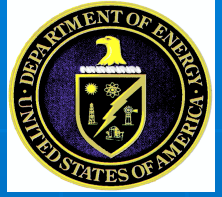


Summary of the D&D Engineering Operations

Keith Rule

Princeton Plasma Physics Laboratory

Project Attributes

- Schedule: October 1999 through September 2002
  - Original Estimated Project Cost: $40.3M
  - Project Cost at Completion: $36.8M
- Objectives:
  - Remove activated and/or contaminated components from the TFTR Test Cell and adjacent support areas.
  - Provide data for the decommissioning of future fusion projects.
- Scope
  - 2398 cubic meters of low level radioactive waste.
  - 1995 metric tons
  - 440 standard containers (IP-1, ~3 m^3 volume)
  - 72 specific design containers (Type A, 22 m^3 to ~42 m^3)
  - Dose rate – 50 mrem/hr (0.5mGy) contact with vacuum vessel
  - Approx. 10,000 curies (370 TBq) of tritium disposed

TFTR - 3 year D&D

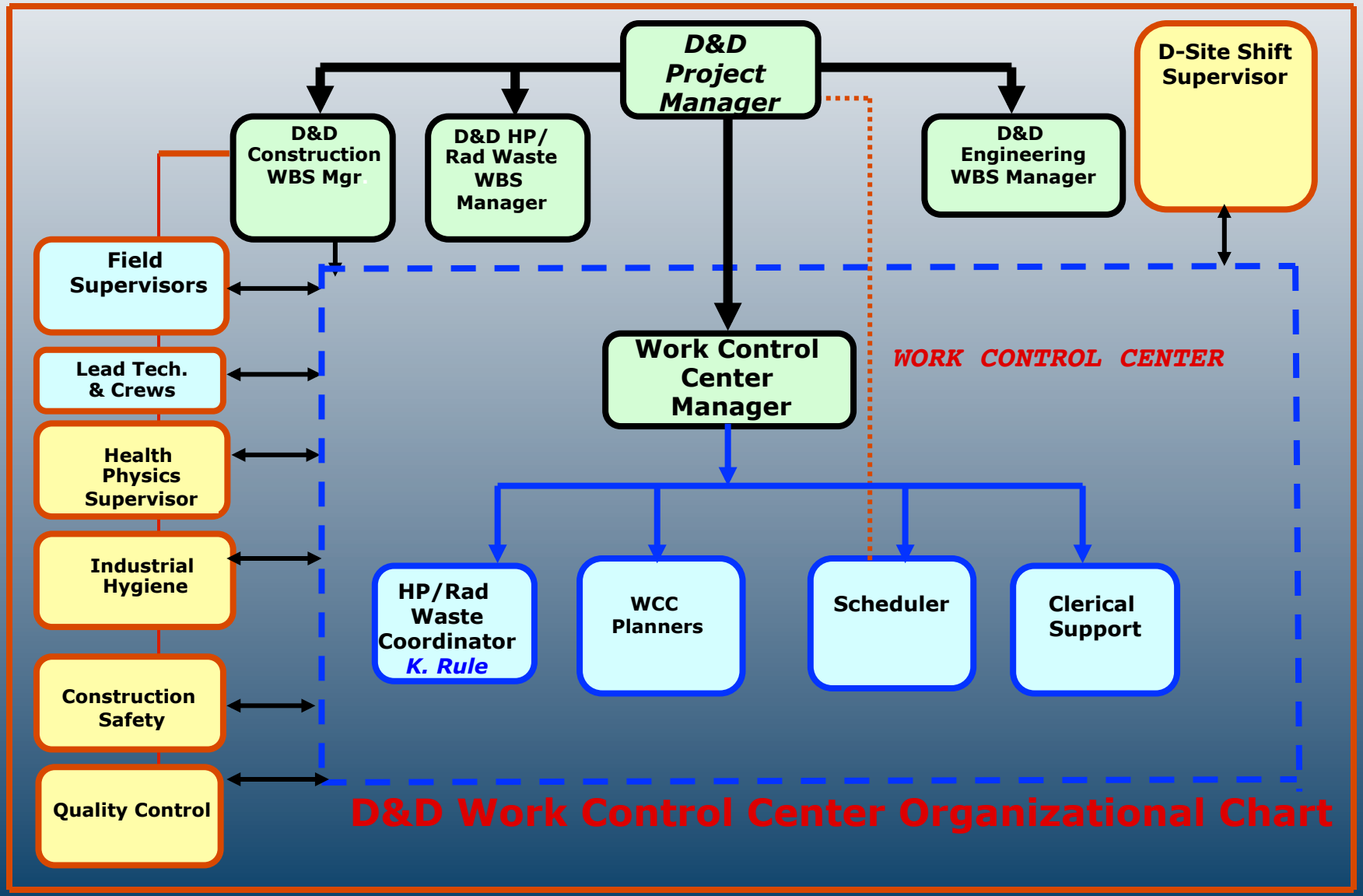
Radiation Protection Facts

- “0” Zero reportable occurrence reports due to health physics related issues based on regulatory requirements.
- < 100 mRem (1 mGy) combined dose from internal exposure due to tritium for all HP technicians and workers monitored for D&D operations
