Harry Diamond Laboratories

Diamond Ordnance Radiation Facility

Fuel Handling Procedures for Transfer of Irradiated Fuel Elements to Shipping Casks

1. Introduction

The decommissioning of the Diamond Ordnance Radiation Facility (DORF) reactor will require the shipment of 92 TRIGA type fuel elements from the facility. These procedures are for the 89 irradiated (partically spent) fuel elements which are to be shipped in a licensed shipping cask to the University of Pennsylvannia, the University of Utah and to the Hanford Engineering Development Laboratory. An intra-agency agreement has been prepared by DOE, Savannah River Operations Office to provide services and responsibility for supplying approved irradiated nuclear material shipping casks and providing for their transport. A modified MH-1A Fuel Shipping Cask will be used with basket inserts to accommodate 48 TRIGA elements per shipment. Two shipments will be required. The basket design provides spaces for the long length requirements of the fuel follower control rods and the thermocouple instrumented elements.

a. Equipment

The fuel elements will be shipped in an approved shipping cask (S cask) and will arrive at DORF on a trailer. A transfer cask (T cask) will be used to transport the fuel from the reactor pool to the S cask.

The DORF 7 element transfer cask will be used. (The DORF transfer cask was designed for transferring fuel from the reactor pool to the fuel storage pits located on the main reactor floor.) The DORF fuel handling tool will be used to move the fuel between the pool storage racks to the T cask and then from the T cask to the S cask The building 3 1/2 ton capacity mono-rail hoist will be used to move the T cask from the pool to the S cask which will be on the trailer in the basement level directly below the main floor hatch. If there is insufficient vertical door clearance for the cask and trailer, the cask will be transferred to a low-boy trailer using a mobile crane. The procedure for handling the cask is contained in the Operations Manual for Spent Fuel Shipping Casks, Serial No. MH-1A, Bureau of Explosives Permit No. 2087. Minor changes to these procedures have been made for DORF loading application.

b. Radiation Monitoring

Radiation levels will be monitored and recorded at key stages of the operation. The DORF staff will be responsible for securing the facility area during fuel transfer. The entrance gate will be closed and monitored during fuel transfer operations and unauthorized persons will be excluded. All personnel involved with the fuel transfer will be issued film badges and pocket dosimeters. Conventional survey equipment will be used and a sufficient number of monitors will be used to provide a redundancy of measurements. The WRAMC Health Physicist will supervise personnel radiation safeguards.

c. Rehearsal

All phases of the transfer operation will be rehearsed before the actual transfer to provide personnel complete familiarity with equipment and procedures. A dummy fuel element is available for practice runs.

II. Shipment of Fuel Elements

a. General

The area involved in the fuel transfer operations is shown in Figures 1,2 & 3. Restricted access will be the area inside the facility fence which includes all buildings within the compound. The Physicist-in-Charge (PIC), or his designee, will have total authority and responsibility during the transfer of the fuel elements from the reactor pool to the shipping cask. Specific tasks and assignments will be given by the PIC. These assignments may be changed for subsequent transfers if necessary.

The vehicle transporting the empty S cask will be positioned inside the truck access door so that the cask is directly below the overhead hatch and mono-rail or outside the building on the truck ramp (Fig. 4).

b. Initial Preparation

The top of the empty S cask will be removed by the mono-rail hoist or a mobile crane. The inside of the cask will be checked to insure that the fuel storage liner is in place. The spacer, if present, which prevents fuel movement during shipment will be removed. The cask may be filled with water if radiation levels warrant (determined by the Health Physicist, Note: the dose-rate at 10 ft. from a single fuel element in air after a 3 month cool-down was 20 mr/hr). A trial placement of the

empty T cask adjacent to the S cask and the transfer of a dummy fuel element from the T cask to the S cask fuel storage ring may be done at this time. After trial practice operations are satisfactory the T cask will be transferred to the reactor pool floor by the mono-rail hoist for the first loading. Using the standard TRIGA fuel element handling tool (Figure 5), the fuel elements will be transferred from the pool storage racks to the cask. The T cask will then be moved by the mono-rail hoist to a position above the open floor hatch and then lowered adjacent to the S cask on the trailer located in the basement area. The elements will be transferred from the T cask to the S cask using the fuel element handling tool from the main floor hatch area. The procedure will be repeated until assigned number of elements are transferred to the S cask for the scheduled shipment.

c. Closing the Cask

The crane will replace the top shield plug of the S cask and plug will be bolted in place as described in cask operational manual.

