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May 24, 1990

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D. C. 20555

Gentlemen:

Subject: **Docket No. 50-206**
**Dose Assessments, and Cleanliness Control**
**for the Cycle 11 Thermal Shield Activities**
**San Onofre Nuclear Generating Station**
**Unit 1**

The enclosure to this letter provides information regarding dose assessments and ALARA objectives, and cleanliness control details for the thermal shield support system replacement activities scheduled during the Cycle 11 refueling outage. This information was requested by the NRC during the meeting of May 7, 1990.

If you have any questions or desire further information, please let me know.

Very truly yours,

Enclosure:

cc: J. B. Martin, Regional Administrator, NRC Region V
C. Caldwell, NRC Senior Resident Inspector, San Onofre Units 1, 2 and 3

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Enclosure

**SONGS 1 THERMAL SHIELD SUPPORT REPLACEMENT CLEAN-UP ACTIVITIES**

One of the major goals of the Cycle 11 thermal shield support system replacement activities is to ensure the reactor vessel, upper internals, core barrel, and the pool area will be clean prior to reassembly. As we discussed during the May 7, 1990 meeting, we are incorporating lessons learned from the Haddam Neck and past SONGS 1 experience. The following is a summary of the cleanliness activities that will be implemented:

1. Before the reactor vessel is opened, Foreign Material Exclusion (FME) areas will be established in accordance with site procedures. Prior to removal of the fuel and core barrel from the reactor vessel, a visual inspection of the existing condition will be performed. This inspection will assess the as-found condition of the thermal shield support system and lower reactor region.

2. Once the upper internals have been moved to their designated storage area, a fine mesh FME net will be placed over them. After all fuel assemblies have been moved to the spent fuel pool, the same type of net will be placed over the rod cluster control assembly change machine and the new fuel elevator. The transfer tube valve and the transfer pool gate will be closed, establishing a double isolation between the reactor cavity and the spent fuel pool.

3. During the support system replacement activities, four filter systems will be in operation: a) ion exchangers will filter the reactor cavity water continuously, b) a temporary 250 GPM pump with pleated 5 micron filters (tri-nuc), c) a Chesterton 200 GPM temporary pump/filter unit with 1 micron filters, and d) a temporary 30 gpm pump and 1 micron filter unit. These systems are used to skim the surface and vacuum at designated areas in the pool.

4. After the core barrel is removed from the reactor vessel, a complete visual inspection of the thermal shield supports will be performed. This is a 100% inspection of the supports, augmenting the inspection performed in step 1, which could not inspect the 0 and 180 degree support blocks.

5. At the completion of the reactor vessel inservice inspection (ISI), a cover plate will be placed on the reactor vessel to ensure no foreign material enters the vessel. This stainless steel plate will seal the reactor vessel and will be in place until completion of the support system replacement.

6. Prior to the start of work a radiological shield and a thermal shield lift mechanism will be installed on top of the core barrel. This will cover approximately 95% of the top of the core barrel. The remaining open areas will be covered by lead blankets or other protective covers.

7. The electrical discharge machining (EDM) process removes metal from the workpiece by spark discharge erosion. This process results in a residue of metal particles. The EDM machinery being used includes a vacuum system that draws water from the refueling cavity into and past the cutting tool and then through a 1 micron filter before being pumped back into the cavity as shown in Figure 1. This provides cooling to the tool and workpiece and also sweeps the cutting residue out of the cutting area and into the filter. The filters are inside-to-outside type to ensure particles are captured and maintained during filter changes. Dowel pin holes are reamed to size the holes after the EDM process. A vacuum box will be installed around the reaming tool, continuously drawing debris through the hole and then through a 1 micron filter as discussed in item 3 above.

8. Two inspection port holes will be drilled through the core barrel flange. The areas being machined will be surrounded by chip pans and all the debris generated will be collected and removed in the pans. This machining will be performed above the reactor cavity water level.

9. When the thermal shield support replacement is completed the work platform will be cleaned prior to its removal. The FME nets will be removed, and the core barrel and upper internals will be cleaned, using temporary pump/filter units discussed in item 3 above, and visually inspected.

