

TMI-2 Lessons Learned

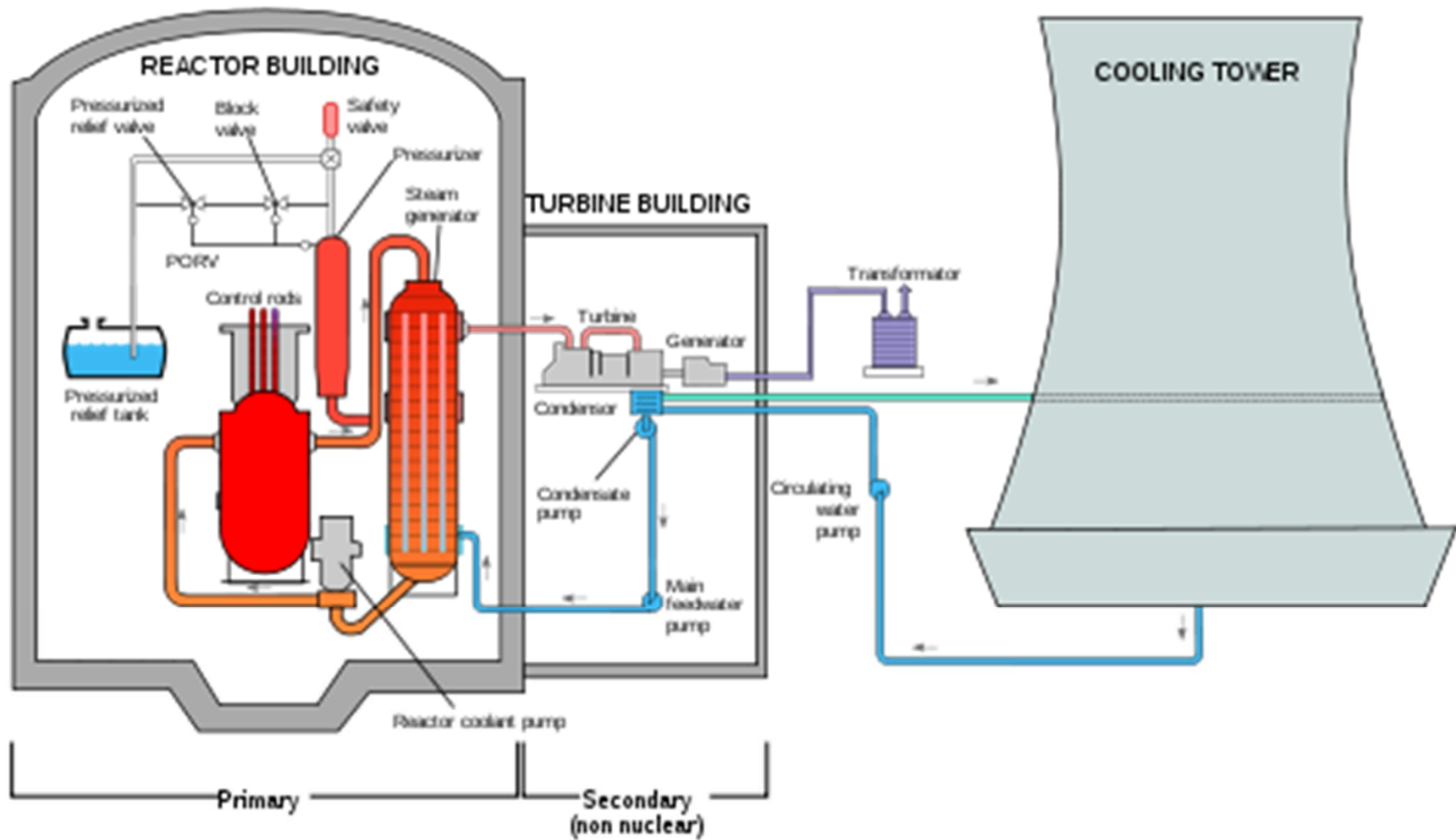
Russ Green



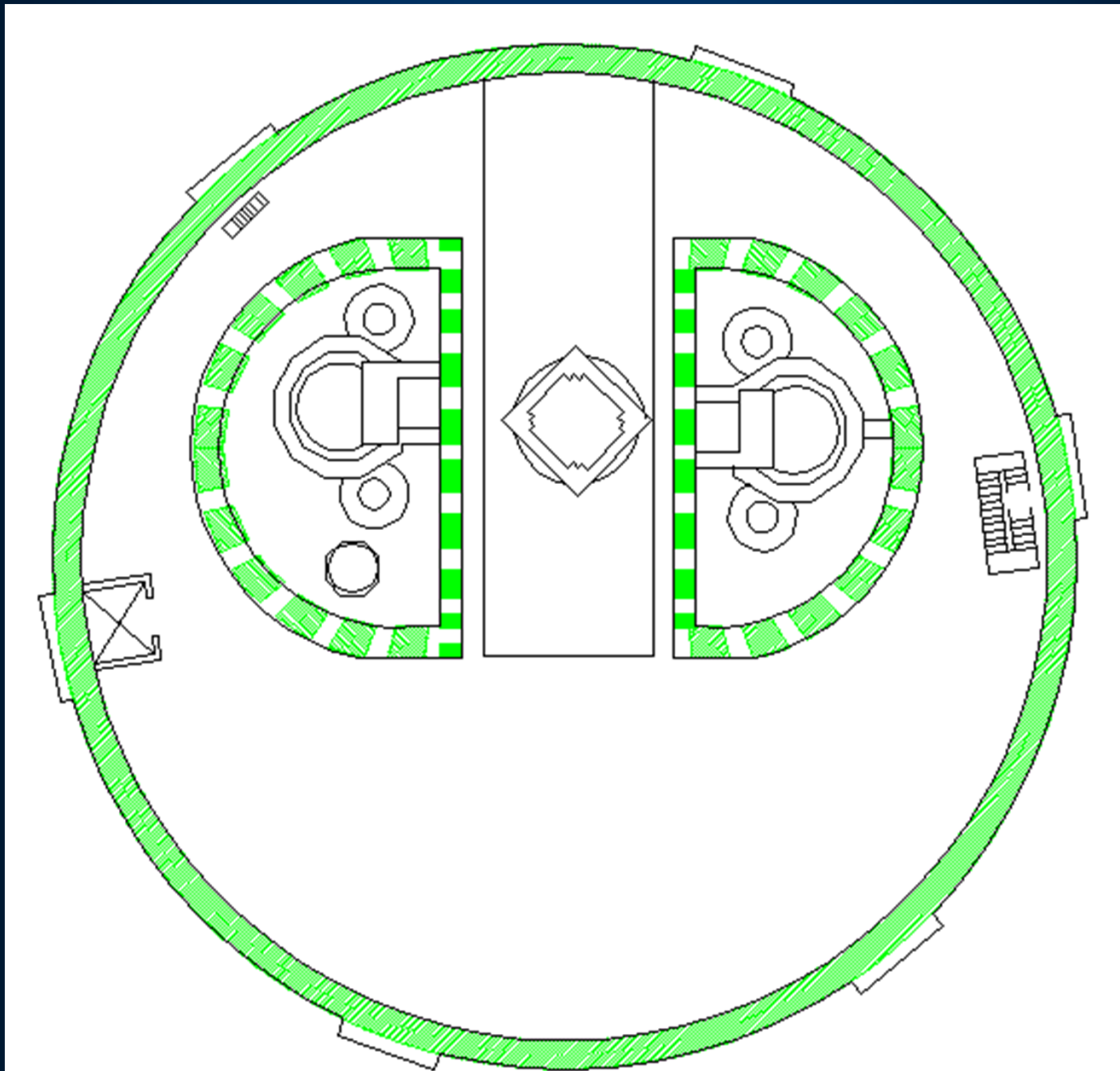
Biography

- Program Engineer at TMI-1 (16 years)
(FAC, Raw Water (MIC), Buried Pipe, GL 89-13)
- Shift Technical Advisor at TMI-1 (7 years)
- Operator at TMI Unit 1 and Unit 2 (5 years)
- United States Navy (6 years)
- PhD in Environmental Engineering from Drexel
- MS in Microbiology from TJU Medical School
- ME in Mechanical Engineering from PSU
- BS in Chemistry from LVC
- BS in Microbiology from LSU

