



NCNR Upgrades (2017 Fall Outage)

TRTR October 2018
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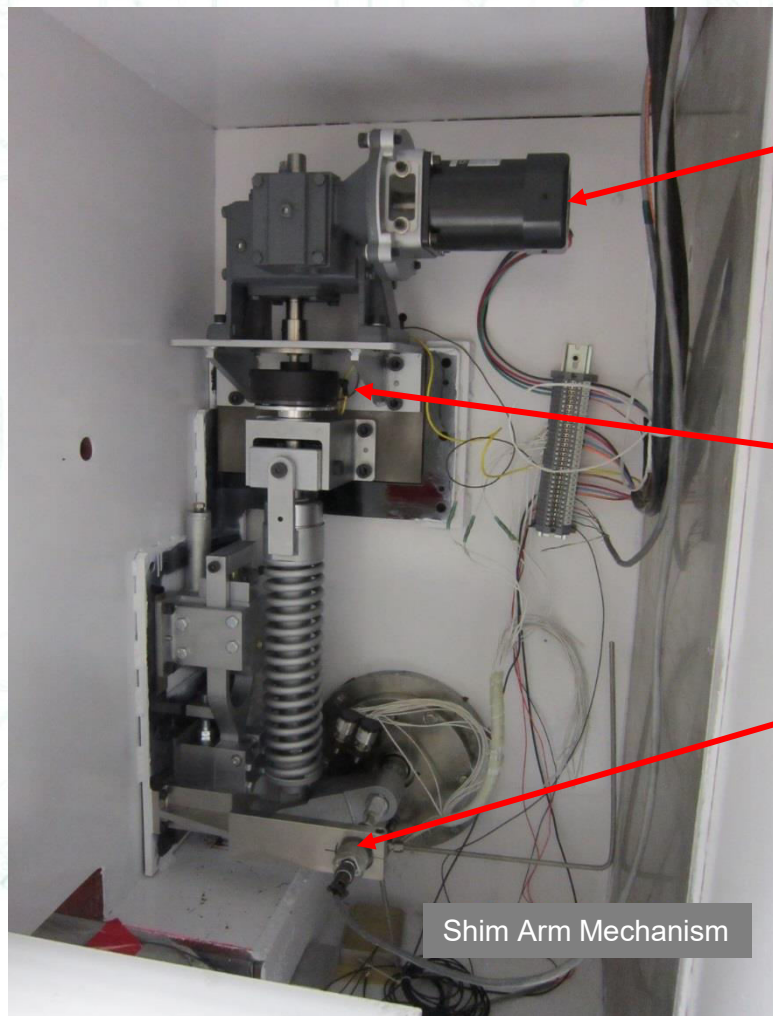
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Fall 2017 Upgrade Projects

- ▶ Major Projects during 3 month shutdown
 - Shim Arms
 - Primary Pumps
 - Thermal Shield
 - Normal Air Effluent monitoring
 - Storage Pool DAC System
 - Fuel Transfer Panel
 - Underwater Fuel and Shim Arm Saw
 - New 7kW Cold Source Refrigerator
 - Electrical Power Panels
 - Re-Epoxy Floor for Research Instrumentation

Shim Arm Drive Upgrade



Motor

Clutch

Position Transmitter

Shim Arm Mechanism

Shim Arm Drive Upgrade

- ▶ Shim Arm Drive Upgrade
 - Considerable testing done to optimize design and to decrease rundown drop times
 - Redesign of motor mechanism due to obsolescence
 - Redesign of clutch for quicker releases
 - Redesign of Shim Arm position transmitter indicator for increased accuracy and reliability
 - Entire drive assembled on a tooling plate for precise alignment

Shim Arm Drive Upgrade

- ▶ Shim Arm Position Transmitter
 - Benefits of a redesign from a potentiometer to a Rotary Variable Differential Transformer (RVDT)
 - Reliable
 - Non-contact construction
 - Continuous rotation
 - Output linearly proportional to angular position
 - No need for gearing to achieve resolution
 - Stable measurement even with power fluctuations
 - Commercial Off The Shelf (COTS) availability

Primary Cooling Pump Assemblies

▶ Pump Upgrade

- Replaced pumps and retained 125 hp rating
- Added vibration and temperature sensing
- Superior pump to motor alignment
- Flexible pipe plumbing on the pumps
 - Less pipe pressure on pumps
- Cooler running physically larger motors
- Continuous lubricating seals
- Replaced outlet air diaphragm (check) valves with nozzle check valves