10. The reactor vessel cover plate and pool area will be cleaned and the cover plate will be removed.

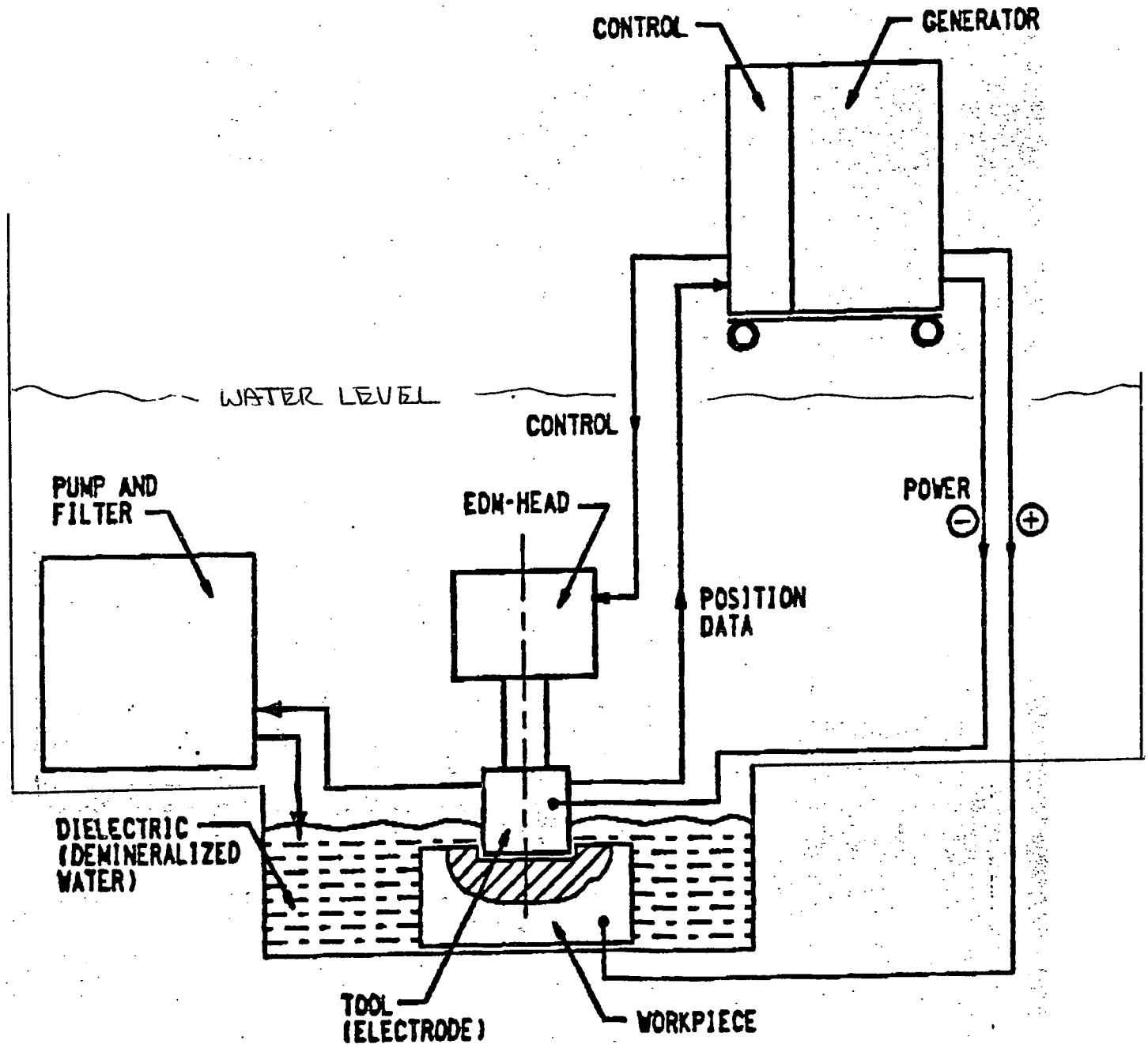
11. After the removal of the cover plate, the inside of the reactor vessel and sections of the hot and cold legs close to the vessel will be cleaned.

