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ADDITIONAL ADDENDA TO THIRD REPORT OF TAAG - Hmb-581-82

The attached addenda should be added to the TAAG report of August 31, 1982. The first addendum corrects the previous addendum (December 1, 1982); it is the proper copy of the Newport News Shipbuilding file of recommendations and is Appendix B of Section V-B. The second addenda (memorandum from TAAG on Closure Head and Fuel Removal Containment, 8/27/82) is Attachment IV-A1 of the TAAG report.

Please advise if you have not received a copy of the Third TAAG Report dated August 31, 1982, and a copy will be forwarded to you immediately.

Very truly yours,

H. M. Burton, Manager
Technical Information and Examination Program

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TO: File | FILE NO. TMI

FOR: Information | DATE July 16, 1982

FROM: G. W. Tucker and C. M. Ball

SUBJECT: Three Mile Island Unit No. 2 500-Ton Polar Crane - NNS Comments and Recommendations for Reactivation

References:

(a) Memo from G. W. Tucker (NNS) to File No. TMI dated May 6, 1982, Subject: Load Testing and Use of Three Mile Island Unit No. 2 500-Ton Polar Crane
(b) Telecon between C. A. Shorts (GPU) and G. W. Tucker (NNS) on July 2, 1982
(c) Letter from D. R. Buchanan, GPU Nuclear, to G. W. Tucker, NNS, File No. RE-0810 dated July 2, 1982
(d) Memo from G. W. Tucker to File No. TMI, dated February 5, 1982, Subject: NNS (OSND) Evaluation of Three Mile Island Unit No. 2 500-Ton Polar Crane

Enclosures:

(1) TMI 500-Ton Crane, Unit No. 2, Basis for NNS Electrical Evaluation to Reactivate Crane
(2) NNS Electrical Comments and Recommendatons for Reactivating TMI 500-Ton Polar Crane No. 2

Reference (a) contains recommendations for load testing the Unit No. 2 500-Ton Polar Crane at Three Mile Island (TMI) using test loads, i.e., missle shields and missle shield hold-down bolts, available in the area.

The purpose of this memo is to recommend steps to be taken to electrically reactivate the 500-Ton Polar Crane to minimize the chances for an electrical malfunction. These recommendations are based on continuity and meggar checks of the crane motor and control circuits as provided by references (b) and (c) and the equipment history summarized on enclosure (1).

NNS notes that between the two Bechtel test reports, provided by reference (c), some test results improved, some deteriorated and some remained the same. No explanation is provided for these changes, other than the approximate two week time lapse, so NNS has assumed that no other action was performed which might have affected the test results. Based on this evidence, NNS concludes that positive action needs to be initiated to stabilize and/or improve the results and that the results must be stabilized before the main crane power can be reactivated.

July 16, 1982

NNS comments and recommendations on procedures to establish acceptable electrical conditions permitting reenergization of the 500-Ton Polar Crane, Unit No. 2, are contained in enclosure (2).

The NNS mechanical and structural recommendations were previously provided by reference (d).

G. W. Tucker

G. W. Tucker

C. M. Ball

C. M. Ball

GWT/CMB/pkv

ENCLOSURE (1)

TMI 500-Ton Polar Crane, Unit No. 2, Basis for NNS Electrical

Evaluation to Reactivate Crane

1. The crane has been subjected to a "hydrogen burn" hot enough to melt a telephone and other plastics and to burn paper.

2. The crane has been subjected to a rapid radiation exposure level resulting in a total estimated exposure of 8 x 10^5 RAD's.

3. The crane and its associated control and power circuits are about 8 - 10 years old.

4. Electrical cables, having low temperature PVC insulation, has been reported as being damaged beyond repair.

5. The crane has been idle (unpowered) in a radiation area for about 3 years.

6. The crane has been idle in an extremely moisture laden, initially saturated steam, environment for about 3 years.

7. Two electrical inspections have been performed - the first during the week of May 10, 1982, and the second on May 26, 1982. No information has been provided identifying any work/changes that would affect the test, occurring between inspections.

8. The entire crane operator's cab and associated control and power circuits/systems will be totally disconnected and replaced with all new control and power cabling.

9. Much of the exposed copper surfaces i.e., motor slip rings, crane power rails, etc. are coated with a "green-colored" corrosion known as verdigris.

ENCLOSURE (2)

NNS Electrical Comments and Recommendations for

Reactivating TMI 500-Ton Polar Crane No. 2

1. Megger and continuity checks of motor windings is a good initial indication. Environmental conditions during and subsequent to the accident would subject windings to excessive quantities of moisture. This moisture must be removed.

Motor Renovation.

1.1 If the condition of a motor is questionable after performing megger checks, additional data can be obtained by performing non-destructive DC high potential tests as outlined in Appendix I. Only experienced operators should perform this test because improper operation of the DC potential tester can become destructive to the installed equipment.

1.2 Moisture can be removed from motors by applying external sources of heat/forced air etc. to motors. Work tents around motors may be required for heating. Another method is to circulate current in windings as required to remove moisture. The internal heaters in motors should be continuity and megger checked. If satisfactory, these heaters should be permanently re-energized when crane is not in service. These internal heaters are not believed to have sufficient capacity to dry out windings.

1.3 Slip rings on wound rotor induction motors shall be cleaned and polished. Appendix II provides guidelines for this.

1.4 Visually inspect windings for cleanliness. Remove dirt and foreign matter with compressed air and/or vacuum if possible. Use cleaning solvents on windings as a last resort.

1.5 Replace/repair motor rotor resistors and wiring as required.

1.6 Prior to attempting to energize motor, operate rotor by hand, if possible, to determine that it is free to turn.

1.7 After megger, continuity, cleaning, drying, inspecting, etc. with satisfactory results, motors are considered safe for energization.

2. Electrical cables, motors and other components have been reported as having been subjected to a rapid radiation exposure of 8×10^5 rads. This exposure level exceeds that normally considered acceptable for some types of polytetrafluoroethylene (teflon) insulation and approaches "recoverable" limits for most electrical insulation materials, i.e., polyethylene, silicon rubber, polyimides and irradiation - modified polyolefin. According to a radiation effects study published by NASA in 1969, (Ref. Radiation Effects Information Center Report No. 46) most of these materials recover to their pre-exposure parameters, or within one or two orders of magnitude of their initial levels, when the radiation exposure is terminated. In some cases, permanent decreases in dielectric strength were noted.

Besides the electrical characteristics, temporary and/or permanent damages may have occurred to the physical properties of the materials. Similar effects occur to organic insulating materials and to encapsulating compounds, such as resins, but generally at doses above 10^6 rads gamma.

If any of the circuits were energized and failed during the high radiation exposure, permanent electrically induced damage (shorts) may have occurred during the weakened state of the electrical insulating materials.

Combined effects of high radiation, high temperature and high humidity are not known. Since the reported environment approached radiation levels known to be hazardous to electrical insulations, NNS recommends that all cables be thoroughly megger tested and replaced, if required, before being re-energized. In addition, cables designed for flexible service should be flexed, then retested to check for physical failures (cracks developing in the insulation materials). Other than by megger checks, damage to insulating compounds on the motor windings may be more difficult to detect and NNS recommends that the critical motors and windings (brakes, etc.) be carefully watched during no load and load testing and, if possible, be remeggered between no-load and load testing. Readings should be compared with pre-energization megger test.

3. Circuit Overcurrent Protective Devices

3.1 All fuses should be replaced prior to energization.

3.2 Circuit breakers should be both operational and load tested or replaced with new units prior to energization.

4. After testing, repairing, replacing, etc. to make the crane operational, it should be run through all operations (hoists, trolleys, etc.) at no load prior to attempting to load test crane. An energized, no run "baking-out" period is recommended to determine if energization alone will cause circuit failures, before circuit operation is attempted. Operating duration and circuit loads should be conducted in progressive stages.