Radiation Monitoring

All personnel involved in the fuel transfer will wear film badges and pocket dosimeters as prescribed by the WRAMC Health Physicist. Portable survey meters will be used to measure the dose rates. The gamma area monitoring system (NMC scintillation detectors) will also be used. The NMC system has a chart recorder which prints out the dose rate readings. There are six of these detectors located in the reactor building.

The radiation levels at each significant state will be:

(1) T cask with fuel in air (1 ft and 10 ft)

(2) Level outside the S cask (3 ft)

The anticipated radiation dose rates to personnel involved in the fuel transfer have been determined from experiments performed with one of the "B" ring elements. The dose rates in air after a 16 month decay period were as follows:

(1) "B" ring element 10 ft from side = 6 mr/hr

(2) "B" ring element 1 ft from side = 135 mr/hr

(3) "B" ring element 10 ft above (along axis) = 3 mr/hr

The dose rate with 7 elements in the T cask were measured to be:

(1) T cask, 10 ft from side = 0.7 mr/hr

(2) T cask, 1 ft from side = 7.0 mr/hr

(3) T cask, 1 ft above = 28.0 mr/hr
= 3.0 mr/hr with cover plate

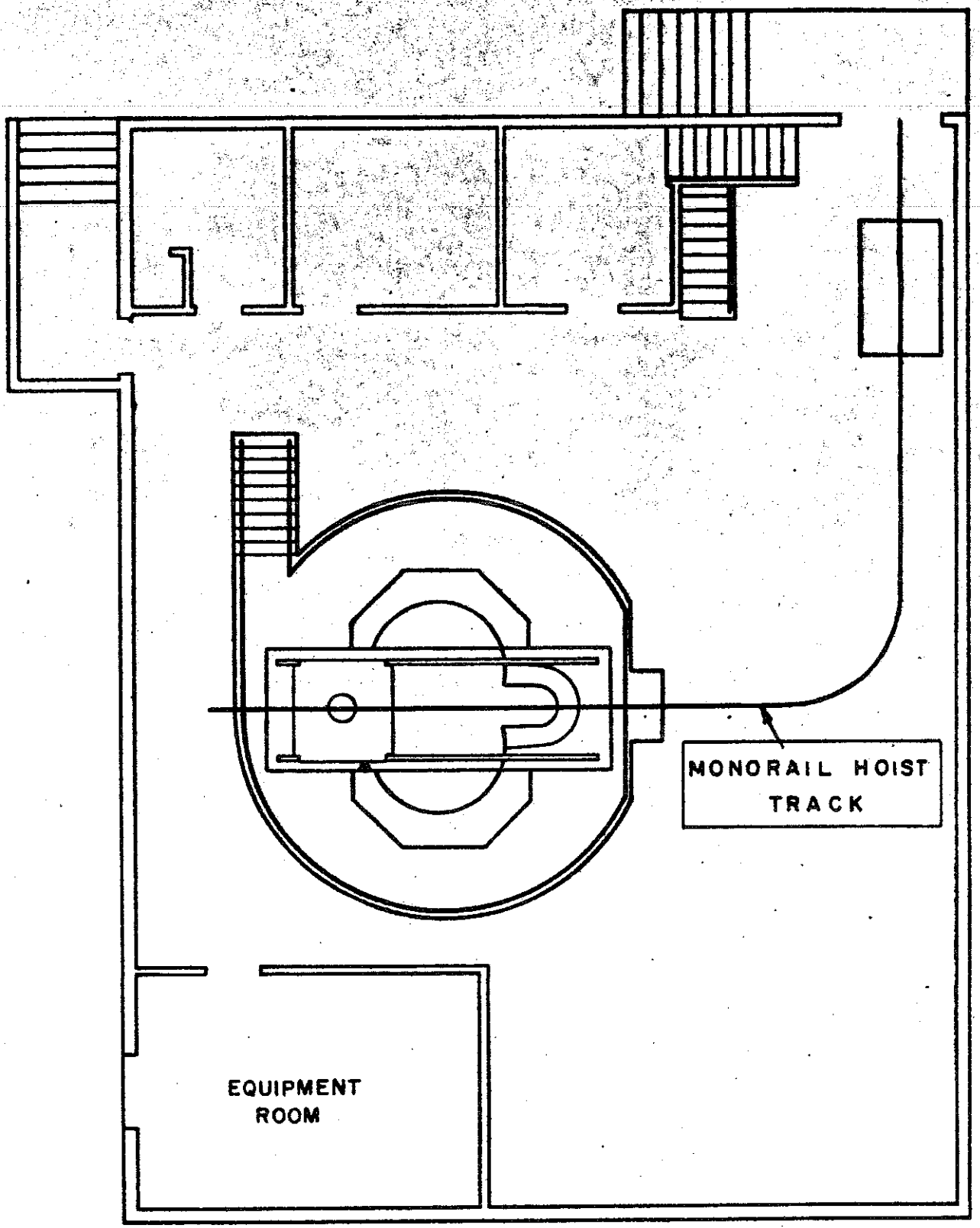
(4) T cask, 10 ft above cask: = 3.0 mr/hr

