Nuclear

GPU Nuclear Corporation
Post Office Box 480
Route 441 South
Middletown, Pennsylvania 17057-0191
717 944-7621
TELEX 84-2386
Writer's Direct Dial Number:

(717) 948-8461

4410-87-L-0037
Document ID 0135P

April 2, 1987

US Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Dear Sirs:

Three Mile Island Nuclear Station, Unit 2 (TMI-2)
Operating License No. DPR-73
Docket No. 50-320
Canister Handling and Preparation for Shipment
Safety Evaluation Report, Revision 4

Attached for your review and approval is Revision 4 to the Safety Evaluation Report (SER) for Canister Handling and Preparation for Shipment (CHAPS). The following sections have been revised:

- o Section 2.3.2, "Verification of Catalyst Function"
- o Section 2.3.3, "Canister Dewatering"
- o Section 11.0, "References"

NRC Letter NRC/TMI-87-003 granted approval to reduce the dewatering criteria to 25 percent of the canister void volume for fuel canisters and to the level required to ensure exposure of at least 25 grams of recombiner catalyst in the filter and knockout canisters. This approval was based on various tests of the recombiner catalyst which demonstrated a minimum factor of safety of six (6) for 100 grams of approved catalyst which corresponds to safety factor of 1.5 for 25 grams of exposed catalyst. The attached revision similarly proposes a method for achieving a minimum catalyst safety factor of 1.5. However the proposed method differs in that it allows fluctuation in the following variables: catalyst safety factor equating to 100 grams of catalyst, minimum quantity of exposed catalyst, and decay heat load of the canister based on the canister payload weight.

A001
1/1

Rec'd w/check $150.00
3928

The proposed GPU Nuclear revision has been judged to be consistent, from a safety and technological standpoint, with the basis for the current NRC-approved canister dewatering criteria (i.e., void volume) in that it assures a minimum catalyst safety factor of 1.5 will be maintained.

Per the requirements of 10 CFR 170, an application fee of $150.00 is enclosed.

Sincerely,

Thomas Jr. Demmitt

for F. R. Standerfer
Director, TMI-2

FRS/RDW/eml

Attachment

Enclosed: GPU Nuclear Corp. Check No. 003928

cc: Regional Administrator - Region 1, Dr. T. E. Murley
Director - TMI-2 Cleanup Project Directorate, Dr. W. D. Travers

GPU Nuclear

SAFETY ANALYSIS

SA # 4350-3256-85-1

Rev. # 4

Page 1 of 39

TITLE

SAFETY EVALUATION REPORT

FOR

CANISTER HANDLING AND PREPARATION

FOR SHIPMENT

Originator Richard E Sheppard Date 3/17/87

CONCURRENCE

Lead Engineer/RTR Thomas VV Date 3-19-87 SRG R. Brownewell Date 3/26/87

Cognizant Eng. Thomas VV Date 3-19-87 Rad Con DW Turner Date 3-26-87

APPROVAL

Mgr. Eng. Section [illegible] Date 3/26/87 Site Ops Director [illegible] Date 3/27/87

FORM 4000-ENG-7310.09-1 (9/86)

Rev.	SUMMARY OF CHANGE	Approval	Date
0	Issued for use.		12/85
1	Revised to incorporate site comments: added reference to SAR for transportation of core debris, revised canister monitoring and integrity verification section, noted the FHB crane modifications, and revised section on seismic design.		1/86
2	Revised commitment pertaining to closing of FHB missile shield door, corrected lowering speeds for canister from transfer cask.		2/86
3	Revised to incorporate more detail on canister and shield plug lifting systems, provide more detail on canister dewatering, increase discussion on heavy load drops, add detail on railcar jacking system, and add discussion on truck bay fire hazards.		5/86
4	Revised to reflect the pressure in a "worst-case" canister "ready for shipment" following a one-year buildup of radiolytic gases and to revise the canister dewatering criterion for determining the dewatered canister void volumes.		4/87

TABLE OF CONTENTS

	PAGE
1.0 INTRODUCTION	4
1.1 Purpose	4
1.2 Background	4
1.3 Scope	4
2.0 MAJOR ACTIVITIES	5
2.1 Plant Conditions	5
2.2 Preparation of Shipping Cask	5
2.3 Preparation of Canisters	6
2.4 Transfer of Canisters	13
3.0 DESCRIPTION OF EQUIPMENT	14
3.1 Fuel Transfer Cask Loading Station	14
3.2 Fuel Transfer Cask	14
3.3 NuPac Shipping Cask	16
3.4 Cask Unloading Station	17
3.5 Cask Hydraulic Lifting Assembly	18
3.6 Cask Support	19
3.7 Railcar Jack	19
4.0 NUREG-0612 COMPLIANCE	19
4.1 General	19
4.2 Evaluation Against NUREG 0612, Section 5.1.1	20
4.3 Evaluation Against NUREG 0612, Section 5.1.5	23
5.0 RADIOLOGICAL ASSESSMENTS	25
5.1 In-Plant Exposures	25
5.2 Releases to the Environment	29
6.0 SAFETY ASSESSMENT	30
6.1 Heavy Load Handling	30
6.2 Criticality	31
6.3 Seismic Event	31
6.4 Fire Hazards Analysis	32
7.0 IMPACT ON UNIT 1	33
8.0 UNREVIEWED SAFETY QUESTION EVALUATION (10 CFR 50.59)	35
9.0 ENVIRONMENTAL ASSESSMENT	37
10.0 CONCLUSION	38
11.0 REFERENCES	38

1.0 INTRODUCTION

1.1 Purpose

The purpose of this Safety Evaluation Report (SER) is to demonstrate that all planned activities associated with the transfer of defueling canisters from fuel pool 'A' to the shipping cask for shipment off site and the on-site activities associated with the shipping cask can be accomplished without causing unacceptable risk to the health and safety of the public.

1.2 Background

A major activity associated with canister handling and preparation for shipment off site is heavy load handling in the fuel handling building (FHB). Reference 1 provides NRC approval of the TMI-2 heavy load handling program up to defueling, including load handling activities in the FHB, and also provides a list of associated correspondence between the NRC and TMI-2. This SER expands the evaluations for heavy load handling presented in previous submittals to the NRC to include load handling during canister transfer and preparation for shipment.

Fuel canister loading, transfer into the FHB, dewatering and placement in the fuel canister storage racks are addressed in the defueling SER (Reference 2). The defueling SER and the SER for Heavy Load Handling Inside Containment (Reference 3) address heavy load handling activities including canister handling through to placement in the fuel pool 'A' storage racks.

The main hoist of the FHB crane is one of the cranes to be used for TMI-2 load handling activities. It is the same crane used in the TMI-1 portion of the FHB and described in the TMI-1 lifting and handling program. In Reference 4 the NRC provided their concurrence with the manner in which the FHB crane complied with the guidelines of NUREG-0612, Section 5.1.1.

1.3 Scope

This SER addresses major activities associated with preparation for shipment off site of all defueling canisters containing fuel debris. The actual sequence of the activities described herein may vary somewhat depending upon the final designs of the canister handling and preparation for shipment equipment. These activities include removal of the canister from the fuel canister storage racks in fuel pool 'A' and transfer to the dewatering station; final dewatering, weighing and preparation for shipment; transfer to the fuel transfer cask (FTC) loading station; loading each canister into the FTC; transfer to the FHB truck bay; lowering the FTC onto the shipping cask; lowering the canister into the shipping cask; and verifying conformance with the shipping cask certificate of compliance.

This SER also addresses the on-site preparation of the fuel shipping cask including unloading the shipping cask from the railcar; raising the shipping cask and restraining the shipping cask in the upright position; preparation of the shipping cask for mating with the transfer cask;

closure of the shipping cask; lowering the shipping cask to the horizontal position; loading onto the railcar; and removal to the site boundary.

The safety issues associated with the shipment of defueling canisters once off-site are addressed in the shipping cask safety analysis report, Reference 5, and the Safety Analysis Report for Transportation of TMI-2 Core Debris to INEL, Reference 16.

2.0 MAJOR ACTIVITIES

2.1 Plant Conditions

The activities included in the SER are performed inside the FHB with the Unit 1/Unit 2 environmental barrier in place with the exception of the removal of the cask protective coverings. The transfer tubes between fuel pool 'A' and the fuel transfer canal may be open during canister transfer. The FHB truck bay roll up door may be partially open occasionally during cask loading. The FHB ventilation system however, maintains air flow through the door opening from outdoors to indoors to minimize exfiltration. The operation of the aircraft missile shield will be controlled by Unit 1. Opening of the aircraft missile shield will be determined by operational considerations between Unit 1 and Unit 2 such as fuel shipments. This is consistent with the original licensing basis for Unit 1 and Unit 2.

The north bridge and the on-site railroad tracks have been inspected and certified by an outside consultant to be safe and acceptable for their intended use during the fuel shipping program.

The jib crane and the jib crane support structure are installed in the truck bay during the fuel shipping program. The support structure bridges the truck bay and door opening to allow free access to the truck bay for rail cars and trucks. The 15 ton jib crane may be used for both fuel shipping related activities and unrelated load handling activities. A 7.5 ton rating for the jib crane will be assumed for all fuel shipping related activities.

Base plates which support the floor support brackets for the skid and the cask unloading station (CUS) legs are installed below grade in the 301'-6" floor and have removable covers which are designed to support truck wheel loading.

All modifications to the truck bay area are reviewed and approved by the TMI Unit 1 organization.

2.2 Preparation of Shipping Cask

The following is the planned sequence of events which will precede the loading of the shipping cask. The sequence will be reversed following cask loading in preparation for off-site shipment of the casks and will include verification of conformance with the shipping cask certificate of compliance.

The NuPac 125-B Shipping Cask, mounted on a skid which is mounted on an eight axle flat bed railcar, is brought onto the site on the existing rail lines to a point outside the security fence protective area. The cask protective coverings (tarp, sunshield and overpacks) are removed at this point. The overpacks weigh approximately 11,700 pounds each and the sunshield weighs approximately 500 pounds.

The floor support brackets for the skid and the CUS are installed. With the rail moat bridge installed, the railcar with the skid/cask assembly is rolled into the truck bay and aligned with the CUS. To accomplish north-south alignment of the skid lift lugs to the CUS clevises the railcar may be jacked from one side to tilt the lift lugs into alignment. The jacking will cause tilting by compressing and relieving railcar springs and will not lift the railcar wheels off the tracks. The railcar may extend into the exclusion zone, but no part of the skid/cask assembly will extend over the exclusion zone. The skid/cask assembly is disconnected from the railcar and connected to the CUS which lifts the assembly from the railcar. The railcar is removed from the building and the assembly lowered onto the skid floor support brackets. When the skid/cask assembly is in place the CUS is removed and staged on the 305'-1" elevation of the truck bay. A saddle is attached to the cask trunnions. The cask hydraulic lifting assembly is attached to the skid and saddle and uprights the cask. A limit switch trips the hydraulic lift assembly when the cask is level. Ratchet binders and screw jacks are used to connect the saddle to the jib crane support platform. The hydraulic lifting assembly is then de-energized. The hydraulic lifting assembly may remain in place until the cask is lowered to the horizontal position.

