestone if fuel is not consolidated. The advantages of this option include: tritium can more easily be eliminated through evaporation due to atmospheric mixing; lower operating cost than C018 disposal option; and no dependency on other facilities. The disadvantages of this option include: greatly increased secondary waste from evaporation ponds exposure to blowing sand and tumbleweeds; likelihood of bird, animal, or insect contamination by open evaporation pond; weather variables impacting anticipated rate of evaporation; increased cost due to seismic qualification, installation, and maintenance costs.

4.4 NON-CONSOLIDATION ALTERNATIVE

The option considered as the "No Action" alternative involves leaving the encapsulated fuel and sludge in the KE Basin. At a later date, the fuel and sludge from both KE and KW would be placed in an interim storage facility that was physically removed from the Columbia River in accordance with the TPA milestone. If consolidation does not take place, TPA Milestone M-34-1 requires treatment of the KE Basin water starting in 1996. Two million gallons per year of the basin water must be

replaced until tritium levels in the KE Basin are maintained at or below 300,000 pCi/L. The water will be treated and disposed of in the same methods discussed in Section 4.3. The levels of tritium will be reduced through dilution from the addition of new water to the basin as water is removed and treated.

5.0 ASSESSMENT OF CONSOLIDATION AND NO ACTION ALTERNATIVES

The recommend methods for consolidating KE fuel to KW are storage of the consolidated of fuel in the KE Basin is using multi-tiered storage racks, transfer of the fuel using the K Area casks drained and trailer trucks, and KE Basin water for disposition by treatment and disposal via the NPDES Outfall 004. These methods were evaluated for feasibility and determined to be feasible. In addition, a comparison of the recommended consolidation methods was made with the No Action alternative. In general, the comparison found that the tangible criteria of cost, occupational radiation exposure and radwaste volumes favored continued two basin operation, while the less tangible criteria of environmental risk, TPA milestone compliance for water disposition, schedule uncertainty favored consolidating the encapsulated fuel and sludge in KW. Section 5.1 provides additional discussion on the feasibility of consolidating fuel, and Section 5.2 compares the preferred consolidation methods with the No Action alternative of continued operation of two separate basins.

5.1 Assessment of Consolidation Feasibility

This section assesses the ability of K Area Facility and equipment, Operations, and support organizations, to implement the preferred alternatives for fuel consolidations. These methods were evaluated with respect to the following considerations.

- Operations,
- Required Supporting Activities,
- Unreviewed Safety Questions,
- Radiological Considerations,
- Waste Management,
- Cost, And
- Schedule.

The evaluation determined that the consolidation of fuel into KW is possible, but there are considerable costs, and schedule constraints to starting work which include budget authorization, completion of encapsulation, obtaining permits, approval of safety analysis, and delivery of major purchases Further, the assessment also determined that meeting the Tri Party Agreement milestone for water treatment requires expedited water discharge permitting if fuel consolidation does not occur. Each of the evaluation areas are discussed in Sections 5.1.1 though 5.1.7 of this report.

5.1.1 Operations

The operational aspect of fuel consolidation were evaluated with respect to the following criteria: procedures, training and qualification, facility safety documentation,

operability of safety systems, conduct of operations, availability of qualified personnel, and security and safeguards. The assessment found no major operations impediments that would prevent consolidation of fuel from KE to KW. A Readiness Review would be required prior to starting fuel consolidation activities. Pertinent observations are presented below.

- Significant procedure development and revision would be required. Including cask loading/unloading and shipping of fuel by well cars. Preventive maintenance procedures necessary for well car operability. Emergency procedures such as a fuel spill from a railroad well car. Procedures for basin fuel handling in a stacking. A procedure for shipping cask decontamination.

- Current training is adequate for anticipated fuel handling operations in the KE and KW Basins including cask loading/unloading. Additional training would be needed for cask movement between KE and KW and for sludge packaging and shipment. The physical modifications for fuel stacking will necessitate additional operator training, and accountability techniques due to layering of canisters will require changes to operator and inspector training.