12. The reactor vessel will be visually inspected and the core barrel installed.

At the completion of these steps we will continue with other outage related activities.

# PRINCIPLE OF AN EDM-EQUIPMENT

FIGURE 1



## PERSON-REM ESTIMATE FOR THERMAL SHIELD ACTIVITIES

| | Activity | Person-Hours | EDER*(rem/hr) | Person-Rem |
|---|---|---|---|---|
| 1. | Assemble core barrel support stand on 42′ elevation by RCP C floor plug. | 6 x 24 = 144 | 0.0005 | 0.072 |
| 2. | Place core barrel support stand in the refueling cavity. | 6 x 24 = 144 | 0.010 | 1.440 |
| 3. | Assemble thermal shield masts on the -10′ elevation east side. | 6 x 28 = 168 | 0.010 | 1.680 |
| 4. | Assemble core barrel lift rig on 42′ elevation, south end of refueling cavity. | 4 x 16 = 64 | 0.0005 | 0.032 |
| 5. | Move core barrel lift rig to RCP B floor plug. | 4 x 4 = 16 | 0.0005 | 0.008 |
| 6. | Assemble thermal shield work stations at steam generator C doghouse. | 6 x 70 = 420 | 0.0005 | 0.210 |
| 7. | Core barrel and thermal shield camera inspection. | 4 x 8 = 32 | 0.002 | 0.064 |
| 8. | Stage and assemble core barrel shield ring on south end of refueling cavity. | 6 x 16 = 96 | 0.0005 | 0.048 |
| 9. | Attach core barrel lift rig from the manipulator crane. | 6 x 8 = 48 | 0.002 | 0.096 |
| 10. | Stage thermal shield work platform. | 6 x 8 = 48 | 0.0005 | 0.024 |
| 11. | Lift the core barrel and place on the support stand. | | | |
| | (Below Water) | 9 x 6 = 54 | 0.002 | 0.108 |
| | (Above Water) | 9 x 1 = 9 | 0.100 | 0.900 |
| 12. | Remove the core barrel lift rig. | 4 x 0.25 = 1 | 1.000 | 1.000 |
| 13. | Place core barrel lift rig on RCP B floor plug. | 4 x 0.5 = 2 | 0.025 | 0.050 |

*Effective Dose Equivalent Rate

| | Activity | Person-Hours | EDER(rem/hr) | Person-Rem |
|---|---|---|---|---|
| 14. | Place shield ring on the core barrel. | 4 x 0.25 = 1 | 0.500 | 0.500 |
| 15. | Construct thermal shield work platform. | 8 x 20 = 160 | 0.005 | 0.800 |
| 16. | Install EDM equipment, masts, tooling, and hydraulics. | 8 x 24 = 192 | 0.005 | 0.960 |
| 17. | Inspection and documentation of components to be repaired. | 4 x 24 = 96 | 0.005 | 0.480 |

18. Bechtel/KWU Alliance will perform the thermal shield repair in 60 days. They will work three 9 hour shifts and expect to be inside the Radiologically Controlled Area 6 hours and 40 minutes per shift. The work location, on the 42′ elevation of Unit 1 containment, has been divided into 5 zones (Figures 2 and 3) for the following time motion study. The estimated effective dose equivalent rate for each zone is:

| | |
|---|---|
| Zone A: | 10 mrem/hour |
| Zone B: | 5 mrem/hour |
| Zone C: | 3 mrem/hour |
| Zone D: | 2 mrem/hour |
| Zone E: | 1 mrem/hour |

**Bechtel/KWU Alliance Personnel**

| Position | Person-Hours | Zone | Person-Rem |
|---|---|---|---|
| Onsite Manager | 60 | D | 0.120 |
| Project Manager | 240 | D | 0.480 |
| Shift Supervisor | 120 | B | 0.600 |
| | 360 | C | 1.080 |
| | 360 | D | 0.720 |
| | 360 | E | 0.360 |
| Technician Mast 1 | 600 | B | 3.000 |
| | 240 | C | 0.720 |
| | 180 | D | 0.360 |
| | 180 | E | 0.180 |
| Technician Mast 1 | 600 | B | 3.000 |
| | 240 | C | 0.720 |
| | 180 | D | 0.360 |
| | 180 | E | 0.180 |

