SAFETY ANALYSIS

SA No. 4700-3882-89-01

Rev. No. 0

Page 1

of 12

TITLE

SAFETY EVALUATION REPORT FOR USE OF

POLAR CRANE AUXILIARY HOOK ABOVE THE INCORE INSTRUMENT SEAL TABLE

TO WITHDRAW INCORE INSTRUMENT STRINGS

Originator Jennifer Regan Date 10/19/89 (17 revised 10/24/89)

CONCURRENCE

Lead Engineer W Kelly Date 10/17/89 SRG [signature] Date 10/25/89

RTR Robert F Ryan Date 10/18/89

Design Cognizant Engineer Robert F Ryan Date 10/18/89 Rad Con J Cavanaugh Date 10/18/89

APPROVAL

Mgr Eng. Section DR Bauhan Date 10/26/89 Site Ops Director G.A. Kuehn per telecon Date 10/25/89

Rev.	SUMMARY OF CHANGE	Approval	Date
0	Initial submittal.		10/89

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Background

Reference 1, submitted for NRC review and approval, is a Safety Evaluation Report (SER) for removal of metallurgical samples from the TMI-2 Reactor Vessel. As part of that sampling project, metallurgical samples will be removed at incore instrument penetration locations in the Reactor Vessel lower head. Prior to removal of these samples, the incore instrument strings must be withdrawn about 2 to 3 feet at the incore instrument seal table. The most simple and safe method for retracting the instrument strings is to rig the incore housing on the incore instrument seal table to the polar crane auxiliary hook. Alternate methods, such as fixed rigging to a nearby structure or bridging the seal table, would increase personnel exposure and contamination risks by requiring prior set up and then movement for withdrawal of each incore string. In addition, the polar crane provides the required verticality for withdrawal of the closely toleranced incore housings. The weight of the polar crane auxiliary hook and block constitute a heavy load (i.e., 2400 pounds or greater); therefore, suspension or travel over the incore instrument seal table requires NRC approval of a docketed SER pursuant to References 2 and 3.

1.2 Purpose

The purpose of this SER is to demonstrate that use of the auxiliary polar crane hook above the incore instrument seal table for the 2 to 3 foot withdrawal of selected instrument strings can be accomplished without adversely affecting the health and safety of the public. Specifically, this SER provides a NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants," evaluation of a postulated heavy load drop over the incore instrument seal table.

1.3 Scope

This evaluation addresses use of the polar crane auxiliary hook to withdraw incore instrument strings from above the incore instrument seal table. The crane will be positioned over the table and the hook connected to a chain fall which will be used to pull the selected incore housings up, one by one, using the rigging typified in Figure 1. (Note that all lifting will be in accordance with GPU Nuclear's established lifting and handling program.) Therefore, this SER evaluates the affects of a postulated load drop of the crane hook and block (i.e., approximate total weight of 3350 pounds) onto the incore seal table. No heavy load will be carried by the polar crane during this activity.

2.0 DESCRIPTION OF ACTIVITIES

2.1 Prerequisites

It is important to recognize that this operation will take place after all Reactor Vessel defueling activities have been completed. Once this defueled condition exists, all remaining risks of operations in

containment, such as withdrawing the incore instrument strings, are minimal. Specific prerequisites are listed below.

- The Reactor Vessel and Reactor Coolant System will have been defueled to the extent reasonably achievable as required by the TMI-2 Technical Specifications (Reference 3). Mode 1 controls will remain in place to assure subcriticality of the remaining residual fuel.

- The polar crane will be operated by qualified personnel trained in the operation and safety of the crane.

- An approved procedure applicable to the activity is available.

- The crane and attachment points shall have been inspected and tested in accordance with approved procedures.