5. NNS recommends any cabling and other electrical components removed from TMI be retained and offered to both the DOE and NASA for electrical and physical testing of the damage caused by combining radiation, heat and humidity- all at the same time.

APPENDIX I

DC HIGH POTENTIAL TESTS. Dc high potential tests are made by applying dc voltage in steps and recording leakage current (microamperes) through the insulation. The voltage and current is plotted on cross-section paper and the shape of the resultant curve is used for checking the cleanliness and moisture content of the machine tested.

A. Applicability. The dc high potential test is prefered during overhaul to determine cleanliness and moisture content of insulation before or during shop reconditioning of equipment since it is less destructive than ac testing. Ac high potential testing should be used as a final shop test on reconditioned or new equipment to detect faulty insulation.

1. All naval shore repair facilities, tenders, and repair ships, are authorized to use the dc high potential test method in the maintenance and overhaul of electrical rotating equipment of 5 HP (or KW) and above.

2. The following test equipment and procedures for testing are applicable.

TABLE I-1. VOLTAGE FOR HIGH POTENTIAL TESTS ON GENERATORS AND MOTORS

	Circuits which have been reconditioned but not rewound or replaced, hence, not restored to a condition which should be as good as new			Circuits which have been rewound or replaced, hence, restored to a condition which should be as good as new		
	Armature circuits of a c and d c machines	Field circuits of a c machines	Shunt field circuits of d c machines	Armature circuits of a c and d c machines	Field circuits of a c machines	Shunt field circuits of d c machines
Generators and motors, including propulsion generators and motors, but excluding all machines listed below.	¾ (2×E+1,000)	7×V but in no case less than 1,000 volts nor more than 2,250 volts.	¾ (2×V+1,000)	2×E+1,000	10×V but in no case less than 1,500 volts nor more than 3,500 volts.	2×V+1,000.
Propulsion generators and motors on electric-drive battleships.						
Generators and motors of not more than 250 volts and not more than 0.25 kilowatts (generators) or 0.5 horsepower (motors), except machines listed below.	600	600	600	900	900	900.
Bracket fan motors	450		450	600		600.
Generators and motors of not more than 35 volts, except engine starting motors.	350	350	350	500	500	500.
Engine starting motors, not more than 35 volts.	500		500	750		750.
Generators and motors which have been temporarily reconditioned after submergence.						

a. The tester should be able to vary voltage smoothly from zero up to maximum required.

b. The micro-ammeter should have sufficient ranges to provide readings from less than 1 to at least 2500 microamperes.

c. A maximum voltage of not less than 5000 is recommended for at least one tester at each activity.

d. It is recommended that each activity have at least two testers. One should be small enough to be carried through ship hatches.

e. Tester should be provided with a protective current relay which can be set to trip at any any given percentage of the micro-ammeter scale. This is to prevent insulation failure when the leakage current rises sharply.

f. Dc high voltage testers are available from (among others) the following:

James G. Biddle Company Model 22005-PR
Plymouth Meeting, Pennsylvania
19462

Associated Research, Inc.
3780 W. Belmont Street
Chicago, Illinois 60618

B. Test Procedure. The following instructions apply to making dc high voltage test on electrical equipment.

1. Maximum dc voltage to be applied to equipment containing old insulation should not exceed 1.1 (2E + 1000) (E = rated voltage).

2. Maximum dc voltage to be applied to equipment containing all new insulation should not exceed 1.6 (2E + 1000).

3. Dc high potential tests are to be made by attaching the positive terminal of the tester to the copper and the negative terminal to the iron.

4. Approximately 25% of the calculated maximum test voltage should be applied and the leakage current recorded. The current relay should then be set to approximately four times this value. The current relay may be adjusted upward for gradually rising current values. The test should be stopped whenever a sharp rise in current is obtained. A curve should be plotted as the readings are taken and usually at least eight points should be taken up to full voltage. The data for each point should be taken after the current becomes steady (this may require several minutes on large machines). The machine temperatures should be recorded. The curve scales should be selected to suit the leakage current being obtained. On some machines this will be less than one micro-ampere. On others it may be in the thousands of micro amperes.

5. Take 500-volt megger tests before and after the dc high potential test. The megger readings taken after each test should be recorded on the curve sheet. After both megger and dc high potential test are made, the copper should be grounded for a sufficient time for the motor or generator to become completely discharged. This may require as much as ten minutes or even longer on large ac machines. After the

ground wire has been removed, a check for remaining charge can be made by attaching the dc high potential tester with its dial in the discharge position. When the meter switch is turned to the low scale position, the micro-ammeter will move off zero if any charge remains. Failure to completely discharge the machine being tested will produce inaccurate megger readings taken after dc high potential tests.

6. Dc high potential curves should be obtained prior to starting overhaul and after each major step in the overhaul procedure. In this manner improvements can be noted as the work progresses.

7. A typical set of curves for a large 1000-KW 415-VDC diesel-driven generator is shown in figure I-2. On large rotating equipment such as submarine and surface ship propulsion motors and generators, a flat low leakage line as illustrated should be obtained before reinstallation in the ship. For example, even though a generator showed 150 megohms after a second cleaning and drying, an additional period in the drying oven removed the hook and lowered the whole curve. For smaller and less important units the cleaning and drying work may be stopped after the second cleaning and drying step.