**Bechtel/KWU Alliance Personnel** (Continued)

| Position | Person-Hours | Zone | Person-Rem |
|---|---|---|---|
| EDM Specialist Mast 1 | 240 | B | 1.200 |
| | 600 | C | 1.800 |
| | 180 | D | 0.360 |
| | 180 | E | 0.180 |
| Technician Mast 2 | 600 | B | 3.000 |
| | 240 | C | 0.720 |
| | 180 | D | 0.360 |
| | 180 | E | 0.180 |
| Technician Mast 2 | 600 | B | 3.000 |
| | 240 | C | 0.720 |
| | 180 | D | 0.360 |
| | 180 | E | 0.180 |
| EDM Specialist Mast 2 | 240 | B | 1.200 |
| | 600 | C | 1.800 |
| | 180 | D | 0.360 |
| | 180 | E | 0.180 |
| Technician Work Station | 600 | B | 3.000 |
| | 240 | C | 0.720 |
| | 180 | D | 0.360 |
| | 180 | E | 0.180 |
| EDM Technician Work Station | 240 | B | 1.200 |
| | 600 | C | 1.800 |
| | 180 | D | 0.360 |
| | 180 | E | 0.180 |
| Mast Service Technician | 120 | B | 0.600 |
| | 360 | C | 1.080 |
| | 360 | D | 0.720 |
| | 360 | E | 0.360 |
| US Analyst | 24 | C | 0.072 |
| US Evaluator | 5 | C | 0.015 |
| E Service | 1 | B | 0.005 |
| | 6 | D | 0.012 |
| TV Service | 1 | B | 0.005 |
| | 6 | D | 0.012 |

**Station Personnel**

| Position | Person-Hours | Zone | Person-Rem |
|---|---|---|---|
| Health Physics Technician | 2400 | B | 12.000 |
| | 1200 | C | 3.600 |
| | 720 | D | 1.440 |
| | 720 | E | 0.720 |
| Radioactive Material Control Technician | 540 | B | 2.700 |
| | 270 | C | 0.810 |
| | 135 | D | 0.270 |
| | 135 | E | 0.135 |
| ALARA Engineer | 30 | B | 0.150 |
| | 60 | C | 0.180 |
| | 30 | D | 0.060 |
| Station Technical Engineer | 30 | B | 0.150 |
| | 60 | C | 0.180 |
| | 30 | D | 0.060 |
| Operator | 36 | B | 0.180 |
| | 72 | C | 0.216 |
| | 72 | D | 0.144 |
| Foreign Material Exclusion | 2880 | D | 5.760 |
| Quality Control | 80 | B | 0.400 |
| | 120 | C | 0.360 |

| | Activity | Person-Hours | EDER(rem/hr) | Person-Rem |
|---|---|---|---|---|
| 19. | Clean, disassemble, and remove thermal shield work platform. | 8 x 36 = 288 | 0.005 | 1.440 |
| 20. | Perform debris inspection and clean core barrel/upper internals. | 6 x 24 = 144 | 0.005 | 0.720 |
| 21. | Perform debris inspection and clean RV cover plate and cavity. | 6 x 8 = 48 | 0.003 | 0.144 |
| 22. | Perform debris inspection and clean reactor vessel. | 6 x 8 = 48 | 0.002 | 0.096 |
| 23. | Remove shield ring from the core barrel. | 4 x 0.25 = 1 | 0.500 | 0.500 |

| | Activity | Person-Hours | EDER(rem/hr) | Person-Rem |
|---|---|---|---|---|
| 24. | Install core barrel lift rig. | 4 x 1 = 4 | 1.000 | 4.000 |
| 25. | Lift the core barrel and position inside the reactor vessel. | | | |
| | (Above Water) | 9 x 1 = 9 | 0.100 | 0.900 |
| | (Below Water) | 9 x 6 = 54 | 0.002 | 0.108 |
| 26. | Remove core barrel lift rig and place on RCP B floor plug. | 6 x 8 = 48 | 0.002 | 0.096 |
| 27. | Decontaminate, disassemble and remove thermal shield repair equipment. | 8 x 400 = 3200 | 0.0005 | 1.600 |