2.2 Polar Crane Activities

The polar crane will be positioned such that the auxiliary hoist (load capacity 25 tons, Reference 4) is located directly above the incore seal table. The load path of the auxiliary hoist will not pass over the "A" D-ring, an exclusion area. The hook will be lowered so that a withdrawal assembly similar to Figure 1 can be attached to the hook and rigged to the incore housing. Using a chain fall to increase tension, the incore instrument string will be withdrawn 2 to 3 feet. The maximum applied tensile load, as measured by the load cell, will likely be less than 4000 pounds, the ultimate tensile strength of the incore instrument string. A safety line will be tied to the walkway or another local structure to restrain the withdrawal assembly in case the incore string should break. Once the string is withdrawn, the load cell hook assembly will be removed from the cover closure (see Figure 1), and will be attached to an installed cover closure on the next selected incore housing, where the process will be repeated. The withdrawn instrument strings will be tied to the walkway above with a lanyard. Approximately 10 to 15 incore strings will be withdrawn in this fashion.

3.0 SAFETY CONCERNS

3.1 General

This activity requires no heavy load handling. The polar crane auxiliary hook will be used only to provide sufficient tension to withdraw incore instrument strings. Therefore, the only risk for heavy load drop is the crane equipment itself, which is highly improbable given that the crane will have a tensile load of approximately 8% of rating (Reference 5). The polar crane main hoist will not be used. It will be de-energized and secured such that a drop is not credible. Furthermore, it is not possible to extend the main hoist beyond the outer periphery of the seal table.

The incore withdrawal will not take place until all Reactor Vessel defueling activities are complete; thus, any safety concern associated with a heavy load drop are much less than during the actual defueling operations described in Reference 6 since Mode 1 controls will remain in place.

3.2 Heavy Load Drop Evaluation

There will be no heavy load handling associated with the incore withdrawal. Therefore, the only load which could fall and impact the seal table or surrounding area is the crane equipment itself. This is highly improbable given that the crane will be parked and the auxiliary hoist used as a skyhook to hold a tensile load of about 4000 pounds, or approximately 8% of the rated load capacity of the auxiliary hook. Furthermore, the hook and enclosed block assembly, including cabling, are inspected at regular intervals in accordance with GPU Nuclear's load handling program, which incorporates the elements referenced in Generic Letter 81-07 and NUREG-0612.

The polar crane main hoist will not be used. It will be de-energized and secured such that a drop is not credible. Furthermore, it is not possible to extend the main hoist over the seal table. In the unlikely event that the polar crane auxiliary hook and block were to fall on the incore instrument seal table, it could cause rupture somewhere along the length of one or more incore instrument string guide tubes. Because the guide tubes are rigidly supported at the bottom of their J-curve shape, a heavy load drop on the seal table might cause buckling and possible local fracture along the long vertical run of tubes under the seal table (see Figure 2). This could cause, in the worst case, a leak in one or more tubes below the Reactor Vessel. The seal table design load capability is 1300 pounds per square foot (Reference 7). The projected area of the auxiliary hook and block is approximately 5 square feet (Reference 4), and would present a load of about 700 pounds per square foot, neglecting dynamic effects since it would likely fall from 10 feet or less above the table. The face area would likely impact between 3 and 6 incore housings. Therefore, it is not considered credible that more than 6 incore tubes would rupture below the Reactor Vessel water level.

Reference 8 states that a 360° rupture in one incore tube at the bottom of the long vertical run will result in a calculated maximum leakage rate of 2.5 to 4.5 gpm, depending upon distance between the break and the vessel. These calculations assume full Reactor Vessel inventory and a fully open annular area between the incore instrument and its tube (i.e., no pluggage or restriction by debris in the bottom of the vessel). Therefore, possible leakage rates due to incore seal table damage and resultant incore tube damage are considered small and within the bounds of incore leakage rates described in current NRC-approved SERs (e.g., Reference 9).

3.3 NUREG-0612 Criteria Specific Evaluations

This section evaluates the result of a postulated drop of the polar crane auxiliary hook and block onto the incore instrument seal table to the criteria set forth in NUREG-0612.