B&W 177



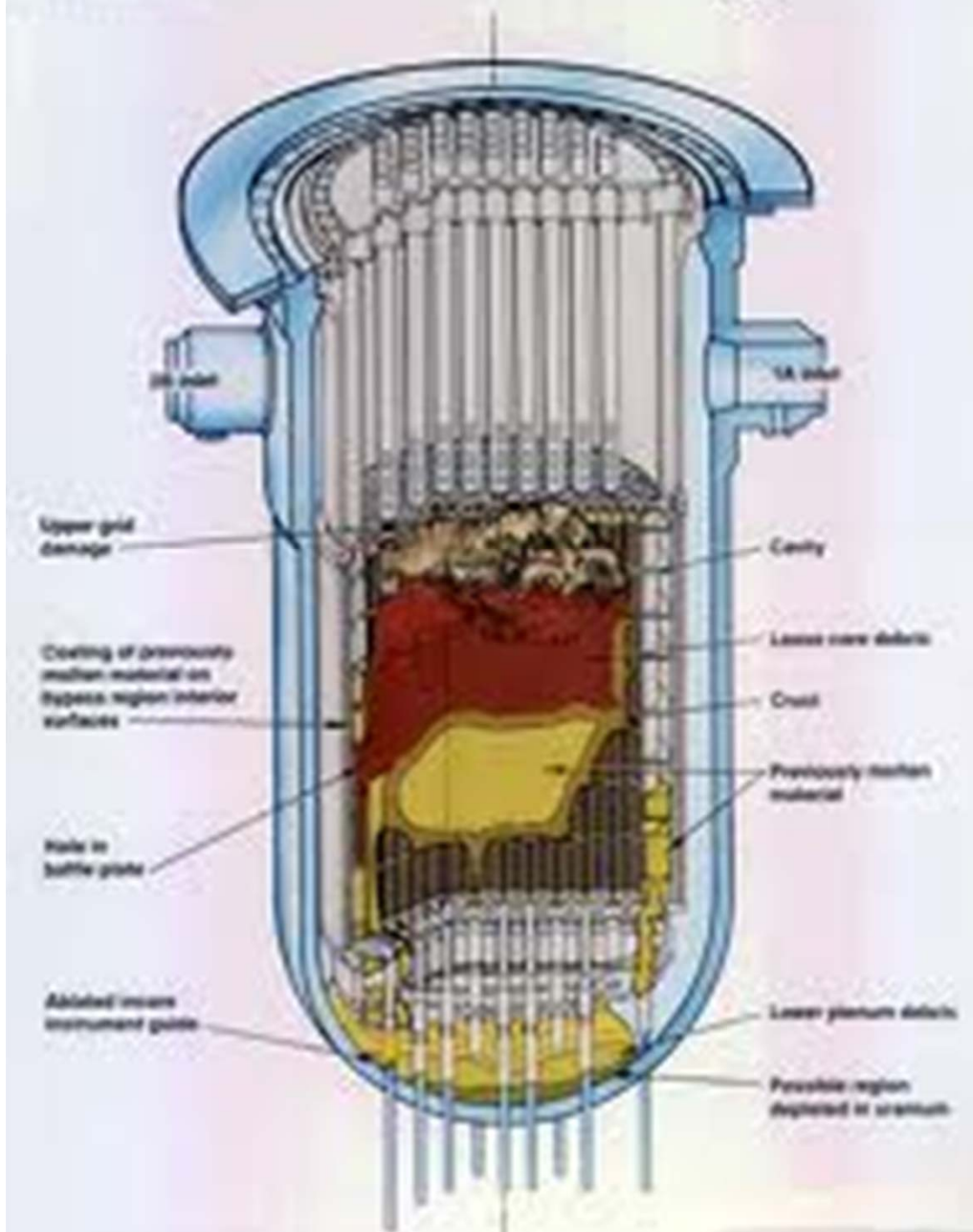
RB Arrangement



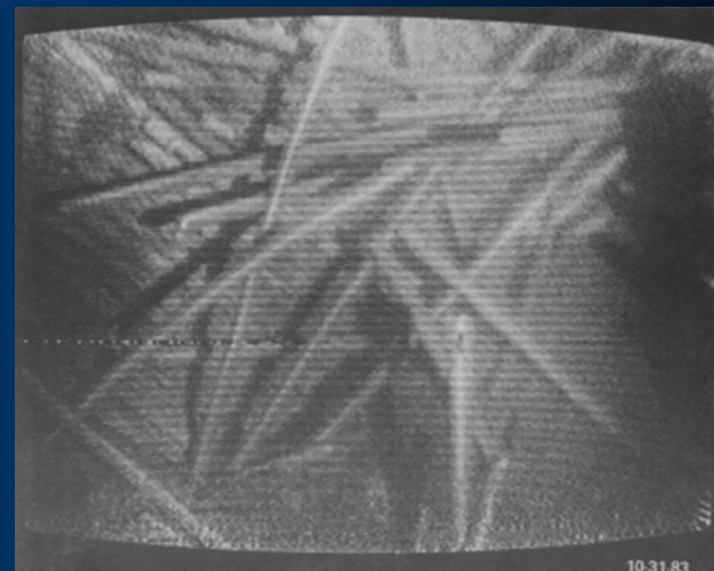
TMI-2 Accident

- PORV leaking by with only indication in alarm
- Loss of Feedwater
- Rx tripped on High Pressure
 - Heat Production / Heat Removal Imbalance
- PORV Opens and does not close
- LOCA at the top of the Pressurizer w/ ES actuation
- PORV/HPI Cooling is defeated over concerns of excess inventory
- EFW not available due to Switching and Tagging mishap
- No heat removal capability results in core damage