These distances are the minimum that personnel will be required to be at anytime. The elements are to be transferred from a position about 10 ft above the casks.

As the S cask is filled, the significant dose rate measurement is at the fuel handler position. The distance the fuel handler will be is about 10 feet above the cask, therefore, as the S cask is filled with fuel elements the dose rate at this position will increase. When the S cask is loaded with 46 fuel elements, the dose rate after the last fuel element transfer will be 6.6 times the dose rate above the T cask (7 elements) dose rate measurement. If we assume that 7 elements are transferred from the T cask to the S cask in each step, the dose rate 10 ft above the S cask would be as follows:

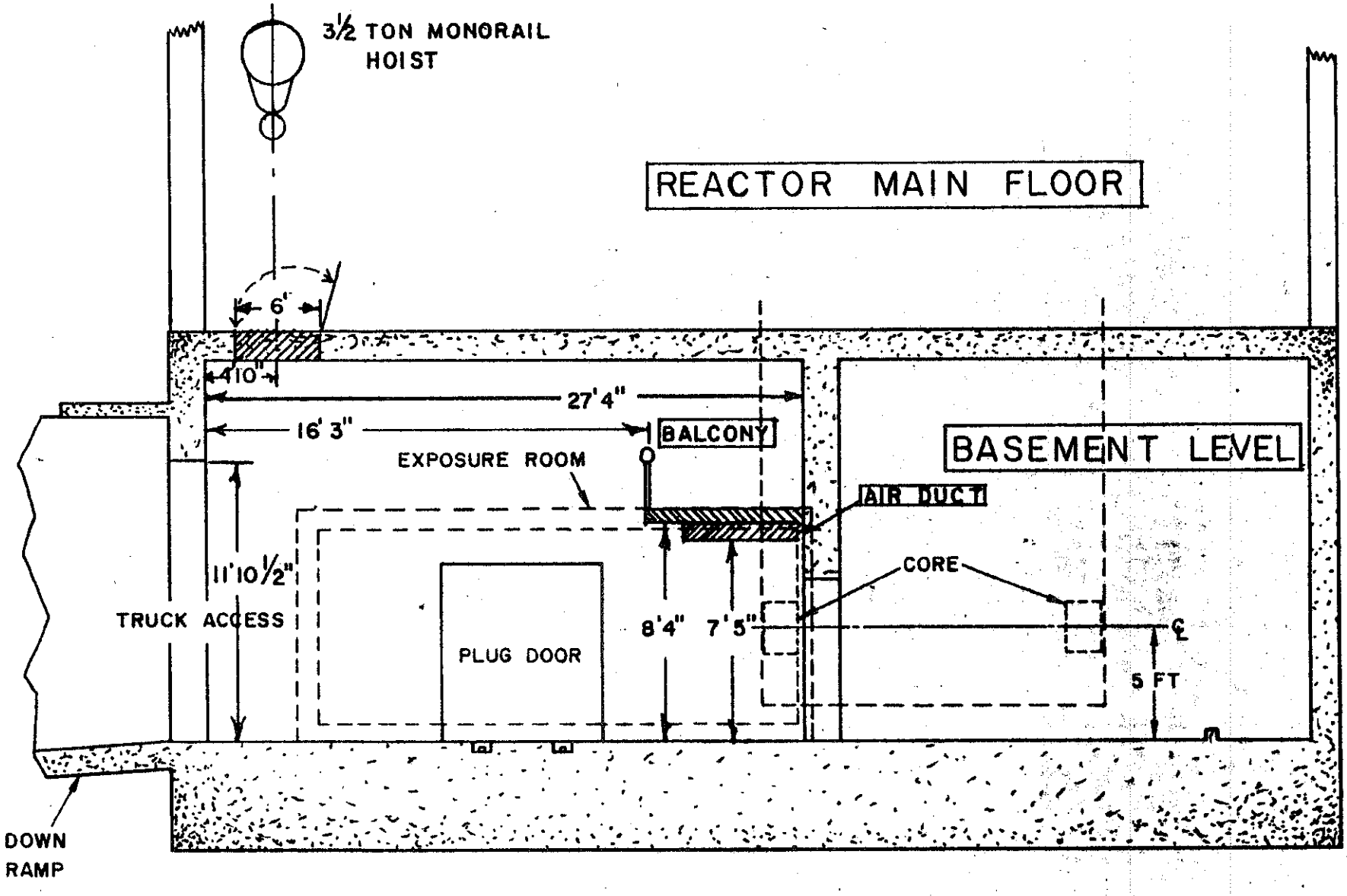
Step No.	No. of Elements	Dose Rate (mr/hr) 10 ft above S cask	Exposure (mr)
1	7	3	0.5
2	14	6	1.0
3	21	9	1.5
4	28	12	2.0
5	35	15	2.5
6	42	18	3.0
7	46	20	3.3
		total	13.8