3.3.1 Criterion I::

Releases of radioactive material that may result from damage to spent fuel based on calculations involving accidental dropping of a postulated heavy load produce doses that are well within 10 CFR Part 100 limits of 300 rem thyroid, 25 rem whole body (analyses should show that doses are equal to or less than 1/4 of Part 100 limits).

Response to Criterion I:

Any activity releases caused by the load drop addressed in this SER would be released within containment. The containment would act as a physical barrier and prevent any liquid releases from escaping to the environment. Likewise, any additional particulates that may become airborne would be removed by the high efficiency particulate air (HEPA) filters so as not to exceed the limitations established in Criterion I.

A bounding analysis was performed and is documented in Reference 10 (for Krypton 85) which showed that even when using "worst case" assumptions (instantaneous total release with no containment), the maximum whole body dose is 9.7 millirem compared to a limit of 6250 millirem.

3.3.2 Criterion II:

Damage to fuel and fuel storage racks based on calculations involving accidental dropping of a postulated heavy load does not result in a configuration of the fuel such that Keff is larger than 0.95.

Response to Criterion II:

The potential for a recriticality event due to a load drop during incore removal is greatly reduced from the potential during defueling activities since the maximum amount of fuel remaining at the end of defueling is expected to be less than or equal to 1% of the original fuel load. However, a boron concentration equal to or greater than 4350 ppm will be maintained in the RCS during this activity which ensures subcriticality under all credible conditions. Reference 11 conservatively demonstrates that with the RCS maintained at a boron concentration of at least 4350 ppm, no re-configuration of the fuel debris in the Reactor Vessel, including a re-configuration resulting from a heavy load drop, can cause criticality. Reference 11 states that Keff is less than 0.99 at 4350 boron concentration and shows that Keff should be

less than 0.97 at 5000 ppm boron concentration. These are conservatively calculated Keff; actual Keff is much lower. Therefore, these values meet the intent of the criterion and are adequate for the proposed activity. The RCS is normally maintained at a boron concentration of greater than 5050 ppm. In the event that a load drop causes vessel leakage, the makeup capability exists to maintain the Technical Specifications required RCS boron concentration (i.e., 4350-6000 ppm). Additionally, the defueling activities will have been completed; thus, a load drop on the seal table is not likely to reconfigure fuel in the vessel or result in substantial transport of fuel from the vessel to the Reactor Building basement. The controls discussed in Section 4.13 of Reference 12 to ensure subcriticality of potential leakage into the Reactor Building basement will continue to be maintained during the sampling activities; therefore, criticality will be precluded.

3.3.3 Criterion III:

Damage to the Reactor Vessel or spent fuel pool based on calculations of damage following accidental dropping of a postulated heavy load is limited so as not to result in water leakage that could uncover the fuel (makeup water provided to overcome leakage should be from a borated source of adequate concentration if the water being lost is borated).

Response to Criterion III:

As described in Section 3.2, it is highly unlikely that impact of a polar crane auxiliary hook and/or block on the incore instrument seal table would rupture a sufficient number of incore tubes below the Reactor Vessel lower head elevation to the drain the vessel. Each incore tube failure would result in a maximum leak rate of 4.5 gpm (Reference 8) which is well within the plant's capability to makeup water to the Reactor Coolant System using gravity feed or pumping. Therefore, it is highly unlikely that a drop of the polar crane auxiliary hook and/or block onto the incore instrument seal table would result in leakage that could uncover the fuel.

3.3.4 Criterion IV:

Damage to equipment in redundant or dual safe shutdown paths, based on calculations assuming the accidental dropping of a postulated heavy load, will be limited so as not to result in loss of required safe shutdown functions.

Response to Criterion IV:

As described in Section 3.3.2, the proposed activity does not jeopardize the safe shutdown condition of the TMI-2 facility since any potential incore leakage due to this activity is bounded by previous NRC-approved SERs. Additionally, the

possible off-site releases are discussed in Section 3.3.1 and are within regulatory limits. Consequently, safe shutdown will be maintained for the load drop accident postulated in this SER.