TOTAL = 85.752 person-rem

## METHODS TO MAINTAIN PERSONNEL EXPOSURE ALARA DURING THERMAL SHIELD ACTIVITIES

1. Core Barrel Transfers:

1.1 The refueling water level will be increased by one foot, from 40′ 6" to 41′ 6" to provide additional shielding.

1.2 Lead shield walls will be constructed on the operating deck for personnel to stand behind.

1.3 Only personnel essential to core barrel transfers will have access to the operating deck.

1.4 The height that the core barrel has to be lifted above the reactor cavity floor will be kept to a minimum.

1.5 Underwater detectors will be used to monitor core the barrel before it is lifted above the refueling water level.

1.6 Established radiation hold points will be used to lift the core barrel above the refueling water level.

1.7 Underwater cameras will monitor core barrel clearance and position.

1.8 Reference points are marked on the reactor service crane for locating the core barrel support stand center line prior to transfers in order to facilitate placement and minimize the time the source is exposed.

1.9 Personnel essential to core barrel transfers, who are not needed on the operating deck, will observe transfers from the top of steam generator 'C' doghouse which will be a low exposure rate area.

1.10 Radiation detectors with remote readouts will be strategically positioned.

1.11 All personnel will wear alarming dosimetry.

1.12 Containment ventilation will be secured to minimize air currents across the operating deck.

1.13 The core barrel and lift rig will be kept wet to minimize airborne radioactivity.

1.14 The core barrel transfer to the support stand will be video taped. A video monitor will be available outside

containment for observers.

1.15 Pre-job briefing will be conducted for all essential personnel.

1.16 Contingency plans will be developed.

2. Core Barrel Lift Rig Installation and Removal While Positioned on the Support Stand:

2.1 The refueling water level will be increased by one foot from 40′ 6" to 41′ 6".

2.2 Lead shield walls will be constructed on the operating deck for personnel to stand behind.

2.3 Only personnel essential to core barrel lift rig installation or removal will have access to the operating deck.

2.4 Long handled tools will be used to install and remove the core barrel lift rig.

2.5 All personnel will wear alarming dosimetry.

2.6 Containment ventilation will be secured to minimize air currents across the operating deck.

2.7 The core barrel and lift rig will be kept wet to minimize airborne radioactivity.

2.8 Pre-job briefing will be conducted for all essential personnel.

2.9 Contingency plans will be developed.

3. Shielding of the Core Barrel on the Support Stand for Thermal Shield Work:

3.1 A new core barrel support stand has been designed which allows the core barrel to sit lower in the water for additional shielding.

3.2 The refueling water level will be increased by one foot, from 40′ 6" to 41′ 6".

3.3 A shield ring constructed with depleted uranium and lead will be placed on top of the core barrel.

4. Thermal shield support system replacement:

4.1 Mock-up training will be conducted by SCE personnel (including an ALARA Engineer) at a Bechtel/KWU Alliance facility in Germany.

4.2 Localized shielding of work areas will be accomplished with lead blankets

4.3 Cool zones will be established at the work location.

4.4 All personnel working in the zone B will wear alarming dosimetry.

4.5 A formal Health Physics Work Control Plan which addresses radiological controls will be written for the support system replacement.