TMI-2 Core End-State Configuration

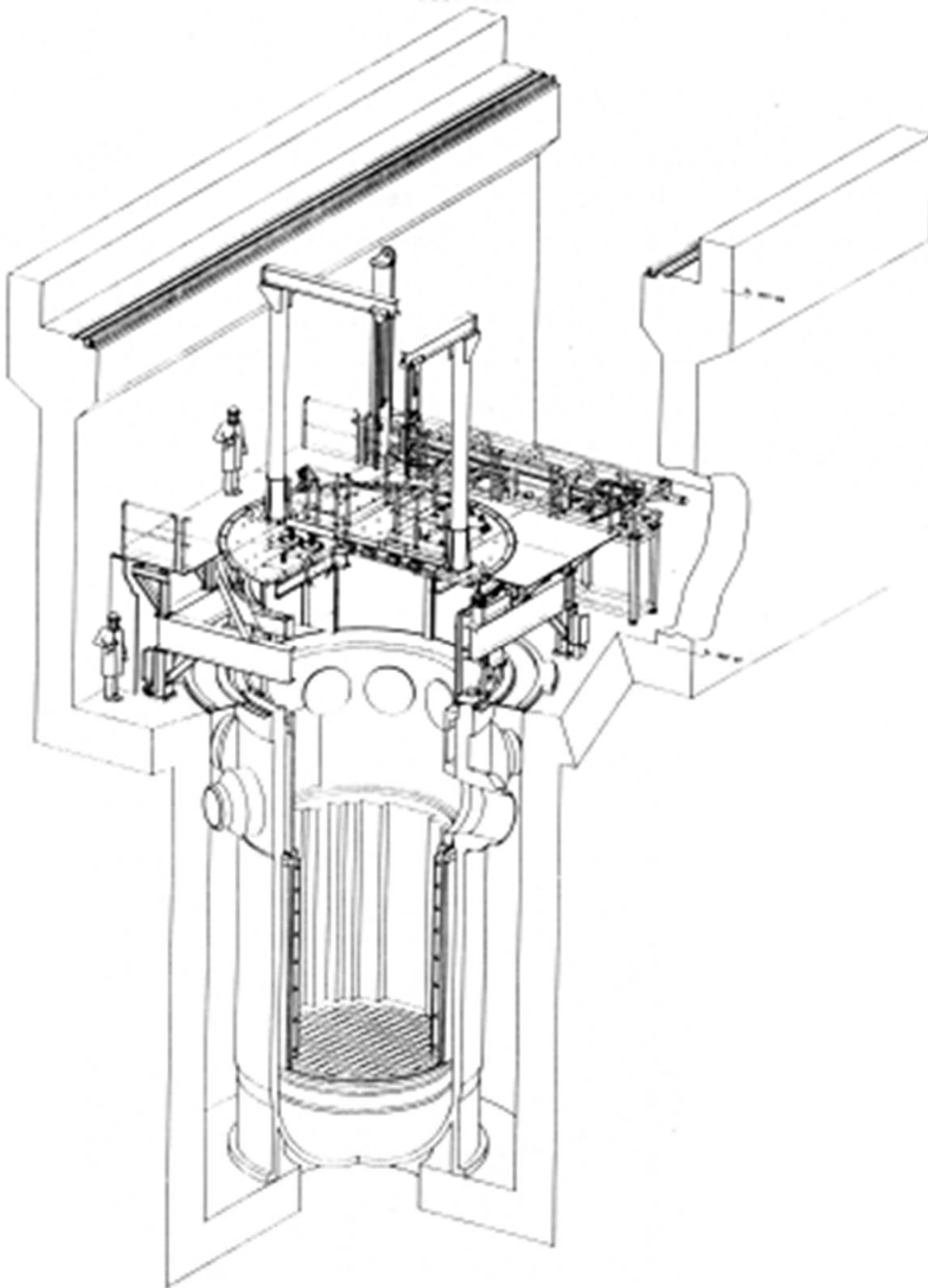


Core Damage

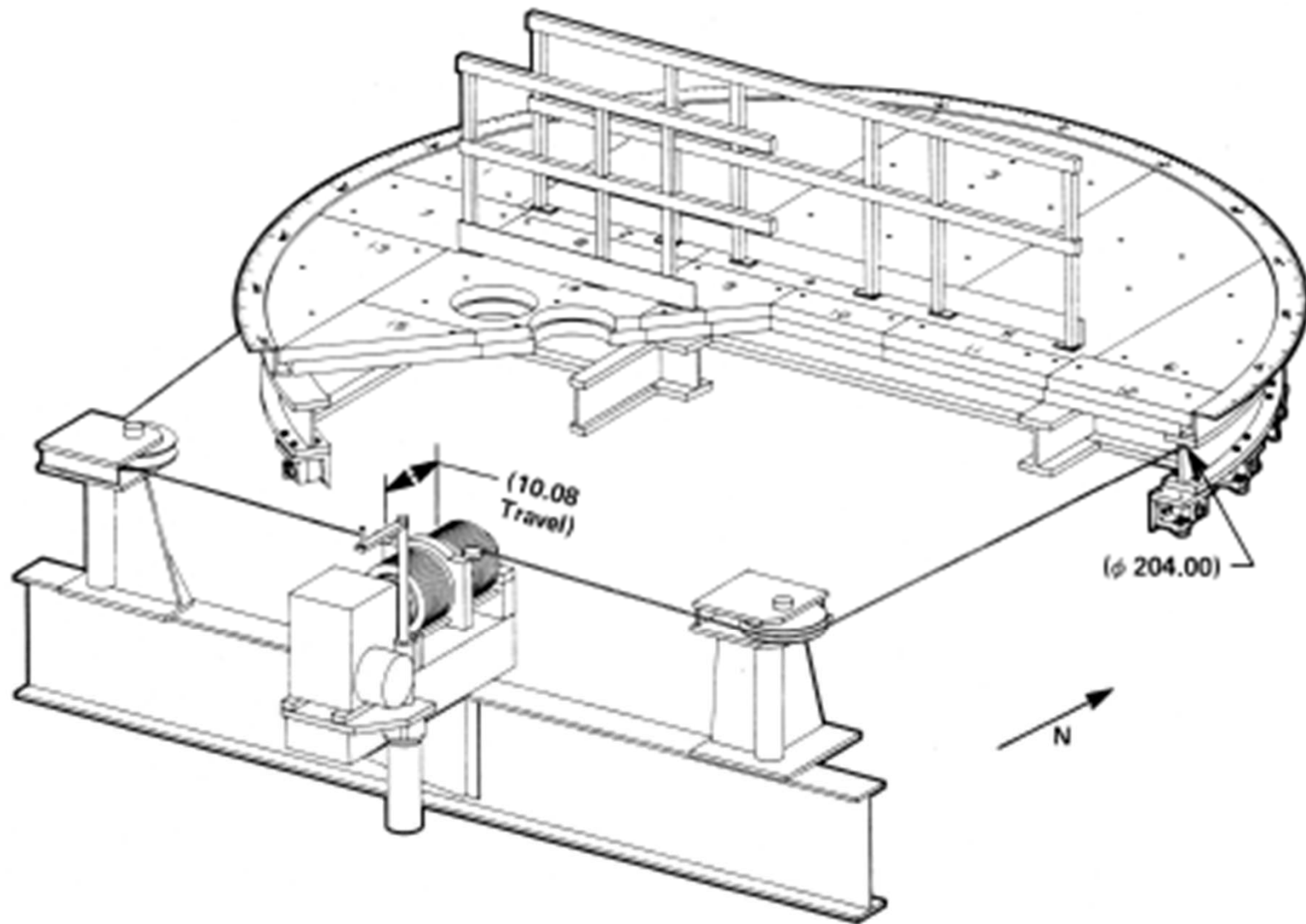


Work Platform

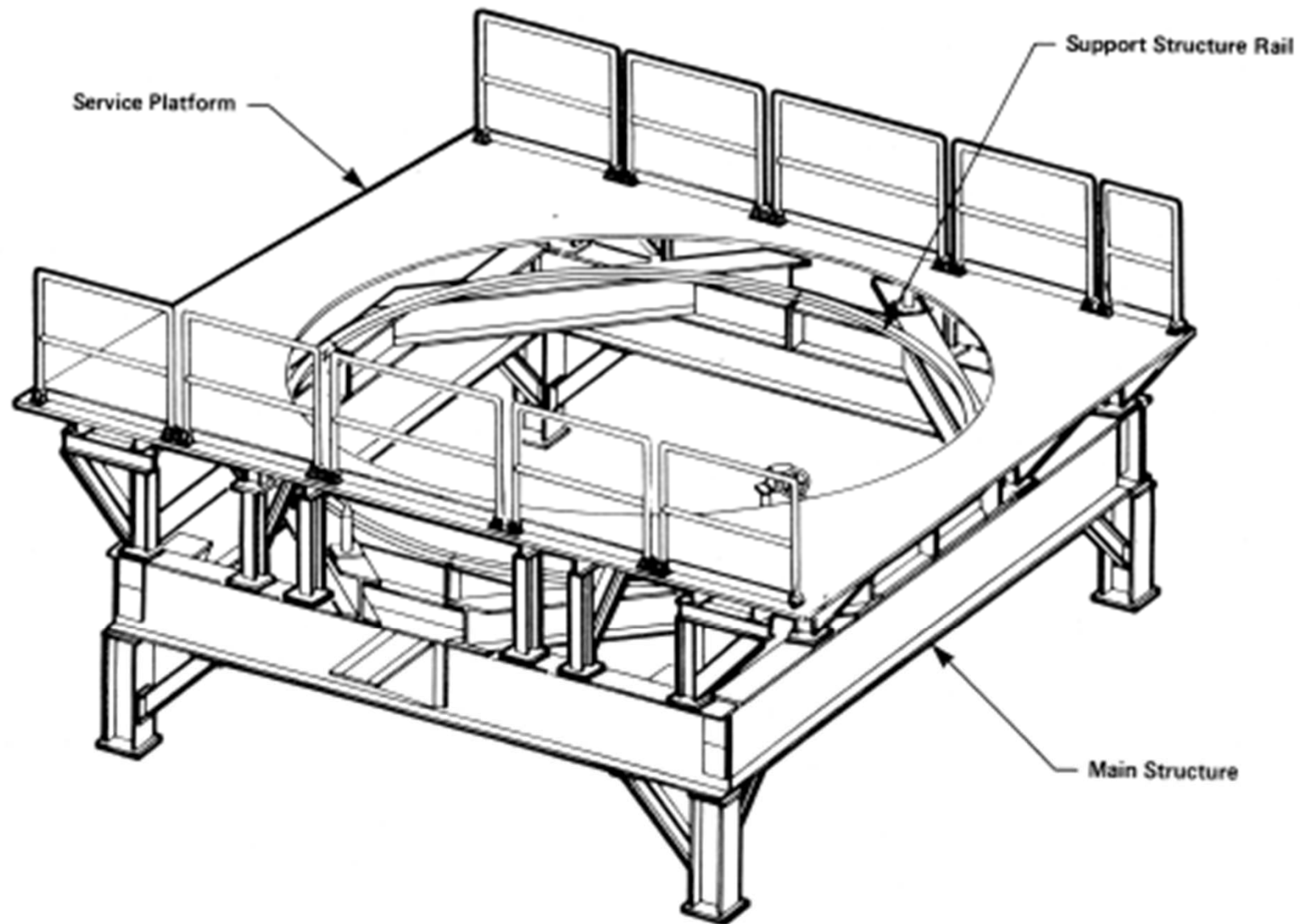
Internals Indexing Fixture
Rotating Work Platform
Rotating Service Platform