From previous experience moving fuel with the DORF fuel element handling tool, it is estimated that it will take less than 10 minutes to transfer 7 elements in each step. Therefore, if one person performed all of the transfers from the T cask to the S cask the accumulated exposure would be only about 14 mr. We plan, however, to divide the fuel handling tasks among several persons to reduce the radiation exposures.



PLAN VIEW MAIN FLOOR

Fig. 1



VERTICAL SECTION

Fig. 2

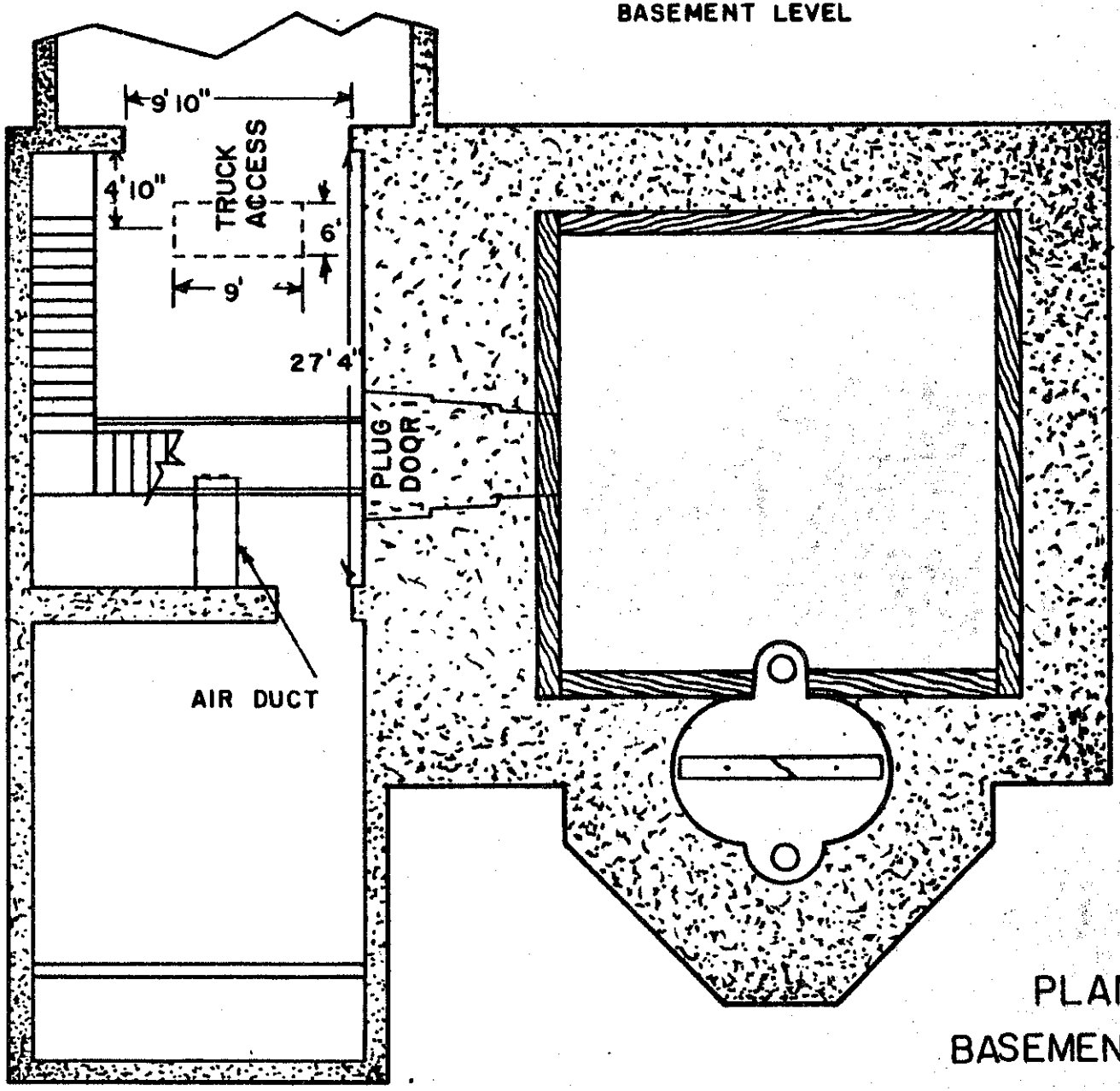

BASEMENT LEVEL
9' 10"
4' 10"
TRUCK ACCESS
6'
9'
27' 4"
PLUG DOOR
AIR DUCT
PLAN VIEW
BASEMENT LEVEL

Fig. 3

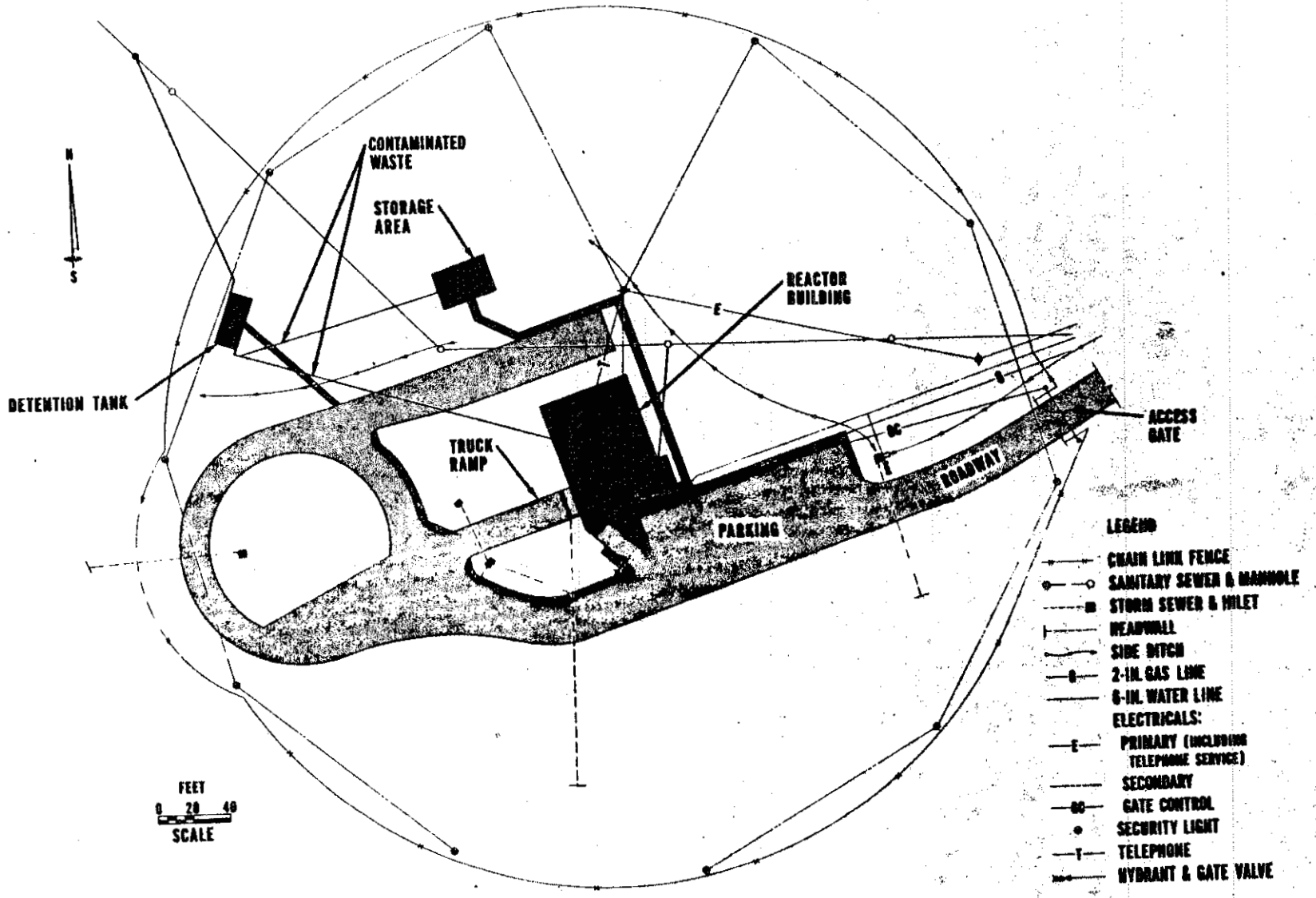
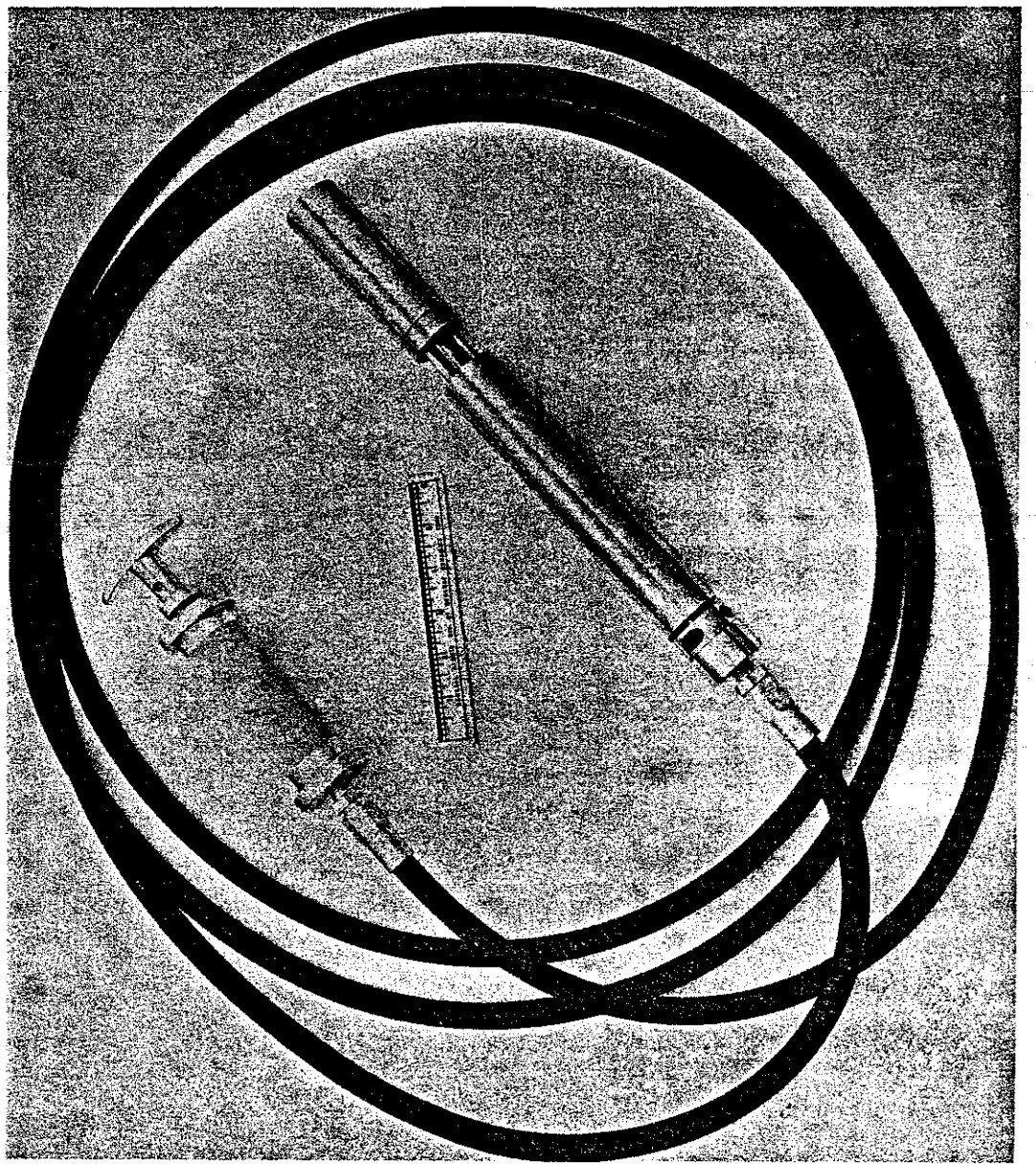