Primary Cooling Pump Assemblies



Primary Cooling Pumps

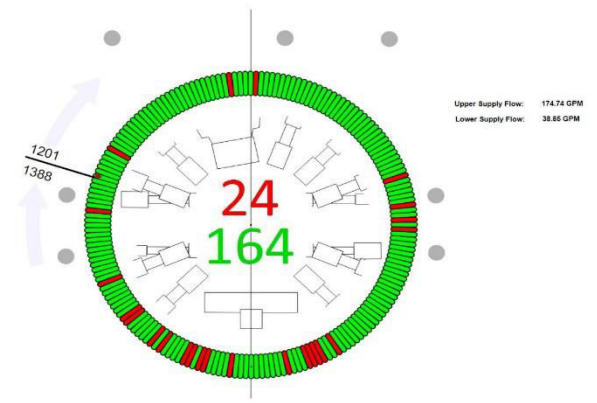
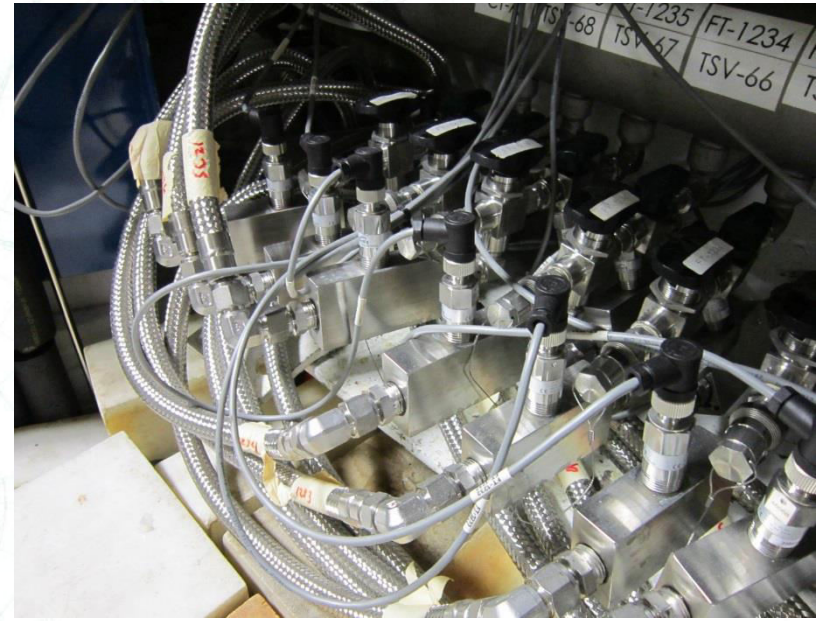
Thermal Shield System

- ▶ Working Conditions:
 - 2012 Switched from a positive pressure system to a negative pressure system due to line leaks
 - Used paddle wheel flowmeters to measure flow
- ▶ Problems with 188 Flow Measurements
 - Problematic through the years until the 2017 upgrade



Thermal Shield Flow Switch Upgrade

- ▶ Installed Thermoelectric flow switches
 - No moving parts
 - Measures temperature difference between heating element and sensor corresponding to water flow
 - HMI software upgrade
 - Alarm setpoint <0.8 L/minute
 - Reactor south corners problematic rundowns



Thermal Shield Update

- ▶ Outcome of installing thermoelectric flow switches:
 - Confidence in reading of which lines are below the minimum flow threshold of 0.8 L/minute.
 - Increased reliability
 - All 188 lines are under vacuum
 - Calculated loss of coolant is due to evaporation, previously due to positive pressure on lines.

Normal Air Radiation Monitor



From → To



- ▶ Switched to Digital Rate Meters
 - Passed CFR50.59 by incorporating analog redundant systems