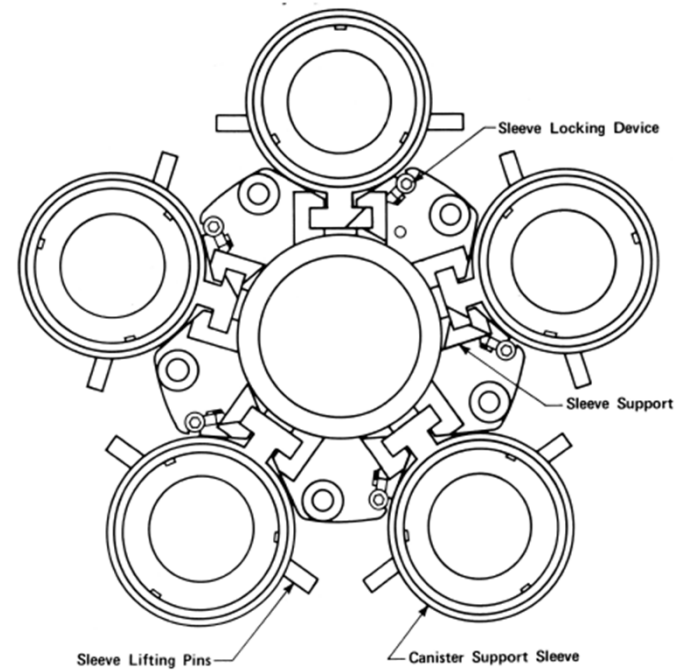
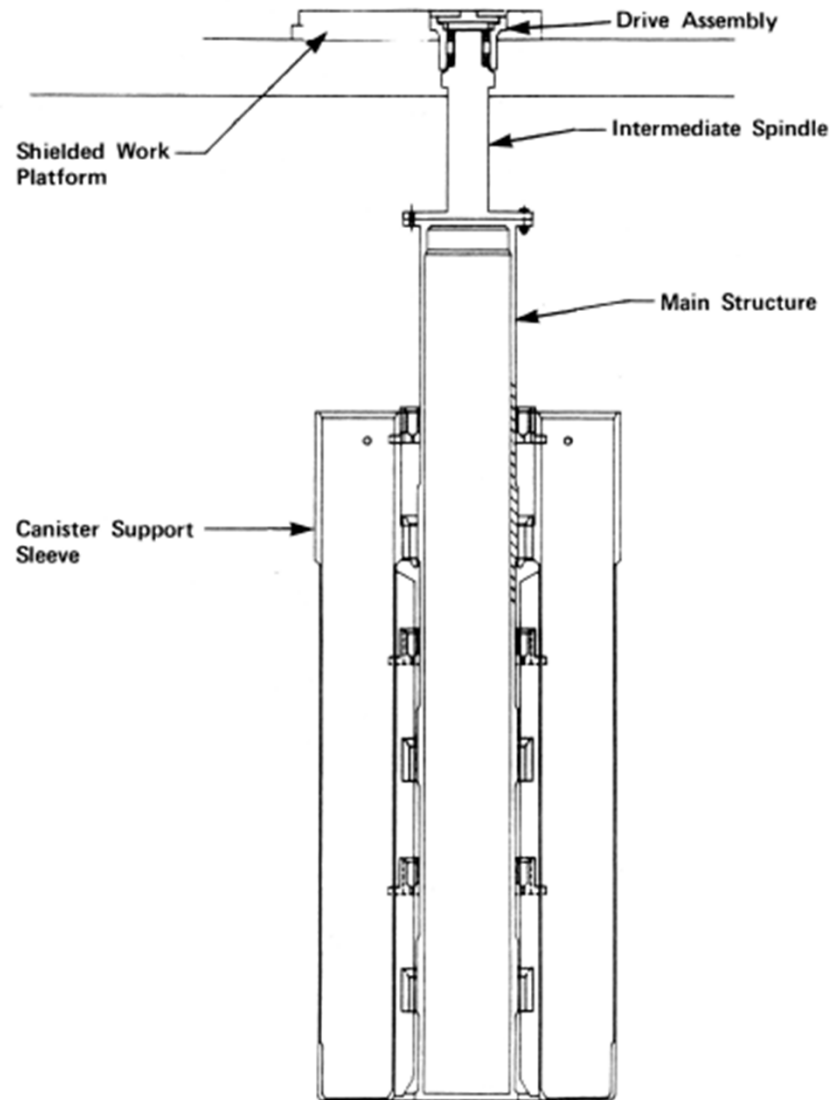
Rotating Shielded Work Platform