The 5,200 pound secondary containment vessel lid and the 3,000 pound primary containment vessel lid will be removed and stored in their respective truck bay storage stands using the FHB crane auxiliary hoist. The shipping cask loading collar (SCLC) which weighs approximately 36,000 pounds will be lifted from its storage stand and placed on top of the shipping cask by the FHB 110 ton crane. The system will then be ready to begin the sequence of operations to load defueling canisters.

2.3 Preparation of Canisters

2.3.1 Verification of Canister Integrity

Canister integrity is initially verified by weighing the canister before and after storage in fuel pool 'A' to detect water inleakage. Each canister is weighed by the FHB canister handling bridge (CHB) after initial canister dewatering. After remaining in the racks for a minimum of two weeks, the canister is again weighed by the CHB. If the weight has increased (more than instrument repeatability) the canister is dewatered again and repaired, if necessary. If the weight is acceptable, the cover gas pressure is checked to further ensure that the cover gas pressure remains at approximately two atmospheres.

Prior to shipping, canister integrity is verified by two methods. Following the dewatering and filling with cover gas at the dewatering station, the canister relief valves are removed and the canister is capped and observed for bubbles for a minimum of 5 minutes. The acceptance criteria is "No Visible Bubbles." Also, when the dewatered canister is moved to the FHB racks prior to shipping, the weight is recorded. This weight is compared to the weight when the canister is moved to the loading station just prior to shipment. These weights must agree within instrument repeatability.

Any canisters whose integrity cannot be verified will be treated as 'damaged' canisters. Procedures to repair these damaged canisters will be developed and implemented on a case by case basis.

2.3.2 Verification of Catalyst Function

Prior to shipment each canister will be monitored for gas control. Canisters may be sampled for the presence of hydrogen and oxygen to determine gas appearance rates. If it is decided to sample a canister, the sampling will take place after the dewatering and following an adequate holding period. The dewatering will occur either in the vessel or at the dewatering station. Following the dewatering, the canister is brought to the FHB racks where they will remain until they are sampled. The period of time that they are allowed to sit will be determined by sampling each type of canister several times. This will determine optimum holding times and general gas appearance rates. The holding time is estimated to be between 2 and 4 weeks.

Following the holding period, the canister may be returned to the dewatering station where the sampling is performed or it may be sampled at its rack location. An evacuated 150 cc to 300 cc sample vessel is connected to a long-handled 1/4" Hansen connection tool. The sample vessel is then connected, via the long handled tool, to the 1/4" purge inlet connection on the canister, the sample is obtained by opening a remote valve connected to the vessel, and the vessel is then retrieved. The volume of the sample will ensure that the Hansen connection on the canister is purged as well as obtaining a part of the top volume of the canister. This will be a conservative sample since, if there is stratification of the gases, released hydrogen will tend to migrate to the top of the canister.

After the sample is taken, the canister may be dewatered again. The argon cover gas pressure is checked and brought to approximately 2 atmospheres, any remaining relief valves are removed, and the canister purge and drain lines are capped. The canister is then taken back to the racks, after performing the bubble test for canister integrity and weighing the dewatered canister as described in Section 2.3.1.

The contents of the sample vessel will be analyzed for the concentration of hydrogen, oxygen, and nitrogen. The nitrogen concentration is obtained to determine air in-leakage into the sample vessel. The oxygen associated with the air is discounted from the gas generation rate. The gas appearance rate is determined by taking the hydrogen and oxygen concentrations and dividing by the time elapsed between initial dewatering and obtaining the sample. This rate will be used in determining the allowable storage time at TMI for canisters which have had their relief valves removed (with the relief valves in place, the canisters may be stored in fuel pool 'A' indefinitely). The allowable storage time is the period of time from the canister final dewatering or purging (at which point the relief valves will be removed) to the departure of the shipping cask. This time will be determined by the following:

$$A = \frac{C}{2R} - P$$

A = Allowable storage time (days)
C = Maximum allowable concentration of H_2 or O_2 (percent)
R = Gas appearance rate (percent/day)
P = Shipping period (days)

For the maximum allowable gas concentration of 5 percent and the estimated shipping period of 21 days the formula becomes:

$$A = \frac{5}{2R} - 21$$

Therefore, the allowable storage time represents that time period which the canister can remain stored at TMI while still ensuring that the canister can be shipped without violating the allowable gas concentrations. A calculation has been performed which shows that for a "worst case" canister "ready for shipment", the pressure in the canister following a one year buildup of radiolytic gases is 50 psig. This "worst case" canister is a dewatered canister with no allowable storage time at TMI-2 (i.e., A = 6 days, for cask loading time). This pressure of 50 psig is much less than the maximum internal canister pressures calculated in Reference 5. If the canister is stored for a period of time that approaches the allowable storage time, the canister may be purged again and stored further at TMI for the previously determined allowable storage time. If the sample taken shows that a higher than acceptable gas concentration (i.e. a lower than acceptable allowable storage time) would occur, the canister is brought back to the dewatering station and the 150 psig relief valve is replaced. The canister is then returned to the rack and allowed to sit for the appropriate waiting period. After the waiting period, the canister is sampled again and a new appearance rate is calculated based on this and the previous sample. If this rate produces an acceptable concentration the canister is considered "ready for shipment." If this rate is unacceptable, steps will be taken to resolve the problem on a case by case basis.

An alternate means of verifying gas control may be used. Following the initial dewatering, the canister pressure and temperature are checked. After the holding period, the pressure and temperature are checked again. If the pressure increase falls within the limits of the following table applying the appropriate temperature corrections, the canister is considered "ready for shipment." (This method may not be used if gas release from the canister is suspected prior to making the pressure measurement.)

Measurement Precision (error)		Observation Period 2 week	3 week	4 week
1.0°c	0.10 psid	0.21 psid	0.41 psid	0.61 psid

2.3.3 Canister Dewatering

Dewatering is performed to purge the canister of removable free standing water. Completion of dewatering is detected in the dewatering system by observing a steady stream of argon flow through the the canister. Following dewatering the dewatered canister void volume is determined by the volume of water removed which is obtained by the difference of the canister weights before and after dewatering. The acceptance criterion for canister dewatering is a dewatered canister void volume which ensures a sufficient quantity of exposed catalyst in any canister orientation.

A sufficient quantity of exposed catalyst is considered to be 50% more catalyst than required. The required quantity of catalyst is determined by laboratory testing and is dependent on the radiolytic gas generation rate within the canister. Laboratory testing involves subjecting 100 grams of catalyst with contaminations which may occur during canister fabrication and loading and chemical additions to improve DHCS filter performance and to control microbiological growth in the RCS. The contaminated catalyst is placed in a chamber which is then brought to two atmospheres of argon. Stoichiometric hydrogen and oxygen is injected into the chamber at a constant rate of 0.3 liter per hour. During the test oxygen concentrations and catalyst recombination rates are measured and recorded. The effectiveness of the 100 grams of catalyst is expressed as a safety factor. The safety factor is defined as the product of two ratios, shown below, at the time of peak oxygen concentration.

$$SF = \frac{\text{Measured Recombination Rate}}{\text{Required Minimum Recombination Rate}} \times \frac{\text{Allowable Maximum Oxygen Concentration}}{\text{Measured Oxygen Concentration}}$$

The required minimum recombination rate is equal to the expected radiolytic gas generation rate in the canister and the allowable maximum oxygen concentration is equal to five volume percent. For conservatism, the expected radiolytic gas generation rate is assumed to be the "probable-maximum" generation rate of 0.11 liter per hour (per 100 watts of decay heat) calculated in Reference 17, and referred to as the "maximum theoretical" rate in Reference 15. Since the gas generation rate is proportional to the decay head load (W) in the canister, the safety factor is inversely proportional to W. Therefore, the safety factor on 100 grams of catalyst in a canister with decay head load of W watts is (100/W) x SF. The required quantity of exposed catalyst is (100 grams)/ (100/W) x SF or W/SF grams. Hence, a sufficient quantity of exposed catalyst is 1.5 x W/SF grams.

Figures 2-1 and 2-2 graphically show the minimum quantity of exposed catalyst for any canister orientation as a function of dewatered canister void volume. Compliance to the canister dewatering acceptance criterion is achieved when the minimum quantity of exposed catalyst, for the calculated dewatered canister void volume, exceeds the sufficient quantity of catalyst defined above.

As an example, previous laboratory testing of catalyst has resulted in a safety factor of approximately 6. Assuming 100 watts of decay heat load in a canister, the sufficient quantity of exposed catalyst is (1.5) x (100)/(6) or 25 grams. From Figure 2-1, the acceptance criterion for fuel canisters with 100 watts of decay heat is a void volume greater than 21% of the canister empty volume. From Figure 2-2, the acceptance criterion for knockout or filter canisters with 100 watts of decay heat is a void volume greater than 32% of the canister empty volume. Calculations have shown that a canister payload of approximately 2150 pounds of TMI-2 core debris is equivalent to 100 watts of decay heat for the remainder of the fuel shipping program. Therefore, the sufficient quantity of catalyst may be reduced to reflect the canister decay heat load based on the actual canister payload weight.

Further laboratory testing on the catalyst will be preformed whenever new potential catalyst contaminants would be used. The results of these future tests would then be used to determine the appropriate dewatered canister void volume, to comply with the dewatering acceptance criterion, for those canisters which could be exposed to the new contaminants.

If compliance with the dewatering acceptance criterion cannot be demonstrated using the above methods, then the canister must be evaluated on a case by case basis. If the evaluation does not conservatively show that the dewatering acceptance criterion has been met, appropriate corrective action will be taken in accordance with approved site procedures. No canister will be shipped unless the dewatering acceptance criterion is met.