4.0 RADIOLOGICAL CONSIDERATIONS

Radiological considerations for withdrawal of incore instrument strings, such as occupational exposure, are discussed in Reference 1. Further details and special precautions will be provided in documents generated for the task including procedures, unit work instructions, and radiological review documentation.

5.0 10 CFR 50.59 EVALUATION

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. 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 analyses report may be created; or

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

The descriptions and evaluations presented in this SER demonstrate that incore instrument string withdrawal using the polar crane auxiliary hook will be performed in a safe manner and is highly unlikely to result in a heavy load drop accident. However, should the crane hook and block fall, this SER demonstrates that any damage to the incore instrument tubes will be limited such that the reactor will remain in a safe condition, and any potential increase in radioactive releases will be within allowable limits. It is, therefore, concluded that withdrawal of the incore instrument strings using the polar crane auxiliary hook and block can be performed without preventing undue risk to the health and safety of the public.

The planned use of the polar crane auxiliary hook and block to pull incore instrument strings will not increase the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety because the polar crane will be used in its normal capacity, to hold a very small tensile load. In the same respect, it will not create the possibility of an accident or malfunction of a different type. Even in the case of a heavy load, consequences are expected to be bounded by References 1, 2, and 10. Additionally, the polar crane auxiliary hook

has been successfully used for defueling-related activities over the Reactor Vessel (References 13 and 14). Thus, any potential accidents associated with use of the auxiliary hook are less severe than those associated with its use over the Reactor Vessel.

The bases for the applicable Technical Specifications are to maintain the fuel in a subcritical condition. As discussed in Section 3.1 and 3.2.2, it is expected that less than or equal to 1% of original fuel load will remain in the vessel when defueling is completed. Also, Mode 1 controls will remain in effect during this proposed activity which will assure the subcriticality of the remaining residual fuel.

Therefore, it is concluded that use of the polar crane auxiliary hook for withdrawal of the incore instrument strings does not involve any unreviewed safety questions as defined in 10 CFR Part 50, Paragraph 50.59.

6.0 REFERENCES

1. Safety Evaluation Report for Removal of Metallurgical Samples from the TMI-2 Reactor Vessel, Revision 0, 4000-3555-89-01.

2. Safety Evaluation Report for Heavy Load Handling Inside Containment, Revision 3, 4350-3153-85-1.

3. TMI-2 Operating License No. DPR-73 with Technical Specifications.

4. Whiting Corporation Drawing No. T-49725, "30 Ton Enclosed Block," Revision 1, September 9, 1969.

5. GPU Nuclear letter 4410-85-L-0084, "TMI-2 Auxiliary Hoist Load Test Results," dated April 18, 1985.

6. Safety Evaluation Report for Defueling the TMI-2 Reactor Vessel, Revision 10, 4350-3261-85-1.

7. Burns and Roe Inc. Drawing #4177, Revision 12, "Reactor Building Steel Framing Plan at El. 347'-6".

8. GPU Nuclear letter 4410-84-L-0154, "TMI-2 Technical Specification Change Request No. 46," dated November 6, 1984, F. R. Standerfer to Dr. B. J. Snyder.