- The current operations staffing is twenty-four operators, at least twelve of which have the requisite prior experience to serve as a lead person on a packaging/unpackaging crew. However, unless ALARA actions can reduce dose rates in KE a factor of three or more, it will be extremely difficult to meet administrative exposure guides without at least doubling the number of personnel. For example, current dose rates would require over thirty additional personnel to satisfy a 1,000 mrem per year administrative dose level.

- Rail crew or truck driver resources need to be examined in regard to a full time shipping campaign. If rail transfer is selected as the transfer option it is recommended that the railroad crews need to be based at the 100K for the duration of fuel transfer activities. Health physics, engineering, and other support staff are considered adequate, but attention needs to be given to providing the proper mix of support on all shifts.

- The current safety envelope governing activities at the 100K areas is defined by the Safety Analysis of Irradiated N Reactor Fuel (SAR), WHC-SD-WM-SAR-062, REV 1, June 3, 1994., and the Operational Safety Requirements (OSR) - 100 KE and KW Fuel Storage Basins, WHC-SD-WM-OSR-006, January 10, 1994. Also, there is a lower tier document titled the K Basin Process Standards, June 15, 1994, which contains additional requirements and restrictions. The SAR and OSR have fairly recent issue dates but contain rules and requirements from the era when N Reactor was an operating facility and the shipment of fuel was a routine occurrence. The SARP governing fuel shipment via well car is referenced in the SAR and is still a valid document. The SAR and OSR also contain provisions allowing

for the suspension of a limited amount of fuel in the KW basin, but the Process Standards prohibits fuel suspension.

- The activities associated with fuel consolidation present no significant change or challenge to the safety systems inside the basin structures at KE or KW. Anticipated basin modifications will not interfere with water makeup or radiation monitoring systems. Prior to the initiation of fuel consolidation activities the Hanford Fire Department (HFD) should be fully informed and it should be verified that they are familiar with anticipated shipping methods. It may be necessary for fire department personnel to reactivate procedures from 1989 or earlier when shipping was a routine Hanford site event.

- The Conduct of Operations manual was evaluated as satisfactory for controlling fuel consolidation activities and provides excellent guidance. The only expected condition not already routinely encountered is the storage of a loaded cask inside the basin bay at KE or KW during the off shift. Conduct of Operations principles will need to be promulgated with along with essential safeguards regulations for this storage condition. Also proper conduct during fuel shipment between KE and KW with respect to approachable distance would need to be provided to all personnel working at the 100K Area.

- Work activities can be scheduled to prevent loaded casks remaining outside the respective building bay. Therefore security for loaded casks that are outside the immediate loading/unloading area of the Fuel Storage building is not required and significant new requirements on security personnel should not be necessary. However, there may be additional security restrictions during actual fuel shipment between KE and KW that did not apply during the last shipping campaign (1988-1989).

- Safeguard requirements call for a random ten percent sample bimonthly, that includes visual confirmation of canister number and weight. Since the new racks can be designed to provide positive locking and tagging of fuel into the tiered array, it may be possible for a waiver reducing this requirement. However, if a waiver is not granted, meeting the safeguards requirements could be especially burdensome. The new tiered racks require special tooling and moving fuel is more difficult. There are some locations in the basin where fuel movement will be especially difficult. Additionally moving fuel requires lifting the fuel at least three feet from the top of the rack. Locations that are three tiers high will require the fuel to be much closer to the water surface, and radiation dose rates during these operations could be significantly higher than currently experienced in KW.

5.1.2 Required Supporting Activities

In addition to K Area operations there are several supporting activities required to consolidate fuel. These include environmental releases and permitting, safety analyses,

packaging and shipping, and training programs. The evaluation showed no major problems in these area. Pertinent observations were:

- Environmental and permitting activities for transferring fuel canisters from KE to KW must satisfy several requirements including air permitting, liquid discharge permitting, and a permit to pave/improve the road (truck transfer). Although there are no obvious difficulties with these activities, they are critical tasks since consolidation work can not start until permits are in place. Further permit requirements must be understood and factored into design and procedures since failure to meet all permit conditions can result in stopping work.

- A criticality analysis of fuel stacking at KW basin has been performed which shows that the K Effective Safety Limit of 0.98 will not be exceeded and is of a sufficient level of rigor to be included as a safety analysis reference to a modified SAR and OSR. However, fuel consolidation necessitate a change to the SAR and OSR. Previous review and approval history for SARs and OSRs shows a range of weeks (six to thirty-six) months for final DOE approval. This time directly impacts schedule completion. Therefore, additional fuel consolidation planning and safety analysis needs to be closely coordinated with the appropriate Department of Energy staff to optimize the approval process.