8. When dc high potential tests are made, ac high potential tests are to be omitted.

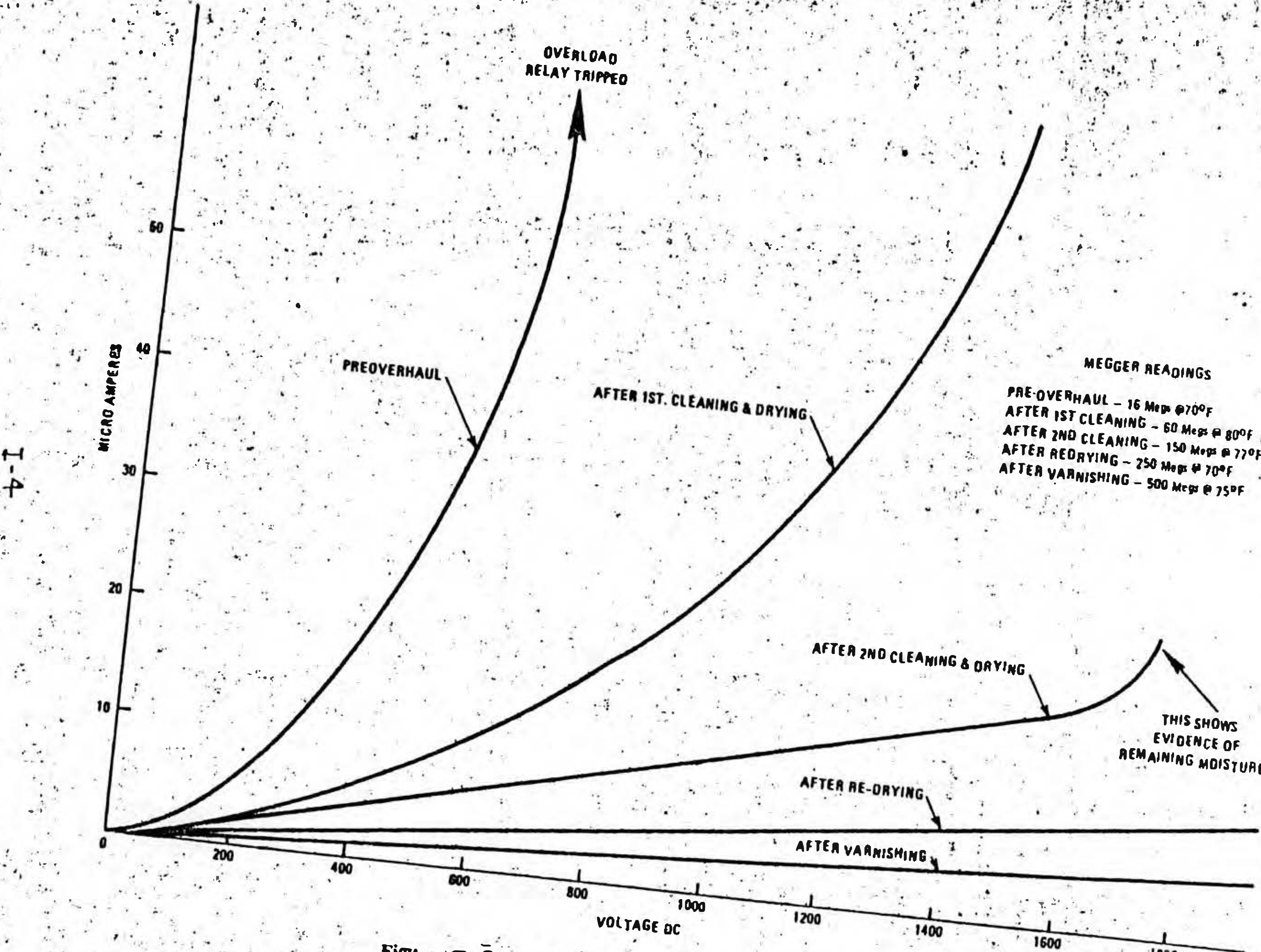

Figure I-2. Typical DC High Potential Test Curves
NOTE: Curves plotted are for a 1000-KW 415-VDC Generator

APPENDIX II

COLLECTOR RINGS AND BRUSHES ON AC GENERATORS (MOTORS). These items on ac generators should be given the same careful attention as the commutator and brushes of dc generators.

1. To obtain and maintain good, polished surfaces:

   a. Inspect the brushes regularly to see that they move freely up and down in their holders.

   b. Keep the rigging free from dust, oil, salt, lint, metal particles, and dirt.

   c. Brushes need no lubrication and the rings should be kept free from coating and scaling of any kind by cleaning periodically.

   d. Inspect the working surfaces of the brushes occasionally and keep the full surface bearing on the rings. To prevent the formation of brush slivers, make sure that the brushes do not extend beyond the edges of the rings.

2. Scoring of collector rings is usually due to hard particles which become imbedded in the brush contact surfaces, or to incorrect grade of brush. This should be corrected by resanding and refitting the brushes, or by changing the grade of brush.

3. Flat spots or pitting may develop on collector rings from any one of the following causes:

   a. Black spots sometimes appear on collector rings. In themselves, they are not serious, but if they are not immediately removed (at the first securing of the generator) by rubbing lightly with fine sandpaper, pitting and flat spots will result, necessitating grinding of the rings.

   b. If a generator is allowed to stand secured in moist salt air, an electrolytic action may take place between the brushes and rings causing a rough imprint of the brushes on the rings. With the generator in operation, the brushes will jump at the passing of each of these rough spots, forming a small arc, thus causing flat spots due to pitting. To prevent such action it is good practice, when secureing the generator for an appreciable period of time, to lift the brushes off the rings and place some insulating material such as Nomex between the brush and the commutator. Be sure to remove the insulating material before energizing the equipment. As an alternative, remove the brushes entirely.

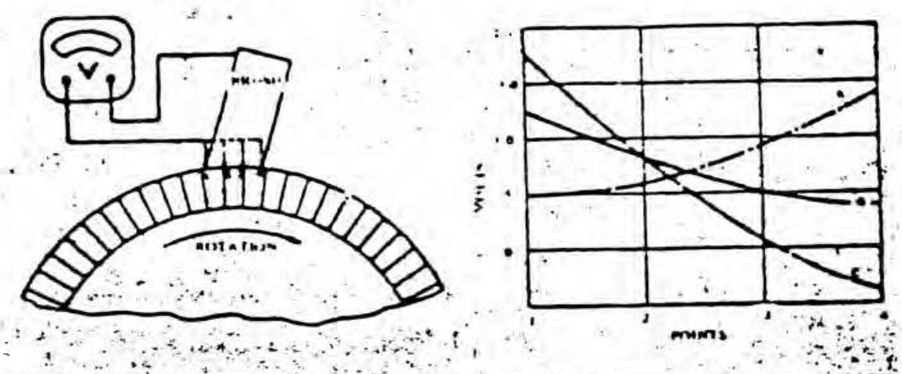

FIGURE II-1. Checking Commutator Pole Strength.

c. If a generator is allowed to stand secured in ordinary moisture or acid fumes, the area of the collector rings not covered by the brushes may be corroded. The best way to prevent corrosion, electrolytic action, pitting, and flat spots is to run the generator for a short time every day.

d. A slight unbalance in the rotor may cause the brushes to jump at each revolution. The resulting small arc will leave an imprint of each brush on the ring to induce pitting and flat spots. Flat spots due to rotor unbalance always occur at the same place on the rings relative to the rotor. Those due to any of the other above causes occur at any point where the machine happens to stop when secured.

e. Flat spots, due solely to brush friction, may develop where the rings are not of uniform hardness. The only cure for this is to replace the rings.

f. Flat spots or an imprint of brushes on the rings may be caused by sticking and cocking of the brush in the holder, instability of the brush holer, or light brush pressure.

g. Pitting sometimes develops because of the electrolytic action on the surface of the rings caused by current flow. Sometimes it will be evident in one ring only. This pitting is general over the whole ring area and does not cause localized flat spots. When this condition is observed, reverse the polarity of the rings. Keep the rings under frequent regular observation and, it pitting and discoloration tend to become unequal in the other direction continue to reverse the polarity at intervals as found necessary to maintain equality in the surface condition. Leads to the collector brushes or at the switchboard should be made long enough to permit this reversal of polarity. This reversal of the polarity of the rings will in no way affect the phase rotation of the generator.

h. Pitting and burning will result if the field current is allowed to flow through the collector rings while the machine is secured.

i. In severe cases, pitting must be removed by turning or grinding. The rings should then be polished to a mirror finish by the use of crocus cloth with the machine running at normal speed. In light cases the rings may be dressed with sandpaper, followed by polishing with crocus cloth.

(REF. D)

FILE: (THREE MILE ISLAND)

NN 26 (3321120)

INTER-OFFICE COMMUNICATION

NEWPORT NEWS SHIPBUILDING AND DRY DOCK COMPANY

A Tenneco Company

TO: File

FILE NO. TMI-

FOR: Information

DATE February 5, 1982

FROM: G. W. Tucker, OSND

SUBJECT: NNS (OSND) Evaluation of Three-Mile Island Unit No. 2 500-Ton Polar Crane

References:
- (a) Technical Note No. N-1594, Nondestructive Test Equipment for Wire Rope, dated October 1980
- (b) Bechtel Northern Division Letter BLGE-0394, dated December 31, 1981
- (c) Letter to G. W. Tucker from Thomas A. Russell, International Energy Associates, Ltd., dated January 20, 1982
- (d) G.P.U. Letter TMI-II-RE-0251, dated January 22, 1982

I have reviewed references (a) and (b) and the drawings, photographs and crane specification forwarded by reference (c) and (d) and submit the following comments and recommendations:

1. After reviewing reference (a), I discussed this report with Mr. Percy Malone, Naval Facilities Engineering Command, Code 453D, Alexandria, Virginia, who informed me that, of the three methods tested, the Magnograph is preferred. He stated that this equipment will provide better inspection than can be performed by visual inspection alone and it will identify and measure internal defects such as broken wires and corrosion. Mr. Malone recommended that, prior to use of the Magnograph, it should be calibrated using a sample section of the same manufacturer's class, construction and size wire rope as that which is to be inspected. Based on the inspection results indicated in reference (b) that the wire rope inspected is in good condition, still well lubricated and with only a thin layer of surface rust on the rope, I consider that the use of the Magnograph for inspection of all the rope which can be made accessible by lowering the crane block to its lowest practical position <u>and</u> by removal of rust by wire brushing and visually inspecting the entire rope for pitting would provide adequate information to determine if it should be reused. The wire rope would not be acceptable if the cross-sectional metallic area is reduced by more than ten percent, if more than three randomly dispersed broken wires are found in one strand in one rope lay or six broken wires in one rope lay, or if significant pitting of individual wires is observed. It is also recommended that the wire rope be opened up in two or three representative locations using a marlinspike, screwdriver or similar tool to verify visually that the rope is not corroded internally.

