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ENGINEERING DATA TRANSMITTAL

Page 1 of 1

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2		Cog. Mgr. C. L. Bennett	[signature]	10/12/93	X0-44						
2	1	QA G. M. Davis	[signature]	10/19/93	X1-80						
2	1	Safety R. V. Skinner	[signature]	10/19/93	S6-21						
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2	1	Operations Assurance J. P. Schmidt	[signature]		X0-41						
2	1	Fuel Storage Basins R. E. Truax	[signature]	11/24/93	X0-43						

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RH Meichle 10/12/93 Signature of EDT Originator Date	[signature] 11/24/93 Authorized Representative for Receiving Organization Date	[signature] 11/24/93 Cognizant/Project Engineer's Manager Date	Ltr. No. 93-FTB-014 [X] Approved [ ] Approved w/comments [ ] Disapproved w/comments

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Author/Requestor (Printed/Signature) Date: C. L. Bennett 12-11-92

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6. Author

Name: C. L. Bennett, Manager
Safety Technical Support

C L Bennett 12/1/92
Signature

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7. Abstract

These Operational Safety Requirements (OSRs) define the approved safety specifications and operational limits for operation of the 105-KE and 105-KW Fuel Storage Facility. This document was originally issued by United Nuclear as UNI-M-139, Volume 1. After consolidation with Westinghouse Hanford Company (WHC), the document was approved by RL on May 11, 1989 and reissued as WHC-CM-5-28, Rev. 10. It was subsequently approved for public release on July 7, 1992. This OSR is being reissued, without change, as WHC-SD-WM-OSR-006 Rev.0.

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Prepared by:	M. V. Shultz - Engineer Process Standards	6-24-80 Date
Revised by:	Keith L Fowler K. L. Fowler, Senior Engineer Process Standards	2-9-83 Date
Reviewed by:	K L Fowler for T. E. Edwards, Manager Process Standards	2-14-83 Date
Reviewed by:	R L Moffitt R. L. Moffitt, Manager Nuclear Safety	2-14-83 Date
Reviewed by:	T. L. Deobald T. L. Deobald, Manager Safety-Assessment & Analysis	2-16/83 Date
Approved by:	M A Payne M. A. Payne, Director Safety & Environmental Engineering	2/16/83 Date
Accepted by:	R. W. Ness, Director Reactor Plant	2/16/83 Date
Approved by:	D L Renberger D. L. Renberger, Vice President Technical	2/16/83 Date

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1.0 INTRODUCTION

The Operations Safety Requirements (OSRs) contained within this document are written in accordance with DOE Order 5480.1A Chapter V requirements. These OSRs define the approved safety specifications and operational limits for the operation of the 105-KE & KW Fuel Storage Facility, and are based on the safety analysis presented in UNI-M-143, "Safety Analysis Report - Handling and Storage of Irradiated N Reactor Fuel in 105-KE & KW Fuel Storage Facilities", which will henceforth be referred to as the SAR.

The criteria for the safety limits are contained in Section B., "Re-Formulated Fundamental Criticality Control Criteria," pages 8 through 10 of DUN-7824, "Fuel Storage Basin Criticality Safety Analysis Report and Technical Basis," dated December 1971, by H. Toffer.

The OSRs consist of the following categories:

Safety Limits

Safety limits are limits within which safe operation of the facility is reasonably assured. Violating a safety limit may not in itself result in any hazardous consequences but it indicates an operational deficiency subject to U. S. Department of Energy-RL review.

Limiting Conditions for Operation

The limiting conditions for operation specify the minimum acceptable levels of system performance necessary to assure safe operation of the facility.

Surveillance Requirements

Surveillance requirements are the tests, calibrations, and inspections necessary to ensure proper operation of those structures, systems and components which are essential to the safe operation of the facility.

Design Features

The design features include those features important to the safe operation of the facility which are an integral part in the design of the facility.

Administrative Controls

Administrative controls are the means by which facility operations are controlled by management. The measures specified in this section provide for the assignment of responsibilities, training requirements, procedural controls, reporting requirements, and radiological and industrial safety. All of these measures are necessary to ensure safe and efficient operation of the facility.

2.0 SAFETY LIMITS

2.1 Fuel Storage

Applicability: Applies to the limitations imposed upon the storage of irradiated N Reactor fuel and a small quantity of fuel from the old single pass reactors.

Objective: Define the limits associated with the storage of irradiated N Reactor fuel.

Specifications:

2.1.1 The KE Fuel Storage Basin is authorized for the storage of lower enriched fuel

0.71 w/o U-235	Mark IB and IVB
0.95 w/o U-235	Mark IC and IV

stored in Mark 0, I* or II** canisters which may be open or encapsulated.

* Dwg. No. H-1-36935 for modified aluminum canisters
* Dwg. No. H-1-42594 for modified stainless steel canisters
* Dwg. No. H-1-42793 for new design stainless steel canisters
* Dwg. No. H-1-42815 for sealing lid
* Dwg. No. H-1-42817 for air trap
* Dwg. No. H-1-42807 for canister assembly
** Dwg. No. H-1-43446 for fuel encapsulation Mark II canister cover & seal arrangement
** Dwg. No. H-1-43447 for fuel encapsulation Mark II canister valve
** Dwg. No. H-1-43448 for fuel encapsulation Mark II canister cover & seal
** Dwg. No. H-1-43449 (2 shts) for fuel encapsulation Mark II canister

2.1.2 The KW Fuel Storage Basin is authorized for the storage of spike and lower enriched fuel

0.71 w/o U-235	Mark IB and IVB
0.95 w/o U-235	Mark IC and IV
1.25 w/O U-235	Mark IA (0.95 w/o U-235 Inner)

stored in Mark I or II canisters which shall be sealed and purged (encapsulated) to provide a water free space in the top of the canister. Fuel canisters shall be decapped and stored (after decapping) in the decapping station area only.

2.1.2.1 Spike fuel shall be stored only in the east and middle bays. (See Figure 2-1.) The west bay shall be limited to lower enriched fuel which may also be stored in the east and middle bays.

2.1.3 <u>Exception to 2.1.1 and 2.1.2</u>

Single-pass reactor fuel shall be stored separately from (not mixed with) N Reactor fuel in buckets with quantities up to five percent (545 pounds) of the minimum critical mass in the K area fuel storage basins. Approved encapsulation is required for KW basin.

FIGURE 2-1

KE & KW AREA STORAGE FACILITY PLAN

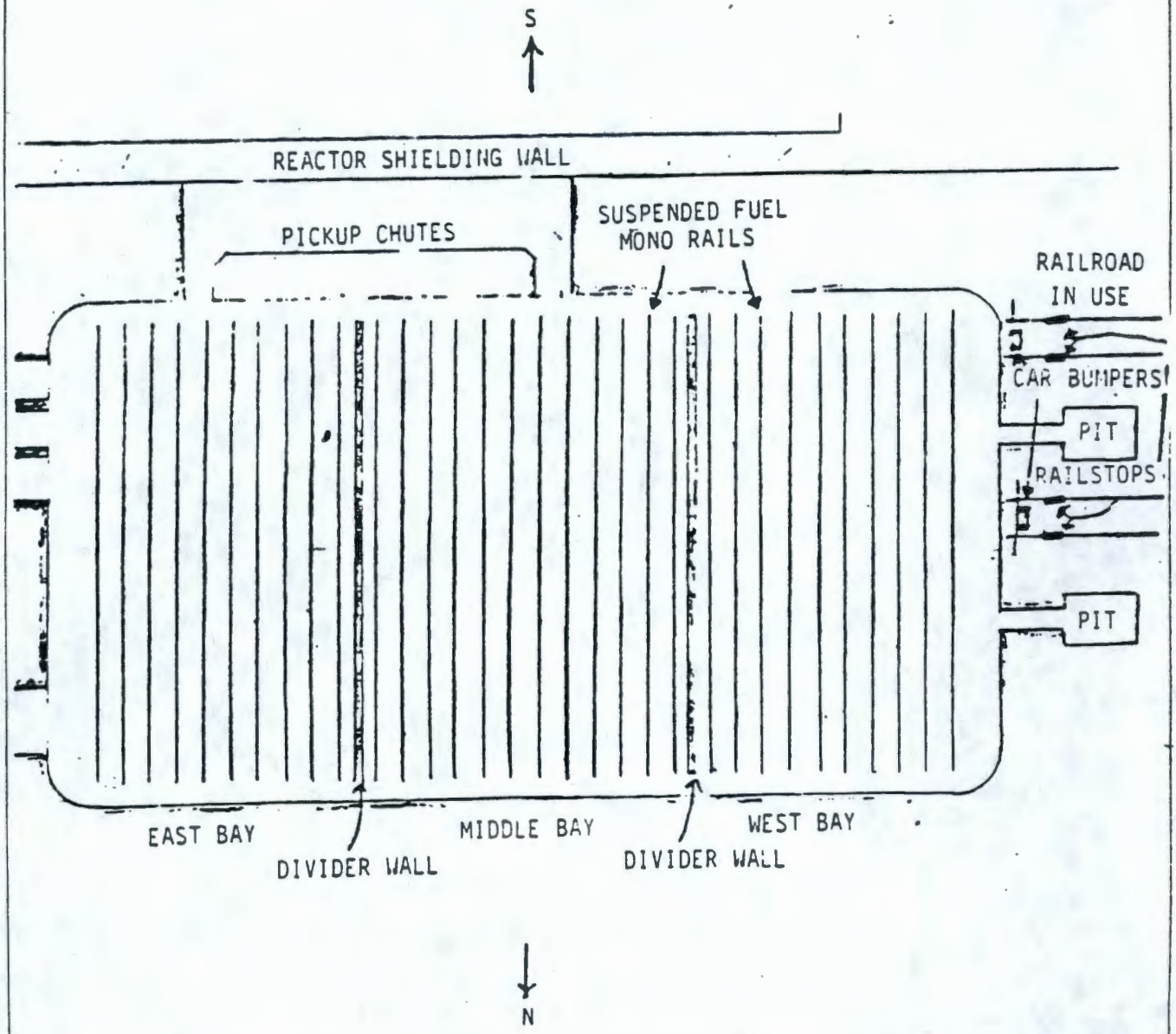
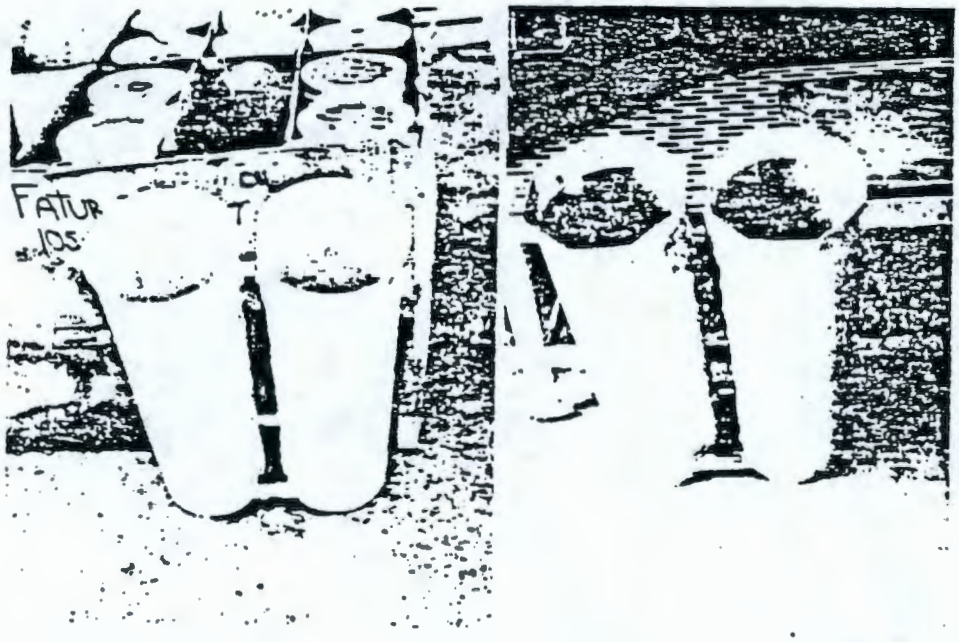
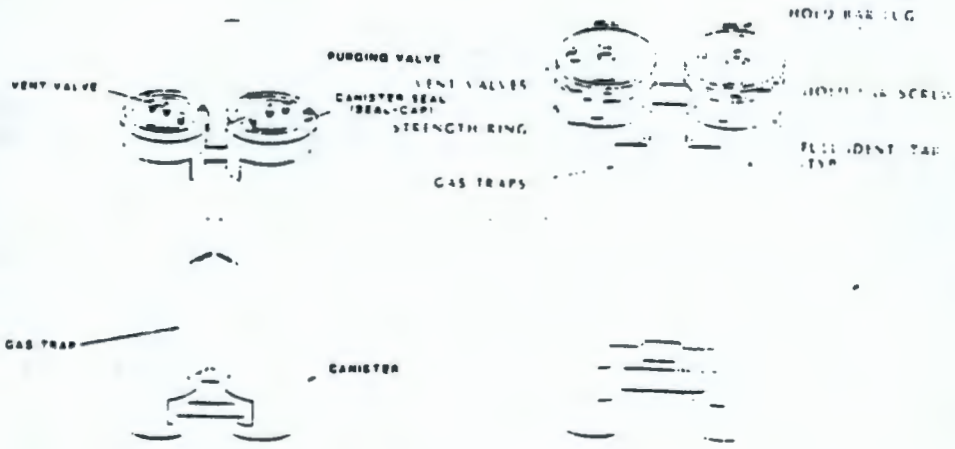