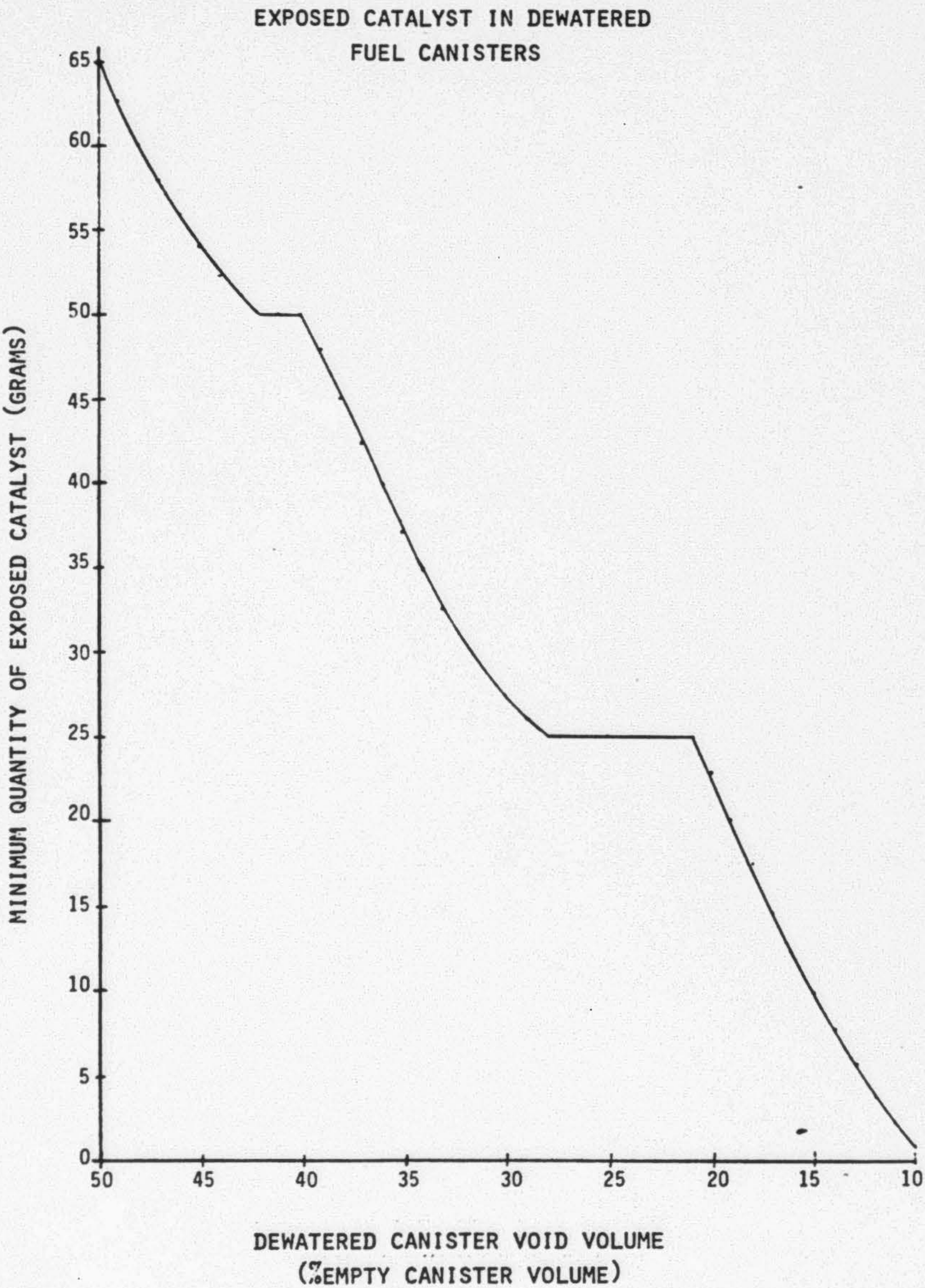
EXPOSED CATALYST IN DEWATERED
FUEL CANISTERS
MINIMUM QUANTITY OF EXPOSED CATALYST (GRAMS)
65
60
55
50
45
40
35
30
25
20
15
10
5
0
50
45
40
35
30
25
20
15
10
DEWATERED CANISTER VOID VOLUME
(%EMPTY CANISTER VOLUME)

FIGURE 2-1

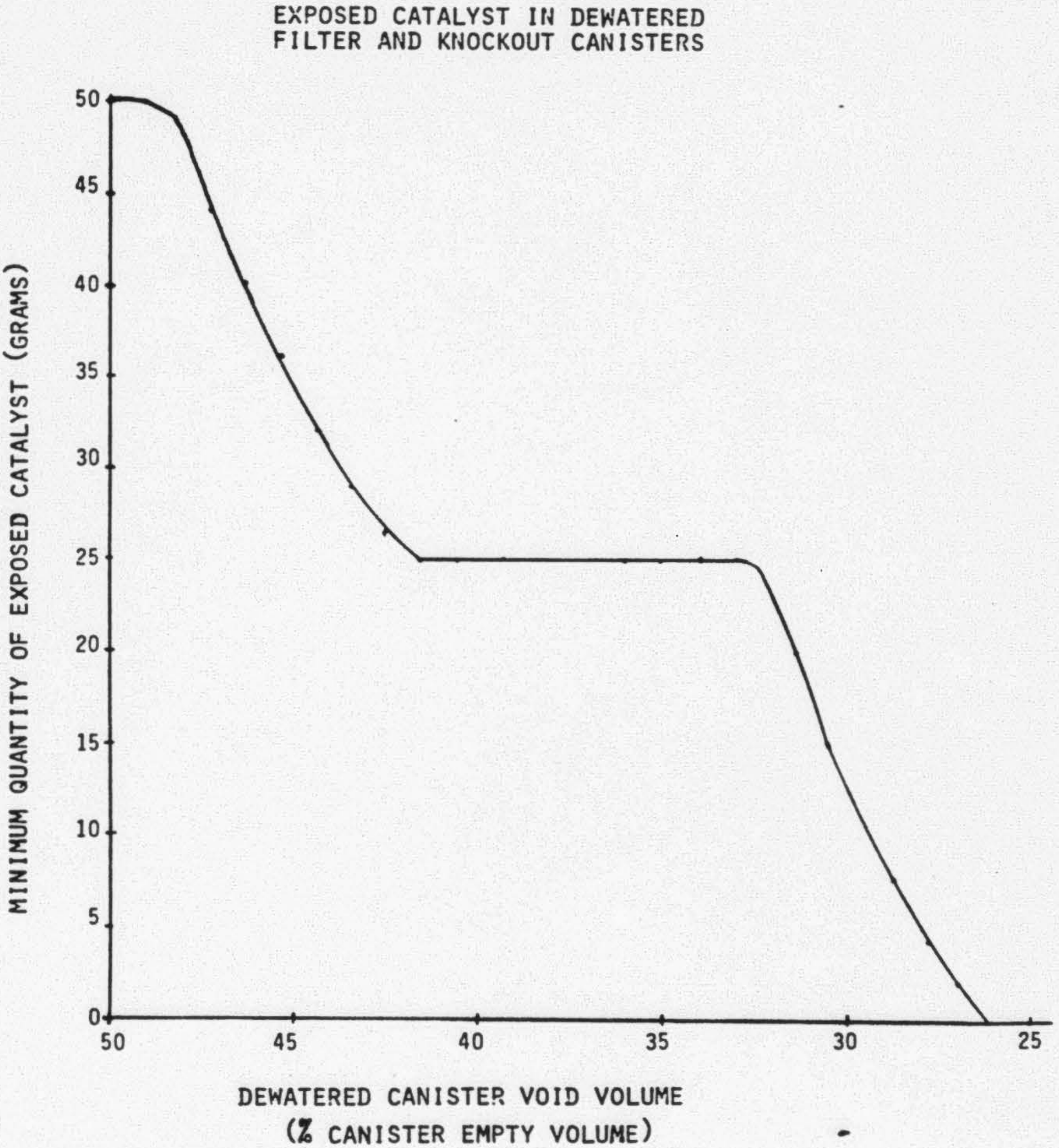
EXPOSED CATALYST IN DEWATERED
FILTER AND KNOCKOUT CANISTERS
MINIMUM QUANTITY OF EXPOSED CATALYST (GRAMS)
50
45
40
35
30
25
20
15
10
5
0
50
45
40
35
30
25
DEWATERED CANISTER VOID VOLUME
(% CANISTER EMPTY VOLUME)

FIGURE 2-2

2.4 Transfer of Canisters

Following final checks and preparations, the canister is moved to the FTC loading station by the FHB CHB. A single canister is placed in the support rack in the loading station. The FTC is rigged to the FHB 110 ton crane and the mini hot cell (MHC) is used to remove the first shield plug from the shipping cask. The MHC is moved by the work platform jib crane from its work platform storage location and placed on the SCLC following alignment of the SCLC to the proper shipping cask cavity. When the MHC is in place, an interlock allows opening of the SCLC foot valve (sliding door). The SCLC foot valve is opened and the MHC grapple is lowered, engaged to the shield plug, and raised, bringing the shield plug into the MHC. The SCLC foot valve is then closed and the MHC is returned to its storage location on the work platform with the shield plug.

The FTC is moved from its storage stand in the truck bay to the FTC loading station by the FHB 110 ton crane following the designated load path. The FTC is placed on its alignment plate on the loading station and the power source is connected. The FTC bottom doors are then opened and the grapple is lowered and engaged to the canister.

The transfer of the canister now begins with the raising of the canister into the FTC. The canister is raised at a speed of no greater than 1 foot per minute (fpm). As the canister breaches the surface of the pool water a spray of demineralized water, that has been borated to a minimum boron concentration of 4350 ppm, sprays the canister. When the canister clears the spray pattern the spray is stopped and the canister is allowed to drip for at least 2 minutes prior to closing the FTC bottom doors.

The FTC with the canister is then disconnected from its power source and moved through the designated load path to the shipping cask. At the shipping cask the FTC is aligned to the SCLC over the proper shipping cask cavity. When the FTC is in place and power is connected, an interlock allows the opening of the SCLC foot valve. The SCLC foot valve is opened and the FTC bottom doors are opened. The canister is lowered at the unit's nominal speed of no greater than 10 fpm. When the bottom of the canister is at least one foot before contacting the impact limiter, the unit's speed shifts automatically to no greater than 1 fpm until the canister rests on the impact limiter. It is unlikely that binding will occur during the lowering of the canisters into the shipping cask. However, the distance the canisters have been lowered can be determined by the height encoder provided for verification that the canister has "bottomed out." The FTC grapple is unloaded when the load cell indicates that the canister is resting in the shipping cask. This allows the grapple to be disengaged and retracted, the SCLC foot valve is closed and the FTC bottom doors are closed. Power to the FTC is disconnected and the FTC is then moved back to the loading station to pick up another canister. The MHC, with shield plug, is placed back on the SCLC, the foot valve is opened, the shield plug replaced and the foot valve closed.

To prepare for the next canister the MHC is lifted from the SCLC, the SCLC is rotated and aligned to the next of the six outer shipping cask cavities. The center shipping cask cavity may be accessed at any SCLC orientation by reversing the operation of the foot valve. Again, the MHC is used in the same manner as above to remove the shield plug, and the MHC is moved to its storage stand on the work platform.