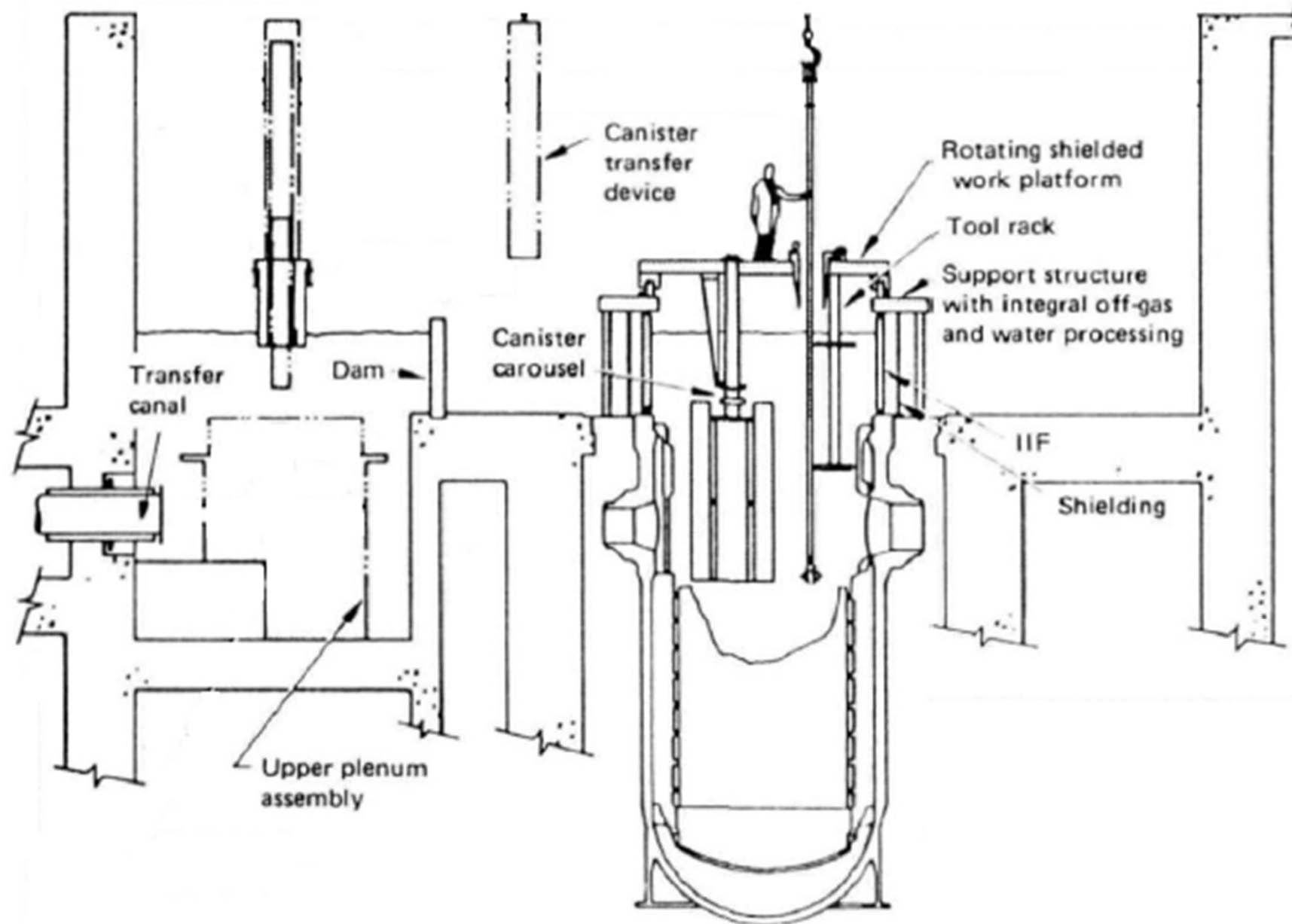
Service Platform



Canister Carousel



Work Platform



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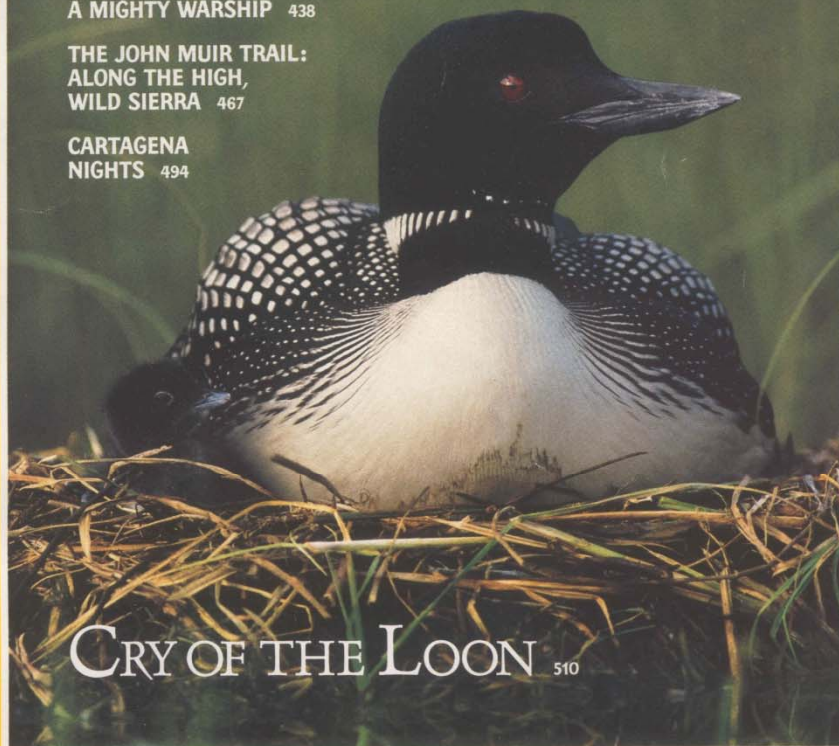
NATIONAL GEOGRAPHIC

LIVING WITH
RADIATION 403

KRONAN—REMNANTS OF
A MIGHTY WARSHIP 438

THE JOHN MUIR TRAIL:
ALONG THE HIGH,
WILD SIERRA 467

CARTAGENA
NIGHTS 494



CRY OF THE LOON 510

SEE "SERENGETI DIARY" WEDNESDAY, APRIL 12, ON PBS TV



Entrance and Exit

Early Defueling Teams

5 Team Members

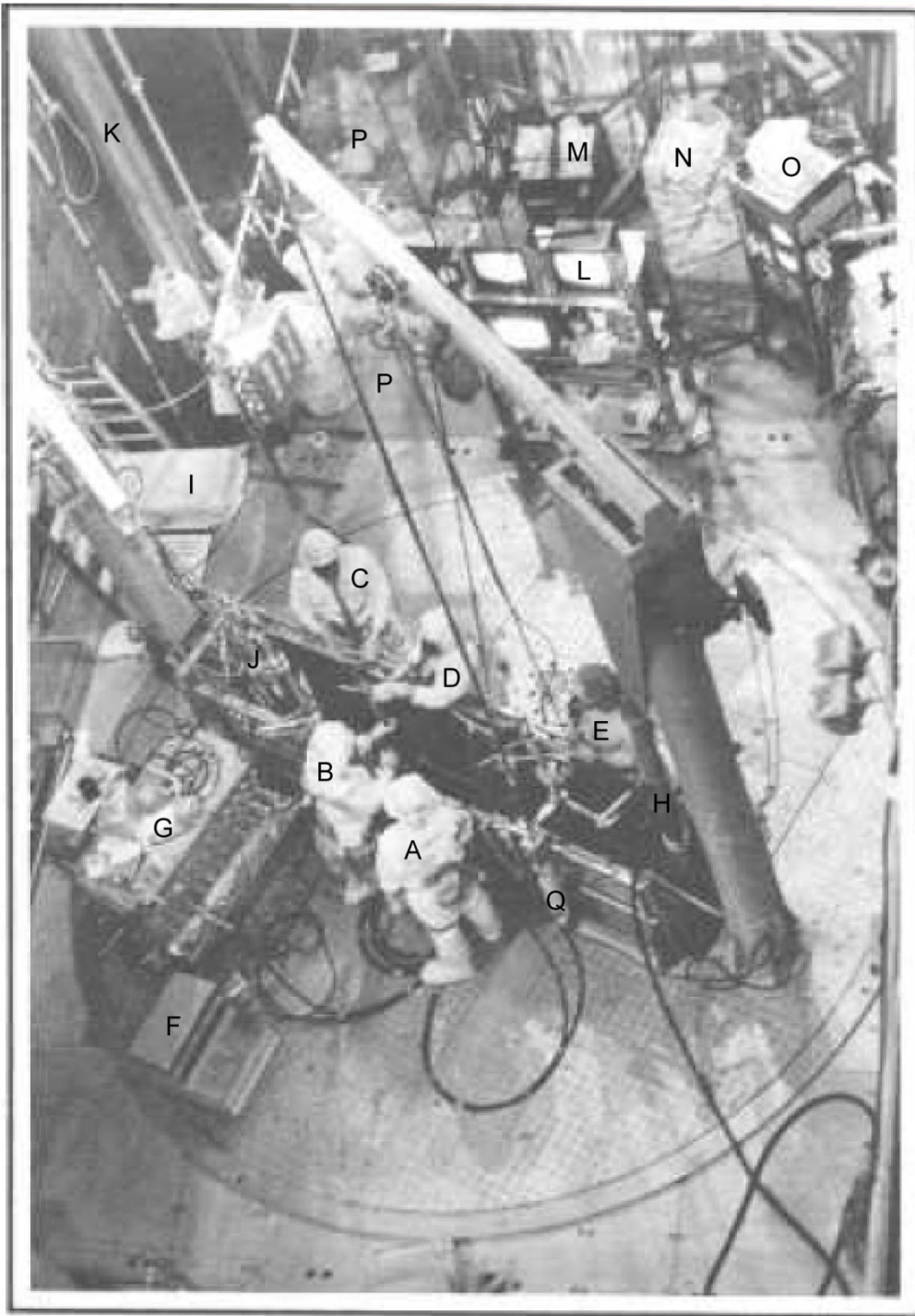
Rad Con with Purple Hood

Later Defueling Teams

3 Team Members

Rad Con as needed only





Defueling

Key:

A: Camera Operator

B: Tool Operator

C: Crane Operator

D: Probably the Camera Controller acting as an assistant to the Tool Operator

E: Radiation Control Technician

F: Step Stool for disconnecting tools from the jib crane when tied off in the slot

G: Hydraulic control skid used to power long handled tools.

H: Long Handled tool tied off in the slot

I: Step off pad to the Defueling Water Cleanup equipment.

J: Small Long Handled tools tied off in the slot

K: Long Handled tools tied off along the fuel canal wall

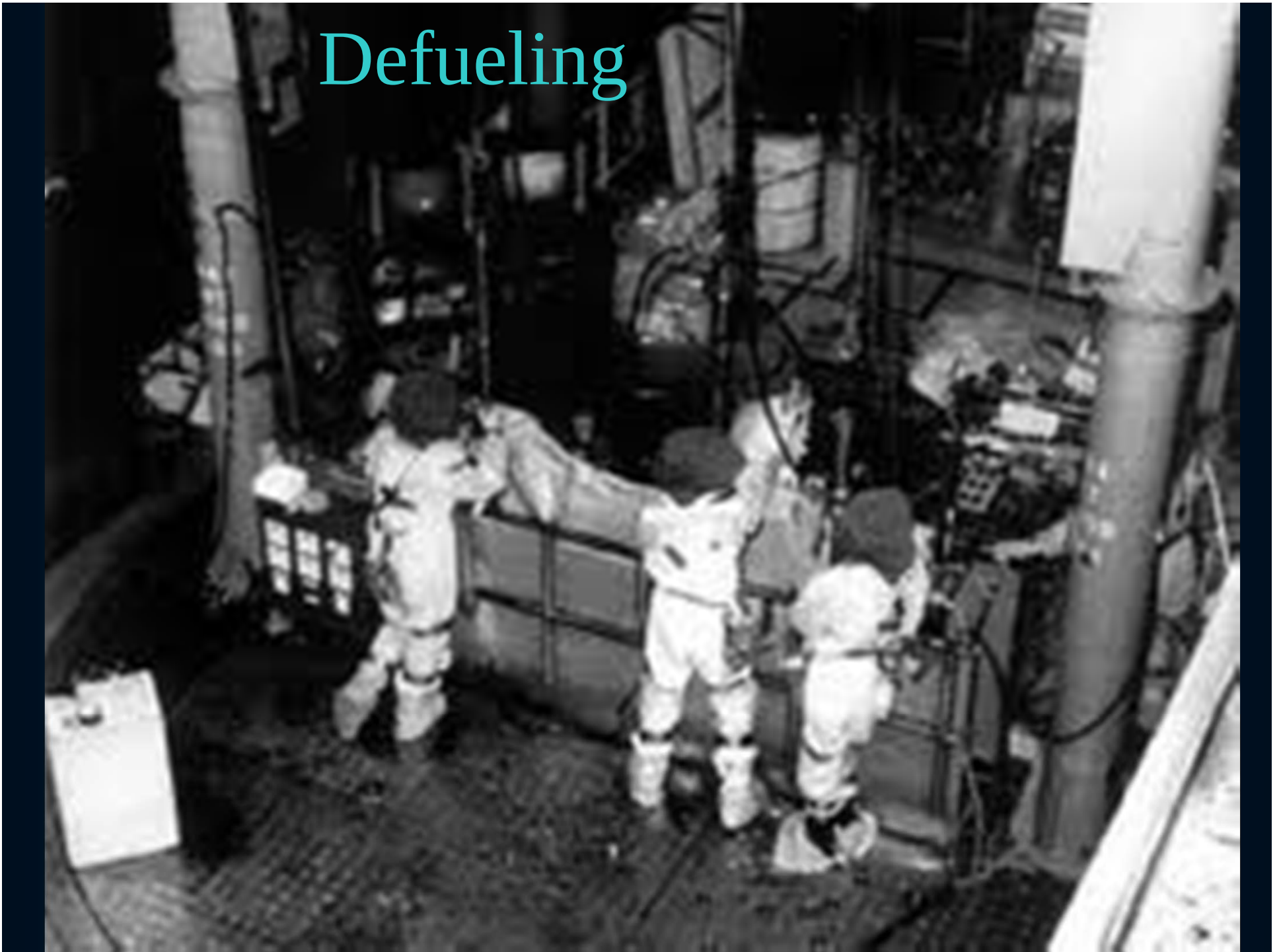
L: Monitor console

M: Rack containing disposable booties and gloves

N: Unknown but may to be a container of discarded booties and gloves awaiting transfer