Rebruary 5, 1982

2. Based on the photographs and preliminary inspection results forwarded by references (c) and (d), which showed no evidence of heat damage to the crane structure, I recommend that all rust should be removed and all accessible areas, including the grooves of the hoist drums with the wire rope removed to the extent practical, should be visually inspected for cracks, deformation or other degradation. If found, deficiencies should be repaired or replaced. Nondestructive testing should be employed, if needed for resolving questionable defects or for inspection of critical load bearing welds. Hooks should be subjected to magnetic particle inspection prior to reuse (preferably after load testing). If sandblasting is used for rust removal, all wire rope should be protected against abrasion and/or adherence of blasting grit to the wire rope lubricant. After resolution of the above, the crane should be repainted as required.

3. I concur with the performance of detailed inspections and replacement of any crane components such as bearings, flexible couplings, clutches, brakes, switches, etc., which are found to be in poor condition. I also concur with a thorough inspection and checkout of electrical components and repair or replacement of all defective items. All of this work plus removal of old lubricants, where applicable, and replacement with new lubricants should be completed prior to operational testing. It is recommended that the crane be then checked out with no load through all of its operational modes to ensure that it operates as designed. Special attention should be paid to proper operation of safety devices, such as limit switches, alarms, indicator lights, etc.

4. It is recommended that the crane be load tested to 312.5 short tons to establish a rated capacity of 250 short tons for performance of the work presently planned to be accomplished. This should provide approximately a 10:1 safety factor at the rated capacity, based on the original rope strength, thus allowing a reasonable margin for unknown contingencies. If any cracking sounds (pings) are heard emanating from the wire rope during load testing, it is recommended that the Magnograph and visual inspections be repeated to verify that breaking of wires does not occur during load testing. If more than one additional broken wire in one strand in one rope lay or more than three additional broken wires in one rope lay occur during load testing, replacement of the wire rope is recommended. Wire rope should be cleaned and lubricated prior to use.

February 5, 1982

5. It is expected that future inspection of the auxiliary hoist will reveal conditions similar to those encountered on the main hoist. If so, the preceeding recommendations except for capacity, load test weight, etc., would also apply to that hoist. I do not have sufficient information to evaluate the load testing and rated capacity of the auxiliary hoist but expect that downgrading of the rated capacity would be recommended if the existing wire rope is to be retained.

6. After completion of use of the crane for the presently planned work at a maximum rated capacity of 250 short tons, it is recommended that, if the crane should be needed to be used at its original capacity of 500 tons, the rope should, as a minimum, be reinspected and determination be made at that time as to whether the ropes should be replaced.

G. W. Tucker

G. W. Tucker

GWT/kfw

1U.H.1

TECHNICAL MEMORANDUM

DATE 8/27/82

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TO E. J. Wagner

FROM R. Oakes/H. Young

SUBJECT W.O. 3680-01
Technical Assistance & Advisory Group
TMI-2 Recovery
Closure Head and Fuel Removal Containment

KEYWORDS TMI-2, Containment Tent, Recovery, DeFueling, Temporary Shielding

References:
(1) Letter, E. F. Sise Jr. To W. H. Hamilton, "Closure Head and Fuel Removal Containment- TMI-2", dated July 19, 1982. (Attachment, a)
(2) B&R Drawing - No. 4198, W.O. 2555, "Reactor Building Stair No. 2 Elevator", Rev. 2
(3) Otis Elevator Co. Drawing No. 364999 - PN, "Class C-1 Industrial Truck, Reactor Elevator", Rev. C, B&R File No. 31-01-0104, W.O. 2555
(4) B&R Calculation #3680-15-12, "Dose Rates in Elevator Shaft at TMI-2", 8/12/82

Attachments:
(a) Closure Head & Fuel Removal Containment
(b) Estimated Dose Rates in Reactor Building Elevator Shaft
(c) Proposed 305' Elevation Pathways
(d) Proposed 347'6" Elevation Pathways
(e) Conceptual Shielding Design for Elevator

Summary & Conclusion

The referenced letter describes the design and use of a temporary containment tent for use inside the TMI-2 Reactor Building. The purpose of the tent is to allow personnel access to the reactor vessel head and fuel handling canal without the use of respiratory protection. Air within the tent would be maintained below MPC, thus allowing personnel to work unencumbered with respiratory

protection which would greatly improve worker efficiency. This approach in controlling airborne contamination is accepted practice and is consistent with ALARA.

Also, providing clean areas inside the containment building would permit personnel to spend less time in wet suit Anti-C's and would allow workers to spend more time in containment.

The use of a containment tent is considered an acceptable approach for allowing work inside the Reactor Building. The design described in the referenced letter is a good first cut. Incorporation or consideration of the recommendations of this Technical Memorandum would enhance the original concept.

Recommendations

The design, installation and use of containment tent should consider the following:

1. A slightly positive pressure should be maintained inside the tent and air flow should be toward the refueling canal.

2. The exhaust from the refueling canal should be routed with flexible duct to the purge exhaust system.

3. Supply air for the tents should be from local HEPA filtered, fan units.

4. The layout of the tent pathways should be rerouted into the lowest dose rate areas available.

5. Temporary lead shielding should be used on floors, decking stairs and walls to achieve a target maximum dose rate of 50 MR/hr.

6. The elevator shaft must be shielded with the equivalent of 2 inches of lead in order to be able to use the reactor building elevator.

7. Equipment removal hatches in the tent roof should be other than tent material (Herculite) or reinforced in such a way to assure good seals.

8. Clear plastic sheeting should be used as windows to allow lighting of the tent interior from existing building lights.

9. Airlocks should be provided to control air flow when personnel leave the tent areas.

Discussion

1. Containment Design

Containment designs of this size and complexity have problems with lighting, supports, and openings for equipment removel. The material being considered for construction, Herculite, is somewhat translucent.

That is, some light will pass through the tent walls and roof dimmly lighting the interior. Transparent plastic (~8 mil sheeting) windows to light the tent interior from the existing building lights should be provided in the walls & ceilings of the tent. The windows will also aid in communicating with workers who may be working outside the tent or with equipment such as the polar crane. Also the windows have a psychological impact in that it makes the tent and tunnels seem less confining.

Equipment access hatches in the roof of the tent should be of rigid material. Frequent openings and closings of a large hatch, which would be required for the TMI-2 containment tent, create sealing problems if only herculite is used. Also the mechanics of opening and closing would be cumbersome because of height between the roof of the tent and working area. It is suggested that the portion of the tent roof between the "D" rings over the reactor vessel head be constructed so that it can be easily opened and can be closed without significant loss of tent integrity.

The containment tent design should also have personnel airlocks. The airlocks would allow personnel to access areas of the reactor building not enclosed within the tent and would be needed to make repairs and modifications external to the tent.

2. Ventilation

Ventilation will be required if ~~the herculite~~ containment concept is utilized.