3.0 DESCRIPTION OF EQUIPMENT

3.1 Fuel Transfer Cask Loading Station

The FTC loading station platform and Canister Loading and Decontamination (CLD) System are designed to be used during the loading of fuel canisters into the FTC and to provide a means of decontaminating the canisters during the loading operation. Once a canister has been prepared for shipping it will be placed into a single canister guide under the loading platform by the FHB CHB. The FTC will then be placed on the loading platform and aligned to the canister below by an alignment plate on the top of the platform. The FTC grapple will then be lowered to the canister and engaged. As the canister is lifted by the FTC canister lifting system into the FTC, it will be sprayed by the CLD system with demineralized water, that has been borated. The region where the decontamination spraying is performed is provided with vertical shielding between the bottom of the FTC and the surface of the pool water. The FTC will then transport the canister to the truck bay for loading into the shipping cask.

The upper platform of the FTC loading station will provide an equivalent of three (3) inches of lead shielding on the deck and one (1) inch of vertical lead shielding supported from the south edge of the platform.

The structural portions of the FTC loading station are constructed of stainless steel and are designed in accordance with the ASME Boiler and Pressure Vessel Code, Section III, Division 1, 1977 edition. The ASME code is used since the AISC manual of steel construction is not applicable to stainless steel construction. The piping and spray ring are designed in accordance with ANSI B31.1, 1983.

The FTC loading station is braced to the defueling water cleanup system hose platform and to the load test fixture on the wall of fuel pool 'A', for stability. The vertical column support legs are shimmed as required to ensure proper bearing on the fuel pool 'A' floor. The top surface of the platform consists of an adjustable alignment plate to mate with the FTC and align it to the canister below.

3.2 Fuel Transfer Cask

The FTC is a lead shielded, bottom loaded, cylindrical cask capable of raising/lowering, fully enclosing and transporting a single defueling canister. An integrally mounted, shielded bottom door provides the final closure of the cask during transport from the loading point in fuel pool 'A' and the unloading point in the truck bay.

The FTC is approximately 17 feet - 6 inches high, on a 5 foot - 2 inch by 4 foot - 3 inch base, and weighs approximately 40,600 pounds when loaded with a defueling canister.

The canister is lifted into, and lowered from, the FTC by an integral canister lifting system.

The lifting system consists of the following components:

- o a 3,000 pound rated capacity hoist designed in accordance with ANSI B30.16, (i.e., safety factor of 5 to ultimate strength for load bearing parts),
- o reeving box, consisting of load bearing parts designed for 3,500 pounds with safety factors of 6 to yield and 10 to ultimate strength, and
- o grapple assembly, consisting of a 3,500 pound rated capacity center point grapple with safety factors of 3 to yield and 5 to ultimate strength, a grapple connector designed at 3,500 pounds with safety factors of 6 to yield and 10 to ultimate strength, and a non-load bearing grapple alignment guide. The grapple is the same as the grapple used in the canister transfer shield, and is also discussed in Reference 2.

The FTC canister lifting system is configured with four part reeving and an equalizer such that the hoist will be subjected to only one half of the total load of the grapple assembly and canister. In general, the maximum weight of a defueling canister that will be lifted by the lifting system is 2,800 pounds. The weight of the grapple assembly is less than 200 pounds. Since the hoist will only be subjected to one half of the combined weight of the canister and grapple assembly, the hoist will be subjected to a load of less than 1,500 pounds. Thus, in general, the hoist can be considered to have a safety factor of 10 to ultimate strength. There is the possibility that up to 5 percent of the canisters may weigh up to 5 percent above 2,800 pounds, or 2,940 pounds. For these canisters, the hoist can be considered to have a safety factor of 9.55 to ultimate strength. In addition, the canister lifting system has been tested with loads up to 4,500 pounds by the FTC vendor and will be tested on-site with a load of at least 3000 pounds.

After being fully withdrawn into the FTC, the canister is held by the canister lifting system, and the bottom door is closed. Indication of the door being closed is provided by limit switches and canister position is given by a height encoder.

The bottom door is designed to withstand a canister drop from within the FTC and, thereby, provide a redundant line of defense against a canister drop out of the FTC during transport. The bottom door is designed to fail "as-is" and is disconnected from its power source during transport. For these reasons the FTC is considered to be "single-failure-proof" with respect to a canister drop during transport. The FTC is not single failure proof while canisters are being raised or lowered. The consequences of a canister drop during this period are discussed in sections 5.2.2 and 6.1.

The lifting device for the FTC and its connection points to the FHB crane are designed to safety factors of 6 to yield and 10 to ultimate for a single attachment point based on the approximate design load of 22.8 tons (includes static load plus 15 percent for dynamic load).

The FTC manual grapple release system consists of a cable attached to the grapple piston extension rod which is reeved through pulleys in the upper portion of the FTC to an external takeup reel. The takeup reel is spring loaded and pays out and takes up cable as the grapple moves up and down. Due to the weight of the canister the grapple can be released manually only when unloaded. Manual release is accomplished by pulling on the release cable along the outside of the FTC. To prevent inadvertent release due to misreeving the cable pulleys are equipped with cable guards. In addition, the takeup reel is equipped with dual limit switches on a pivoting base which trip the FTC grapple hoist on high release cable tension. The switches are redundant and the actuation of either switch will stop the grapple hoist.

3.3 NuPac Shipping Cask

The NuPac 125-B Fuel Shipping Cask has been developed as a safe means of transporting the TMI-2 core debris from the TMI site to INEL at Idaho Falls, Idaho. The design is optimized for minimum weight and maximum safety during loading, transport, and unloading operations. The shipping cask is a rail cask designed to transport up to seven (7) canisters per shipment. The cask provides two levels of testable containment for the canisters during both normal and hypothetical accident conditions to comply with the requirements of 10 CFR 71.63(b). Gross shipping weight of the shipping cask is approximately 183,000 pounds. The cask consists of an inner vessel and outer (lead shielded) cask. The inner vessel provides the primary containment boundary for the cask payload (canisters). The outer cask provides a secondary containment boundary for the payload and also acts as an environmental barrier. Each canister is axially protected by honeycomb energy absorbers located within the inner vessel at both ends of each canister. The outer, lead shielded cask is protected at each end by energy absorbing overpacks which consist of stainless steel skins filled with medium density, closed cell polyurethane foam. These overpacks also provide thermal insulation which protects seal areas during the hypothetical fire transient event. Due to the relatively low maximum heat loading of 100 thermal watts per canister active cooling of the cask is not necessary. Additional details of the NuPac cask are provided in Reference 5.

The following describes FTC/shipping cask auxiliary equipment associated with loading the shipping cask (dimensions and weights are approximate):

o Shipping Cask Loading Collar (SCLC)

The SCLC will provide an interface between the FTC and the shipping cask and will also provide shielding of personnel during the loading of the shipping cask. The SCLC is currently comprised of two pieces - a fixed lower ring (1366 pounds) which is pinned to the shipping cask inner vessel, and a rotating upper disc (36,000 pounds) which includes the sliding door and auxiliary shield collar. The overall dimensions of the SCLC are 79 inches in diameter and 44.5 inches high with an 11.5 inch protrusion on one side for the sliding door drive mechanism.

- Mini Hot Cell (MHC)

  The MHC provides a means of removing the shipping cask shield plugs while maintaining shielding integrity during loading of the canisters into the shipping cask. During the loading sequence, the MHC will normally be handled by the MHC jib crane. The MHC may also be handled by the FHB crane main or auxiliary hook, as required. A single shield plug is lifted into, and lowered from, the MHC by an integral shield plug lifting system.

  The MHC shield plug lifting system consists of the following components:

  - a 1,000 pound rated capacity hoist designed in accordance with ANSI B30.16, i.e., safety factor of 5 to ultimate strength for load bearing parts;

  - reeving box, consisting of load bearing parts designed to at least 1,000 pounds with safety factors of 6 to yield and 10 to ultimate strength;

  - grapple assembly, consisting of a 3,500 pound rated capacity center point grapple with safety factors of 3 to yield and 5 to ultimate strength, a grapple connector designed to at least 1,000 pounds with safety factors of 6 to yield and 10 to ultimate strength, and a non-load bearing grapple alignment guide. The grapple is the same as the grapple used in the canister transfer shield, and is also discussed in Reference 2.

  The MHC shield plug lifting system is configured with four part reeving and an equalizer such that the hoist will be subjected to only one half of the total load of the grapple assembly and shield plug. The total weight of the grapple assembly and shield plug is less than 750 pounds. Since the hoist will be subjected to only half this load, the MHC shield plug lifting system can be considered to have a safety factor of 10 to ultimate for its intended use. The MHC is 5 feet 9 inches tall with a 28 inch diameter base and a horizontal envelope of 5 feet by 3 feet 6 inches. The MHC weighs approximately 10,000 pounds.

- MHC Jib Crane and Platform

  The MHC jib crane and platform provide the means and location to stage the MHC and shield plug during the loading of canisters into the shipping cask. The MHC jib crane is a 15 ton crane that has been derated to 7.5 tons in order to provide a safety factor of 10. The platform has a maximum horizontal envelope of 19 feet by 22 feet and an overall height of approximately 33 feet. The total weight of the platform and jib crane is approximately 66,000 pounds.

3.4 Cask Unloading Station

The Cask Unloading Station (CUS) is a portable lifting device staged by the FHB crane and used to handle the fuel shipping cask/skid assembly. It utilizes four screw jacks mounted on a frame which straddles the railcar with the skid and cask mounted in a horizontal position. The CUS attaches to the transport skid. It lifts the cask/skid assembly so that the rail car can be removed and then lowers the assembly onto the skid floor support brackets. The CUS is then removed so the cask can be uprighted for loading operations. These steps are reversed to replace the loaded cask on the rail car for transport. The CUS is designed so that no single jack failure will cause an uncontrolled lowering of the load. It will have the capability to lower the load to the railcar or floor brackets should the normal powered means be lost during a lifting or lowering operation.

The CUS is designed in accordance with ANSI N14.6-1978, including Section 6 for critical loads. The design also includes the dynamic effects of normal movement as specified in NUREG-0612 for normal crane movement. The attachment points are also in accordance with ANSI N14.6-1978. The equipment may deviate from ANSI N14.6-1978 paragraph 3.5.5 by blast cleaning prior to coating in accordance with Steel Structures Painting Council Surface Preparation Specification No. 10, Near White Metal Blast Cleaning (SSPC-SP10) in lieu of No. 5, White Metal Blast Cleaning (SSPC-SP5).