O: Camera control console and radio repeater equipment

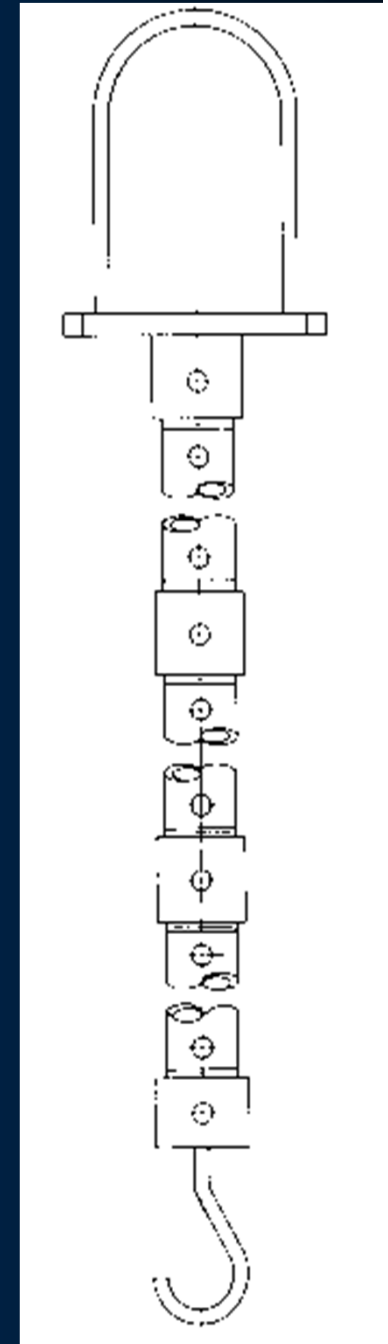
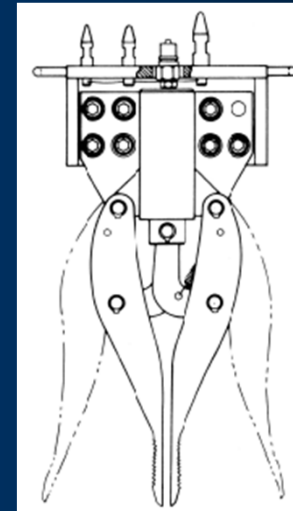
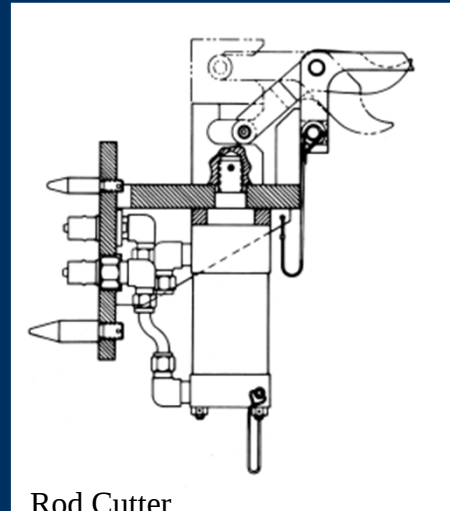
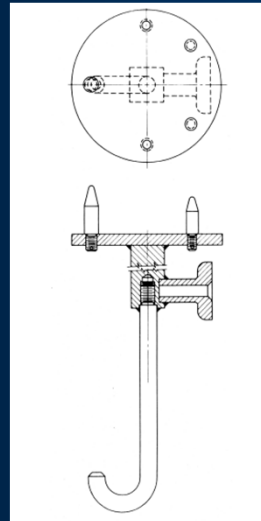
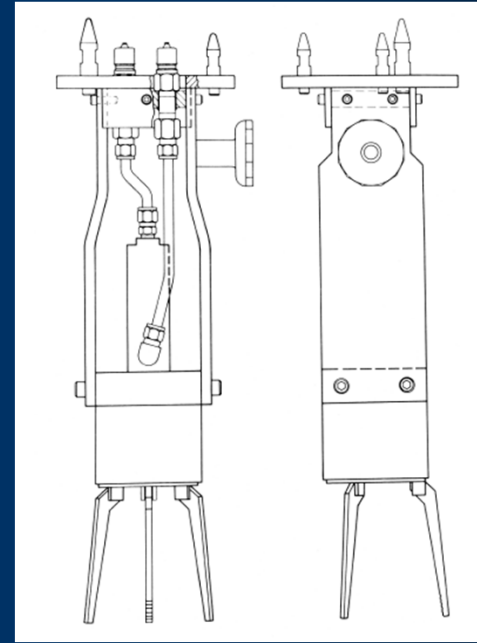
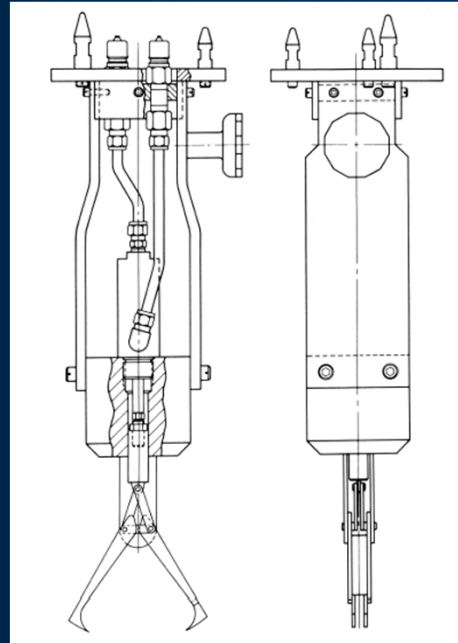
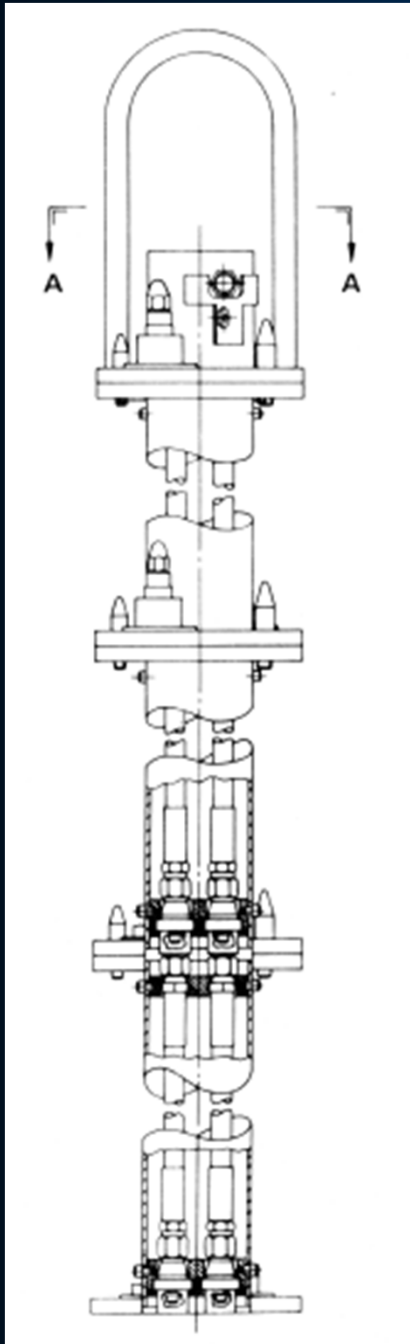
Defueling



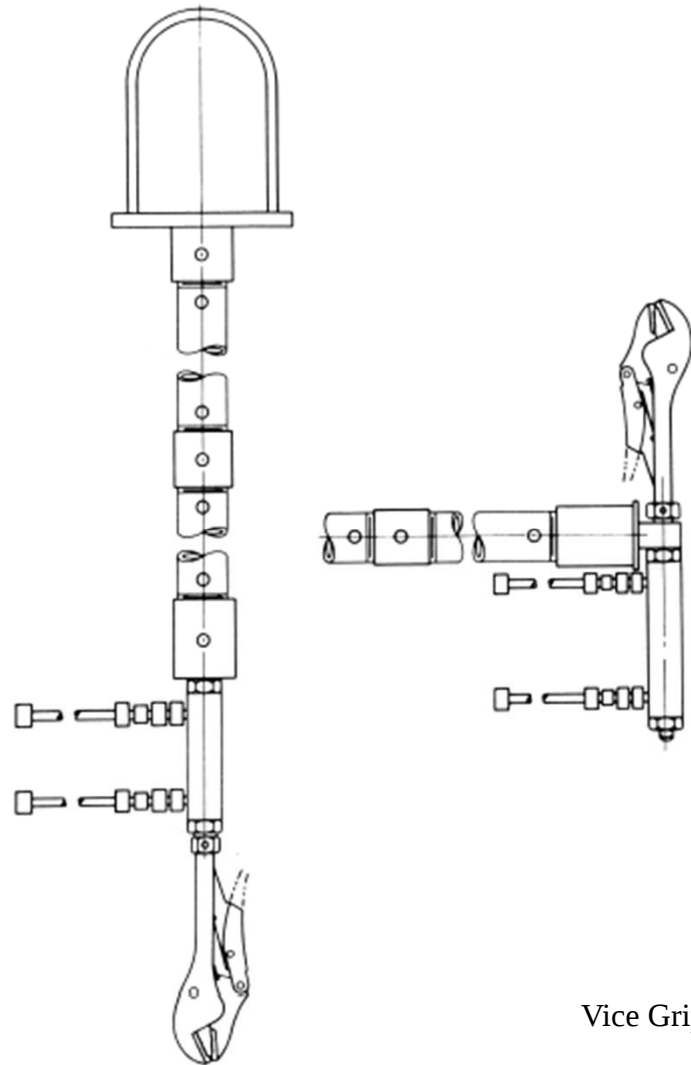
Man Power

- Manpower Will be Critical
 - Apply Skilled and Unskilled labor effectively
 - Don't Overwork the Teams
 - Unsustainable in the long run
- Allow the crews learned experiences to benefit future work (defuel in series)
 - Defuel the least damaged unit first
 - Defuel the remaining two in parallel if desired
- Robots are useful but always require more work than human labor alone
 - Personnel Safety / Dose