- Maximum single individual external dose of 573 mRem (5.73 mGy) attributed to the sheer compression panel removals.
- “0” Zero detectible internal exposures due to activated metals.
- More than 150,000 individual liquid scintillation vial samples analyzed.
- Just over 530 Ci (19.6 TBq) of tritium total for the site released up the stack.
- 1.4 mrem (0.014 mGy) maximum cumulative off-site EDE.

Conduct of Operations

- Worker safety highest priority
- Protecting environment from tritium release
- Very different set of hazards than TFTR operations
- Centralized control of work activities
- Procedure compliance mandatory
- Clear responsibility and accountability

Conduct of Operations



Work Planning Process

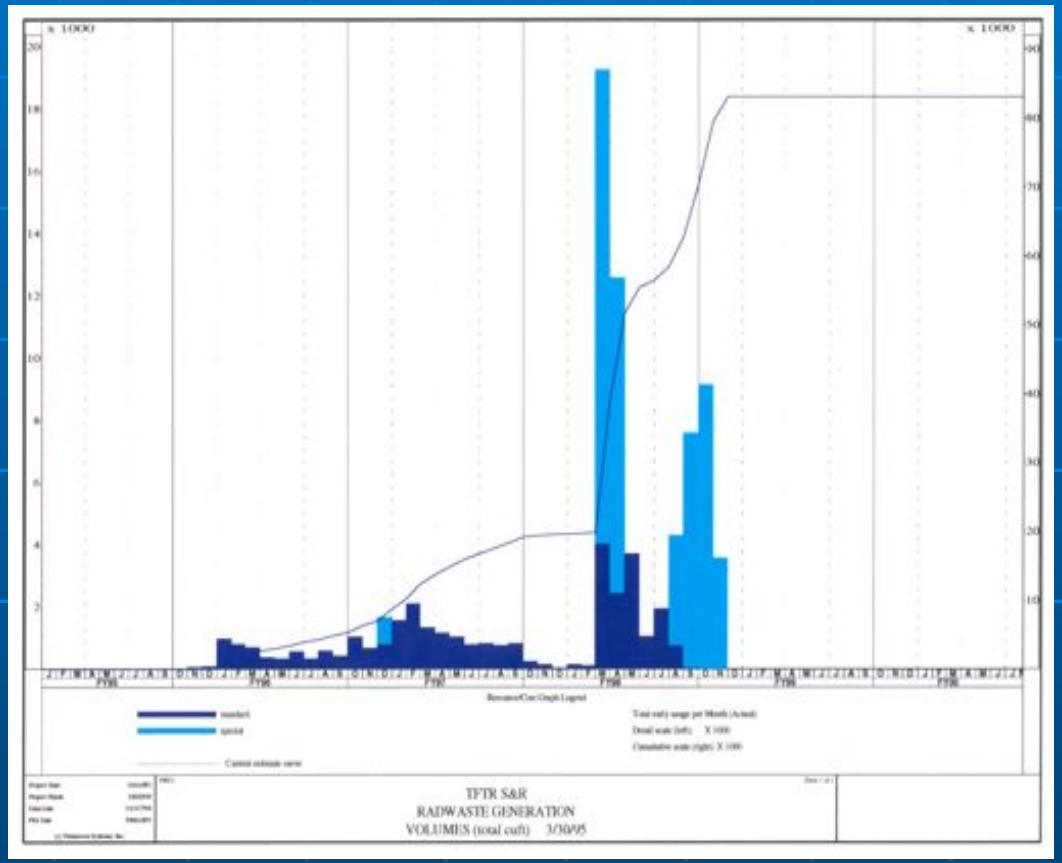
- Safety for workers and environment
  - Reduce exposure to hazards including radioactivity
- Three step process for worker protection
  - Engineering controls
  - Administrative controls – procedures, work planning
  - Personnel Protective Equipment
- Engineering
    - Define work scope
    - Conduct Peer Reviews and Design Reviews
    - Prepare installation/removal procedure
    - Define prerequisites for field work
    - Update or void drawings after removal is complete