FIGURE 2-2

FUEL STORAGE CANISTERS



A. LOWER ENRICHED FUEL MARK O CANISTERS B. SPIKE FUEL MARK O CANISTERS



C ENCAPSULATED FUEL MARK I CANISTERS D. ENCAPSULATED FUEL MARK II CANISTERS

2.1.4 The fuel shall be cooled for at least 150 days following reactor shutdown prior to storage in the facility.

2.1.5 Lower enriched fuel shall be stored in canisters identified by a round flared top, or for the Mark II canister, by lack of an identification tab. (See Figure 2-2.)

Spike fuel stored in canisters shall be identified by octagon flared top or identification tab. (See Figure 2-2.)

2.1.6 Floor storage of N Reactor fuel in racks as shown in Figures 2-3, 2-4 and 2-5 is authorized in the K basins.

2.1.7 Suspended storage is defined in 2.1.8 and is authorized for the east and middle bays of both K area basins. Suspended storage of spike fuel shall be in Mark II canisters and in KW only. Suspended storage in the west bays of KE and KW is not authorized. Canisters of fuel segments from the fuel segregation pit shall not be placed in suspended storage.

2.1.8 Suspended storage (see Figures 2-3, 2-4 and 2-5) shall be canisters of fuel suspended from hangers secured to trolleys with a maximum of four groups of ten hanger trolley assemblies holding fuel per overhead monorail. During storage the hangers shall be latched to the adjacent hanger in groups of ten on the same monorail by a restraining bar just above the canister hook. To prevent movement of the trolleys, each trolley shall be secured to its assigned position by two locking bolts torqued to a nominal 35 to 40 inch-pounds against the side of the overhead monorail.

2.1.9 No more than three loaded fuel storage canisters may be in transit per bay at any one time. Only one scrap canister may be in transit in the basin. Thus, only two loaded canisters plus a scrap canister may be in transit at any one time in a bay.

2.1.10 A maximum of four canisters shall be in the transfer channel, not including the loadout pit, at 100-KW at any one time. All but one of the canisters shall be stored in the canister receptacle or storage racks provided.

2.1.11 There shall be no more than four canisters in the loadout pit excluding the transfer channel.

2.1.12 In the vicinity of the South transfer channel at the 100-KW basin, the sludge on the floor shall be less than 5.8 inches after 1.25 w/o fuel has been decapped in the area.

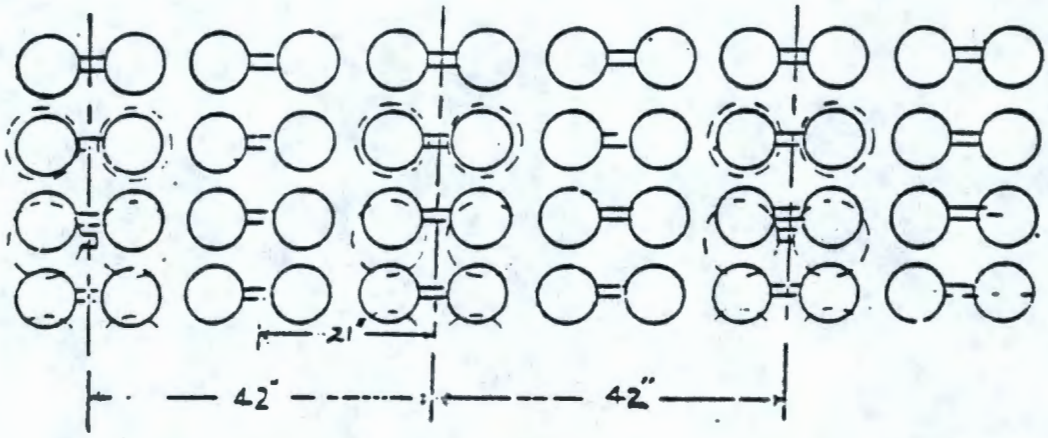
Action: If these specifications are not met, all involved operations in the affected basin shall be halted. Other operations and basins shall be inspected for similar problems. An investigation shall be conducted, as specified in Section 6.4, and appropriate corrective action determined and initiated.

Bases: Review of the physical barrier to prevent a cask car from entering the basin (see Figure 2-1) reveals that prevention of the accident is eventually dependent upon administrative controls. Fuel storage has therefore been limited to avoid exceeding a k-eff of 0.98 from one cask car