3.5 Cask Hydraulic Lifting Assembly

The Cask Hydraulic Lifting Assembly (CHLA) is used to upright the fuel shipping cask for attachment to the jib crane support structure for canister loading, and to lower the cask to the horizontal position for transport. The CHLA consists of a saddle which attaches to the cask lifting trunnions, two hydraulic cylinders, a support frame for attachment to the skid, and hydraulic power and control systems. After the cask/skid assembly is lowered onto the skid floor support brackets and the CUS removed, the CHLA is installed with the FHB crane.

The hydraulic cylinders are of the multi-stage telescoping design with at least one double acting stage to allow precise cask positioning at the jib crane support structure. Each cylinder will be fitted with a hose break valve to prevent uncontrolled lowering of the cask in the event of rupture of any of the hoses or piping in the hydraulic circuit. The break valve also provides control for normal cask lowering. The cask will lower to its horizontal position over a time of 15 to 20 minutes. The cask can similarly be lowered manually to the horizontal position should the normal powered means be lost during a lifting or lowering operation.

The hydraulic cylinders of the CHLA are designed as dual load paths. Load bearing members of each will have a design safety factor with respect to ultimate (burst pressure) of five times the maximum combined concurrent static and dynamic load after a single point failure.

The cask lifting saddle provides the interconnection between the hydraulic cylinders and the cask. Once the cask is vertical, ratchet binders are connected to the saddle and tighten against screw jacks on the jib crane support structure to secure the cask for canister loading. Although the CHLA may remain in place during loading, no c dit is taken for the hydraulic cylinders as normal operating or seismic support of the cask.

The CHLA is designed in accordance with ANSI N14.6-1978, including Section 6 for critical loads. The design also includes the dynamic effects of normal movement as specified in NUREG-0612 for normal crane movement. The attachment points are also in accordance with ANSI N14.6-1978. The equipment may deviate from ANSI N14.6-1978 paragraph 3.5.5 by blast cleaning prior to coating in accordance with Steel Structures Painting Council Surface Preparation Specification No. 10, Near White Metal Blast Cleaning (SSPC-SP10) in lieu of No. 5, White Metal Blast Cleaning (SSPC-SP5).

3.6 Cask Support

Once the cask is secured to the jib crane support structure as described above, it is ready for canister loading. Structural support of the cask is provided by this connection to the cask top trunnions, and by the pivot trunnions attached to the skid which is in turn attached to the floor.

The cask support members are designed with conservative allowable stresses under normal operations and during the inadvertent impact of the FTC with the shipping cask. The cask support members are also designed to withstand the maximum hypothetical earthquake (SSE) without yielding. The equipment configuration considered during the SSE is: uprighted cask with 0 to 7 canisters loaded in any cell configuration, SCLC in place on the cask, the unloaded jib crane, and the MHC with shield plug in its storage location on the jib crane platform. The FTC is decoupled from the stackup. The SSE design loading criterion envelopes the OBE caused stresses.

3.7 Railcar Jack

The force required to jack the railcar to accomplish north-south alignment of the skid lift lugs to the CUS clevises will be determined by test outside of the protected area. A jacking height limit and associated jack force will be determined. The jack used during operations will then be sized such that the capacity and/or manufacturer's safety factor will achieve an overall safety factor of 5 to failure at the maximum permissible load determined above.

4.0 <u>NUREG 0612 COMPLIANCE</u>

4.1 General

Generic Letter 81-07 of December 22, 1980 (Reference 6) requested that all licensees of operating plants review their controls of the handling of heavy loads to determine the extent to which the guidelines of NUREG-0612 are satisfied and identify the changes and modifications that would be required in order to fully satisfy these guidelines. This letter was not originally sent to TMI-2, but NRC letter of February 27, 1981, B. J. Snyder to G. K. Hovey (Reference 7), informed TMI-2 that Generic Letter 81-07 is applicable to TMI-2 and requested compliance with the generic letter.

The submittals to the NRC requested in Generic Letter 81-07 were grouped into two phases. The Phase I submittal included an evaluation of such matters as safe load paths, operator training, crane inspection, etc. which essentially addresses the guidelines in Section 5.1.1 of NUREG-0612. Phase II included an evaluation of postulated load drops or a description of a single failure proof crane design which prevents load drops, depending upon the option chosen by the licensee.

Prior to the submittal of Reference 3, TMI-2's responses to Generic Letter 81-07 have addressed heavy load handling associated with recovery activities prior to the start of defueling. The following discussion addresses load handling activities associated with some of the activities following the start of defueling, specifically canister handling in preparation for shipment and loading of the shipping cask.

NRC generic letter 85-11 (Reference 8) was transmitted to TMI-2 by NRC letter dated July 17, 1985 (Reference 9). This generic letter notes that based on the improvements in heavy load handling obtained from implementation of Phase I of NUREG-0612, further action is not required to reduce the risks associated with the handling of heavy loads, i.e., implementation of Phase II of NUREG-0612 is not necessarily required. The discussion which follows demonstrates compliance with Section 5.1.1 of NUREG-0612 (Phase I) for all heavy load handling activities associated with canister handling and preparation for shipping off site.

The heavy load handling cranes used for these activities are the fuel handling building crane (both main and auxiliary hoists), the mini hot cell jib crane, and the canister lifting mechanism within the fuel transfer cask. The canister handling bridge will be used to transfer the canisters from the storage racks to the dewatering station and from there to the fuel transfer cask loading station, or storage racks, and is addressed in the SER for early defueling (Reference 2).

4.2 Evaluation Against NUREG-0612, Section 5.1.1

The following specific evaluations correspond to each of the items described in Section 5.1.1 of NUREG-0612.

4.2.1 Safe Load Paths

For the movement of heavy loads within the FHB associated with canister transfer and preparation for shipment, a safe load path has been defined. The designated load path, shown as the transfer cask load path in Figure 4-1, minimizes the potential for damage to defueling canisters and other equipment important to safety.

The load path avoids the defueling canisters staged in fuel pool 'A', the fuel pool 'A'/pool 'B' transfer gates, SDS equipment in fuel pool 'B', the defueling water cleanup system ion exchangers, and the fuel handling building ventilation system. The loads will be lifted high enough to avoid any obstructions along the load path. The heavy loads, including the fuel transfer cask, will be lowered into the truck bay area south of the rail bay. In particular, the fuel transfer cask will be lowered over its storage stand or the shipping cask which are more than 20 feet from the exclusion zone (see Figure 4-2) in the truck bay. The potential for a load hangup involving the FTC is reduced by minimizing FHB crane hoist movements while moving the bridge/trolley.

Loads of up to 3000 pounds may be lifted up to 10 feet above the floor level in the exclusion zone (See Evaluation of Heavy Load Handling Operations at TMI-1; Volume 1 - Fuel Handling Building, Reference 10).

All heavy load paths are identified in the appropriate procedures or unit work instructions. These procedures or unit work instructions contain a plant layout drawing which is marked to clearly define the safe load path handling area for the designated load. The safe load paths will be clearly marked on the floor and adherence to the safe load paths is insured by the lift supervisor. The lift supervisor is qualified per GPUN procedure 4000-ADM-3890.01 and has no other responsibilities except to direct the lift operation. Any changes to these safe load paths require a revision to the appropriate procedures or unit work instructions.

4.2.2 Procedures

For heavy load handling operations over or in proximity to irradiated fuel or safe shutdown equipment, approved procedures or unit work instructions will govern the lift operation. These approved procedures and unit work instructions contain the sequence of steps necessary to complete the lift operation and will either include or have attached approved rigging sketches. The rigging sketch identifies the load, the maximum weight of the load, and the equipment to be used. The fuel handling building crane is operated in accordance with GPUN procedure 2502-1.2 (4220-IMP-3883.01).

4.2.3 Crane Operators

Overhead crane operators are trained and qualified in accordance with GPUN procedure 4220-ADM-3891.01 which qualifies operators in accordance with ANSI B30.2-1976. The conduct of overhead crane operators is governed by GPUN procedure 2502-1.2, "Fuel Handling Building Crane Operation", which is in accordance with ANSI B30.2-1976.

4.2.4 Special Lifting Devices

The FTC and MHC will utilize special lifting devices to interface with the main hoist of the fuel handling building crane and the jib crane, respectively. The MHC may also be handled by the auxiliary hoist of the FHB crane. These and any other special lifting devices that may be identified later, will be designed, constructed, inspected and tested in accordance with ANSI N14.6. Safety factors will be based on the combined maximum static and dynamic loads that could be imparted to the special lifting devices (excluding seismic loads).

4.2.5 Standard Lifting Devices

Lifting devices that are not specially designed are installed and used in accordance with the guidelines of ANSI B30.9-1971, "Slings" and used in accordance with the TMI-2 Lifting and Handling program. Sling rating is based on the sum of the static and maximum dynamic loads (not including seismic loads).

4.2.6 Crane Inspection, Testing and Maintenance

GPUN Procedures 4220-PMG-3883.01 and 4220-PMG-3883.02 govern the inspection and preventive maintenance of the fuel handling building crane and comply with ANSI B30.2-1976. The fuel handling building crane was load tested using a load that was 125% of the 110 ton rated capacity. The load test was performed prior to ANSI B30.2-1976. The newly assembled jib crane will be load tested in accordance with ANSI B30.11-1980. Maintenance will be performed in accordance with ANSI B30.11-1980 for jib cranes and ANSI B30.16-1981 for hoists.

4.2.7 Crane Design

The maximum loads listed for cranes in this section apply only to the activities within the scope of this SER. The design of the canister lift mechanism in the FTC is described in the defueling SER (Reference 2).

Fuel Handling Building (FHB) Crane - Main and Auxiliary Hoists

The FHB crane was built prior to the issuance of ANSI B30.2-1976 and CMAA 70-1975. This crane was designed to meet EOCI specification #61, which was later superseded by CMAA-70. Design evaluations comparing the crane design to the more recent specifications show that the FHB crane design meets the intent of ANSI B30.2-1976 and CMAA 70-1975. These evaluations have been accepted by the NRC in prior correspondence (Reference 4) for TMI-1. As a result of these evaluations, the restart protection criteria from CMAA-70, which were not addressed in EOCI specification #61, have been incorporated. Accordingly, the control switches in the FHB crane cab have been modified to include a spring return to the "OFF" position, to satisfy the protection criteria. Additionally, it was determined that modifications should be made to the FHB crane electrical interlock system in order to inhibit load handling in the east portion of the truck bay (see Figure 4-2). Work on this modification is presently scheduled to be completed prior to the start of canister shipping.

In order to further improve the reliability of the FHB crane, the following modifications will be made: a second upper limit switch will be added, an emergency stop button will be added, and the remote control pendant will be relocated.

Loads to be handled by the auxiliary hoist will be limited to less than 6.6 tons in order to maintain a minimum safety factor of 6 to yield.