Fig. 4--The DORF site



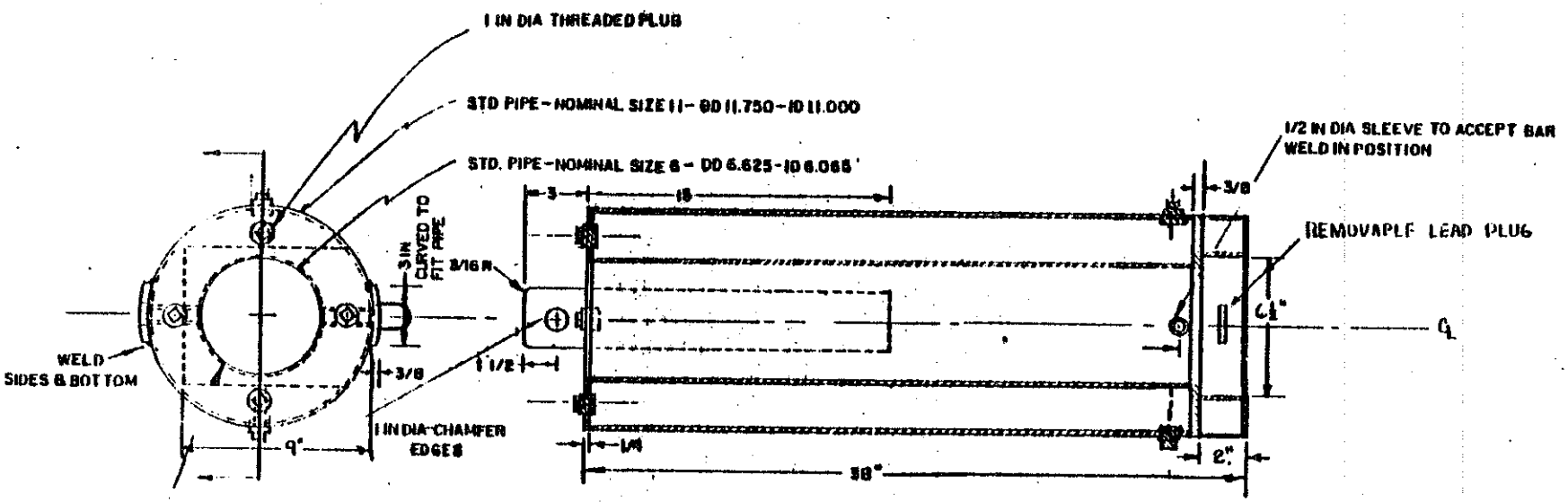
MIS 17

Fig. 5 Fuel Handling Tool

AMC FORM 1031-3

C

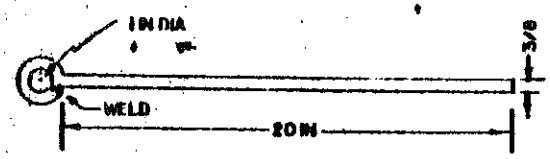
REVISIONS			
ZONE	DESCRIPTION	DATE	APPROVED



NOTE – WELD TOP PLATE OF 1/4 IN STEEL TO BOTH PIPES, HOLDING DIA. OF CENTER HOLE AS CLOSE TO ID OF INNER PIPE AS POSSIBLE. REPEAT SAME FOR BOTTOM PLATE

CAREFULLY CLEAN, PRIME AND PAINT WITH A HIGH GRADE TITANIUM DIOXIDE PIGMENT WHITE PAINT AFTER ASSEMBLY

MATL – MILD STEEL FOR TOP & BOTTOM PLATES & LIFTING SUPPORTS
PIPE – STEEL



STEEL BAR

APPROX WT 880 LBS
LOADED WITH LEAD

SEE ENGINEERING RECORDS	PHYSICAL PROPERTIES	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: FRACTIONS DECIMALS ANGLES	PART NO.
APPLICATION		MATERIAL	CODE IDENT. NO.
DO NOT APPLY PART NO AS SPECIFIED		HEAT TREATMENT	TRANSFER FUEL CASK DORF
		FINISH PROTECTIVE FINISH	U.S. ARMY MATERIEL COMMAND HARRY DIAMOND LABORATORIES WASHINGTON, D.C. 20438
			SIZE C — 11006905