FIGURE 2-3

FULL DENSITY CANISTER FUEL STORAGE IN FLOOR RACKS

WITH SUSPENDED FUEL SUPER-IMPOSED



LEGEND

40 suspended canisters
Over 152 canisters on the floor

- Fuel Storage Canister
- Monorail Centerline

PLAN VIEW

Canister Storage Spaces - Approx. 5186
Fuel Storage Capacity - Approx. 1500 Tons

FIGURE 2-4
SUSPENDED STORAGE ARRANGEMENT

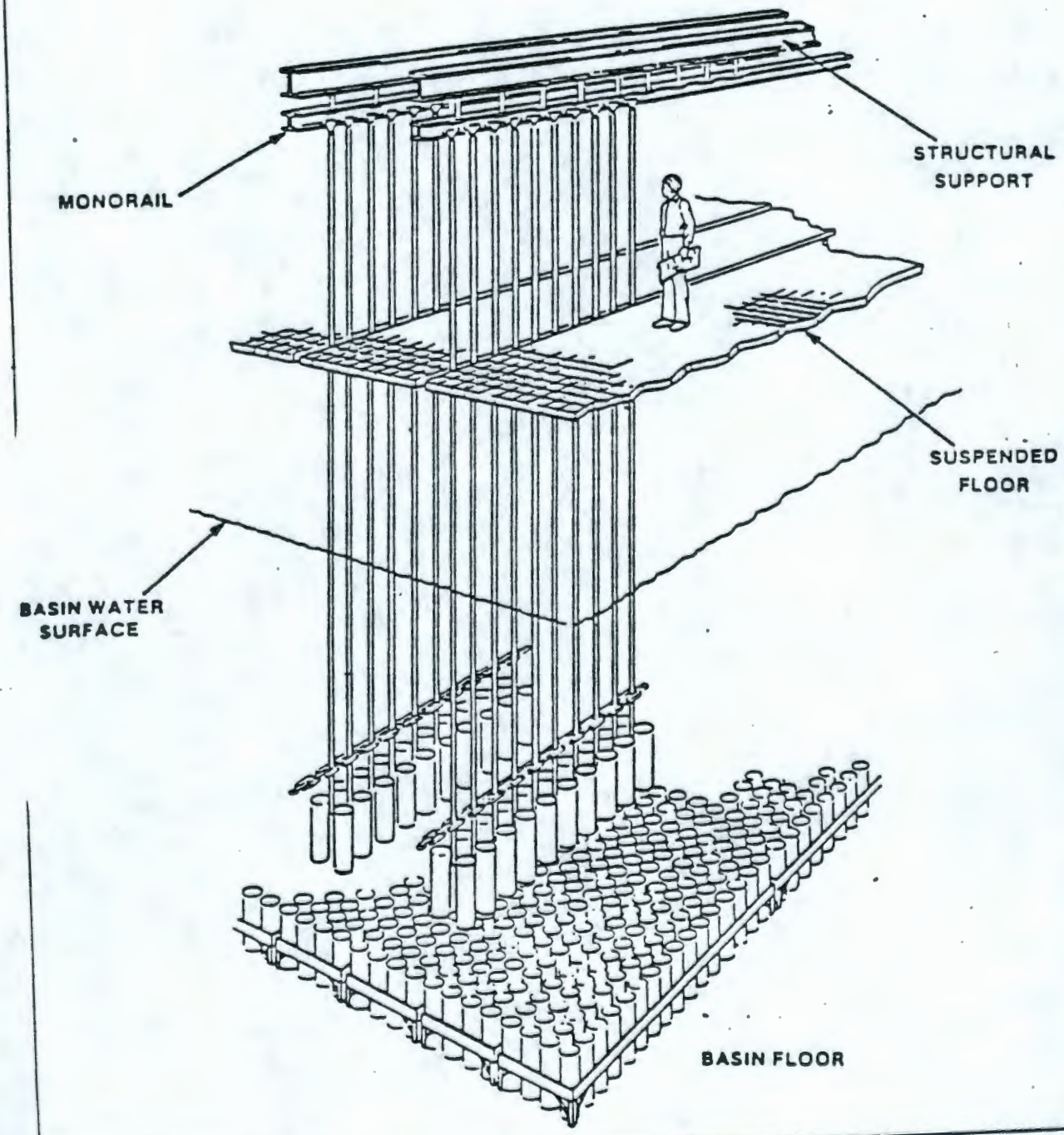
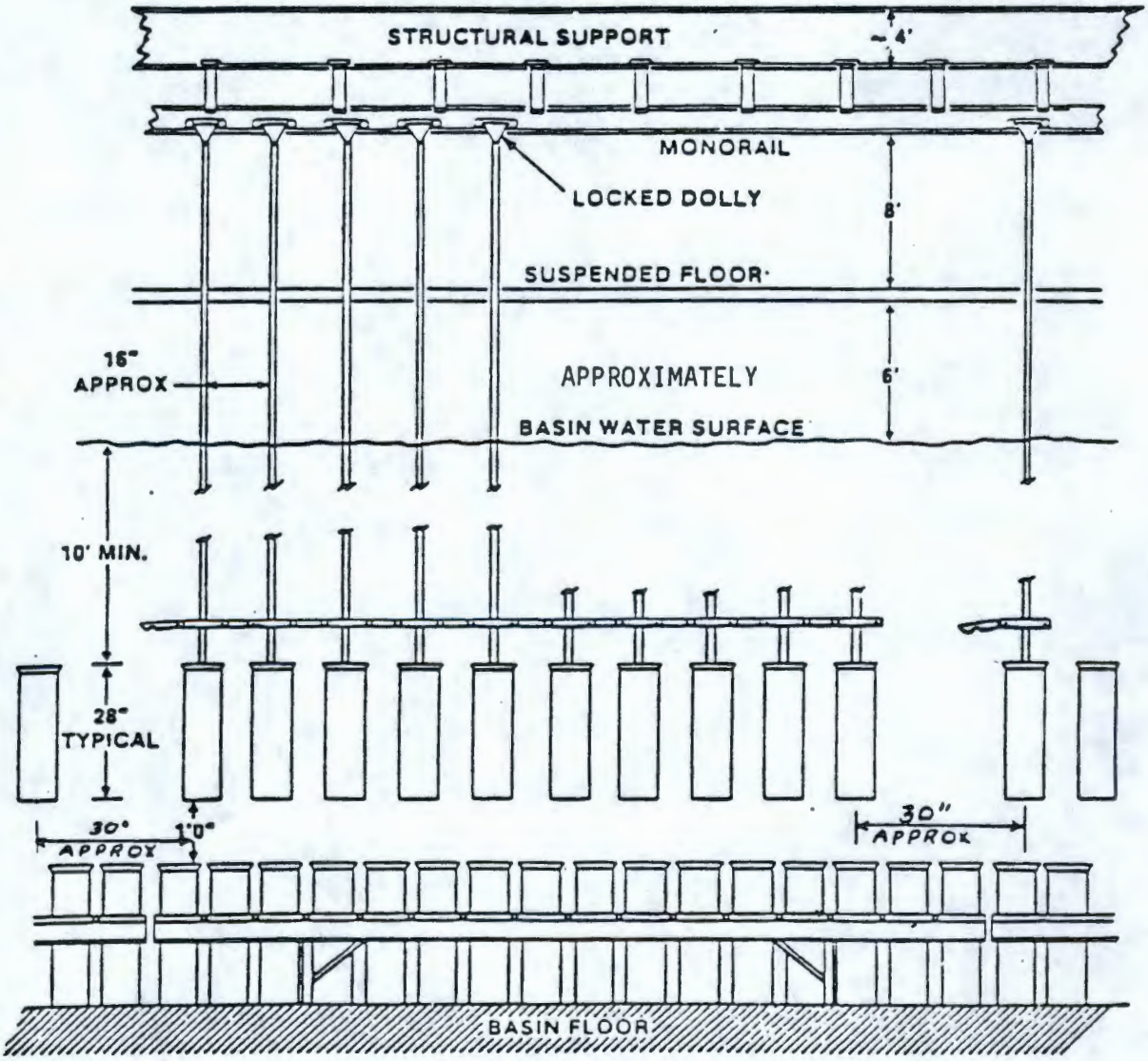


FIGURE 2-5

SUSPENDED STORAGE ARRANGEMENT



falling into the west bay of the basin and adding its nine canisters (see Figure 2-2) of fuel to the fuel stored in the west bay. It is assumed the racks, canister, hangers, and cask car disappear as far as their physical restrictive or neutron absorbing characteristics are concerned. The KE basin has been restricted to lower enriched fuel which has been shown to be safe under potential accident conditions since suspended fuel will be excluded from the west bay. The cask car fuel will thus only affect the full density storage configuration. The KE west bay under this design basis accident reaches a maximum of 1 over 3 configuration of lesser enriched fuel which is less reactive than the 1 over 3 configuration of spike fuel which has been shown to be safe.*

Spike fuel will be shipped to KW basin only. To avoid the possibility of exceeding the safe 1 over 3 configuration of spike fuel with the cask car accident, two restrictions have been applied. First, only lesser enriched fuel will be stored in the west bay. Second, suspended storage will not be authorized in the west bay.

All future shipments of encapsulated fuel will be in Mark II canisters with a positive locking lid which will preclude dumping the fuel from the canister.

The design basis accident for the remaining middle and east bays is the dropping of the suspended fuel onto the full density storage. As previously mentioned, this has been shown to be safe even for unirradiated

*UNI-1779, "Nuclear Criticality Safety Analysis and Technical Basis for Contingent Irradiated Fuel Storage in 105-KE/KW Basins," H. Toffer, J.H. Eaves, May 12, 1981.

spike fuel in all locations. This is all based on the double contingency criterion of one accident not resulting in a critical condition. Actually, both the dropping of suspended fuel and loss of water at the same time were considered. Under these conditions the k-eff did not reach or exceed the criticality safety criterion of 0.98 established for UNC Nuclear Industries fuel storage basins.

The two fuel configurations used are full density storage as shown in Figure 2-3 and suspended storage shown in Figures 2-4 and 2-5. Suspended storage consists of fuel suspended by hangers from monorails at a ratio not to exceed one canister over three storage canisters in any critical hemispherical diameter. Storage of fuel on latched hangers suspended from locked trolleys, in up to four groups of ten to each of 31 rails, insures maintaining the required 1 to 3 ratio of suspended canisters in all locations of the basin over the potential full density in rack canister floor storage, even during a seismic event. Use of the hanger (H-1-34855) insures the one foot separation of the suspended fuel from the fuel in the storage racks on the floor (see Figures 2-4 and 2-5). There is a 30-inch hanger separation between the four groups of ten hangers on each monorail. The reinforcing of the roof and rail supports and bracing insures integrity of the rail and its supports during a seismic event. These storage configurations may be used on any fuel authorized in Specification 2.1.1 and 2.1.2. The criticality analysis supporting this storage configuration is discussed in Sections 7, "Criticality Safety Analysis", and 8.1, "Criticality Related Accidents", of the SAR.

The prevention of accidental formations of critical masses in the facility is based primarily on confining the fuel in a restrictive geometry. Storage racks were installed on the floor of the cooling pools to ensure

the canistered fuel remains in the proper storage station. It is physically impossible for any one storage station to hold more than one canister due to dimensional restrictions.

The restrictions on fuel movement are based on the analysis presented in Sections 8.1.2, "Cask Fuel Spill", and 8.1.3, "Fuel Transfer Basket Drop", of the SAR, which state that the spilling of one cask full of fuel (three canisters), or a fuel transfer basket (28 elements) will not increase the k-eff of the basin above 0.833.

The restriction on storage buckets of single-pass reactor fuel is based on dropping or spilling a bucket (545 pounds) into the storage array of N Reactor fuel so that the change in k-effective value of the array will be no more than spilling of a canister of N Reactor fuel into the array. The 73 single-pass reactor fuel elements are normally stored in two buckets, in the viewing pit which is isolated from the rest of the basin.

The KE and KW Fuel Storage Facilities were designed to store irradiated N Reactor fuel cooled at least 150 days following reactor shutdown. This cooling off period will allow much of the initial decay heat and radiation to decay away, thus reducing the cooling and shielding requirements at the facility. Based on previous irradiated fuel storage experience at N Reactor and at the other Hanford reactors, only a small amount of radioactive noble gases is expected to be released from fuel which has decayed for 150 days. In addition, the minimum cooling pool water level and the consequences of the accidents, as discussed in Section 8.2.4 of the SAR, "Crane Failure and Cask Dropped onto the Floor of the Transfer Area", are based on this 150 day cooling off period.

Prior to shipment for chemical separation, the irradiated N Reactor fuel, both inners and outers, was segregated by measurement of the spontaneous neutron count into a number of groups. This work was performed in the KE Basin segregation pit. The assemblies were separated into outers and inners prior to measurements. They were then reassembled with elements of the same group prior to repackaging in canisters and stored for shipment. The segregation equipment used for this task has now been removed from the KE Basin.

The decapping/recanning design change added equipment and requirements to 100-KW basin. Additional limits were added to address the criticality concerns from handling plutonium solutions. A four canister limit was established in the 100-KW transfer channel (Figure 2-6) area where the decapping equipment is located.

The 5.8 inch slab thickness limits are based upon analysis for safe slab thicknesses for mixed uranium plutonium systems.* The buildup of sludge from fuel segregation has been slow in 100-KE. No fuel dumping is anticipated in 100-KW, so no significant additional sludge is anticipated due to decapping. The slab thickness limit applies only in locations where 1.25 w/o sludge buildup could occur.

*UNI-2352, "Sludge Removal System and Decapping/Recanning Program Equipment Criticality Evaluation," by D. A. Tollefson and H. Toffer, March 7, 1983.

2.2 Fissile Material Concentrations

Applicability: Applies to the fissile material present in various components of the pool cooling and recirculation system.