The safety factors for structural (load bearing) components for the FHB crane are provided in Table 4-1. The safety factors for the main hoist are given relative to the design load of 110 ton and the FTC load including a maximum weight canister and load block (approximately 22.8 tons). The safety factors for the auxiliary hoist are given relative to the design load of 15 tons and to the defueling operations limit of 6.6 tons. The safety factors presented in this table are best engineering estimates by the crane manufacturer.

Additionally, Section 9.7.1.6 of the TMI-1 FSAR states "the structural design of the fuel handling crane is also required to ensure no loss of function during and after a seismic class 1 event while lifting rated load."

Mini Hot Cell (MHC) Jib Crane

The MHC jib crane will handle the MHC between the shipping cask loading collar (SCLC) and the storage location on the adjacent platform in the FHB loading bay. This crane also may be used to handle other heavy loads. The MHC jib crane is designed in accordance with ANSI B30.11 and CMAA #74-1974. The MHC jib crane is additionally designed so that the SSE cannot cause the collapse of the crane or otherwise impart unacceptable loads over the exclusion area or other safe shutdown areas. The structural safety factors imposed by the above specifications afford at least a 10:1 margin to ultimate material strength, based on the approximate design load of 7.5 tons.

4.3 Evaluation Against NUREG-0612, Section 5.1.5

Pursuant to Paragraph (2), Section 5.1.5 of NUREG 0612, an analysis has been performed which demonstrates that should the jack fail while jacking the railcar, the maximum possible dynamic load applied to the rail by the wheels will not exceed the capacity of the floor.

TABLE 4-1

Fuel Handling Building Crane Safety Factors

Crane Structural Component	Main Hoist: Safety Factor to Rated Load (110 ton)	Main Hoist: Safety Factor to FTC w/canister (22.8 ton)	Auxiliary Hoist: Safety Factor to Rated Load (15 ton)	Auxiliary Hoist: Safety Factor to Max. Allowable Load 6.6 ton)
Wire Rope (ultimate)	5:1	24:1	6.7:1	15.2:1
Mechanical Drive Train Gearing (yield)	2:1	9.65:1	2.7:1	6.1:1
Shafting (ultimate)	5:1	24:1	6.7:1	15.2:1
Hook Forging (ultimate)	5:1	24:1	6.7:1	15.2:1
Cast Steel Drums & Sheaves (ultimate)	5:1	24:1	6.7:1	15.2:1
Major Structural (yield)	2:1	9.65:1	2.7:1	6.1:1
Components (Girders, etc.) (ultimate)	4:1	19.3:1	N/A	N/A
Welds (yield)	2.4:1	11.6:1	N/A	N/A
(ultimate)	3.9:1	18.8:1	N/A	N/A

5.0 RADIOLOGICAL ASSESSMENT

5.1 In-Plant Exposures

5.1.1 External Exposures

All individuals entering the fuel handling building will be monitored for external exposures in accordance with radiological control procedures. All personnel exposure will be maintained as low as reasonably achievable (ALARA) and all external radiation exposures will be maintained within the exposure limits established in 10CFR20. Administrative control points in accordance with the procedures will be used in order to assure specified dose limits are not exceeded. Extremity monitoring will be performed as needed in accordance with existing procedures. Radiological Controls Department personnel will monitor dose rates in the FHB during canister handling and preparation for shipment activities according to existing procedures.

The following estimates of radiological conditions during the activities are presented for information only. These estimates are based on hypothetical source terms for an average fully loaded defueling canister. The source terms used for defueling canisters are described in Reference 2. Radiological controls required during these activities will be determined based on actual measured dose rates. During these activities it is assumed that personnel will be located on the dewatering station platform and along the edge of fuel pool 'A'. Note that these estimates do not include background radiation or sources not identified here.

a. <u>Transfer of canister from the storage racks to the dewatering station</u> Maximum dose rates expected at various locations are given below.

CHB Trolley	5 millirem/hr
Dewatering System Platform (6' from transfer shield)	90-240 millirem/hr
349'-6" el.	5-16 millirem/hr

The maximum dose rate on the Dewatering System (DS) platform, as shown above, is expected to last for a very short period of time (i.e., when the CTS collar is fully lowered in the pool water and the canister is drawn fully up in the CTS). The average dose rate on the DS platform during canister transfer operations is estimated to range from 50-100 millirems/hr depending on the location of the canister being transferred.

b. <u>Canister dewatering</u> The DS platform is shielded with 2" of lead. DS piping is routed below the platform. Reach rods are used to operate valves which are located under the platform. The platform was designed to maintain dose rates on the platform and on the FTC loading station from the DS piping to approximately 2.5 millirem/hr.

c. Canister transfer to the FTC loading station The FTC loading station platform is shielded with 3" lead. Access to the FTC loading station while the canister was being raised or lowered is not normally expected. Dose rates during the transfer to the FTC loading station are estimated for the following locations.

CHB Trolley	5 millirem/hr
Dewatering System Platform	40-75 millirem/hr
349'-6" el.	16 millirem/hr

d. Canister transfer from the FTC loading station to the shipping cask The FTC is shielded with a total of 4-1/2" lead and 2" steel. The bottom door is 5" lead or shielding equivalent. The maximum dose rates in the FHB will be less than 10 millirem/hr at a distance of 4 feet from the FTC.

The total whole body exposure anticipated for the activities described in this SER is calculated to be 184 person-rem assuming 252 canisters are shipped. This total dose estimate is based on the following activities, person-hours and doses, and includes Radiological Controls support:

a. Move shipping cask into fuel handling building and prepare for mating with FTC - 80 person-hours and negligible person-rem per 7 canisters (one shipping cask load)

b. Weigh canister and transfer to dewatering station; dewater, weigh and sample canister; load canister in FTC; and transfer FTC to truck bay - 20 person hours and 0.6 person-rem per canister.

c. Lower FTC; mate FTC with shipping cask loading collar; connect FTC to its control panel; lower canister into shipping cask; disconnect control panel; and move FTC to storage stand in truck bay or back to fuel pool 'A' - 8 person-hours and 0.10 person-rem per canister for seven canisters.

d. Install shield plug and impact limiter into the shipping cask - 4.2 person-hours and 0.011 person-rem per canister for seven canisters.

e. Prepare shipping cask for transport off-site - 40 person-hours and 0.14 person-rem per 7 canisters.

Person-hours for Radiological Controls support is included in the above estimates. Based on job loading estimates the person-rem estimate for Radiological Controls support is 49 person-rem, and the total for all groups other than Radiological Controls is estimated at 135 person-rem.

Due to the uncertainty in the person-hour estimate and the radiological conditions which will exist during these activities, it is estimated that the total exposure could vary by up to ± 30 percent. Considering these uncertainties, a range of 130 to 240 person-rem has been selected to be used as the estimate for the performance of the activities within the scope of this SER, including Radiological Controls support.

5.1.2 Internal Exposures

All individuals entering the fuel handling building will be monitored for internal radiation exposures according to established procedures. This monitoring will be accomplished by periodic whole body counting or bioassay, or both. All exposures to airborne radioactivity will be maintained ALARA and within the limits established in 10CFR20. Airborne radioactivity in work areas will be monitored according to established procedures. Air sampling for particulates will be performed using devices such as breathing zone air samplers and grab samples. Tritium grab samples will be taken as required according to established procedures.

5.1.3 ALARA Considerations

The objective of minimizing occupational exposure has been a major goal in the planning and preparation for all recovery activities. The actions that have been taken or are being planned will minimize the time personnel must work in radiation fields, maximize the distance between personnel and radiation sources to the extent practicable, and utilize shielding where appropriate to meet the ALARA objective. Protective clothing will be used as necessary to reduce the potential for external contamination and internal exposure of personnel. Execution of individual tasks are maintained ALARA by a detailed radiological review by Radiological Controls.

Canisters are staged under water prior to removing them for shipment off site. When moving canisters from the fuel canister storage racks to the dewatering station and fuel transfer cask loading station, the canisters are raised directly into the canister transfer shield and retained there until they reach their destination.

Shielding has been designed for components and structures that may present high dose rates during the activities described in this SER.

The FTC loading station is shielded with 3" lead to ensure reasonably low dose rates on the dewatering station platform and around the edge of fuel pool 'A'. A shielded curtain extends down from the south side of the FTC loading station into the water to ensure no streaming occurs during canister transfer. The dewatering station platform provides shielding for any streaming which might occur from the east side of the FTC loading station.

The dewatering station platform incorporates 2" lead shielding to shield operators from radiation from DS piping which runs under the dewatering station platform. Shielded handrails may be used to create a low dose rate area for operators during canister transfer operations.

The canister transfer shield limits dose rates to trolley operators to less than 5 millirem/hr from the canister being transferred. In addition, dose rates around the edge of the pool are estimated to be less than 16 millirem/hr for all transfer operations within fuel pool 'A'.

The FTC limits dose rates to less than 10 millirem/hr at a distance of 4 feet from the axis of the canister.

At the FTC cask loading station the canisters are raised into the FTC where they remain until lowered into the shipping cask. The mini hot cell provides shielding of the canisters while the shield plug and impact limiters are installed on each canister cell in the shipping cask. Shield doors are provided at the bottom of the fuel transfer cask to minimize dose rates below the fuel transfer cask during transfer.

Other features have been incorporated to ensure that operator doses are minimized.

a. The canister grapple was designed to permit "blind grapple" and to permit canister coupling while allowing for tolerances of the canister racks and the grapple mechanism. This permits a smooth and efficient operation.

b. Dewatering system piping and valves are located below the shielded platform where practical and reach rods are provided for valve operation.

c. Sufficient shielding is present on the dewatering system platform and handrails to ensure low dose rates on the platform during all transfer operations.

d. A decontamination ring has been provided for final washdown of the canister prior to loading in the fuel transfer cask. This will minimize the spread of contamination during canister transfer and loading of the shipping cask.

e. Canister dewatering couplings have been designed to allow easy connection/disconnection. Different size couplings have been used for inlet and outlet to ensure easy identification and to prevent misalignment.

5.2 Releases to the Environment

5.2.1 Normal Operations

The activities within the scope of this SER do not present a credible source of radioactive liquid release to the environment. The activities within the scope of this SER are not expected to increase airborne radioactivity in the FHB. Since no significant changes in FHB airborne radioactivity are expected, these activities will have negligible effect on off-site releases. This conclusion is based on the following considerations.

- o The contents of the canisters are completely sealed during all activities except during connection to or disconnection from the Hansen fittings.
- o During these activities the canisters are at least partially dewatered so that the in-canister catalysts are activated. This will prevent the buildup of gas pressure and the relieving of internal canister pressure to the FHB atmosphere.
- o Airborne radioactivity potentially created by argon gas flowing through a canister during dewatering activities will be vented to the SDS off gas system.
- o A decontamination spray ring will be used at the FTC loading station to reduce any loose surface contamination adhering to the canister.
- o The FTC has bottom doors which create an enclosure which will minimize the creation of airborne radioactivity from the canister during transfer to the truck bay.