Work Package Process

- Work Control Center
  - Review Engineering Package for completeness
  - Ensure prerequisites are completed prior to issuing package for work
  - Arrange for all permits
  - Release work package to field per schedule
  - Arrange for resolution of field problems
  - Return completed work package to Engineering for drawing update/voiding
- Construction
  - Verify and/or perform safing and lockout/tagout per PPPL procedures as required
  - Perform field work per procedure
  - Return completed work package to Work Control Center

Radioactive Waste – Integrated to Schedule

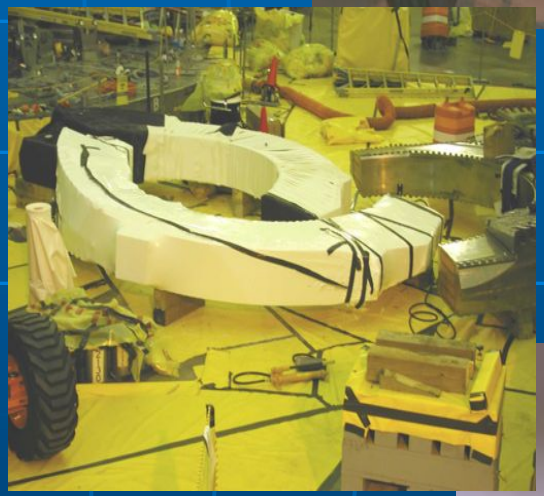
- Information integrated into Master Schedule
- Volume, containers, shipments, and cost.
- Any change to schedule reflects impact to waste management



VV Segment Container

Characterization

- In-Situ Object Counting System - Portable Gamma Spec system
- Liquids – sample and analyze
- Surface contamination measurements
- Radioactivity values for major components – Code calculations L.P. Ku



Disposal Sites

- Hanford (DOE)– Washington State
  - Lengthy approval process to ship each load.
  - Waste is routinely analyzed at Hanford
  - Actual costs averaged to $22/ft^3 (surcharges)
- Nevada Test Site (DOE)
  - Lengthy approval process to become an approved generator. ~ 1.5 years
  - Emphasis is placed on procedures and generator documentation
  - Cost - $6/ft^3, no surcharges