The tent areas require air which is either clean air from outside containment, or air which has been filtered with HEPA filtration. The tent must be maintained at a positive pressure, not negative pressure as described in Attachment (a). Sufficient air should be provided to keep the air in the tent fresh and maintain the tent at a positive pressure. Air should leave each tent area partially through leakage, but mostly through a low velocity duct leading to the purge exhaust.

The actual layout of the tents are shown on Attachments c & d. All aisleways should be ventilated with about 10 air changes per hour. For the entrance tent to the elevator shown on Attachment c, approximatly 300 CFM supply would be required. The elevator would be a unique situation. Since it is mobile, a small fan and HEPA unit of 200 CFM would be required to keep the elevator clean. The unit would be located in the elevator and would take air from the elevator shaft. Power for the fan would be from the elevator lighting circuit. The entrance tent would dump the supply air out of the tent into containment through a backdraft damper. The elevator supply air would exfiltrate out into the elevator shaft.

On elevation 347'-0" the aisleway tent from the elevator to the fuel handling canal requires a supply of about 1000 CFM. This air will be transfered to the fuel canal through a controlled opening at the entrance to the canal. The canal exit corridor extends to the stairway, down the stairway to elevation 305'-0" and out to the equipment airlock. This entire area requires approximately 2000 CFM, which must be supplied near the airlock. The air will travel through the corridor on elevation 305', up the stairway, through the corridor on elevation 347' and into the fuel canal through a controlled opening.

The combined transfer of air into the fuel canal area would be 3000 CFM, minus the leakage through the herculite tents into containment. Conservatively assuming a 1000 CFM leakage, 2000 CFM would transfer into the fuel canal tent. This would represent four air changes per hour. This quantity would be sufficient. Discharge from the tent area would be through a large diameter flexible duct which would be routed to discharge near the Purge exhaust system intake. This would capture almost all activity released from the tent.

The sytem as described would provide a slight positive pressure in all areas, keep contamination from the fuel pool out of the access corridors, and would have most exhaust captured by the purge exhaust system.

A source of clean supply air must be found. The Reactor Building Purge Supply System could be used.

In order to use this system, ductwork modifications to the existing system as well as new ductwork would be required. Each Purge System has two supply reactor building penetrations. Each penetration connects to a duct system with a branch above floor elevation 347'6" and below floor elevation 347'6". Each branch has a damper. Any connections to this system would have to be between the two branch dampers to insure that sufficient air can be diverted to the tent areas. Since the upper damper is at the elevation 347'6" floor level, it will have to be moved upwards to allow a duct connection to be made. The purge supply would be tied into the various tent areas through a tent supply duct system. The advantage of using the purge supply is that no electrical power is required in containment. One disadvantage is that the system controls will not be accessable by personnel inside the tent. A second disadvantage is that the existing supply ductwork must be choked down in order in order for air to be diverted to the tents causing overall purge supply capacity to be reduced. This will reduce overall containment purge rates because the exhaust system flow rate must be identical to the supply in a closed containment. A third disadvantage is that long ductwork runs and major ductwork modifications must be made in containment.

Another method is to provide a separate HEPA filter and fan unit for each tent area. These would be small units which could be placed on a wheeled skid. The HEPA filter would be of the bag in - bag out type, so it could be placed inside the tent without spreading contamination. About four of these skids would be required. The disadvantage of this arrangement is that electrical power is required to be run throughout the Reactor Building. Also, such fan/HEPA units would be ineffective against noble gases & tritium airborne contamination. One advantage is that the fan would be under local control of the personnel inside the tent. Another advantage is that the purge system purge rate would be unaffected by this method. A third advantage is the small amount of sheet metal construction required in containment.

Based on the above discussion, using the skid mounted filteration units is preferrable. This judgement is made principally from an ALARA viewpoint due to reduced construction time required in containment.

In order to allow access to the areas outside the tent without losing positive pressure inside the tent, airlocks would have to be provided. These would consist of a small tent addition with a door into the clean tent and a door out to the containment building. This area would not be considered clean and would not be ventilated. It would prevent the sudden loss of positive pressure in the tent when a door is opened.

3. Installation & Layout

The tent installation shown in Attachment (a) sketch has personnel using the existing elevator to access El 347'6" from the El 305' personnel airlock. The use of the elevator is desirable because of the reduction of worker fatique levels. However, the high radiation levels (~16R/hr) in the elevator shaft at elevation 305' requires the placement of temporary shielding in the shaft to permit the use of the elevator. It would take approximately 1.5" of lead to reduce the dose rates to ambient reactor building levels (~100 mR/hr.). However, covering the elevator truck's floor with 1.5" of lead will nearly equal the maximum load capacity of the elevator (5680# vs 6000# per Ref. 3). If the lead thickness is reduced to 1" in order to leave 2000# of load capacity, the dose rate at the elevation 305' position will be 1.3 R/hr and will decrease with elevation as shown on attachment (b). These dose rates are too high.

Therefore, shielding must be inserted into the elevator shaft to reduce the dose rates. The elevator shaft is a 2 hour fire rated structure so it has no exposed structural steel to facilitate supporting shield material. The shielding will have to be supported on structural beams inserted through the open doors and through the block wall at the back of the elevator shaft. Metal decking will be laid over the beams and 2" of lead will be placed on the decking. Modifications to the elevator controls will be necessary to prevent damage to the shield.

The layout of the tent on the 347'6" elevation on the Attachment (a) sketch has the following deficiencies: it routes personnel into areas of higher radiation, it places the change room on or near the covered hatch, and it does not show the open stairway being enclosed.

A better layout is proposed on Attachment (c) & (d). Radiation Zones are shown on these Attachments as are locations for temporary shielding. The proposed layout is a preliminary path and must be verified by a directinal radcon survey prior to finalization.

Special consideration should be given to the head service stand because of the future potentially high dose rates from the reactor vessel head once it is removed. The head stand can not be moved for two reasons: fist the 347'6" elevation floor is rated at 1.2 KSF where as under the head storage stand the floor is rated at 2.0 KSF, and the crane hook limit arc would place the stand over the covered hatch.

The installation of the tent should follow a sequence which minimizes exposure and minimizes workers using respiratory protection. The following is a possible installation sequence:

a) Lay temporary lead shielding on El 305' floor.
b) Install tunnel containment on EL 305'.
c) Erect temporary shielding in elevator shaft.
d) Continue tunnel upstairs to El 347'6".
e) Lay temporary lead shielding on El 347'6" floor.
f) Erect tent change area and tunnel to open stairway.
g) Shield stairway down to El 305'.
h) Erect containment around stairway and erect tunnel containment to equipment removal hatch.
i) Complete erection of tent over reactor vessel head/refueling canal.

4. Shielding

The temporary lead shielding mentioned in this Technical Memorandum is made up of 1/4" thick pieces of lead sheet. Each piece is 1' x 3' (x ¼" thick) which weighs approximately 45 lbs. This size and thickness were selected to enable one person to easily handle each piece and so that the sheeting can be bent to conform to various shapes. The shielding installation would consist of overlapping layers of the lead sheet laid on the floor, stairs, etc. The number of layers are determined from either the allowable structural loading or the desired reduction in general area radiation level. This method of reducing radiation levels is inexpensive and easy to install.

The shielding of the elevator shaft must be accomplished in order to utilize the elevator as described in Section 3. A method of supporting two inches of lead in the shaft must be developed. A conceptual design for such an arrangement is shown in Attachment (e). If required, the structural steel can be cut in pieces to facilitate handling. The I beams are ten feet long and can be carried into the containment building through the personnel airlock.

ATTACHMENT A

Closure Head & Fuel Removal Containment

E. F. Sise, Jr.
7/19/82

ATTACHMENT A

Closure Head & Fuel Removal Containment

During closure head and fuel removal operations at TMI-2, a containment work tent with a covered means of ingress and egress should be provided to eliminate continuous use of respirators while working in the containment.