- Required packaging and shipping activities involve minor changes to the K Area casks, well car or truck trailer modifications. In addition, a significant level of effort will be required to update the Safety Analysis for Packaging (SARP).

- Consolidation of fuel will require an extensive training program. This training is required for existing personnel who need to be trained on the new procedures and requirements associated with transferring fuel to KW, and operating the KW basin with tiered racks. In addition, new operations personnel, needed to transfer fuel, will need training and qualification on all aspects of their assigned work.

5.1.3 Unreviewed Safety Questions

The purpose of this section is to evaluate the proposed options for fuel consolidation from 100KE to KW to determine the potential for Unreviewed Safety Questions (USQs). This assessment is governed by the guidance and requirements of Department of Energy Order 5480.21 and Westinghouse Hanford Company MRP 5.12. It is determined that fuel consolidation activities as described in this report do not constitute an Unreviewed Safety Question. However, three items that must be resolved to assure adequate resolution of safety issues.

- If drained transfer is to be used, a detailed thermal characterization of a loaded canister without water cooling should be performed, using the most reactive type of fuel currently stored.

- Vehicular speed of a truck (prime mover must be restricted to five (5) miles per hour or less.

- Suspension of fuel must be specifically prohibited.

5.1.4 Radiation Exposure

Occupational radiation exposure is one of the primary factors impacting consolidation of KE encapsulated fuel/sludge, and an estimated 129 man-rem of exposure is required to complete consolidation activities. Both the installation of new fuel racks in KW and the transfer of canisters from KE have radiation exposure issues that need to be addressed. Installation of new racks in KW requires the use of divers who are specially qualified and available in limited numbers. Therefore, special ALARA planning will be required for diver work. It is also possible that authorizations will be needed to increase administrative levels for divers and also for operators during fuel transfer at KE. Additional details for each of the consolidation phases are provide below.

The estimated exposure needed to prepare KW to store the consolidated fuel and sludge is 35 man-rem, with 25 of the 35 man rem being received by the nuclear divers. Cutting out and assisting in the packaging of the old racks and installing the new racks, requires an estimated 12,000 man hours of diver time. It is estimated that approximately half this time will be underwater work. Underwater dose rates are not accurately known. An estimated 20 man-rem of exposure would be used by divers to remove the old racks and instal new racks, and an additional five man-rem of exposure is estimated for above water diver work. Packaging and disposing of the old racks will result in an estimated six man-rem. Above water KW dose rates for other tasks are only one mr/hr, HPTs, operators and maintenance personnel will receive approximately only four rem exposure installing new racks and shuffling fuel from old racks to new racks.

Radiological conditions associated with the transfer of fuel are similar to current conditions and fuel transfer activities are also similar to current work and planned encapsulation work in KE. Therefore, current radiation protection practices, equipment and procedures will be adequate for controlling fuel transfer activities. Estimated radiation exposure for transferring fuel canisters from KE to KW is 94 man-rem for drained transfer using truck trailer. Dose rates in KE are moderate averaging 5-15 mrem/hr, and contamination levels are moderate to high. Dose rates in K West are low averaging 1-2 mrem/hr, and contamination levels in KW are also low. The impact of a 500 mrem and 1000 mrem annual administrative exposure level were evaluated, and the 500 mrem administrative level was shown to be extremely disruptive to accomplishing work. A 1000 mrem level is marginally workable, requiring an additional 39 operators. Based on this evaluation additional ALARA efforts may be warranted.

Radiation exposure should not be a significant issue for processing KE basin water, and administrative dose limits should not have an impact on water processing. The water treatment equipment is located in shielded locations, and very little exposure is associated with routine operation of the equipment. Some radiation exposures results from changing out filters, ion columns and ion exchange modules. The equipment used to process water after consolidation will be similar to what is currently used, and once

fuel is encapsulated the radioactivity levels in the water will slowly decrease. The frequency of media change out, however, will be higher since a large volume of water will need to be processed.