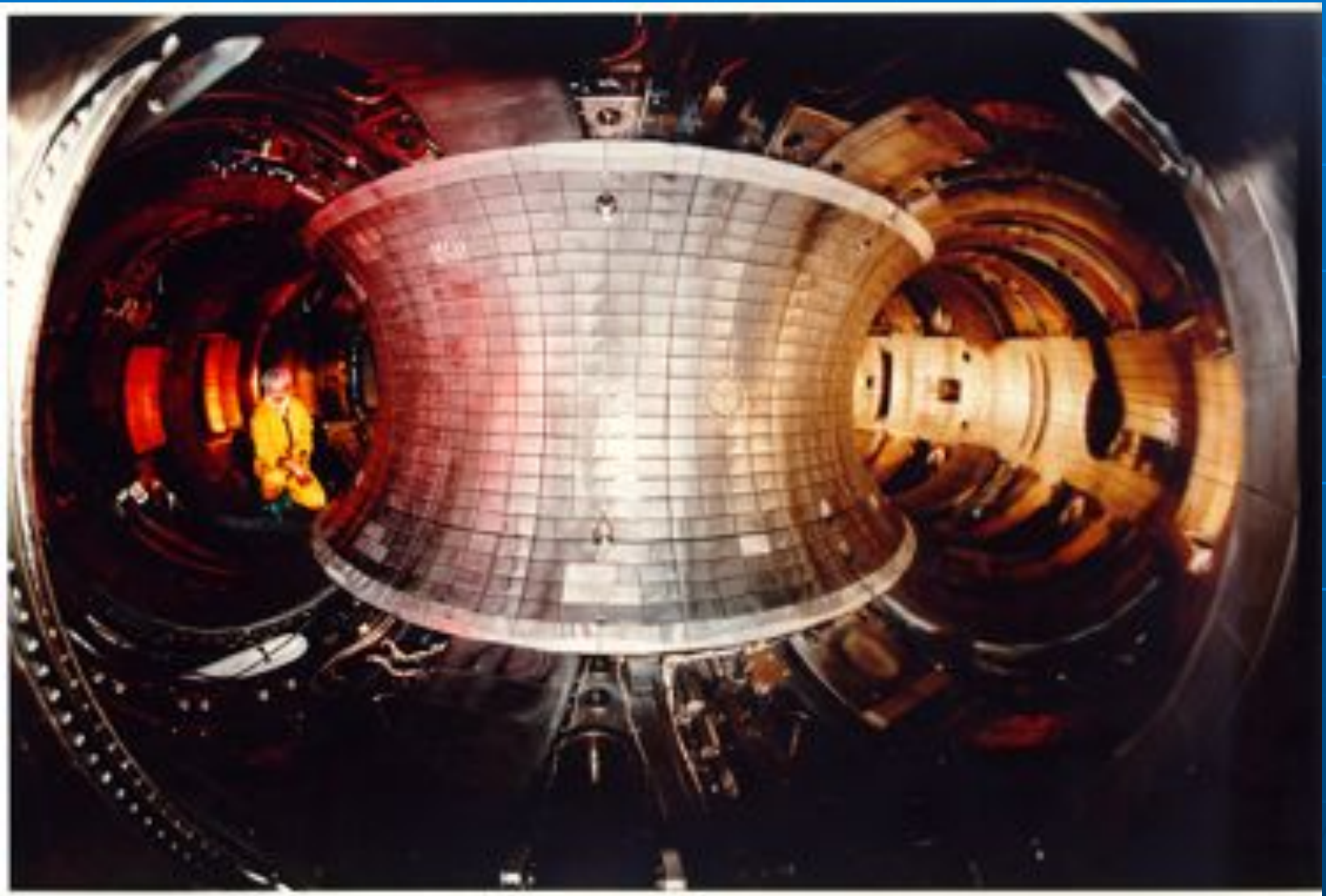
Final Analysis

- 1995 estimate - 84,703 ft^3
- Deleted scope – 30,525 ft^3 → 54,178 ft^3
- Added scope - Moratorium - 15,440 ft^3 → 69,618 ft^3
  - 9,940 in dump trailers – cost of $260,680
  - 5,500 used for void filling – saved $145,000
- Disposed at Hanford – 27,312 ft^3
- Disposed at NTS – 21,918 ft^3
- Total disposed → 49,230 ft^3