9. GPU Nuclear letter4410-86-L-0122, "Extended Core Stratification Sample Acquisition Activity," dated July 11, 1986.

10. Safety Evaluation Report for Heavy Load Handling Over the TMI-2 Reactor Vessel, Revision 0, 4350-3153-85-2.

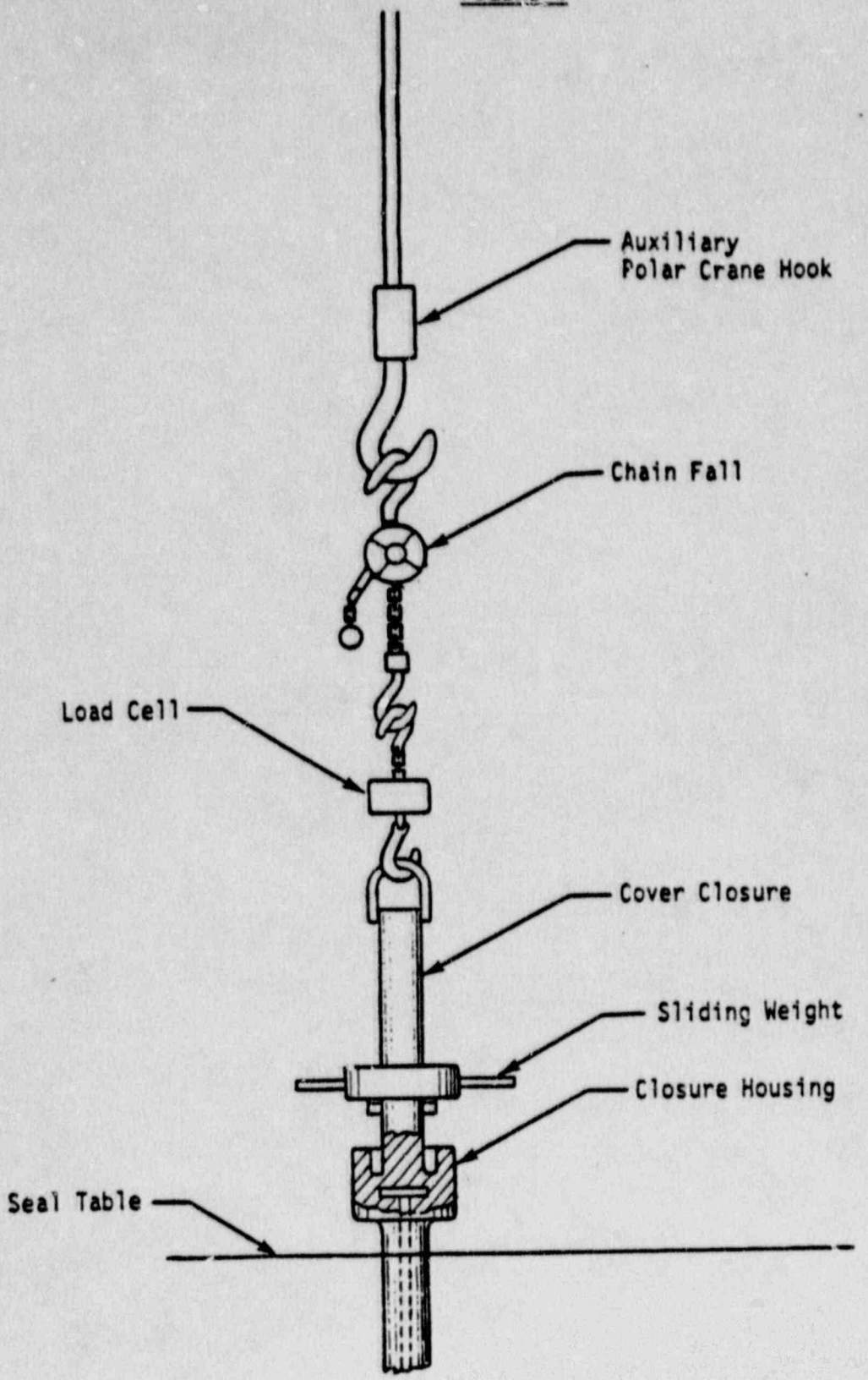
11. GPU Nuclear letter 4410-84-L-0199, "Criticality Report for the Reactor Coolant System at TMI-2," dated November 8, 1984.