The attached drawings depict a typical work containment which could be used for closure head and fuel removal at TMI. Personnel would enter through air lock #2 and walk through a herculite covered tunnel to the elevator and proceed to the 347'-6" level. Upon exiting the elevator, personnel would again walk through a herculite tunnel to a change room attached to the work tent. When exiting the change room, personnel would walk through a herculite tunnel to the stairway, down the stairway and through a herculite tunnel exiting through personnel air lock #1.

The actual work tent portion of the containment would cover the entire reactor fuel handling pit beginning at the top of the pit extending to approximately the 367' level. The top of the work tent would either fold back or have sliding hatches which would allow equipment or components to be removed from the work area.

In addition, the existing ventilation system would be connected to the work containment and balanced to provide negative ventilation within the containment. Also, continuous air monitors would be located as required to monitor the air within the containment.

Personnel would enter the work containment tunnel wearing one set of ANTI-C apparel. Once within the change room, they would put on additional ANTI-C apparel as required within the work area. When leaving the work area, personnel would remove all ANTI-C apparel except the original set which would be worn to exit the work containment.

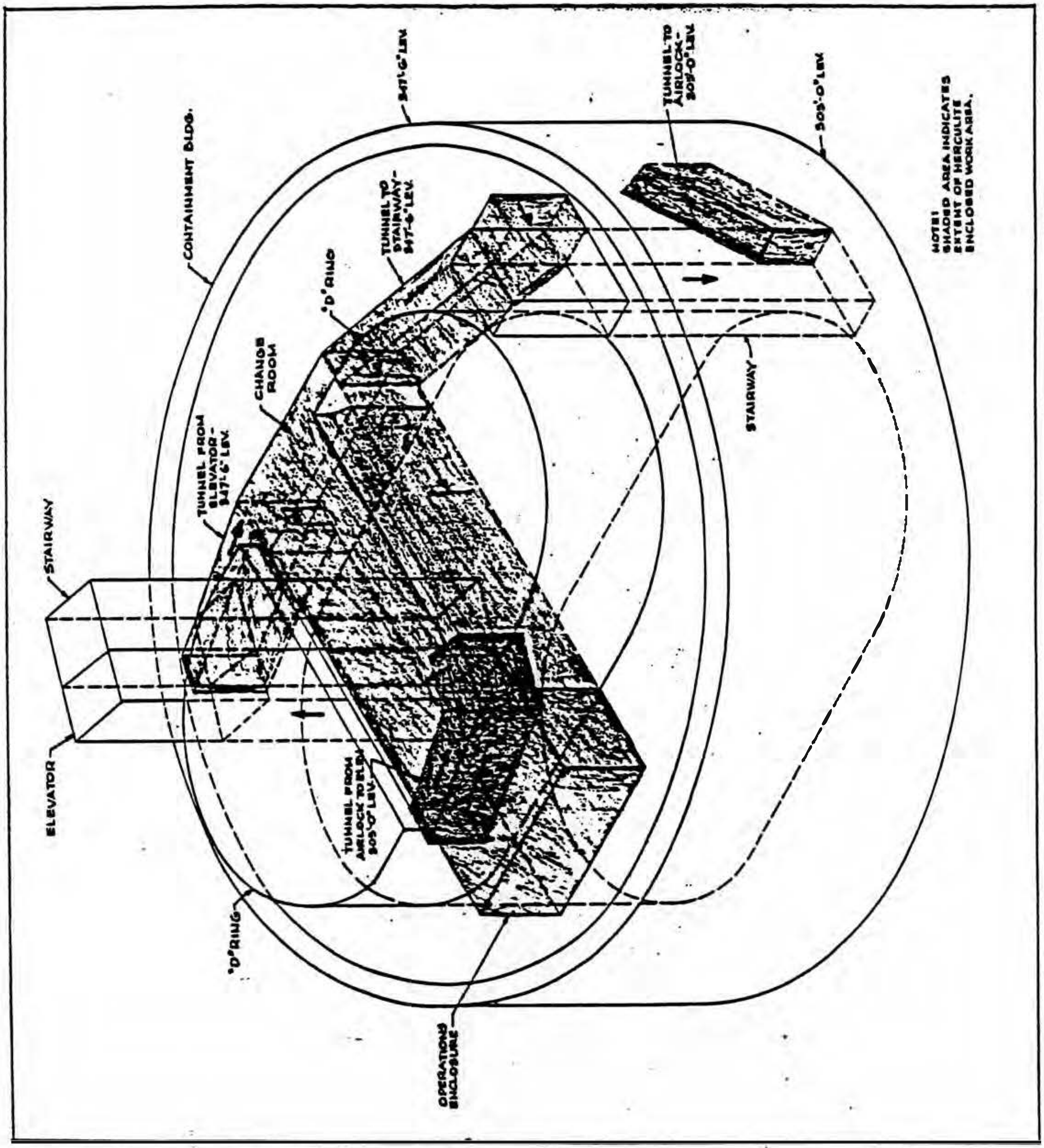
Based on previous work, it is estimated that it will take ten (10) men approximately two (2) weeks to install the entire work containment. The containment would be fabricated prior to installation and then installed using pipe structure or suspended from existing structure, etc. Also, it is estimated that it will cost $12,000 to fabricate the work containment.

The basis for using the work containment is two fold:

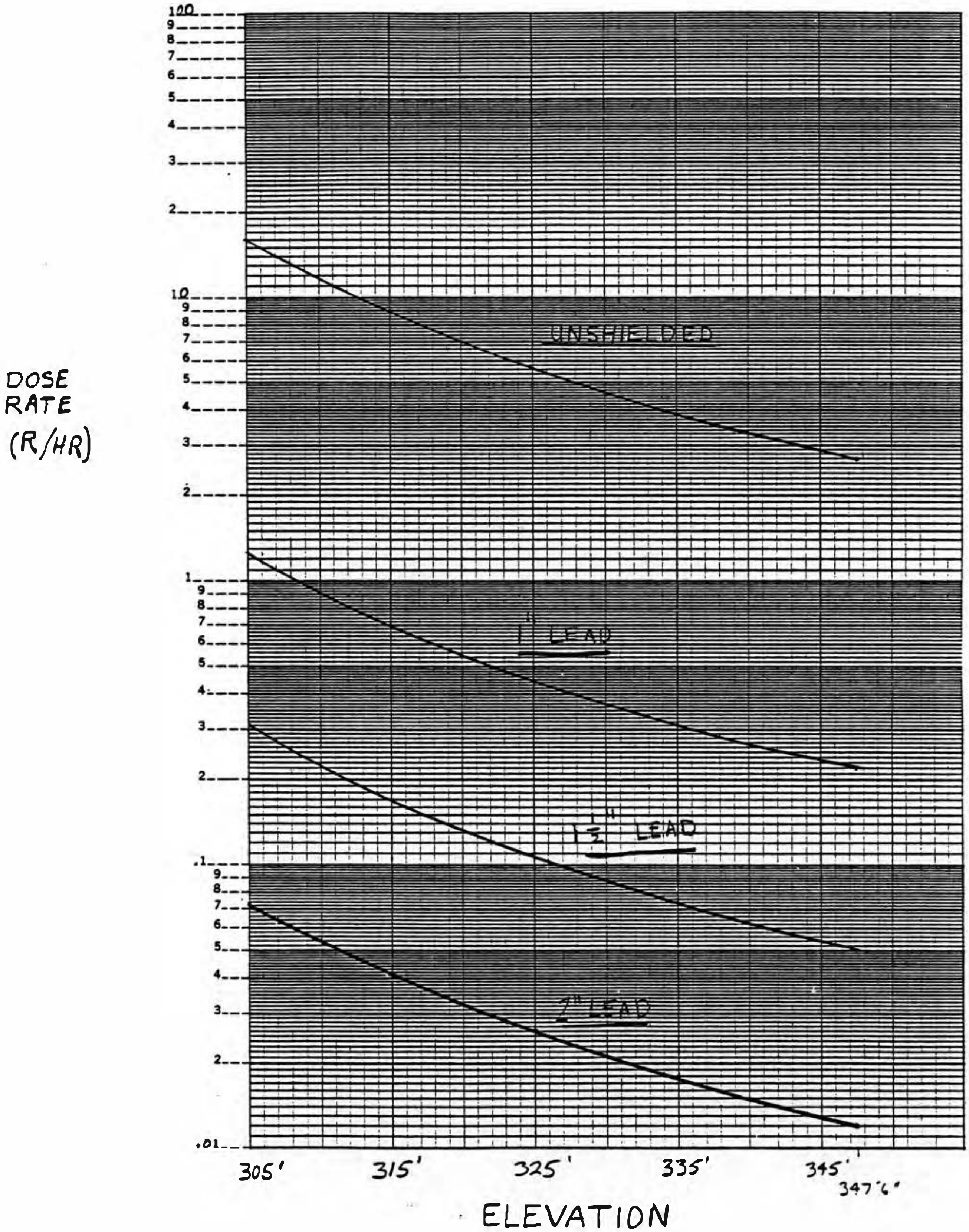
1. It allows personnel to work in a better environment by eliminating respirator equipment for most operations and while entering and exiting the work area.