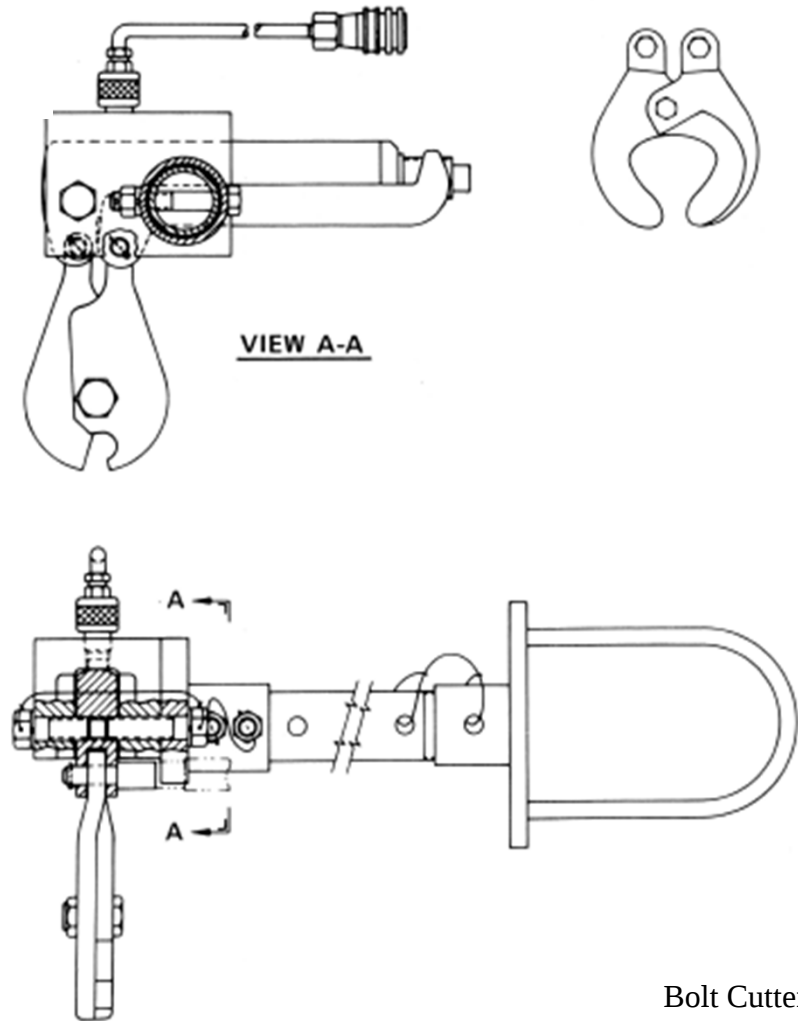
Tools



Tools



Vice Grip



Bolt Cutter

Design & Fabrication crew on site for Fast Turnaround. Many Tools: Lariat tool, Fuel Assembly Lifting tool, Hydraulic Fuel Assembly Clamps, Peters tool, Jet Pump Vacuum Cleaners, Frew Screw, Socket Wrench, All Bolts were Standardized w/ threaded receivers (no nuts), Rinse System, more

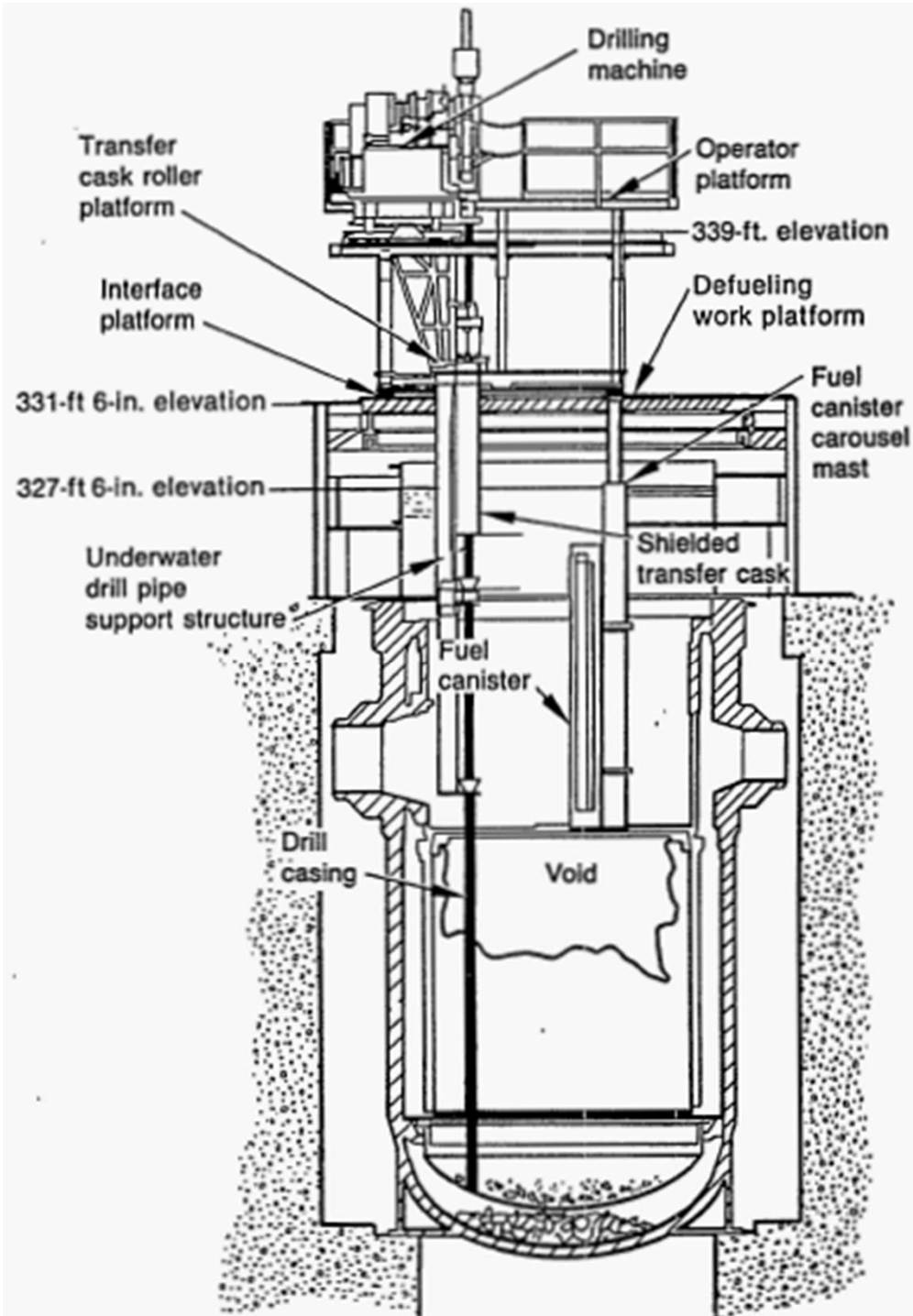
Water Clarity

- DWCS (Defueling Water Cleanup system)
 - Stopped Work
 - Design and Testing Under High Stress
 - Solution: Diatomaceous Earth Filter on a larger scale
 - Very Effective
 - Suggestion: Minimize Hoses
- Bacteria (Hydraulic Oil Leakage as Carbon Source)
 - Stopped Work
 - Testing Performed Under Stress
 - Solution: Addition of Oxidizing Biocide (H_2O_2)
 - Heavy Decontamination Required
 - Very Effective
 - Suggestion: Use UV light if possible

Core Bore

Data for Accident Analysis

Monolith Break up



Internals Cut Out

Underwater Plasma Arc Cutter



Shipping and Rad Waste



Fuel



Other:

Liquid Cleanup - SDS and Epicore II

Ion Exchange Vessels

Solid Rad Waste (Disposal of gloves, booties, etc)

Anti-C's Processing and Supply

Respirators – Cleaning Testing and Supply

Suggestions

- Water Clarity
- Biological Issues
- Minimize Hoses
- Mockup
- Clean Robotic Design
- Plan Conservatively
- Expect Popular Discontent
- Weld More Bolt Less
- Use Load Cells
- Utilize Experience
- Vacuum Cleaners
- UV with H_2O_2
- IAEA TRS-321

Questions?

Now or Future

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