Objective: Define the maximum amount of plutonium allowed in the sand filter, sand filter sludge, cartridge filters, and the ion exchange tanks.

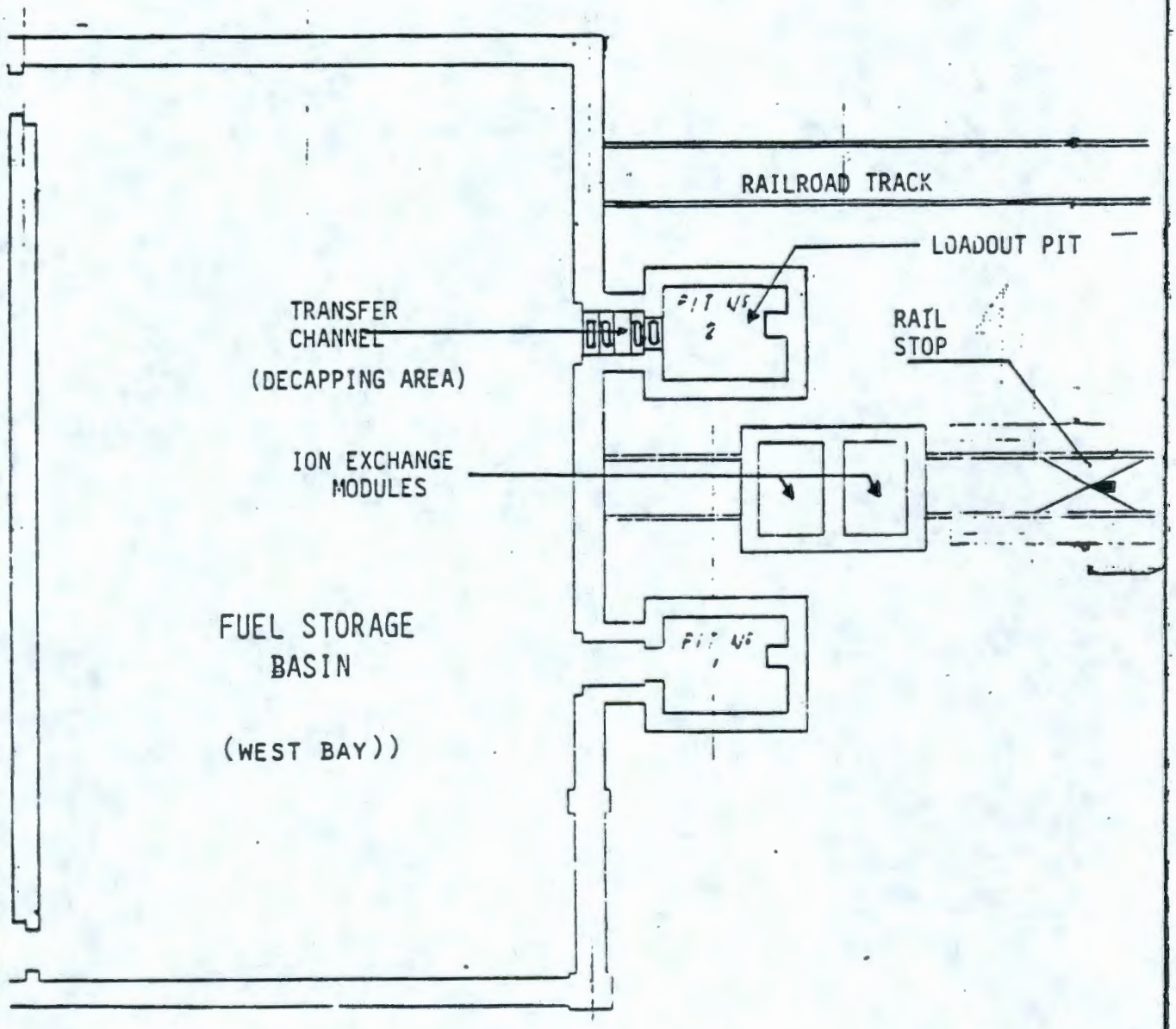
Specifications:

2.2.1 The total calculated amount of plutonium present in the sand filter, sand filter sludge, cartridge filter pre-filter, ion exchange tank, or an ion exchange module shall be limited to 225 grams (per filter, tank or module) or less.

Action: If these specifications are not met, all involved operations in the affected basin shall be halted. Other operations and basins shall be inspected for similar problems. An investigation shall be conducted, as specified in Section 6.4, and appropriate corrective action determined and initiated.

Bases: A nuclear criticality assessment was performed to evaluate any possible criticality hazards associated with accumulation of plutonium in various components of the pool cooling and recirculation system. The minimum spherical critical mass for plutonium (Pu-239) homogeneously distributed in hydrogeneous materials and fully water reflected is 500 grams. To assure adequate criticality control, the amount of plutonium permitted in the various components of the pool cooling and recirculation system will be limited to 45 percent of the minimum critical mass, or a

FIGURE 2-6


RAILROAD TRACK
LOADOUT PIT
TRANSFER CHANNEL
(DECAPPING AREA)
RAIL STOP
ION EXCHANGE MODULES
FUEL STORAGE BASIN
(WEST BAY))

total of 225 grams. A routine surveillance program will be maintained by Fuel Processing to insure the total amount of plutonium accumulated in these various components remains below 225 grams.

The presence of fission products and other nonfissile isotopes will tend to increase the minimum critical mass. The effective enrichment of the uranium in the cooling pool water is less than one w/o of U-235; and homogeneous distributions of uranium below this enrichment, in hydrogeneous materials, cannot be made critical.

2.3 Fuel Transfer Train Movement (See Figure 2-7)

Applicability: Applies to the limitations imposed upon fuel transfer trains entering the facilities.

Objective: Define the limits for fuel transfer trains entering the facilities.

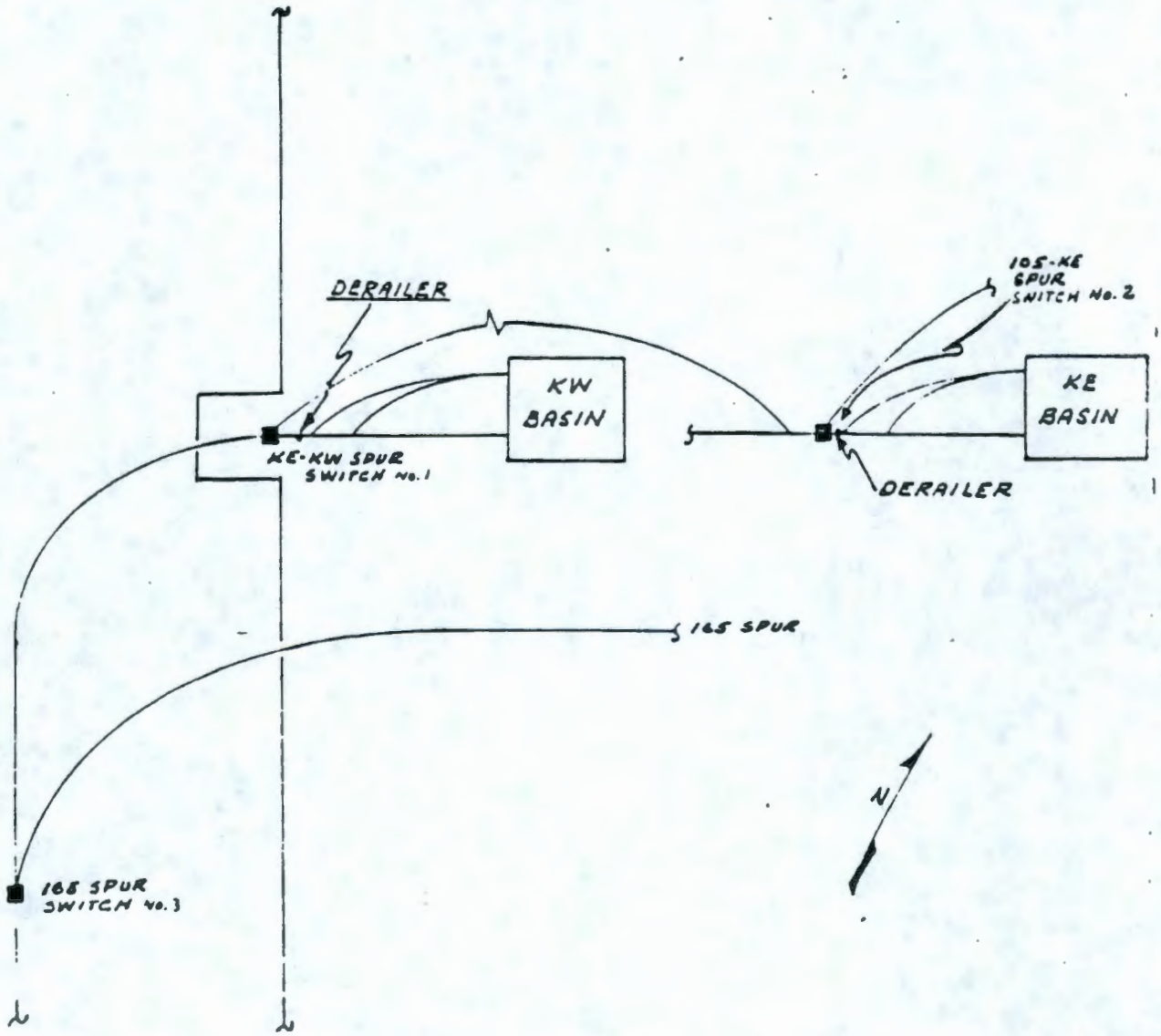
Specifications:

2.3.1 The railroad track switch (No. 1) west of KW Area which routes the train to either the KW or KE Storage Basin shall always be locked in the KE position (see exception).

2.3.2 The railroad spur (Figure 2-7) shall be in place and the railroad track switch (No. 2) at KE shall always be locked in the spur position (see exception).

FIGURE 2-7

RAILROAD TRACK LAYOUT TO K AREA BASINS



Exceptions (to 2.3.1 and 2.3.2):

- The locks may be removed and the switch position changed when a train is actually entering, in, or exiting from the storage basins.

- The locks may be removed and the switch position changed as required for track maintenance provided the switch (No. 3) located approximately 420 feet west of the KW Area fence (see figure 2-7), which routes a train to the basins or the 165 spur, is locked in the 165 spur position.

2.3.3 The train derail devices shall not be opened until the train has come to a full stop before the derail device and a UNC lock has been installed on the General Electric, American Locomotives Company's (ALCO) locomotives throttle return and throttle position limiting device to limit the speed to two miles per hour. For the General Motors' (GM) engines, the speed controller shall be set to limit the locomotive speed to one mile per hour. The procedure shall be followed for all moves inside the derailers.