Waste Packaging – Container Design

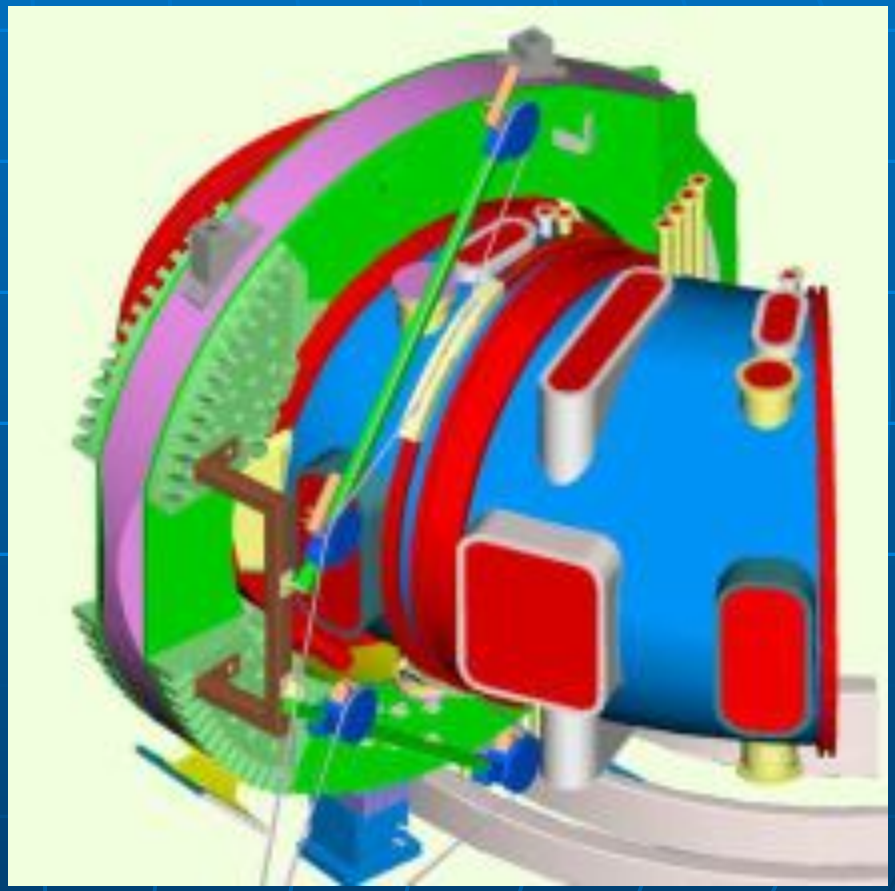
- Standard Containers – 6 & 8 feet long
- Weight capacity – 10,000 pounds
- Closure types – clip down and bolt down
- Use sealants and bolt down lid for tritium