12. Safety Evaluation Report for Lower Core Support Assembly Defueling, Revision 2, 4710-3221-86-0011.

13. GPU Nuclear letter 4410-89-L-0044, "Polar Crane Operations," dated May 3, 1989.

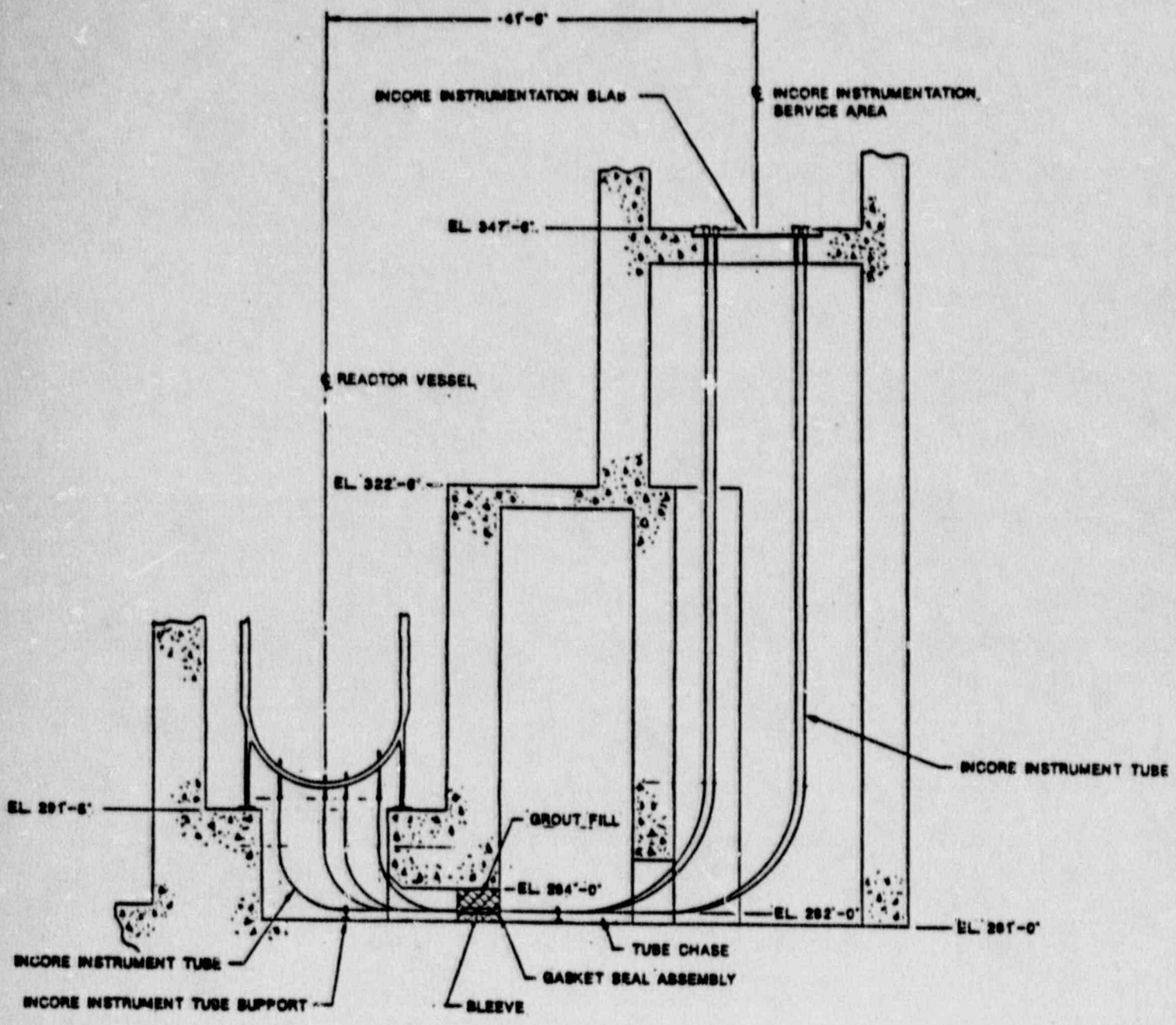
14. NRC Letter, "Use of Polar Crane Auxiliary Hook for Defueling," dated December 30, 1988.

FIGURE 1



TYPICAL WITHDRAWL ASSEMBLY

FIGURE 2



IN-CORE INSTRUMENT LAYOUT