2.3.4 When entering the storage basin area (past the derailers), the fuel transfer train shall be controlled at a speed not greater than two miles per hour. A Fuel Processing supervisor shall ride the locomotive cab whenever a cask car is being moved into the storage basin area. This is to insure by a trip of the emergency stop that the train speed does not exceed one mile per hour for GM locomotives or two miles per hour for the ALCO locomotives. An increase in speed is detected by increased locomotive engine noise on the old ALCO locomotives and by a speedometer reading on the GM engines.

2.3.5 No more than one well car shall be coupled to the locomotive when the derail device is open.

Action: If these specifications are not met, all involved operations in the affected basin shall be halted. Other operations and basins shall be inspected for similar problems. An investigation shall be conducted, as specified in Section 6.4, and appropriate corrective action determined and initiated.

Bases: Two hypothetical accidents of a runaway train have been identified. The first accident assumes the train approaches K Area at excessive speed, out of control and could crash all barriers to enter a fuel storage basin. The KW (No. 1) switch will route the train to KE Area where the switch (No. 2) for the rail spur will divert the train away from the basin. The derailers at each area are located about 520 feet or more from the rail termination point located inside the facility.

The 165 spur switch (No. 3) will divert a runaway train away from the K Basins during track maintenance, when other switches may not be positioned properly.

The second accident assumes that the engineer is unable to stop the train during operation past the derailer.

To prevent the second accident rail stops and bumper bars have been installed inside each basin transfer area at the rail termination points. These are designed to stop a locomotive and loaded cask car, total weight of 235 short tons traveling at a controlled speed of two miles per hour from entering the fuel cooling pool.

The ALCO locomotives used to transfer fuel between TOO-N and the facility have been equipped with a throttle return and throttle position limiting device. This device will, when engaged and locked in position, limit the maximum throttle position set to the lowest tractive power setting required to move a fully loaded transfer train (approximately two miles per hour; however, the speed can be as high as four miles per hour). The ALCO locomotive engineer will maintain the speed of the transfer train not greater than the two miles per hour limit by normal locomotive operating techniques. The throttle return and throttle position limiting device will automatically return to the off position if the throttle is released, thus further reducing the probability of a loaded transfer train impacting the restraining structure with a speed greater than two miles per hour. The GM, EMD MP 15AC, locomotives have a speed control which can be preset to a maximum speed of one mile per hour. The Fuel Processing supervisor will ride in the locomotive cab during this time to monitor and take necessary action to insure the train does not exceed the limiting speed. The two miles per hour speed is the slowest speed at which the ALCO locomotives have power to move the cask car. An increase in speed is detected by increased locomotive engine noise for the ALCO locomotives and by a digital speedometer on the GM locomotives.

2.4 Fuel Cask Transport Time Limits for Encapsulated Irradiated Fuel

Applicability: Applies to the limitations imposed upon encapsulated irradiated fuel transfer between N Reactor and the storage facility.

Objective: Define time limits for shipping encapsulated irradiated fuel by train such that temperatures experienced by the fuel shall not reach a point where increased oxidation and/or hydration of damaged elements may occur.

Specifications

2.4.1 If the transfer time for transfer of the loaded fuel cask from the well car to the facility basin exceeds that allowed by Figures 2-8 or 2-9, which is a function of well car temperature and age of the fuel, the cask shall be continually flushed with cooling water.

Action: If these specifications are not met, all involved operations in the affected basin shall be halted. Other operations and basins shall be inspected for similar problems. An investigation shall be conducted, as specified in Section 6.4, and appropriate corrective action determined and initiated.

Bases: In the sealed canister, the canister water is isolated from the cask water and the heat must be conducted through the inside and outside convection boundary layers and the canister wall. Should the canister water reach the boiling point the canister could boil dry leaving the fuel in a steam atmosphere. High fuel temperatures would then be experienced, which might increase oxidation and/or hydration of damaged elements. These limits establish fuel handling and shipping times to assure that boiling within the sealed canisters will not occur. No time limit is imposed for travel of the loaded cask car between N Basin and the storage facility.

The time limits are based on 120 percent of 150 day decay heat rates. The maximum heating rate associated with a cask loaded with 150 day cooled fuel is used and the method of heat transfer at all wetted surfaces is by natural convection. It has been determined that the highest heat generation rates will come from MKIV fuel and these limits are based on those rates. The limits therefore, are also valid for MKIA fuel.

FIGURE 2-8

MAXIMUM ALLOWABLE CASK UNLOADING TIME (K BASINS), WITHOUT SUPPLEMENTAL COOLING, BASED ON 150 DAY FUEL AND VARIABLE WELL CAR WATER TEMPERATURE

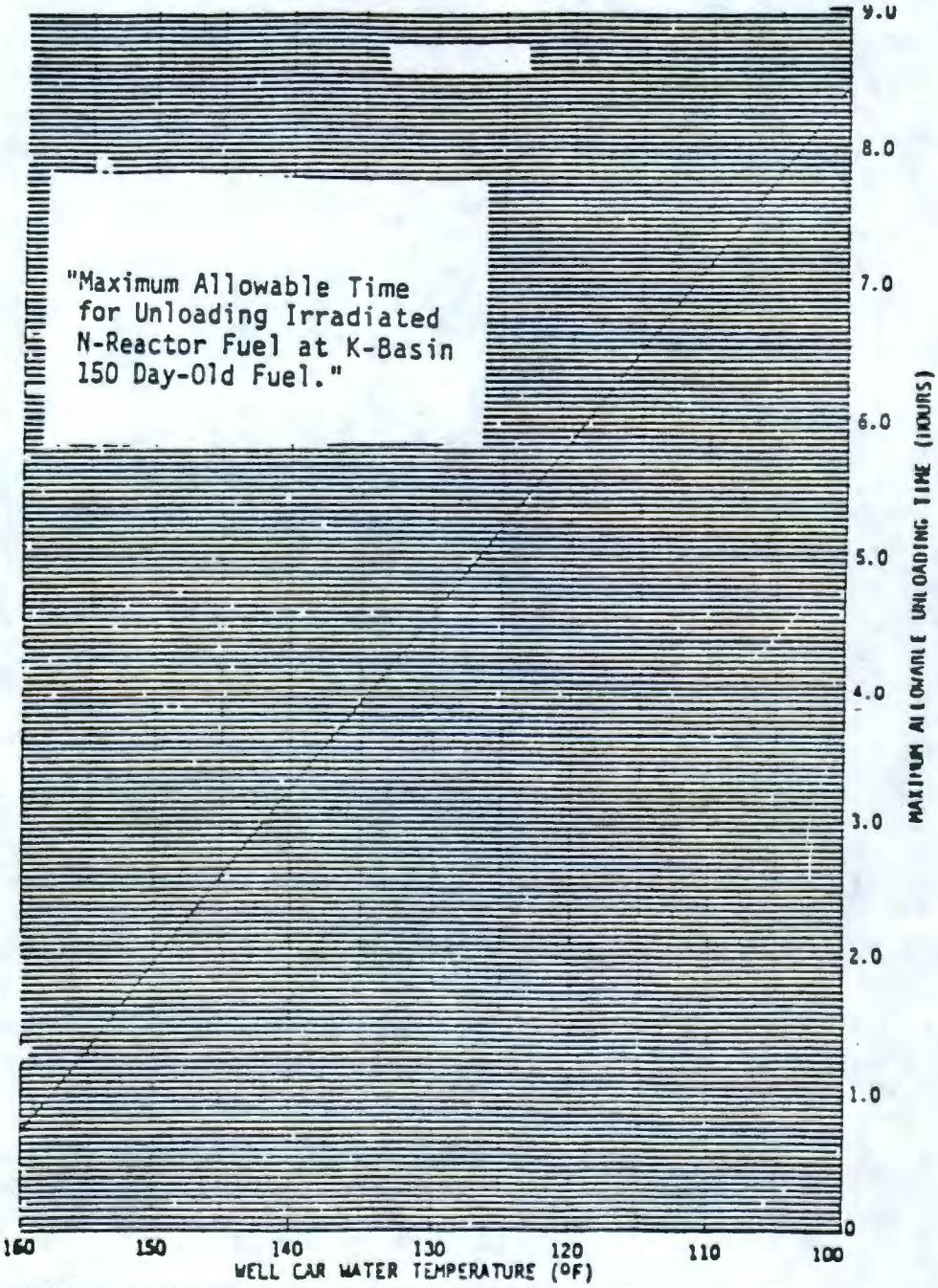
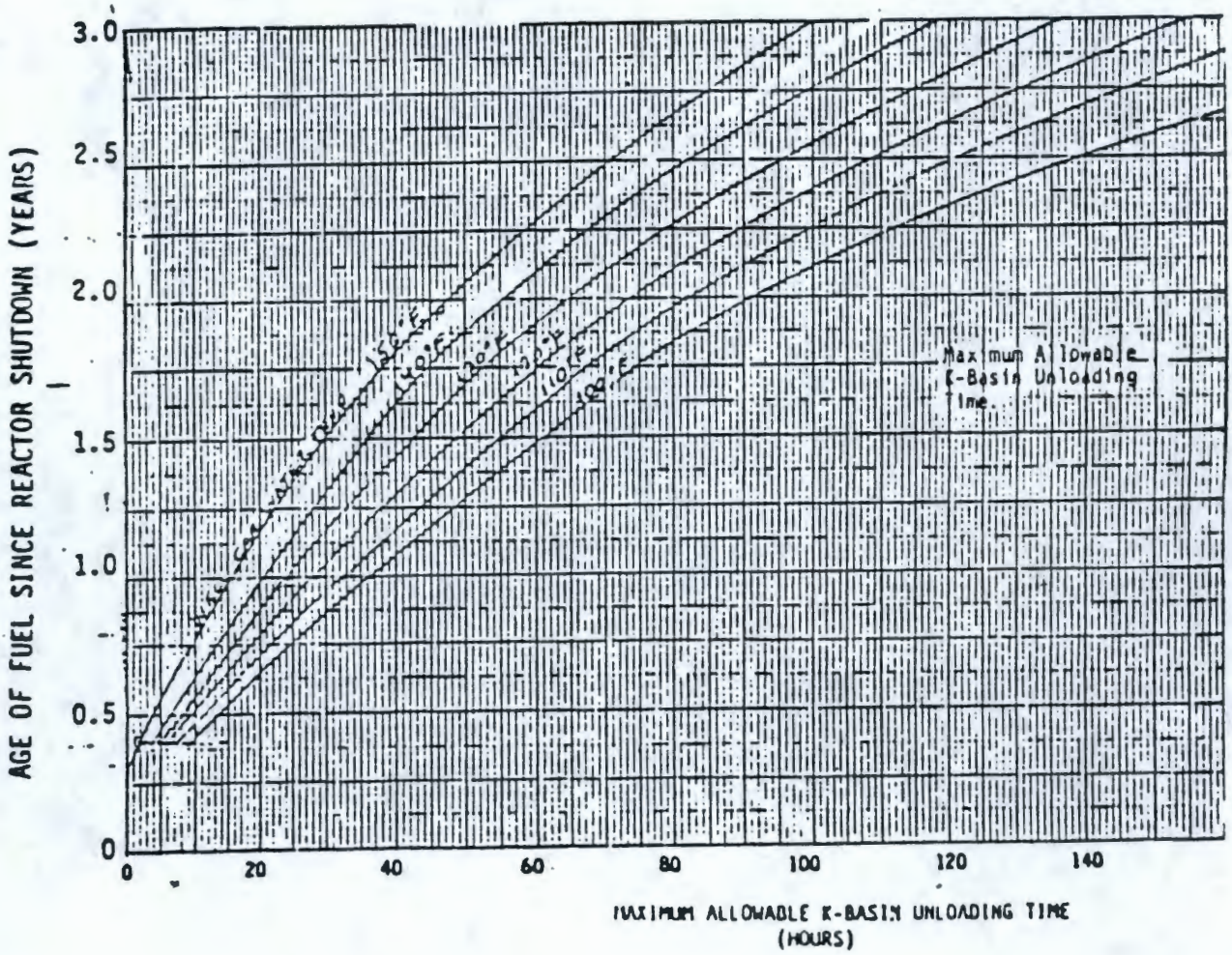