TFTR Vacuum Vessel



Diamond Wire Cutting

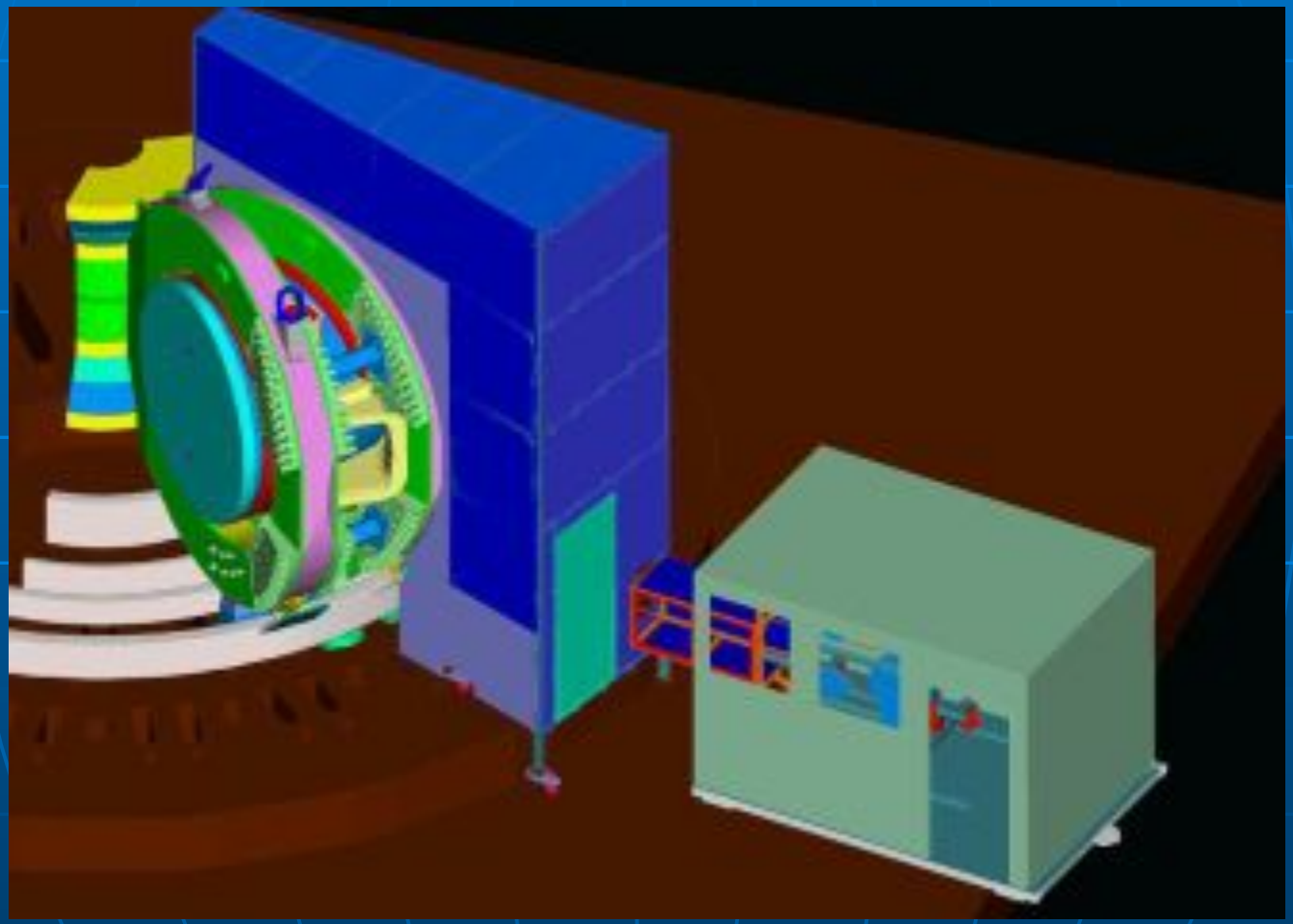
- Eliminates vapors and fumes associated with burning techniques.
- Keeps workers further away from hazards.
- Proven to be the least time consuming.



Diamond Wire Cutting

- VV filled with low-density concrete.
- Reduced T2 emissions.
- Lower dose rate.
- Cutting rate greatly increased.
- VV segmenting duration shortened.
- Personnel exposure to hazard from enclosure entries minimized.