2. Permits a work force outside the work containment to perform work at the same time.

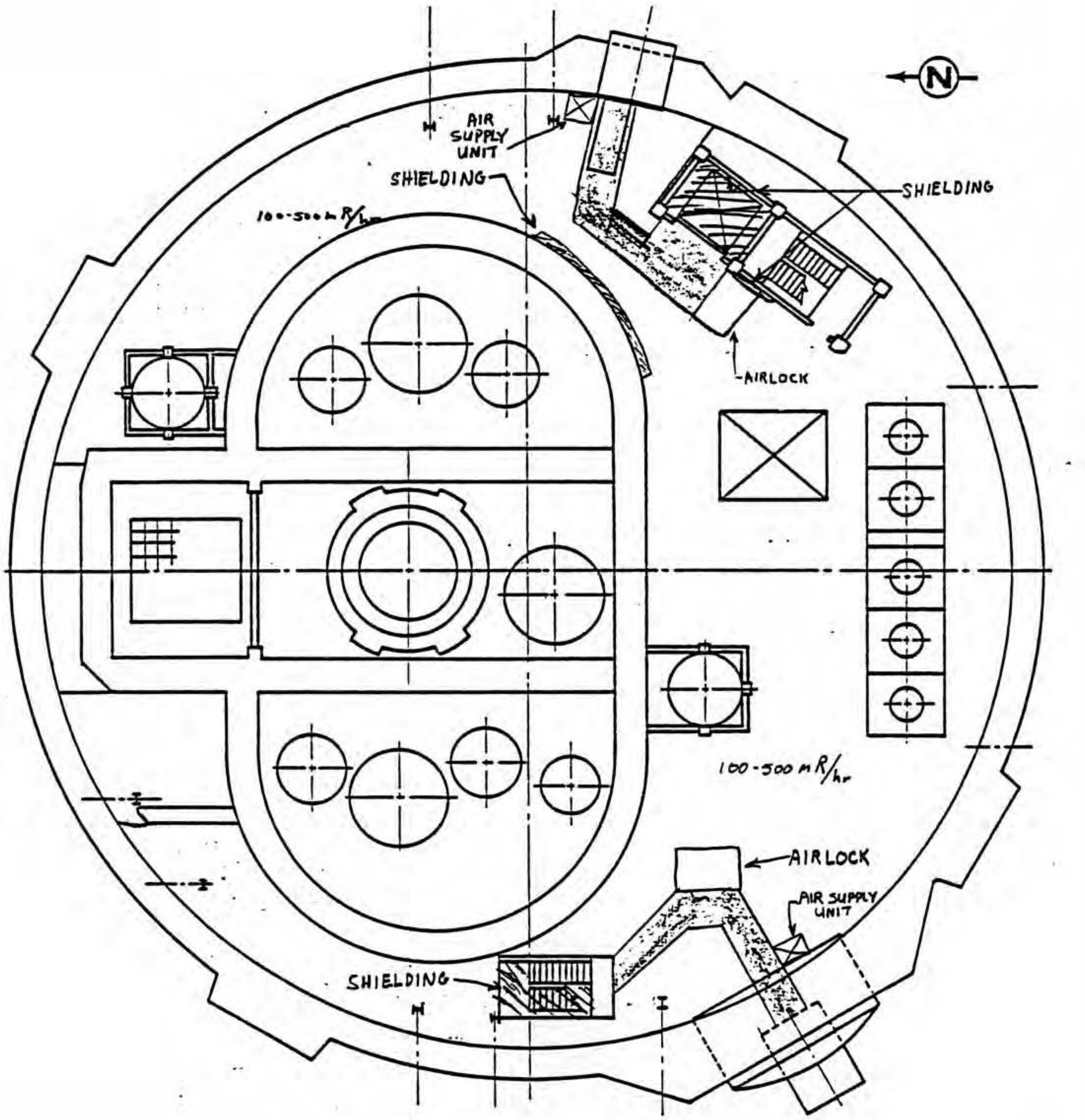
ATTACHMENT A



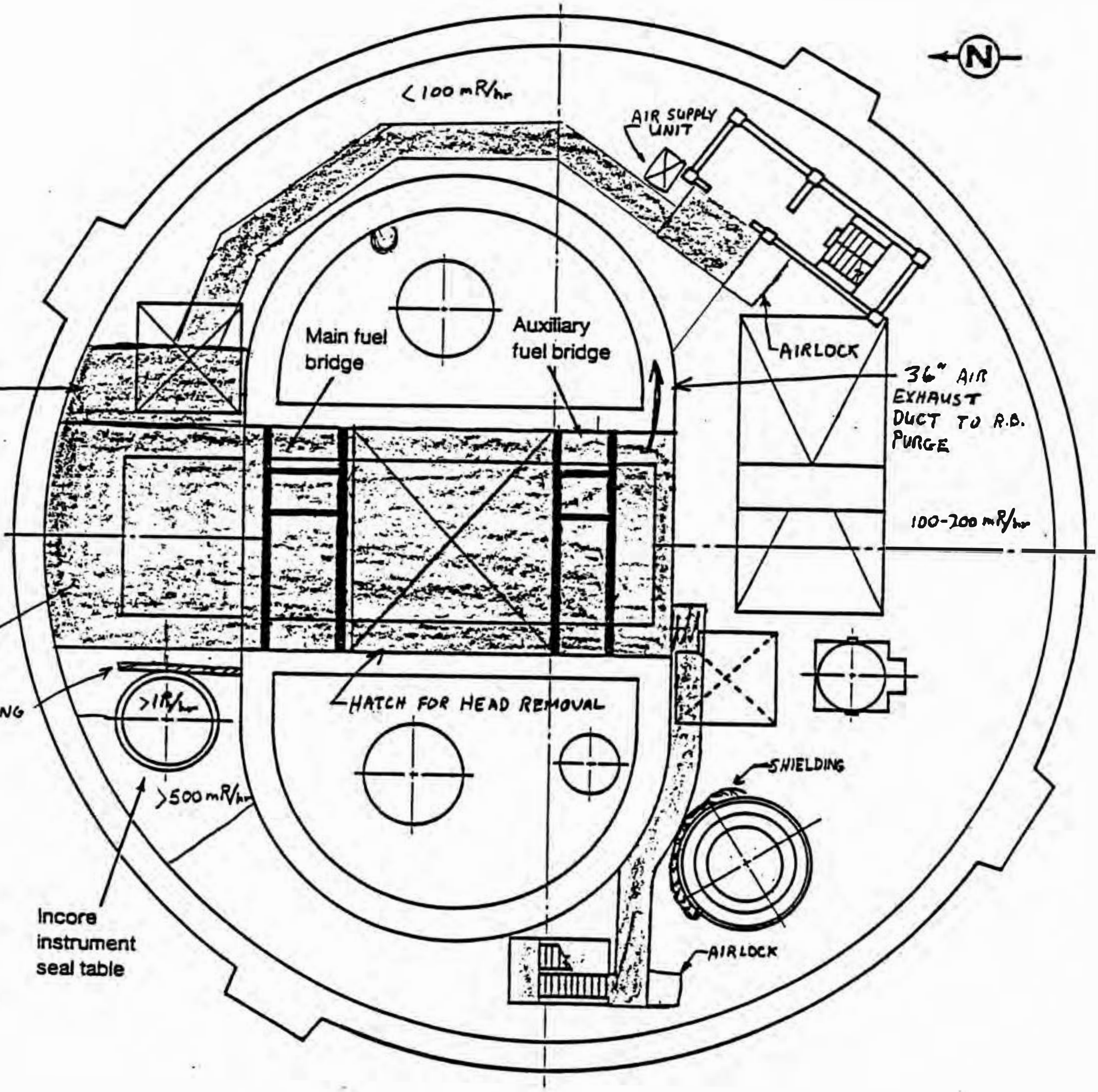
ATTACHMENT B



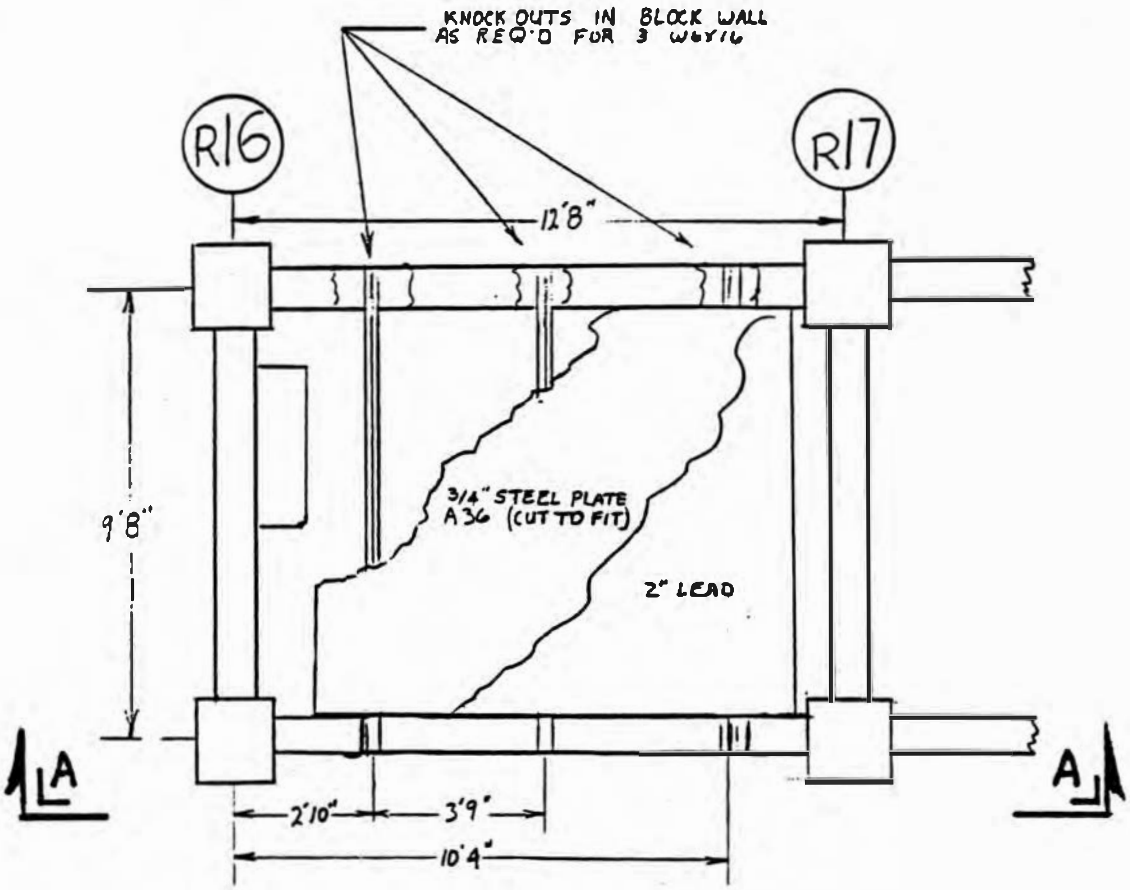