Tritium exists primarily as tritiated water. Due to evaporation and the use of the spray ring, some of the tritium in fuel pool 'A' will become airborne. However canister handling operations will not create new sources of tritium in the water or an increase in tritium releases to the environment. Any tritium release is monitored and maintained within Technical Specification limits.

5.2.2 Accident Conditions

As discussed in Section 6.0, the probability of criticality or load handling accidents is extremely small or negligible. However, previously postulated accidents have been evaluated for potential off-site releases. Reference 11 presents a wide range of potential accident scenarios and source terms, including releases from a defueling canister. The maximum off-site dose involving releases from a defueling canister dropped in the dry defueling canal and crushed by non-seismic equipment was calculated to be 12 rem. This is the dose to the bone of an adolescent due to a two hour unfiltered release. The off-site releases presented in Reference 11 are bounding for the activities within the scope of this SER.

6.0 SAFETY ASSESSMENT

This safety assessment evaluates the potential safety impact of heavy load handling, criticality and seismic events.

6.1 Heavy Load Handling

The description of heavy load handling equipment and the evaluation of load handling equipment and activities presented in Section 4.0 of this SER demonstrate that the potential for a load drop is extremely small. Heavy load handling devices are conservatively designed in accordance with industry standards. Heavy loads will be transported along a designated load path which minimizes the potential for damage to equipment important to safety. Cranes are inspected, tested and maintained in accordance with industry standards and are operated by qualified personnel. Additionally, the jib crane support structure has been designed to withstand the impact of the FTC into the shipping cask at 1 fpm horizontally or up to 5 fpm vertically without causing the failure of the jib crane support structure and/or loss of the shipping cask restraint function. This impact is assumed to occur with the shipping cask in the uprighted position and restrained by the jib crane support structure.

Even though the potential for a load drop is very small, an evaluation of the consequences of dropping a canister from the FTC has been performed. The consequences of dropping a canister from the FTC are summarized below.

If the canister and grapple were to drop when lifting a canister from the cask loading station into the FTC, the canister would fall back into the loading station canister guides. No unacceptable damage to either the FTC loading station or spent fuel pool would result from this drop. The distance the canister would fall is less than what it is designed for. Therefore, dropping a canister while being raised into the FTC results in no unacceptable consequences to equipment.

Prior to moving the FTC from the cask loading station, the door on the bottom of the FTC will be closed and will remain closed until the FTC is positioned over the shipping cask cell where the canister will be lowered. The door is designed to withstand the drop of the canister and grapple. Thus, the consequences of dropping the canister during movement from the spent fuel pool to the shipping cask will not result in unacceptable damage to any equipment.

A drop of a canister and grapple into the shipping cask may result when the FTC is positioned over the shipping cask cell for canister lowering, with the door on the bottom of the FTC open. This load drop is within the bounds of the design basis vertical drop for the defueling canisters and as such the canisters and contained poisons would still meet design requirements (Reference 12) following this drop. Thus, there is no potential for a criticality event resulting from the drop of a defueling canister into the shipping cask.

The design features of the canisters and the handling equipment make the potential for a leak very small. It is expected, under design drop conditions, that no leakage will occur. If leakage does occur as a result of dropping a canister into the shipping cask the resulting off-site dose would be bounded by the analysis discussed in Section 5.2.2. Due to the presence of the impact limiters it is not considered credible that the shipping cask would be damaged due to a canister/grapple drop.

Further, an analysis has been performed to determine the effects on the truck bay floor slab due to the drop of a defueling canister/grapple into the shipping cask. This analysis showed that the structural integrity of the slab would not be impaired. Furthermore, little if any damage to the floor slab would result due to this drop.

In the event of a canister drop into the shipping cask, both the canister and shipping cask will be evaluated to verify their acceptability for shipment.

6.2 Criticality

The analyses presented in the criticality report (Reference 13) and the boron dilution report (Reference 14) demonstrate that any fuel debris configuration will remain subcritical if the debris is in water which is at a boron concentration of 4350 ppm or greater. Since fuel pool 'A' is maintained at a boron concentration of greater than 4350 ppm, any postulated accident which results in a reconfiguration of the fuel debris (e.g., canister damage) will not cause criticality within fuel pool 'A'. Since each canister is transferred individually, only an accident in fuel pool 'A' can result in damage to more than one canister.

Evaluations have also been performed which demonstrate that an undamaged canister can be transferred in the fuel transfer cask (surrounded by a lead reflector) and not cause the k_{eff} of the canister contents to exceed 0.95 (Reference 15).

6.3 Seismic Event

In general, equipment that is used or staged in the truck bay, including storage stands associated with the transfer and off-site shipment of defueling canisters, is designed such that the design basis seismic event will not cause that equipment to fail/collapse in such a way as to cause damage to Unit 1 safe shutdown equipment or systems. An evaluation was performed for canister and cask handling activities in the truck bay area to estimate the probability of the failure of equipment and structures used to perform the activity concurrent with the postulated seismic event. When the probability and/or consequences were acceptable, no seismic analysis was performed. The fuel handling building crane is designed to withstand the design basis seismic event, while retaining its design rated load, per the TMI-1 Final Safety Analysis Report. Additionally, analyses of the truck bay with fuel shipping equipment installed has been performed to ensure the truck bay floor can withstand the loads imparted to it, for all load cases. Due to the low probability of a seismic event during the period when the FTC is stacked on the SCLC and shipping cask the seismic analyses will not include this case.

The MHC jib crane will be seismically designed structurally; however, it will not be seismically qualified when loaded. Additionally, the cask righting system and CUS are not designed to withstand a seismic event while raising or lowering the shipping cask/skid. These determinations were made due to the very low probability of the occurrence of a seismic event while the jib crane is moving a heavy load or the cask righting system or CUS is raising or lowering the cask.

The FTC loading station is classified as non-seismic, since the failure of the FTC loading station during a seismic event will not create any safety concerns.

6.4 Fire Hazards Analysis

The present fire analysis for this area (Zone 2) of the Fuel Handling Building includes the 305' Model Room, the 328', the 347' and the Truck Bay. The Model Room is technically a separate fire area from the remainder of the building but since the Atlas Door between the Model Room and the Truck Bay is normally open, it is included in the general area.

6.4.1 Characterization/Classification of Combustibles

Zone 2 of the Fuel Handling Building contains predominately ordinary combustibles, IEEE 383 qualified fire resistant cable, some cable not qualified per IEEE 383, rubber (various types) hoses, and lubricants contained in as built and recovery components/systems. The most significant fire problem in Zone 2 is the DOE Trailer (sprinkler protected) in the Model Room.

6.4.2 Location of Combustibles

The present fire loading is distributed between the 305' Model Room and the 347' Fuel Pool. The truck bay and dock contains few combustibles.

6.4.3 Fire Protection Features

The individual elevations have been pre-planned.

The Model Room and Fuel Pool have fire detection and hose standpipe systems. The Model Room Atlas Door to the Truck Bay could be shut if necessary to reduce combustibles. These and other fire protection features are shown on the attached pre-plan sketches (see figures 6-1 through 6-4). Also, Unit 1 erected the Environmental Barrier using a 2 hour fire rated design with seals rated at 3 hours However, the wall and seals are not subject to fire surveillance.

6.4.4 Fire Loading

The present fire loading for Zone 2 is 3.09 X 10^8 BTU or 13,800 BTU/ft^2. This equates to approximately a 10 minute fire loading with a peak temperature of approximately 1300°F (based on ASTM E119 Time Temperature Curve). An administrative limit of 80,000 BTU/ft^2 has been established (limit prior to additional reviews for fixed suppression modifications or compensatory measures such as firewatches). This 80,000 BTU/ft^2 limit represents approximately a 1 hour fire load with a maximum temperature of 1700°F.

6.4.5 Conclusions

- o The fire loads in the truck bay are presently very low with the principle concentration in the Model Room which can be isolated from the truck bay.
- o The installed detection system would provide notification of a fire to enable prompt extinguishment by the fire brigade.
- o The Environmental Barrier is of a 2 hour fire rated design and provides separation from TMI-1 with exception of the 347'.

7.0 IMPACT ON UNIT 1

Although the fuel handling building crane and the truck bay are shared by the two units, their use by one unit or the other will be determined by operational considerations on a case by case basis.

Because the Unit 1 and Unit 2 FHB both join a common area in the truck bay the activities described in this SER have been evaluated for the possible radiological impact on Unit 1. The following concerns were considered: liquid release, airborne release, and direct radiation.

The activities described in this SER do not present a credible potential for radioactive liquid release to Unit 1. Any transfer of liquid, such as by the dewatering system, is controlled and maintained within the Unit 2 FHB. Since the activities described in this SER are not expected to generate significant quantities of airborne radioactivity, no increase in airborne radioactivity in Unit 1 is expected.

During loading of the defueling canisters into the shipping cask, however, the canister sources may increase the gamma dose rates in the Unit 1 FHB. To minimize the impact on Unit 1 operations and personnel exposures, operations in Unit 2 will be carried out in such a fashion, that the expected dose rate in Unit 1 from Unit 2 activities will not exceed 2.5 millirem/hr. The truck bay is normally considered part of Unit 1, however no Unit 1 work will be performed in the truck bay area when Unit 2 fuel shipment activities are being performed, without approved procedures. Consequently, for the purpose of this dose assessment, the Unit 1/Unit 2 boundary was considered to be at the interface between accessible areas of the Unit 1 FHB and the truck bay. Specific points of interest are the 347'-6" el. of the Unit 1 FHB, the open stairway on the Unit 1 side of the truck bay, and the environmental barrier. The environmental barrier is an unshielded structure in the north side of the truck bay which provides a separation of the Unit 1 and Unit 2 atmospheres below the 347'-6" elevation.

The canister source term used to calculate the dose rates at the Unit 1/ Unit 2 boundaries was more conservative than that used to predict average dose rates to workers in Unit 2. Previous analyses were done to develop best estimates of anticipated dose rates. The analyses of Unit 1 dose rates were done to determine the maximum credible dose rate. Therefore, the source term used to predict Unit 1 dose rates included conservative parameters not used to provide best estimate average dose rates. These parameters use a maximum amount of cobalt-60 expected based on B&W material assay of cobalt-59 present in core structural materials and use of hot channel factor of 1.9 to account for areas of the core where higher specific activity of radioactive materials may occur. Other conservative parameters used in previous analyses, e.g., maximum loaded canister and no shielding credit for the canister or its internal structures, were maintained in the model used to determine the maximum credible dose rate in Unit 1.

Activities carried out within the confines of fuel pool 'A' will not affect dose rates in Unit 1, due to the distance to Unit 1, and the shielding provided by fuel pool 'A' concrete walls.