5.1.5 Waste Management

Significant volumes of solid radwaste will be generated by consolidating fuel. In addition over 1.2 million gallons of water will need to be treated and discharged. A very small amount of Transuranic Waste (TRU), and mixed waste may be generated. No hazardous wastes are expected from consolidation. The estimated wastes from each consolidation phase is discussed below.

Modification of the KW Basin to install new racks will result primarily in radioactive solid wastes from disposal of old storage racks. Each rack will be treated as rad waste and packaged into burial containers. However, before being packaged, the racks must be sampled for TRU. It is expected that racks will not be TRU after decontamination. The volume of racks to be removed is approximately 10,000 cubic ft. Other rad waste generated will be contaminated protective clothing, chain used on the hoisting system, and any materials left from cutting the racks. All underwater work should be completed without the generation of hazardous waste. No solvents, cleaners, grease, or oil will be used or present during this activity

Fuel transfer wastes are generated from Decontamination, Equipment Repair, Area Preparation, and Transferring Canisters. Radioactive solid will include plastic, protective clothing and rags which are not able to be laundered, and small quantities of water used for decontamination washing or CO_2 blasting. Water volumes will be small and an integrated with the other material, which may require adding absorbent material to eliminate free standing water. A small amount of mixed wastes may be generated during the decontamination of the casks, as a result of oil, grease, as well as paint chips potentially containing lead and cadmium. The inspection, repair, and modification of the railroad tracks or roads is not expected to generate radioactive wastes or hazardous wastes.

Processing of KE Water will generate wastes primarily from the operation of the water processing systems. Some radioactive wastes may be generated during construction as a result of contamination from the areas related to the basin. It is unlikely that hazardous or mixed waste will be generated during system installation or operation. Water treatment system operation wastes will include backwash from the sand filters and the micro-filters, spent ion exchange columns, and spent ion exchange modules. Backwash wastes will be returned to the sandfilter backwash pit were they would make only a small increase to existing backwash volumes. It is estimated spent IXM volumes will increase over current volumes. It is unlikely but possible that some resin media may be classified as TRU. Mixed wastes or hazardous wastes are not anticipated from operation of water treatment equipment.

5.1.6 Cost

The total cost for consolidating canisters in KW using the preferred alternatives is estimated as $20.2 million. Installing the multi-tiered storage racks in the KW Basin

is estimated at $14.9 million, and transferring the fuel using the K Area casks drained and well cars was estimated to be approximately $5.3 million.

The total cost for disposal to the river of 1.2 million gallons is approximately $5 million. These costs are based on consolidation, and continued two basin operation will require larger volumes of water to be processed which will result in significantly higher total costs for water processing. This is discussed further in Section 5.2.6 of this report.

5.1.7 Schedule

Fuel storage rack installation and fuel transfer have numerous shared constraints. The shortest possible schedule duration for rack installation and fuel transfer is 36 months. However, budget authorization, environmental assessments and safety analysis are potential constraints on starting purchasing and installation activities which are critical path tasks. Completion of consolidation in KW requires at least 24 months after release of funding, and without special priority funding of major capital items would not occur before October 1997. Therefore, consolidation completion is estimated as October 1999. If budget is obtained earlier, work could be completed sooner. A GANT chart annotating major consolidation activities is given in Figure 5-1. Additional details on the schedule of each of the consolidation phases are provided below.

INSTALLATION OF NEW RACKS - The engineering study on fabricating and installing new storage racks identified a schedule duration of 18 months to design and construction the racks. This include six months for design and 12 months for construction. In addition to the identified design/construction work, several non construction tasks are part of the critical path. The tasks include duration of procurement, safety analysis, OSR changes and procedure preparation. Start of procurement would need budget authorization, and start of construction requires delivery of materials, completion of the safety analysis, procedures, OSRs and granting of a permit. Non-construction tasks are estimated to require approximately 18 months.

TRANSFERRING FUEL - Fuel transfer is constrained by budget approval and by completion of encapsulation, permit approval, availability of procedures and installation of new racks. Once these constraints are cleared actual transfer of fuel from KE to KW is estimated to require only 7 months. If truck transfer is used, 18 months are required to procure the needed equipment. Completion of decontamination and truck modifications required an estimated three more months. Thus 20 months are available to complete safety analysis, SARP, permitting and procedures which is considered a reasonable time frame.