5. Removal of EDM Filters, Flexures and Lower Support Blocks from the Refueling Cavity:

5.1 A shield bell will be used to remove items from the refueling cavity.

5.2 Mock-up training will be conducted.

5.3 Underwater detectors will be used to monitor items.

5.4 EDM filtration systems will operate underwater for shielding purposes.

5.5 Shielded containers will be provided to transport items from containment.

6. Withdrawal of Tooling from the Refueling Cavity:

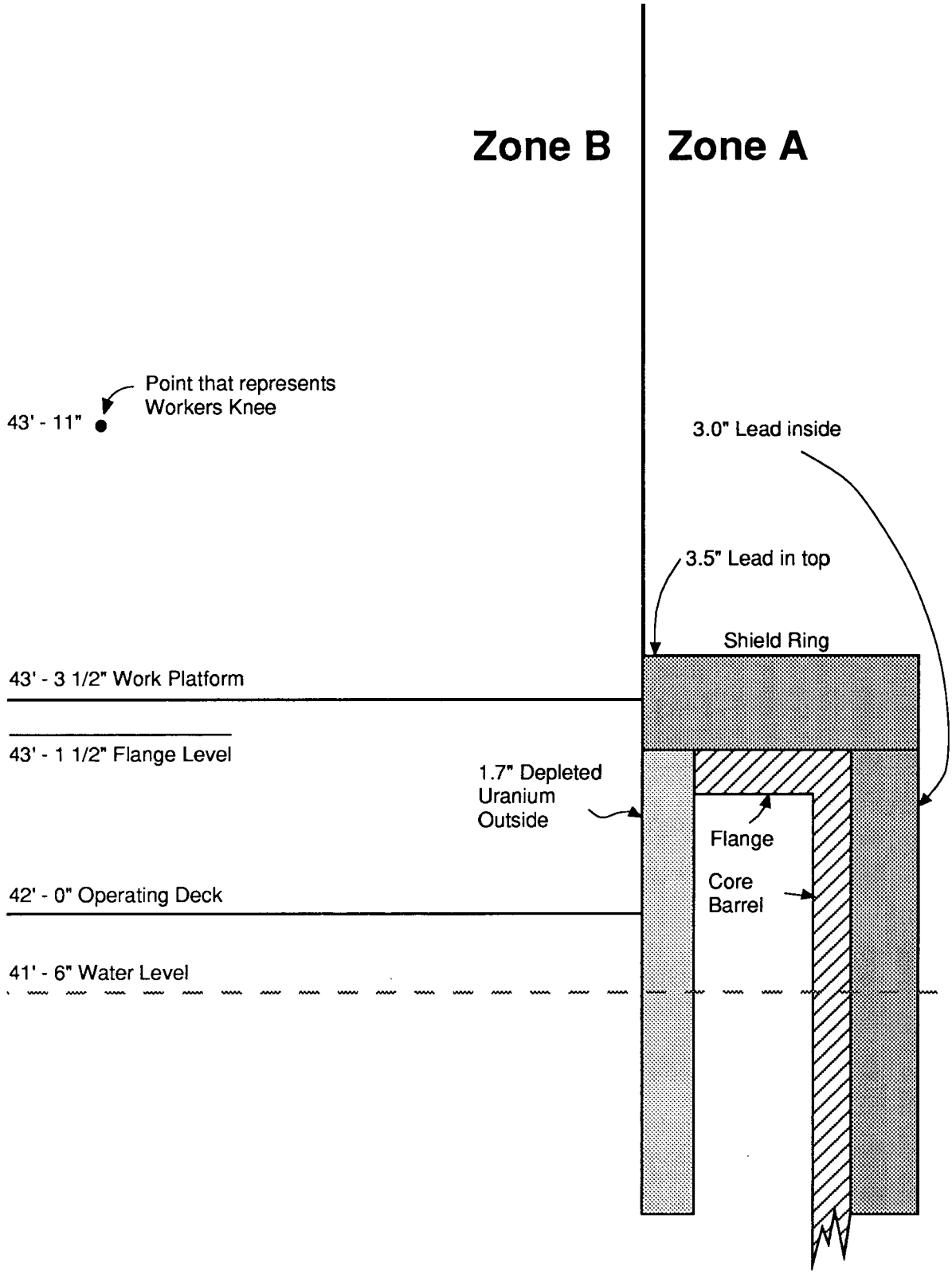
6.1 Tooling will be withdrawn from the refueling cavity in accordance with established radiation hold points.

6.2 Tooling will be sprayed underwater to remove contaminants before withdrawal.

6.3 Underwater detectors will be used to monitor tooling.

6.4 Shielded containers will be staged on the work platform to receive tooling.

# Figure 2


Zone B
Zone A
Point that represents Workers Knee
43' - 11"
3.0" Lead inside
3.5" Lead in top
Shield Ring
43' - 3 1/2" Work Platform
43' - 1 1/2" Flange Level
1.7" Depleted Uranium Outside
Flange
Core Barrel
42' - 0" Operating Deck
41' - 6" Water Level

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