Canisters are transferred from the FTC loading platform to the shipping cask via the FTC. The canister is loaded into the FTC at the FTC loading station. The FTC is then moved along the west side of the FHB to the truck bay where it is lowered onto the shipping cask loading collar. The maximum dose rate at locations in Unit 1 from a single canister loaded in the FTC are given below for the following scenarios:

Activity	Dose Rates
FTC during transfer	1.6 millirem/hr at Unit 1 FHB el 347
FTC during transfer	1.7 millirem/hr at environmental barrier
FTC during transfer	1.7 millirem/hr at Unit 1 stairwell
FTC on shipping cask	0.3 millirem/hr at environmental barrier
FTC on shipping cask	1.7 millirem/hr at Unit 1 stairwell

In addition, the shipping cask may contain up to 7 canisters. The shipping cask was designed to meet Department of Transportation regulations for shipment on public highways. These requirements include a limit of 10 millirem/hour, 6.6 feet from the cask. The cask was designed to ensure that this limit would not be exceeded. The highest calculated dose rate from a fully loaded shipping cask was 6.3 millirem/hr at a distance of 6.6 feet (Reference 5). The total dose rate from a fully loaded shipping cask or from the FTC with a single canister and a shipping cask with up to six canisters is expected to be 2.5 millirem/hour or less at all accessible areas in Unit 1.

In conclusion, the activities described in this SER can be performed without an unacceptable increase in personnel exposure in Unit 1.

In addition, access to the FHB is gained via the FHB truck bay door. The aircraft missile shield for this door is controlled by Unit 1. Access to the FHB is frequently required during normal plant operations; therefore, Unit 2 use of this door for fuel shipping activities will not affect normal operation of Unit 1.

Section 6.0 of this SER demonstrates that the activities described in this SER will not have an unacceptable impact on the safe operation of TMI-1.

8.0 UNREVIEWED SAFETY QUESTION EVALUATION (10 CFR 50.59)

10 CFR 50, Paragraph 50.59, permits the holder of an operating license to make changes to the facility or perform a test or experiment, provided the change, test, or experiment is determined not to be an unreviewed safety question and does not involve a modification of the plant technical specifications.

10 CFR 50, Paragraph 50.59, states a proposed change involves an unreviewed safety question if:

a. The probability of occurrence or the consequences of an accident or malfunction of equipment important to safety previously evaluated in the safety analysis report may be increased; or

b. The possibility for an accident or malfunction of a different type than any evaluated previously in the safety analysis report may be created; or

c. The margin of safety, as defined in the basis for any technical specification, is reduced.

Canister handling and preparation for shipping is similar to normal spent fuel handling and shipping preparation. However, due to the nature of the TMI-2 fuel, certain additional activities are required that are not part of normal defueling activities. These activities include movement of canisters to a dewatering station, dewatering of canisters, weighing of canisters, and the use of a loading station and transfer cask. Normal fuel shipping activities place the shipping cask in the spent fuel pool whereas TMI-2 will use the FTC to move fuel canisters to the shipping cask located in the FHB truck bay. Although both activities are basically similar, minor variations exist. The planned activity is assessed below.

Transfer to the dewatering station, final dewatering, weighing, and transfer to the loading station are accomplished either underwater or within the canister transfer shield and involve a single canister. The types of activities required for this process are similar to those described in Reference 2 and the safety aspects of heavy load handling in fuel pool A are addressed in the SER for Heavy Load Handling Inside Containment (Reference 3). Additionally, dewatering activities are similar to the dewatering performed for SDS vessels.

The loading of the fuel canisters into the shipping cask is similar to normal fuel shipping activities. Fuel canisters are loaded into the FTC in fuel pool "A" and transported to the truck bay via a specified load path. This operation is similar to spent fuel transfer from the fuel racks to a shipping cask. The proposed activity varies from normal in that normally fuel bundles are loaded into a shipping cask under water where the proposed activity loads a single canister into the FTC which is above water. However, the canister is raised directly into the FTC from a submerged position and the FTC is shielded to compensate for the loss of water shielding. Additionally, as stated in this SER, the FTC is designed to meet NUREG-0612 and to provide single failure proof protection against the drop of a canister during transport. The movement of the FTC to the FHB truck bay is along a safe load path, as defined by Section 5.1.1 of NUREG-0612. Although the dropping of a canister is not considered to be a credible event, the consequences of a drop have been evaluated and are bounded by the analysis presented in Reference 11.

The loading of canisters into the canister shipping cask from the FTC may be compared to the loading of fuel assemblies into a shipping cask underwater. In each case the entire operation is shielded, the first by lead and the second by water. Note that the proposed fuel shipping activities involve more transfers from the fuel pool to the FHB Truck Bay than normal fuel shipping since only one canister is transferred at a time. The proposed loading operation is heavily shielded via the design of the FTC and the SCLC. Additionally, accidents involving more than one canister are precluded by design features. The canister shipping cask is designed to comply with the requirements of 10 CFR 71.63(b). The cask restraint system is designed to keep the cask upright under seismic conditions; since a drop of the FTC onto the canister shipping cask is not considered credible, an accident involving more than one canister in the shipping cask is not considered credible. However, the consequences of postulated events have been analyzed and are bounded by the analysis presented in Reference 11.

10 CFR 50.59 REVIEW

To determine if canister handling and preparation for shipment activities involve an unreviewed safety question, three questions must be evaluated.

Has the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety previously evaluated in the Safety Analysis Report been increased?

A variety of events have been postulated in this SER. It has been demonstrated that these events are bounded by events in several documents previously submitted to the NRC. By analyzing the postulated events, it has been demonstrated that canister handling and shipping preparation activities will not increase the probability of occurrences or the consequences of an accident or malfunction of equipment important to safety over those previously evaluated.

Has the possibility for an accident or malfunction of a different type than any evaluated previously in the safety analysis report been created?

This SER considers the spectrum of event types which potentially could occur during canister handling and preparation for shipment and compares these activities to those associated with a 'normal' refueling and with similar activities in previously submitted SER's. These evaluations demonstrate that the type events postulated in this SER are similar to and are bounded by previous SER's and the TMI-2 Final Safety Analysis Report (TMI-2 FSAR). Therefore, the canister handling and preparation for shipping process has not created the possibility of occurrence of an accident or malfunction of a different type than evaluated in previously docketed licensing submittals.

Has the margin of safety, as defined in the basis for any technical specification been reduced?

Technical Specification safety margins at TMI are concerned with criticality control and releases to the environment. As demonstrated by this Safety Evaluation Report, Technical Specification safety margins will be maintained throughout fuel handling and fuel shipping preparations. Subcriticality is maintained by design of the canisters, the FTC, and the shipping cask.

Potential releases to the environment are limited by design of the canisters and casks and by the FHB ventilation system and are bounded by previously submitted SERs.

SUMMARY

In conclusion, the canister handling and preparation for shipment activities do not:

- o increase the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety previously evaluated in the TMI-2 FSAR and SER's, or
- o create the possibility for an accident or malfunction of a different type than any evaluated previously in the TMI-2 FSAR, or
- o reduce the margin of safety as defined in the basis for any technical specification.

Therefore, the canister handling and preparation for shipment activities do not constitute an unreviewed safety question. Furthermore, no Technical Specification changes are required to conduct the activities bounded by this SER.

9.0 ENVIRONMENTAL ASSESSMENT

The activities associated with canister handling and preparation for shipment have been assessed and it has been concluded that these activities will be performed with no unacceptable consequences to the health and safety of the public or workers.

Releases to the public resulting from planned canister handling activities are not expected to be significant. Past releases of radioactivity to the environment have been well within the limits of the TMI-2 Environmental Technical Specification. Specifically regarding the potential for a tritium release, Section 5.2.1 states why releases to the environment will not be significant. In order to further limit the potential for environmental releases due to canister handling, loose contamination will be removed by spraying the canisters, the FTC bottom doors will be closed during canister transfer and the canisters will be sealed during all handling activities.

A single accident with the potential for off-site dose consequences has been evaluated. This accident is the dropping of a defueling canister. The analysis of this accident was performed using extremely conservative assumptions in order to provide bounding results. Using the conservative assumptions the results were found to be within past analyses that have been found to have acceptable consequences. The canister drop resulted in doses that were less than a fuel handling accident as described in the TMI-2 FSAR.

Therefore, the planned activities will be performed with no significant environmental impact.

10.0 CONCLUSION

The descriptions and evaluations presented in this SER demonstrate that activities associated with fuel canister handling and preparation for shipment will be performed in a safe manner. Accident conditions will not result in a criticality event nor will they cause site release levels which exceed allowable limits. Normal site releases are also shown to be within allowable limits. Consequently it can be concluded that the activities described in the SER can be performed without unacceptable risk to the health and safety of the public.

11.0 REFERENCES

1. NRC Letter from B. J. Snyder to B. K. Kanga dated January 5, 1984.
2. Safety Evaluation Report for Defueling of the TMI-2 Reactor Vessel, 4350-3261-85-1, Revision 10, May 5, 1986.
3. Safety Evaluation Report for Heavy Load Handling Inside Containment, 4350-3153-85-1, Revision 3, June 2, 1986.
4. NRC Letter from J. F. Stolz to H. D. Hukill dated January 11, 1985.
5. Safety Analysis Report for the NuPac 125-B Fuel Shipping Cask, Revision 2, May 1985.
6. NRC Generic Letter 81-07, "Control of Heavy Loads", December 22, 1980.
7. NRC Letter from B. J. Snyder to G. K. Hovey dated February 27, 1981.
8. NRC Generic Letter 85-11, Completion of Phase II of "Control of Heavy Loads at Nuclear Power Plants" NUREG 0612, June 28, 1985.
9. NRC Letter from B.J. Snyder to F.R. Standerfer dated July 17, 1985.
10. Evaluation of Heavy Load Handling Operations at TMI-1, Fuel Handling Building, November 16, 1983, TERA Corporation.
11. Safety Evaluation Report Supporting Exemption from Seismic Design Requirements, SA #4430-7322-85-1, Revision 0, April 1985.
12. TMI-2 Defueling Canisters Final Design Technical Report, B&W Document 77-1153937-05, March 1986.
13. Criticality Report for the Reactor Coolant System, Revision 0, October 1984.
14. Hazards Analysis: Potential for Boron Dilution of Reactor Coolant System, Revision 2.
15. Technical Evaluation Report for Defueling Canisters, 3527-016, Revision 2, March 1986.
16. Safety Analysis Report for Transportation of TMI-2 Core Debris to INEL, September 1985.

17. Evaluation of Special Safety Issues Associated with Handling the TMI-2 Core Debris GEND-051, Rockwell Handford Operations, June 1985.