TABLE 5-1 (Page 1 of 2)

EARLY START	EARLY FINISH	
		I - PERMITTING & ADMINISTRATIVE ACTIVITIES:
30CT94	10CT97	**RIVER DISCHARGE PERMITS** 1) Modification of NPDES Permit / 36 months 2) U.S. Army Dredge & Fill Permit / 16 months 3) U.S. Dept Natural Resources - River Bottom 4) U.S. Park Service / Wild & Scenic River Act 5) EPA Notice of Intent / State Water Pollution 6) Benton County / Shoreline Development Permit 7) DOH / modify Notice of Construction
3APR95	1APR97	**FACILITY MODIFICATION PERMITS** 1) Perform Safety Analysis Work 2) Prepare OSRs and Procedures 3) Obtain Permits and Approvals
3APR95	1APR97	**WELL CAR TRANSFER PERMITS & ADMIN ISSUES** 1) Update SAR 2) Obtain Air Permits 3) Obtain Permits and Approvals 4) Update SARPs
		II - DESIGN MODS & PROCURE EQUIPMENT:
30CT94	10CT96	**DEVELOP "K" WEST WATER PROCESSING SYSTEM** 1) NEPA Permit / Samples / Pilot Test - 8 mo 2) Procurement Spec / Bid / Fabricate - 10 mo 3) Install Water Processing System - 3 mo 4) Test / Resolve & Train Operators - 3 mo
20CT95	1APR96	**DESIGN FUEL STORAGE RACKS** 1) Design Phase includes displacement of fuel 2) Develop Fuel Placement Plan with matrix 3) Plan to include installation & Fuel Transfer
20CT95	1APR98	**DESIGN / MODIFY / PROCURE / RAIL CAR OR TRAILER** 1) Select method of transportation 2) Longest lead time for new trailer is 18 month delivery (duration based on 18-mo)
20CT97	10CT97	**PROCUREMENT FUNDING APPROVAL**
20CT97	20APR98	**PROCURE FUEL RACK MATERIALS & EQUIPMENT** 1) These activities will start when funded

FY94 FY95 FY96 FY97 FY98 FY99 FY00 FY01

"K" EAST TO "K" WEST
FUEL CONSOLIDATION PROJECT
ESTIMATED SCHEDULE

TABLE 5-1 (Page 2 of 2)

EARLY START	EARLY FINISH	
		III - IMPLEMENT MODIFICATIONS & DECON EQUIPMENT:
20CT97	2JUL98	REMOVE EXISTING FUEL RACKS & INSTALL NEW 1.) Includes implementation of replacement plan 2) Plan is critical to installation & transfer 3) Plan to allow for displaced water
20CT97	20EC98	IMPLEMENT MODIFICATIONS TO "K" WEST 1.) Modify Electrical Systems 2.) Modify Mechanical Systems 3) Modify Structural Members
3JUL98	24SEP98	PREPARE "K" EAST / WEST & TRANSPORT VEHILCES 1.) Prepare load out of "K" East & West 2) Prepare Rail Road Track or Road 3) Prepare "K" East & West Washdown Areas 4.) Prepare Decon Area
25SEP98	11MAR99	DECONTAMINATE & REPAIR TRANSPORT EQUIPMENT 1) Decon Well Car internals & externals 2) Decon "K" cask internals & externals 3) Implement Well Car Repairs 4) Implement "K" Area cask repairs
		IV - CONSOLIDATE FUEL:
12MAR99	10NOV99	TRANSFER FUEL FROM "K" EAST TO "K" WEST 1) Remove fuel from basin and insert into casks 2) Load casks onto transport vehicle 3.) Transport casks to "K" West. 4) Unload casks at "K" West 5) Move fuel into basin storage
		V - PROCESS & DISCHARGE "K" EAST WATER:
10CT97	30EC01	PROCESS - DISCHARGE WATER / NO CONSOLIDATIN *** THIS ACTIVITY ASSUMES THAT NO FUEL *** ******* CONSOLIDATION WILL OCCUR *******
11NOV99	11JUL00	PROCESS - DISCHARGE WATER / AFTER CONSOLIDATION ***** THIS ACTIVITY ASSUMES THAT FUEL ***** ******** CONSOLIDATION WILL OCCUR *******