FIGURE 2-9

MAXIMUM ALLOWABLE CASK UNLOADING TIME (K BASINS)
WITHOUT SUPPLEMENTAL COOLING, BASED ON VARIABLE FUEL AGE
AND WELL CAR WATER TEMPERATURE



Heat transfer from the cask in air is assumed to be by natural convection and thermal radiation.

For a complete discussion of the basis calculations refer to UNI-1568, "Shipping Time Limitations of Encapsulated N Reactor Irradiated Fuel" D. T. Buchanan, dated 8-31-80.

3/4.0 LIMITING CONDITIONS FOR OPERATION AND SURVEILLANCE REQUIREMENTS

Limiting Condition for Operation

3.0.1 Adherence to the requirements of the limiting conditions for operation (LCFO) and associated action within specified time intervals shall constitute compliance with the specification.

Surveillance Requirements

4.0.1 Surveillance requirements shall be applicable during the operating modes associated with individual limiting conditions for operation unless otherwise stated in an individual surveillance requirement.

4.0.2 Each surveillance requirement shall be performed within the specified time with a performance deviation allowance as defined below:

4.0.1.1 Weekly surveillance checks are due during the week due.

4.0.1.2 Monthly and quarterly surveillance checks are due during the month due.

4.0.1.3 All specified intervals greater than quarterly may be adjusted plus 25 percent to accommodate operating mode and related test schedules.

4.0.3 If a surveillance requirements is not performed within the prescribed frequency and performance deviation, the following action shall be taken:

4.0.3.1 The contractor shall notify DOE-RL.

4.0.3.2 Investigate the matter and record the results of the investigation.

4.0.3.3 State the reason for not complying with the requirements and the corrective action that will be taken.

3/4.1 Cooling Pool Water Temperature

Applicability: Applies to the cooling pool water temperature.

Objective: Define the maximum allowable cooling pool water temperature.

Limiting Conditions for Operation

3.1.1 The cooling pool water temperature shall not exceed 38 C (100 F).

Action: Return the cooling pool water temperature to limits within 48 hours or notify Nuclear Safety.

3.1.2 Continuous cooling pool water temperature monitoring capability shall be maintained at all times.

Exception: The cooling pool temperature monitoring equipment may be removed from service for up to 24 hours for testing or repair.

Action: Return the water temperature monitoring equipment to service within 24 hours or provide alternate water temperature monitoring capability.

Surveillance Requirement

4.1.1 The equipment used to monitor the cooling pool water temperature shall be calibrated at least once per year, and operation of the high temperature alarm shall be functionally tested at least once a month.

Bases: The 105 KE and KW Fuel Storage Facilities were designed to operate with a maximum water temperature of 38 C (100 F). The cooling pool recirculation system consists of recirculation pumps, heat exchangers, cartridge filters and an ion exchange system. One of the primary functions of this system is to remove the decay heat generated by the irradiated fuel stored in the basin. This is accomplished by circulating the basin water through the heat exchangers where the heat is transferred to the secondary water system and released to the river. The effect of this heat, when released to the river, will not result in any measurable increase in the mixed river water temperature.

The pool cooling and recirculation system is not completely redundant but does have some redundant equipment (three recirculation pumps, two cartridge filters, and three ion exchange tanks, etc.). It is possible that the complete system may need to be removed from service for short periods of time for equipment repairs or normal maintenance work. Emergency cooling water is available, either from the clear well reservoirs or directly from the Columbia River if it is needed. Analysis made on fuel heatup indicate that at least 60 hours are available to restore the heat removal equipment to service before emergency cooling water will be needed.

3/4.2 Cooling Pool Water Level

Applicability: Applies to the cooling pool water level.

Objective: Define the minimum and maximum allowable water level in the cooling pool.

Limiting Conditions for Operation:

3.2.1 The cooling pool water level shall be maintained at 16' ± 8" above the bottom of the cooling pool floor.

Action: Cease fuel handling operations and initiate action to return the water level to limits.

3.2.2 Continuous cooling pool water level monitoring capability shall be maintained.

Exception: The cooling pool water level monitoring equipment may be removed from service for up to 24 hours for testing or repair.

Action: Return the cooling pool water level monitoring equipment to service within 24 hours or provide alternate water level monitoring capability.

Surveillance Requirement:

4.2.1 The high and low cooling pool water level monitoring equipment shall be calibrated at least once per year, and operation of the high and low water level alarms shall be functionally tested at least once a month.

Bases: By maintaining the cooling pool water level above 15' 4" ensures approximately ten feet of water will be over the fuel during normal fuel handling operations. With ten feet of water over the irradiated fuel, the radiation dose rate from the fuel has been calculated to be less than one mR/hr.

The maximum cooling pool water level is specified to ensure that the wall between the basin and the segregation area is not overturned during the design basis earthquake. Analyses* show that with the water depth limited to about 16 feet or less, the facility will survive the design basis earthquake without incurring major damage.

3/4.3 Cooling Pool Water Chemistry

Applicability: Applies to the cooling pool water chemistry.

Objective: Define the operational limits for the cooling pool water chemistry.

*UNI-287, "Extreme Load Analyses of the 100-K Fuel Storage Basins and Clearwell," H.S. Davis, March 10, 1975.

Limiting Condition for Operation:

3.3.1 The cooling pool water shall have a pH between 5.0 and 9.5 for KE and KW basin.

Action: Initiate corrective action if the limit is exceeded or if a trend is indicating that the limit will be exceeded. Return to limits as soon as possible.

3.3.2 Continuous cooling pool water pH monitoring capability shall be maintained at all times.

Exception: The cooling pool water pH monitoring equipment may be removed from service for up to 24 hours for testing or repair.

Action: Return the cooling pool water pH monitoring equipment to service within 24 hours or provide alternate water pH monitoring capability.

Surveillance Requirement:

4.3.1 The equipment used to monitor the pH of the cooling pool water shall be calibrated at least once per month, and operation of the recorder and meter shall be functionally tested at least once a week.

Bases: Maintaining the pH in the ranges specified will provide acceptable corrosion rates for fuel storage canisters and steel components in the pool cooling and recirculating system. Technology has determined that reducing the minimum pH from 6.5 to 5.0 to accommodate

demineralization of the KE Basin, should cause no increase in carbon steel corrosion. (Reference: Memo, W.K. Kratzer to K.L. Fowler "KE Fuel Storage Basin pH Limits", dated January 24, 1986.)

The KW Basin walls are protected with an epoxy coating and are not subject to significant dissolution. The KE walls are not coated and are subject to a minimal amount of dissolution.

3/4.4 Radioactive Materials Release

Applicability: This section applies to the release of all liquid, solid, and airborne effluents containing radioactive material from the facility.

Objective: This section specifies the conditions required to control the release of radioactive materials from the 105-KE and KW fuel storage basins to the environs and assures that all releases comply with DOE Order 5480.1A.

Limiting Conditions for Operation:

3.4.1 Liquid Waste Specifications

3.4.1.1 The basin water radionuclide concentration shall be monitored to identify adverse trends.

3.4.1.2 The release of radioactive materials in liquid effluent streams discharging from the 105-KE and KW Fuel Storage Facilities to the Columbia River shall be limited such that the concentrations of radionuclides in the streams do not exceed the following concentration guides (averaged over a one year period):

Radionuclide	*Concentration Guide, pCi/ℓ
H-3	3.0×10^5
Mn-54	1.0×10^4
Co-60	5.0×10^3
Sr-90	3.0×10^1
Ru-106	1.0×10^3
Cs-134	9.0×10^2
Cs-137	2.0×10^3
Ce-144	1.0×10^3
Pu-239/240	5.0×10^2

* Values represent 10% of MPC Table II values from DOE 5480.1A.

Action: If adverse trends are indicated in basin water radionuclide concentrations, steps shall be taken to identify and correct the trend.

If the concentration guides are exceeded, an investigation shall be made to identify the source of the release and a program of corrective action shall be defined and implemented.

3.4.1.3 An effluent sampling system shall be in service sampling the 100-K outfall as follows:

A. An automatic composite sampling system shall be in operation,

OR

B. Grab samples shall be taken on a weekly frequency.

Action: If the above sampling requirements are not met, an investigation shall be made to determine the deficiency and the corrective action to be implemented. The inoperative sampling system shall be returned to service as soon as practicable.

3.4.1.4 The release of liquids containing radioactive materials by way of leakage pathways discharging to the ground from the 105-KE and KW Fuel Storage Facility shall be monitored by means of basin drawdown testing performed at least once a month.

Action: If the drawdown testing requirement is not met, an investigation shall be made to identify the deficiency and determine the corrective action to be implemented.