OPERATING PROCEDURES FOR THE USE OF

FUEL SHIPPING CASK MH-1A

MODIFIED FOR TRIGA FUEL ELEMENTS

1. Loosen the tension on the four (4) turnbuckles and detach them from the cask.
2. Remove the eight bolts which attach the cask to the skid.
3. Lift cask from transport vehicle with crane using lifting yoke attached to cask lifting trunnions. The yoke is supplied with the cask.
4. Place cask on low-boy trailer, disconnect crane from cask yoke or yoke from the cask, and move trailer to basement truck entrance area so that the cask is directly below main floor hatch.
5. Remove covers from lifting holes on cask cover and attach cable sling to remove cover. Use 3 1/2 ton capacity mono-rail hoist.
6. Check "O" ring placement and "O" ring sealing surface on cover for scratches, nicks, gouges, etc. If any defects are discovered, they should be repaired and cask checked for leakage.
7. Check that the four 12 element TRIGA fuel baskets are in place. (NOTE: the baskets may be installed at DORF)
8. Place the DORF seven element transfer cask (T cask) on the reactor pool floor using the 3 1/2 ton mono-rail hoist.
9. Move standard fuel elements from the pool storage racks into transfer cask using TRIGA fuel handling tool until seven elements are loaded. Check each fuel element identification number, transfer cask position and record in log book.
10. Move the transfer cask from the pool, using the mono-rail hoist, to a position adjacent to the shipping cask located at the basement truck entrance area.

11. Move the elements, one at a time, from the transfer cask to a standard fuel element position in the MH-1A cask basket. (NOTE: the standard positions are not color coded). Check the element identification number, basket position and record in log book.
12. Repeat 8 through 12 until all standard fuel elements are loaded for the specific shipment. (One shipment of 44 standard elements to Utah, and one shipment of 38 standard elements to Penn State and Handford, not including FFCR's or TCE's).
13. The following, 14 through 20, are procedures for the TCE loading.
14. Move the transfer cask into the reactor pool for the TCE loading.
15. Move TCE from the pool storage rack into the transfer cask.
16. Raise the transfer cask to the surface of the water so that the swage-lok fitting located 18 inches above the top of the element is a few inches above the water surface.
17. Disconnect the conduit by loosening the top swage-lok nut. Remove the conduit sliding the thermocouple wire through the removed conduit.
18. Fasten TCE handling fixture provided to the swage-lok fitting guiding the thermocouple wire through the slot in the fixture.
19. Tighten swage-lok nut and coil TC wire into about a 6 inch diameter circle.
20. Repeat, 8 through 12, except that the TCE are placed in a TCE basket position identified by the color RED.
21. The following, 22 through 27, are for FFCR loading.
22. Move transfer cask into the reactor pool and load one FFCR.

23. Raise cask to the pool surface so that the top fitting of the FFCR is a few inches above the surface of the water.
24. Remove the shear-pin from the threaded section of the FFCR top fixture and connecting rod using a pin-punch and ballpeen hammer.
25. Unscrew connecting rod from FFCR threaded stud.
26. Thread fuel handling fixture provided on the FFCR threaded stud.
27. Repeat 10 and 11 except place the FFCR in one of the FFCR basket positions colored YELLOW.
28. Lift cask cover with mono-rail hoist using cable sling. Before moving cover over cask, rotate the crane hook until the cover is correctly oriented with respect to the two cover guide pins attached to the top of the cask. Place cover in position on the loaded cask and disengage sling.
29. Replace nuts on cask cover and tighten nuts to 40 ft-lbs torque.
30. Perform leak test described in SAR.
31. Attach lifting yoke to cask lifting trunnions.
32. Move low-boy trailer and cask to transport trailer. Tighten 8 base nuts to 50 ft-lbs torque. Tighten turnbuckles to 100 ft-lbs and turnbuckle lock-nuts to 75 ft-lbs torque.
34. Cask is ready for shipment. Provision for anchoring the cask to the vehicle floor has been provided by holes in the skid beams and by cable anchor pins between the fins at the top corners of the cask.