FY91 FY95 FY96 FY97 FY98 FY99 FY00 FY01

"K" EAST TO "K" WEST
FUEL CONSOLIDATION PROJECT
ESTIMATED SCHEDULE

WATER DISPOSITION SCHEDULE - Designing, procuring, installing and operating a system to treat and discharge KE water is straight forward with respect to schedule. Discharging KE water to the Columbia River requires obtaining a NPDES liquid discharge permit. The schedule duration to obtain this permit is identified as 36 months which is considerably longer than the required duration to design, purchase and install the system. If water disposition is not needed until after consolidation, the 36 month permitting time is acceptable. However, special efforts are needed to support the TPA milestone date of 1996 for water disposition if fuel is not consolidated.

5.2 COMPARISON OF PREFERRED ALTERNATIVES WITH NO ACTION ALTERNATIVE

The preferred consolidation options were evaluated with respect to the no action alternative. Consolidation of KE fuel/sludge to KW will have a large up-front cost, and will require a significant amount of additional radiation exposure, and generate additional solid radioactive wastes. Based on these factors, it does not appear that consolidating fuel and sludge to KW is cost effective compared two basin operation.

Although consolidation is not evaluated as cost effective, several intangible factors such as risk, required facility life time, TPA milestones compliance, and the potential cost of maintaining two versus one aged facilities favor consolidation. The most important intangible factor is facility life time. Consolidation results in lower annual operating costs, radiation exposure usage and water disposition costs, and lower relative risk. Therefore, the longer the fuel/sludge remains in the K Basins, the greater the cost and exposure savings. The uncertainty of when transfer of fuel to an interim off river facility will actually occur also creates uncertainty with respect to the degree of facility aging. If additional repairs/modifications to KE are required, the amount of money and exposure would directly offset savings from two basin operation. Therefore, the potential for avoiding significant facility upgrades to the KE Basin also favors consolidation. However, it is not possible predict what (if any) additional KE upgrades might become necessary. Table 5.2 provides comparison of one versus two basin operation. Brief discussions of each of these factors are provided in Sections 5.2.1 through 5.2.7.

TABLE 5.2
COMPARISON OF ALTERNATIVES

EVALUATION FACTOR	TWO BASIN OPERATION	CONSOLIDATED FUEL AND SLUDGE
COST	+	-
RADIATION EXPOSURE	+	-
WASTE GENERATION	+	-
RISK TO WORKER	0	0
RISK TO PUBLIC	0	0
RISK TO ENVIRONMENT[1]	-	+
TPA WATER DISPOSITION MILESTONE	-	+

+ Means more favorable impact
- Means less favorable impact
0 Means no difference in impact

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1 Consolidation was evaluated as lower environmental risk based on KE's past leak history.

5.2.1 Risk to Site Personnel

Risks for both the consolidation and no action alternatives are very low for workers. Therefore, discussions in this section focus on the relative risks of the alternatives in comparison to each other, and there is no overall absolute scale for risk in this discussion. It should be noted worker risks do not include the occupational radiation exposure associated with the action which is discussed separately.

There should be no significant increase or decrease in worker risk associated with consolidating fuel in the KW basin. However, two consolidation tasks, diver operations in KW and the many truck transfers of fuel between KE and KW will require special controls. Limiting the speed of transport to less than 5 mph minimizes transportation risks.

5.2.2 Risk to the Public

Since all activities are contained within the K Area, the risks to the public are similar and extremely small for both alternatives. Transport of fuel is limited to K Area which does not have any public traffic, and there is very little potential for significant off-site release of material from either alternative.

5.2.3 Risk to the Environment

Consolidation should have slightly less risk than two basin operation, due to the better material condition of KW and lower potential for unplanned leakage. If a leak were to occur, it would release basin water with radionuclide levels substantially higher that those in the water that will be disposed of after treatment. The KE basin requires substantial upgrades to meet seismic qualification requirement. The KE Basin contains a large source term for a release to the environment.