Estimated Dose Rates Inside Reactor Building Elevator Shaft



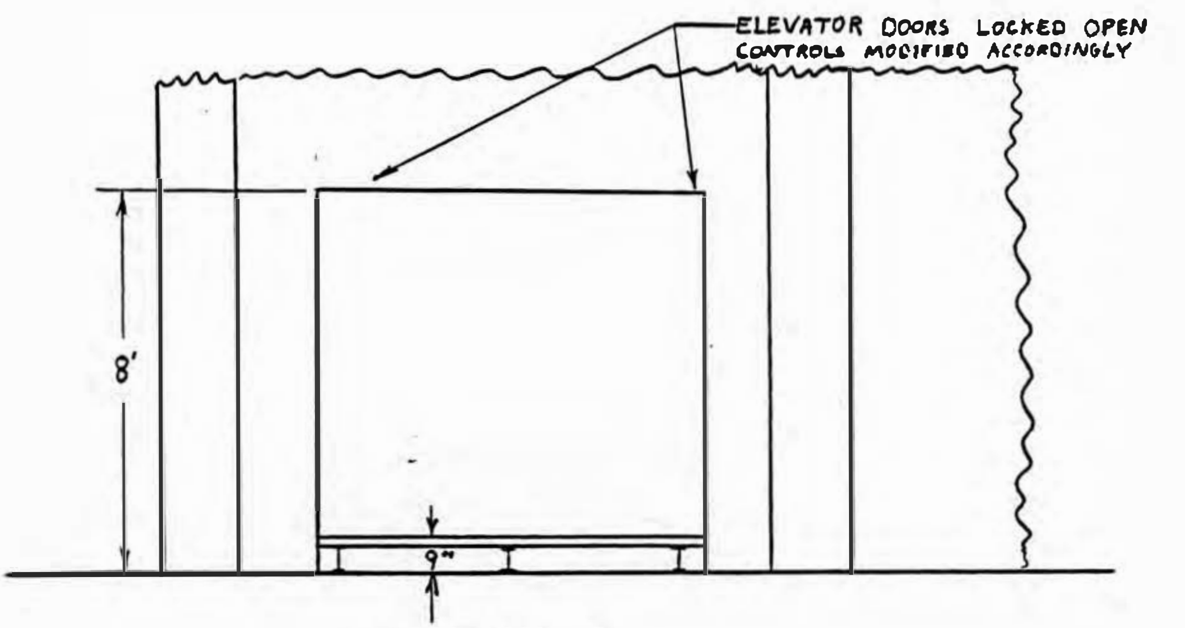
PROPOSED 305′ ELEVATION PATHWAYS



PROPOSED 347'6" ELEVATION PATHWAYS



PLAN EL 305'



SECTION A-A

CONCEPTUAL SHIELDING DESIGN FOR ELEVATOR