3.4.2 Airborne Waste Specifications

3.4.2.1 The release of radioactive materials from the KE and KW Fuel Storage Facilities to the atmosphere shall be limited such that the concentration of radionuclides in any airborne effluent stream do not exceed the following concentration guides (averaged over a one year period):

Radionuclide	*Concentration Guide, pCi/ℓ
H-3	2.0×10^{1}
Mn-54	1.0×10^{0}
Co-60	1.0×10^{0}
Sr-90	3.0×10^{-3}
Ru-106	3.0×10^{-1}
Cs-134	1.0×10^{-1}
Cs-137	2.0×10^{-1}
Ce-144	3.0×10^{-2}
Pu-239/240	6.0×10^{-6}

* Values represent 10% of MPC Table II values from DOE 5480.1A.

Action: If the concentration guides are exceeded, personnel entry shall be limited to protective mask use only. An investigation shall be made to identify the source of the release and a program of corrective action shall be defined and implemented.

3.4.2.2 An effluent sampling system shall be in service sampling the exhausted 105-KE and KW Storage Basin air as follows:

A. An automatic composite sampling system shall be in operation,

OR

B. Grab samples shall be taken on a weekly frequency.

Action: If the above sampling requirements are not met, an investigation shall be made to determine the deficiency and the corrective action to be implemented. The inoperative composite sampling system shall be returned to service as soon as practicable.

Surveillance Requirements:

4.4.1 Liquid Waste Specifications

Composite samples from the 100-K outfall shall be obtained and analyzed at least once per month.

4.4.2 Airborne Waste Specifications

Composite samples of the 105-KE and KW Storage Basin exhaust air shall be obtained and analyzed at least once per month.

Exceptions: The weekly grab samples or their composites may be analyzed once a month to substitute for the monthly analysis of composite samples of 4.4.1 and 4.4.2 surveillance requirements.

Bases: The specifications on radioactive materials release are based on the policy of the Department of Energy as stated in DOE Order 5480.1A and in WASH-1202 (73), "Plan for the Management of ERDA - Generated Radioactive Wastes." Based on this policy, releases of radioactive material to the environs will be reduced to the lowest level below established standards to the extent technically and economically practical.

3/4.5 Heat Exchanger Differential Pressure

Applicability: Applies to the heat exchangers water pressure.

Objective: Define the minimum allowable pressure differential between the two sides of the heat exchangers.

Limiting Conditions for Operation:

3.5.1 The pressure on the tube side shall be eight psig or more than the pressure on the shell side of the operating heat exchanger.

Action: Shut off the recirculating pump, if it has not been tripped off by the differential pressure device.

Operation may continue on the basin chiller, once the heat exchanger has been isolated on the shell side. Isolation shall occur within four hours.

Surveillance Requirement

4.5.1 The differential pressure sensing equipment shall be calibrated quarterly.

Action: Follow action item of 3.5.1 above until calibration has been completed.

Bases: Maintaining the differential pressure above eight psi will ensure any heat exchanger tube leakage will be from the tube side (clear water) to the shell side (radioactive water). This will prevent the pool coolant, which contains radioactivity, from passing into the tube side and being discharged to the Columbia River.

3/4.6 Tornado Missiles

Applicability: Applies to the area west of the storage basin to the fence between a southwest and northwest line from the south and north corners of each basin structure. See cross hatched area of Figure 3/4-1, page 3/4-13.

Objective: To prevent damage to the basin and its structures from tornado missiles.

Limiting Conditions for Operation:

3.6.1 The area west of the basins as defined above shall be kept free of tornado missiles which are defined as objects between 50 and 4000 pounds in weight.*

*NUSAR, UNI-M-90, Section 3.3.3.1 "Description of Tornado Generated Missiles".

Action: The area shall be cleared of tornado missiles as soon as practicable, but not to exceed a week or fuel shipments into the subject basin shall be halted.

Surveillance Requirements:

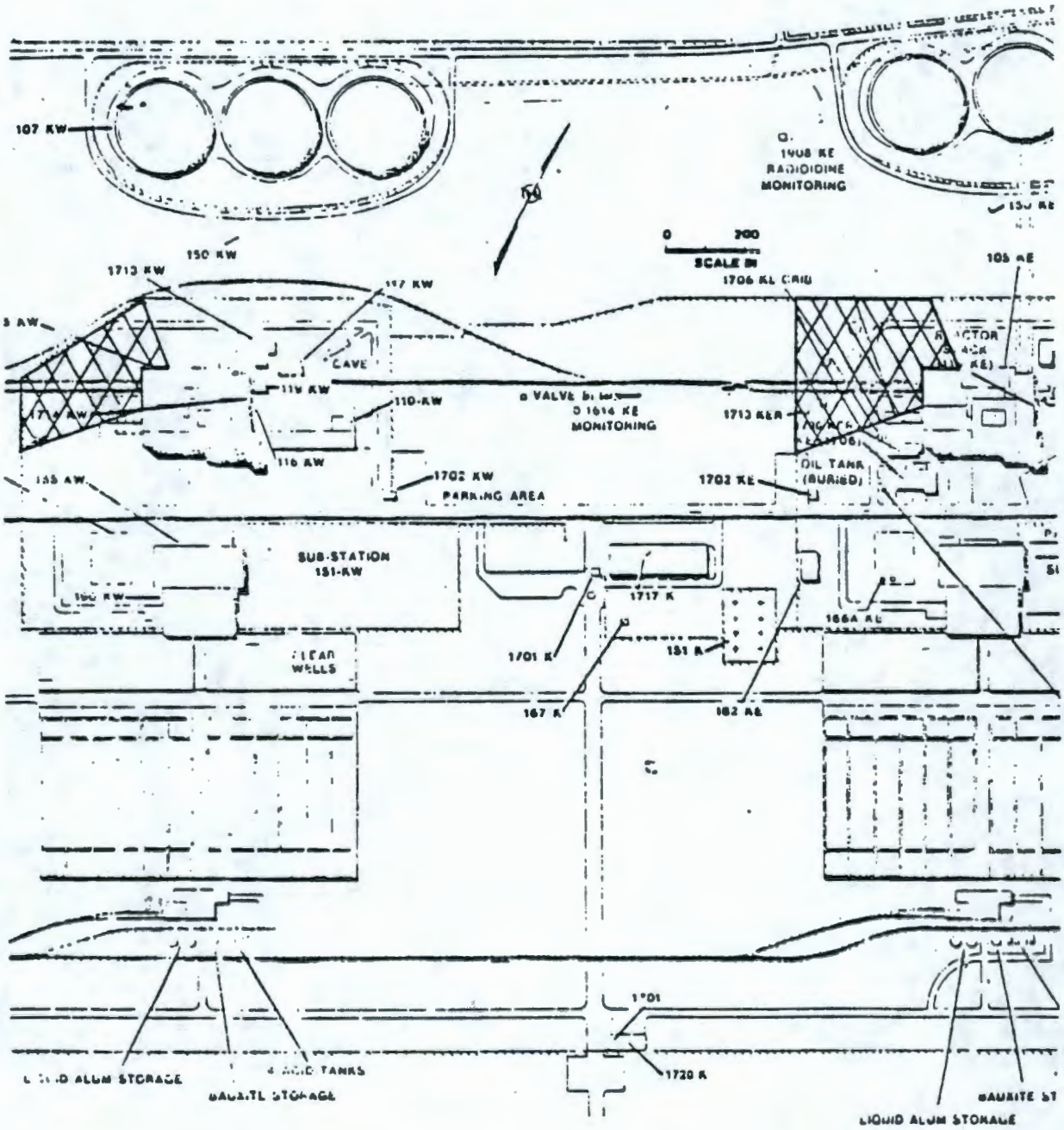
4.6.1 The area west of each K area basin shall be inspected monthly to determine that there are no tornado missiles in the area. Records of the inspections shall be maintained.

Action: Perform the inspection as soon as practicable after identification of the surveillance interval violation, not to exceed a month.

Basis: Objects the size and weight of automobiles are not likely to become airborne missiles. The prevailing winds may vary from southwest in the winter to the northwest in the summer. Tornados tend to follow the prevailing wind directions so clearing the westerly area of potential missiles will minimize the possibility of tornado missiles. Missiles would be expected to disturb mostly the suspended fuel storage by damage to the structure or fuel supporting members.

FIGURE 3/4-1

K BASINS TORNADO MISSILE FREE AREAS



3/4.7 Fissile Material

Applicability: Applies to fissile material present in components of the cooling pool.

Objective: Define the controls to maintain maximum plutonium limit of 225 grams in the cooling pool.

Limiting Conditions for Operations:

3.7.1 Representative samples shall be obtained from the 100-KE and 100-KW Basin water and analyzed for plutonium concentration every two months.

3.7.2 A representation sample shall be obtained from the following locations and analyzed for fissile material content at least once every six months of operation: 1) Sand Filter; 2) Sand Filter Sludge; and 3) Ion Exchange Tanks.

Action: Based on data obtained in 3.7.1 or 3.7.2, cleanout of any component (sand filter, sand filter sludge, cartridge filter, pre-filter, ion exchange tank, ion exchange module) shall be accomplished prior to exceeding a calculated buildup of 225 grams of plutonium.

3.7.3 A cartridge filter, ion exchange module or pre-filter shall not be in service more than six months in 100-KE or one year in 100-KW.

Exception: The composite samples may be used as a basis for operating the components beyond the six months or one year limit provided calculations show that the plutonium buildup is less than 110 grams.

Surveillance Requirement

4.7.2 The sludge in the vicinity of the south transfer channel at the 100-KW basin shall be measured at least once every three months, after 1.25 w/o fuel has been decapped in the area.

Bases: A nuclear criticality assessment was performed to evaluate any possible criticality hazards associated with accumulation of plutonium in various components of the pool cooling and recirculation system. The minimum spherical critical mass for plutonium (Pu-239) homogeneously distributed in hydrogeneous materials and fully water reflected is 500 grams. To assure adequate criticality control, the amount of plutonium permitted in the various components of the pool cooling and recirculation system will be limited to 45 percent of the minimum critical mass, or a total of 225 grams. A routine surveillance program will be maintained by Fuel Processing to insure the total amount of plutonium accumulated in these various components remains below 225 grams.

The presence of fission products and other nonfissile isotopes will tend to increase the minimum critical mass. The effective enrichment of the uranium in the cooling pool water is less than one w/o of U-235; and homogeneous distributions of uranium below this enrichment, in hydrogeneous materials, cannot be made critical.

The buildup of sludge from fuel segregation has been slow in 100-KE. No fuel dumping is anticipated in 100-KW, so no significant additional sludge is anticipated due to decapping. The slab thickness limit applies only in locations where 1.25 w/o sludge buildup could occur.

5.0 DESIGN FEATURES

The more prominent design features of the KE and KW Fuel Storage Facilities are described below, additional details may be found in Sections 4 and 5 of the SAR.