Diamond Wire Cutting



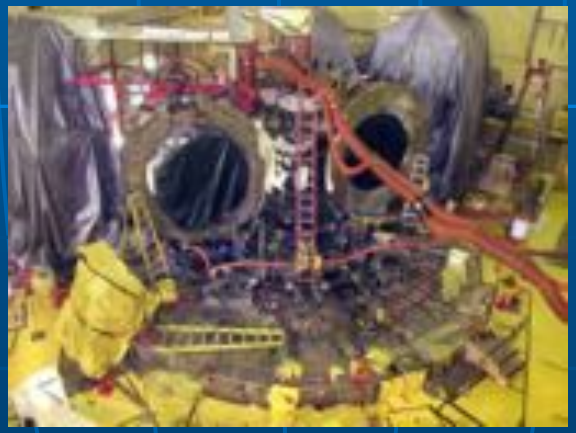
Diamond Wire Cutting

Progress

October 1999

November 2000

April 2002



Summer 2001

Conclusion

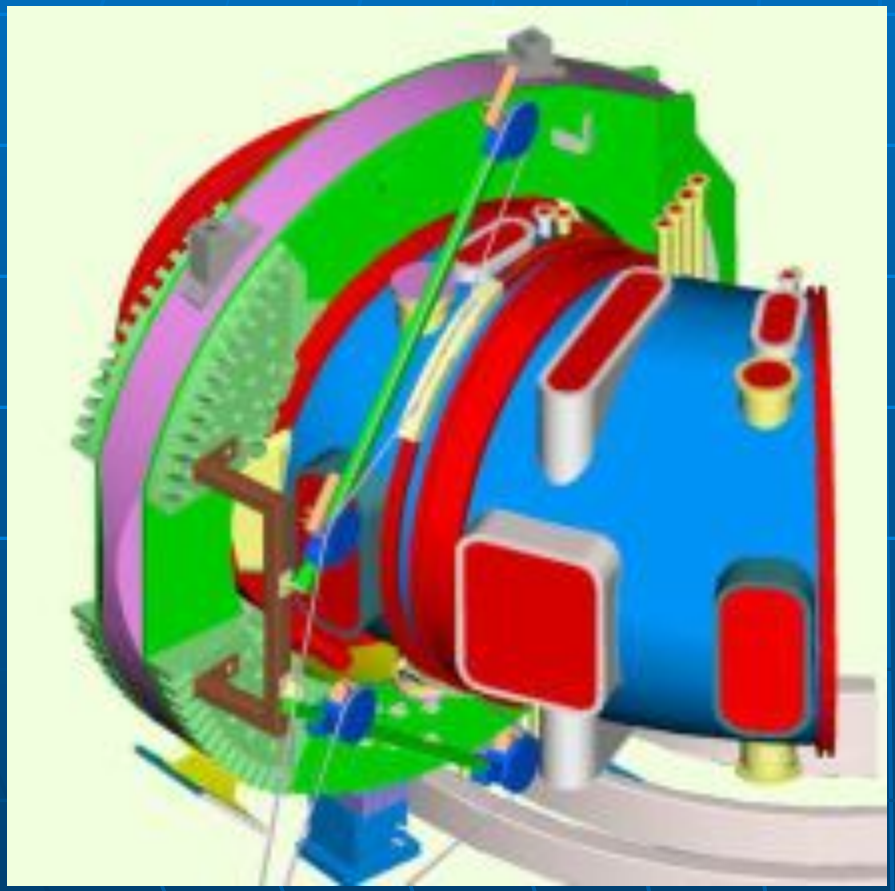
- TFTR D&D was a very successful project for the fusion community.
  - Management - Work Planning and control.
  - Engineering- Diamond wire cutting
  - Radiological – low exposures, workers and environment
  - Performance
    - R&D with existing technology
    - Involve peers and hands-on techs
    - Take the time to find technology
    - Learn from others
    - Train, practice, mock-ups

Project Management

- Cost - Performance Measurement System employed utilizing earned value techniques
- Schedule - PC based “Primavera” System

- 1.0 Engineering
- 2.0 Field Operations
- 3.0 Project Management
  - 3.1 Project Office
  - 3.2 Work Control Center
  - 3.3 Configuration and Document Control
- 4.0 Health Physics and Safety
- 5.0 Radioactive Waste Management

Diamond Wire Cutting



- Upper and lower pulley is mounted on adjustable gear rack. Pulley is re-positioned to ensure that wire does not bend sharply around edge of cut.
- Camera provided real-time visual feedback to DWC saw operator for accurate positioning of pulleys.

Champion Cutting Tool

- Plunging blade
- Inherently safe
- Multiple end-effectors

Wachs Clamshell Cutter

- 15 Models for ½” to 36” pipe
- Machine splits for quick mount
- Pneumatic motor drive
- auto feed
- Cuts carbon, stainless, and harder alloys

Wachs Guillotine Saw

- Used to cut copper coils and umbrella structure
- 4 models available
- 2” to 24” diameter
- Chain pipe vise attachment
- Pneumatic driven
- Auto and manual feed control

Waste Packaging – Filling voids

- Low density concrete
  - contains tritium and other contamination
  - 30 – 50 pounds per cubic foot
  - Provides shielding
  - Exceeds all disposal facility criteria

Waste Packaging – Special Containers

- Identify package needs with engineering.
- Account for disassembly techniques
- Plan for voids and material to fill voids
- Incorporate weight of void fillers into design.
- Give yourself contingency
  - weight capacity
  - interior dimension