Storage Pool DAC System

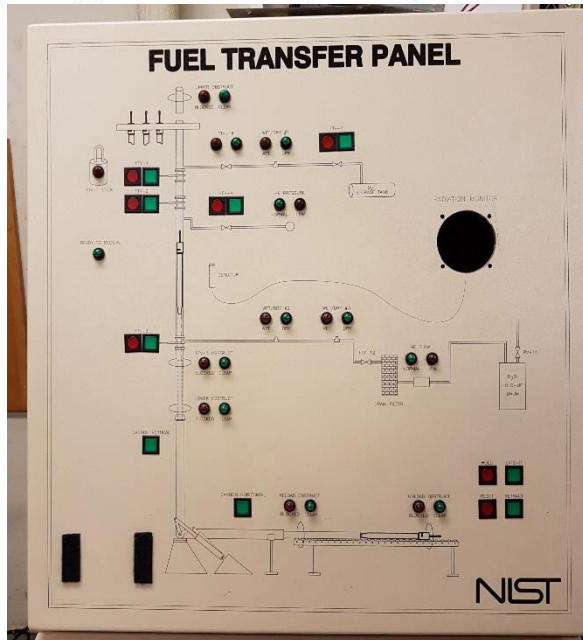


From → To

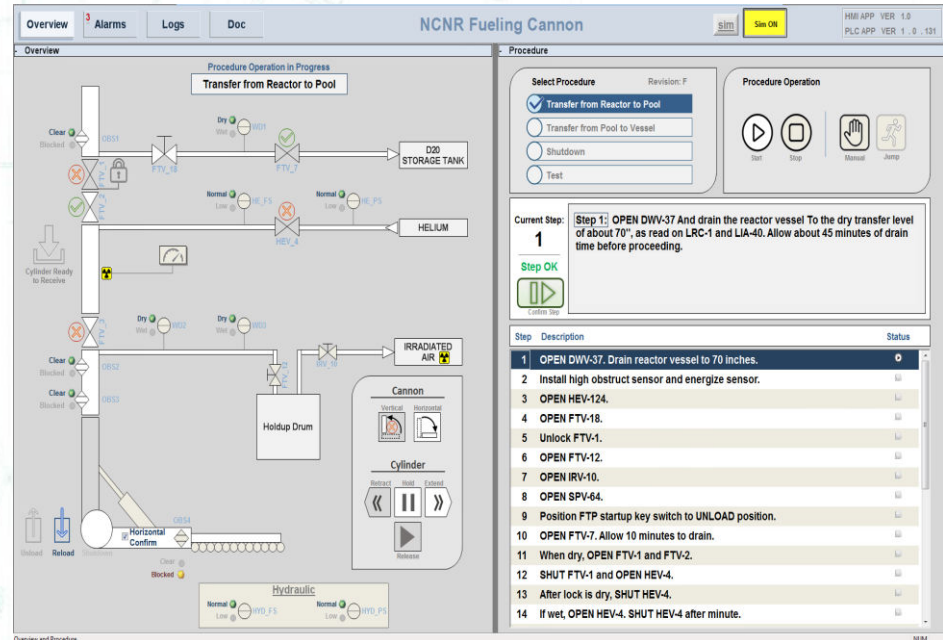


- ▶ Switched from analog displays to Digital
 - Critical analog displays replaced with industrial grade digital meters
 - Added touch screen recorder and mimic display

Fuel Transfer Panel



From → To



- ▶ Transfers spent fuel to the storage pool
 - Replaced obsolete equipment
 - Switched to digital HMI display screen
 - Viewable step-by-step instructions

Underwater Saw for Fuel and Shim Arms

- ▶ Developed New Underwater Saw
 - Purpose to separate the fueled regions from the non-fueled regions and remove the heads from the Shim Arms for disposal
 - Advantages:
 - Permanently stationed in the storage pool
 - Precision cutting
 - Cleaner sawing-chip management
 - Time saver

Underwater Saw for Fuel and Shim Arms



Size:
3'x5'x20'

Weight:
3800 Lbs.



New 7 kW Cold source Refrigerator

- ▶ Added a second Cold Source
 - Design and assembly completed by the cold source team.
 - Operational, on its fifth cycle
 - Mike Middleton will do a detail presentation

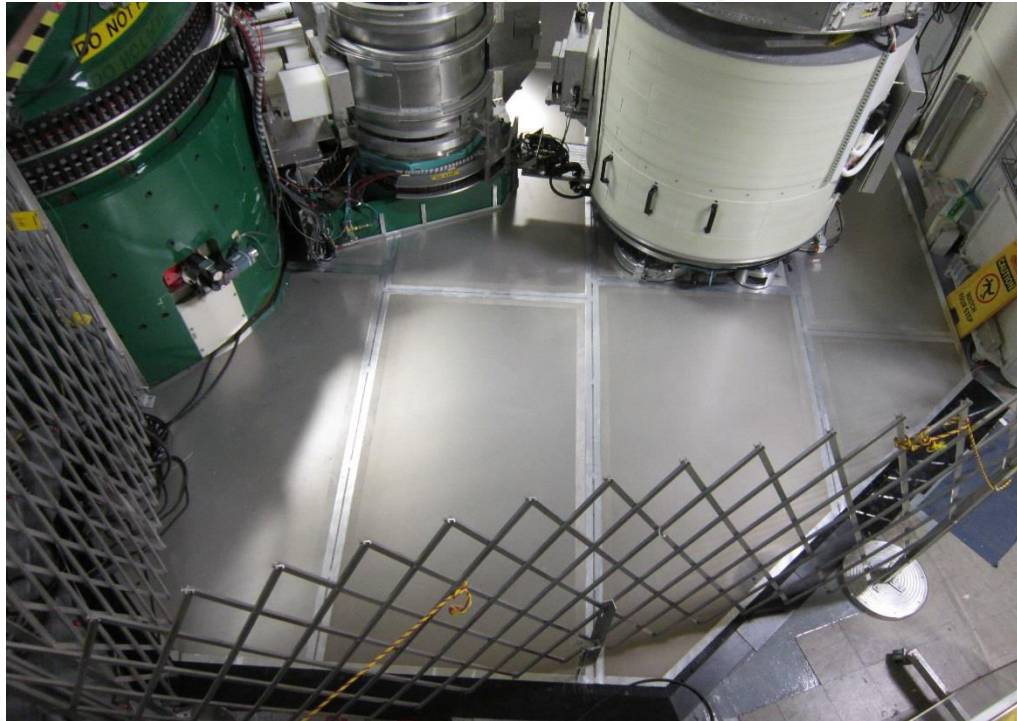


Confinement Power Panels



- ▶ Started the upgrade all Confinement power panels
 - Due to obsolescence and poor performance

Epoxy/Aluminum Flooring



- ▶ Precision leveling floor for BT-7 & BT-9
 - Necessary for movement of sensitive equipment

NCNR Reactor