5.1 Facility Cooling Pool

The facility cooling pools are rectangular reinforced concrete structures 125 feet long, 67 feet wide and 21 feet deep. These structures are located in the 105-KE and 105-KW reactor buildings directly behind the reactor. These facilities were modified to provide for storage and handling of the N Reactor fuel design (Mark IA, IB, IC, IV, and IVB). These modifications include a recirculating system for the pool water with in-line filters, an ion exchange system, a sand filter system, heat exchangers, chillers, and instrumentation to monitor radiation levels, heat generation rate and pool water level.

All of the pool floor drains have been plugged and sealed with concrete. The floor and walls of the KW pool are coated with a pliable epoxy sealant. Water provides the radiation shielding over the irradiated fuel stored in the cooling pool. The level in the pool is maintained at sixteen feet which provides for ten feet of water over the fuel during all normal operation conditions. Analysis show that with the water depth less than approximately sixteen feet the facility will survive the design basis earthquake without incurring major damage.

5.2 Fuel Canister Storage Racks

The fuel canister storage racks are designed with individual storage stations large enough for only one fuel canister per station. These storage racks are interlocked to form one solid unit across the cooling pool floor and are butted against the walls. These storage racks provide 5186 fuel canister storage stations. Each storage station is identified and records are maintained regarding the type of fuel stored in each storage station. These storage racks are designed to insure the storage configuration remains intact during the design basis earthquake.

5.3 Fuel Handling System

The fuel handling system consists of equipment and structures utilized at N Reactor and KE and KW Facilities for handling irradiated fuel elements in a safe manner during transfer and storage operation. The fuel handling equipment was designed to handle the irradiated fuel under water from the time it is loaded into the shielded casks until it is stored in the canister storage racks in the facility cooling pool. The water provides an effective, economical and transparent radiation shield as well as a reliable cooling medium for removal of the decay heat.

Operation of the overhead cask crane is limited such that a loaded fuel cask is physically prevented from traversing over the irradiated fuel storage pool by the building structure and the absence of crane rails over the cooling pool, thus assuring that the storage configuration will not be altered by a cask dropping onto the fuel canister storage racks.

5.4 Fuel Encapsulation

N Reactor spent fuel elements destined for storage in the KW basin will be encapsulated in standard N Reactor fuel storage canisters modified by welding a seal plate on the bottom and installing a sealing cap on the top of the canister. New designs of fuel canisters incorporate these features.

Encapsulation of the spent fuel elements in the modified or new design fuel canisters is intended to prevent the escape of solid and dissolved radionuclides into the KW Storage Basin. Gaseous fission products are vented from the fuel canisters and dissipated through the building ventilation system.

5.5 Suspended Storage of Fuel in Canisters

The fuel canisters are suspended from the existing overhead monorails. This is accomplished by numbered trolleys, installed on the rails, which support canister hangers to suspend the fuel 40 inches off the basin floor and ten feet below the water surface. Thus the suspended canisters are one foot above the floor stored canisters and have adequate shielding by water to protect personnel above. The rails are painted to designate and identify specific trolley stations in four groups of ten on each rail. One of the 32 rails is reserved for temporary storage for the case of removing an inside trolley from one rail. The remaining 31 rails holding 40 trolleys each provide 1240 canister storage locations in each basin for suspended fuel. The trolleys each have two locking bolts for securing the trolley in its numbered assigned location. The fuel canister hangers have a restraining bar latching device just above the canister hook for restraining the canisters in groups of ten from swaying together in case of a seismic event. The existing roof and rail structures have been reinforced and the trolleys and hangers designed to avoid failure or other loss of spacing during a seismic event.

5.6 Additions and Modifications

Design of changes for modifications, additions, or replacement of pumps, piping*, equipment, facilities, and process, shall be done in a controlled manner to assure continued safe operation. Such consideration shall include criticality consideration and protection from the natural events of winds, floods, earthquakes and volcanic ashfall.

5.7 Floods

The probable maximum flood (PMF) would submerge the two 181-KE electric powered river pumps under about two feet of water. However, the fuel storage facility and supporting equipment would be more than 35 feet above the flood. The fuel basins could be supplied with water from the clearwells.

5.8 Seismology

The design basis earthquake (DBE) produces a maximum horizontal ground acceleration of 0.25 g simultaneously with a maximum vertical ground acceleration of 0.17 g at zero period. The cooling pool with the water depth limited to about sixteen feet, will survive the DBE as will the water supply and recirculating system, equipment foundations and support structures, and the fuel storage rack and hanger.

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*UNI-2352, "Sludge Removal System and Decapping/Recanning Program Equipment Criticality Evaluation" by D. A. Tollefson and H. Toffer, dated March 7, 1983.

The K Area ventilation stacks have been reduced from a height of 300 feet down to 175 so that they will be able to withstand the DBE.

The storage basin monorail system and supports have been upgraded and the fuel canisters tested to assure withstanding the DBE.

5.9 Tornado

The structures were designed to withstand a bomb blast. Tornados could be expected to remove siding, but not collapse the structure. A tornado is not expected to cause the hanging fuel to drop nor the basin to lose water.

Tornados follow the prevailing winds which at Hanford are westerly. Administrative controls are required to keep the area west of the storage basins free from potential tornado missiles.

5.10 Volcanic Ashfall

Hanford has experienced four volcanic ashfalls in the past 12,000 years. Most recently, about 3/16 inch of ashfall resulted from the May 18, 1980 eruption of Mt. St. Helens. There are many potential active volcanos in Washington and the nearby states and provinces. A six inch ashfall followed by an extremely heavy rain would produce a roof loading of about 25 pounds per square foot. The 100-K basin roofs are designed for a 47 pound per square foot loading.

6.0 ADMINISTRATIVE CONTROLS

6.1 Responsibilities

6.1.1 The Fuel Processing organization is directly responsible to the Reactor Plant Manager for the safe operation of the facility, and provides the operators and supervision necessary to safely operate the facility. This organization is responsible for maintaining current operating and emergency procedures and for assuring that all activities are conducted in accordance with the approved quality assurance program.

6.1.2 The Facilities organization provides the craft help (instrument, electrical, millwright, etc.) required to maintain the facility in safe operating condition as requested by the processing organization. This organization also reports to the Reactor Support Manager.

6.1.3 The 100-N reactor plant shift managers are responsible for taking immediate action on all facility alarms received whenever the facility is unoccupied by authorized personnel. They will dispatch qualified personnel to take corrective action as outlined in the operating and emergency procedures, and notify the appropriate personnel in the fuel processing organization of any serious conditions.

6.1.4 The Quality Assurance and Control organization is responsible for defining the plant quality assurance program, for auditing and measuring compliance with the requirements of the program, and for auditing compliance with OSRs.

6.1.5 The Radiological Control organization will provide the radiation monitoring personnel necessary for the operation of the facility. This organization is also responsible for assuring that radiological controls are provided to maintain radiation exposure to personnel as low as reasonably achievable (ALARA).

6.1.6 The Industrial Safety organization is responsible for assuring that appropriate industrial safety and industrial hygiene controls are provided in accordance with applicable requirements.

6.2 Training

6.2.1 All persons working at the facilities shall be trained to the extent necessary to assure safe execution of their duties in the following areas:

Radiological Health and Safety
Industrial Safety
Emergency Procedures

6.2.2 All persons involved in the control, handling, storage, processing or transferring of fissile materials in quantities that could support a chain reaction shall be trained in the area of nuclear criticality safety. Retraining shall be done annually and qualification verified every two years by discussion with the trainee and sign off of the training record by the trainer.

6.3 Procedures

6.3.1 An operating procedures program shall be maintained and shall include written procedures, applicable checkoff lists, and

specific review and approval authorities. The program shall be designed to ensure operation within the Operations Safety Requirements.

6.3.2 An emergency procedures program shall be maintained and shall include written procedures to provide preplanning for, and guidance during, potential emergency conditions.

6.4 Action to be Taken in the Event of an Unusual Occurrence

The unusual occurrence (UO) criteria and procedures for notification, investigation, and reporting of occurrences are found in section 5.14, "Investigation and Reporting of Health, Safety or Programmatic Events and Unusual Occurrences", of the Management Requirements and Procedures (WHC-CM-1-3).

6.5 Radiological Control

A radiation protection program shall be maintained to assure that radiation exposures to individuals in controlled areas and to population groups comply with the radiation protection standards specifed in DOE Orders 5480.11 (1-1-89) and RL 5480.11A (9-17-86) and in WHC-CM-4-10, "Radiological Protection." The program shall include written requirements and procedures for control of radiation exposure to occupationally exposed individuals and to the public, for internal and external dosimetry for occupationally exposed individuals, for control of radioactive material and contamination, for conduct of work with radioactive material and for personnel respiratory protection to keep internal deposition of radioactive material as low as economically and technically practicable.

6.6 Industrial Security System

The industrial security system for the KE and KW Fuel Storage Facilities is implemented to meet DOE Orders 5632.1A (2-9-88), "Protection Program Operations", and 5632.2A (2-9-88), "Physical Protection of Special Nuclear Material and Vital Equipment" and applicable DOE-RL directives. The physical protection and related security systems of the KE and KW Facilities shall be consistent with baseline protection requirements for appropriate Nuclear Material Safeguards Categories (I,II,III and IV).

Any attempts, suspected attempts, actual revmoals of SNM or sabotage of the Facilities shall be reported in accordance with DOE Order 5631.5 (2-12-88), "Violations of Laws, Losses, and Incidents of Security Concerns", immediately after the initial assessment is made.

6.7 Records Retention

Records relative to the operation, maintenance or modification of the facilities shall be maintained as specified in DOE Order 1324.2A.

6.8 Facility Staff Qualifications

The management to whom the following personnel report are located at N Reactor and their qualifications are stated in WHC-CM-5-26, "N Reactor Technical Specifications." Only personnel located in K area will be specified below.

6.8.1 K Area Lead Supervisor

The K Area lead supervisor shall have a high school diploma or equivalent, and three years of responsible nuclear plant or fuel handling experience of which two years may be fulfilled by academic or related technical training.

6.8.2 K Basin Supervisors

The K Basin Supervisors shall have a high school diploma or equivalent, and two years of responsible nuclear plant or fuel handling experience of which one year may be fulfilled by academic or related technical training.

6.8.3 Nuclear Reactor Operators

Operators shall have a high school diploma or equivalent and a working knowledge of equipment and procedures.

6.9 Safety Review

The Nuclear and Environmental Safety Review system is designed to meet or exceed DOE Order 5480.1, Chapter VI (8-13-81).

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