Even with no unplanned leakage, the two basin operation presents a slightly higher risk to the risk due to the increase in the volume of water that must be treated and discharged to the environment. KE Basin water treatment will tend to reduce radionuclide concentrations over time. However, contamination on basin walls and equipment surfaces will continue to be assimilated back into the water as long as water is in the basin.

If fuel is consolidated, the transfer of fuel between KE has potential for small amounts of liquid spillage if the wet transfer method is used. This small amount of spillage represents an insignificant off-site risk but would need to be cleaned up.

5.2.4 Radiation Exposures

Consolidating fuel in KW results in higher radiation exposure than continued operation of two basins. Most of this increase is due to transferring the fuel which requires approximately 94 man-rem of exposure and installation of new racks which requires an estimated 35 man-rem of additional exposure. Operations activities in the KW Basin after consolidation also has potentially higher dose rate, due to the decreased depth of shielding water above the storage racks.

Consolidating fuel into KW does save exposure associated surveillance and maintenance of KE Basin without fuel or water compared to operating both basins, and to a lesser extent requires less exposure for water disposition. Radiation exposure to will continue at an estimated 14 man-rem per year for KE Basin. However, comparing total consolidation exposure to total two basin exposure through the year 2002 shows that consolidation requires an estimated 70 man-rem more exposure than two basin operation.

5.2.5 Generated Wastes

Consolidation results in a greater volume of solid wastes than two basin operation. This is due to the added volume of waste that will eventually result from the new multi tiered storage racks when the basins are decommissioned. No TRU wastes should result from the new racks. If the new racks could be decontaminated and released, it is possible that total waste volumes could favor consolidation. However, the ability to decontaminate and release the new racks is questionable at best.

In addition to storage racks, other wastes generated include radioactive solid waste from the materials used in support of radiation area work: clothing, drop cloths, plastic drapes, tools and other equipment. The use of the current 200-ton chiller unit in place at KW should generate no new wastes. The primary wastes generated by the transfer portion of the project will be radioactive solid waste resulting from the materials used in support of radiation area work: clothing, drop cloths, plastic drapes, tools and other equipment. An extremely small quantity of mixed wastes may be generated by the transfer portion of this project. These wastes will result from decontamination activities of the K Area casks and well cars include small amounts of paint, possibly containing lead, and petroleum products, lubricating oils, axle grease, etc., may become mobilized in the decontamination stream. No TRU wastes should be generated by the transfer portion of this project.

The "No Action" alternative generates several million additional gallons of radioactive liquids that must be treated and disposed of. This increased volume of liquids also results in an increase of solid radwaste due to the number of spent IXMs, ion exchange columns and filter media that will need to be disposed of. However, these volumes will be much less than the volume of the new storage racks.

5.2.6 Costs

Comparison of consolidation versus continued two basin operation shows approximately $3 million higher total cost for consolidation than operating two basin through the year 2002. This value is based on the estimated $20.2 million dollars needed to consolidate fuel which is partially offset by a postulated $3.5 million operations savings for one basin operation and a $7 million savings (maximum possible) associated with decreased water processing costs.

Facility upgrades or repairs for the KE Basin represent a potential increased cost for two basin operation. However, the modifications required to provide a safe and efficient environment for working at the K Basins as identified in Project W-405,

K Basins Essential System Recovery are the same for one or two basin operation. Therefore, two basin operation has higher potential for needing additional upgrades to mitigate aging effects, but it is not possible to predict what (if any) additional modifications might become necessary.

5.2.7 TPA Compliance

A TPA Milestone (M-34-00-T04) has been established for submitting a schedule for the disposition of the KE Basin water. This schedule will be used in supporting the 100-KR-4 Record of Decision in October 1994. The schedule will affect the establishment of the due date for Milestone M-34-1, involving the removal of the water from the KE Basin. If fuel is not consolidated, water disposition must start in 1996.

6.0 REFERENCES

Chilton, 1979, Chemical Engineering. (Entire reference as provided by Water Disposition Study)

WHC, 1994a, *105KE to 105KW Basin Fuel and Sludge Transfer Engineering Study*, WHC-SNF-ES-002, Rev. 0, Columbia Energy and Environmental Services Inc. for Westinghouse Hanford Company, Richland, Washington, June 1994.

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