

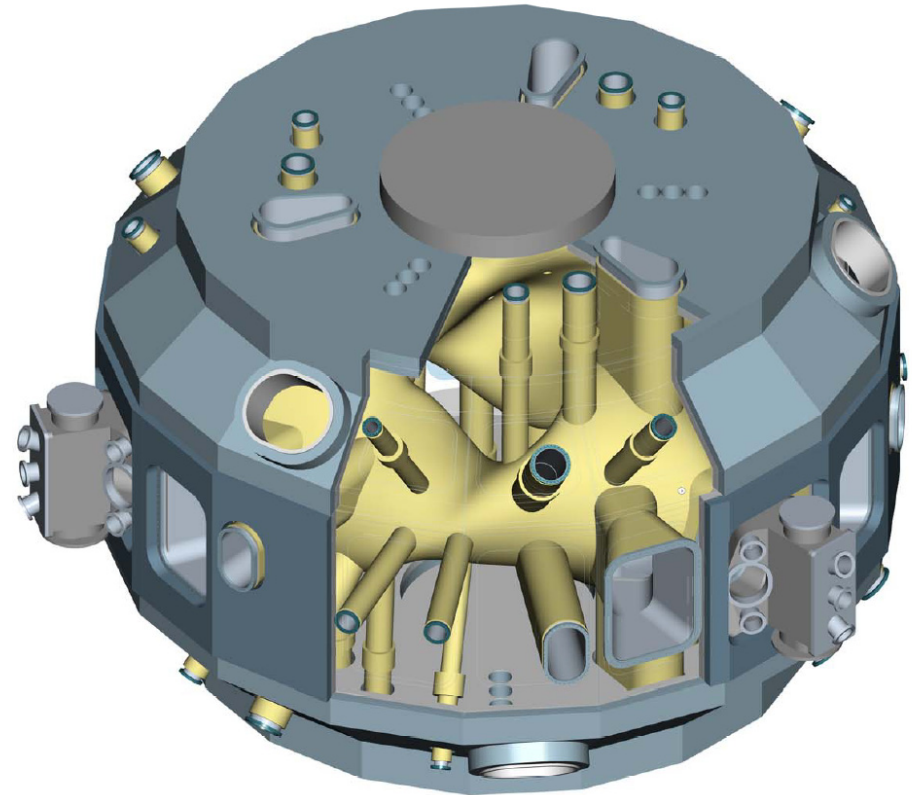
# NCSX Cryogenics Systems LN2 Distribution

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*NCSX Cryogenic Systems WBS(62)*

# Overview

The stellarator core is supported by two cryogenic facility systems:

- **WBS 621** delivers LN<sub>2</sub> to the machine area.
- **WBS 622** performs heat removal from the field coils



# Requirements



- WBS621
  - Provide LN2 for distribution to:
    - LN2 Coil Cooling system
    - LN2/GN2 Structure Cooling
- WBS622
  - Provide LN2 (~210gpm @150 psig ) to coil distribution manifold (WBS16) for extracting heat from PF, TF and Modular Coils.
  - Maintain single phase flow.

# Interfaces

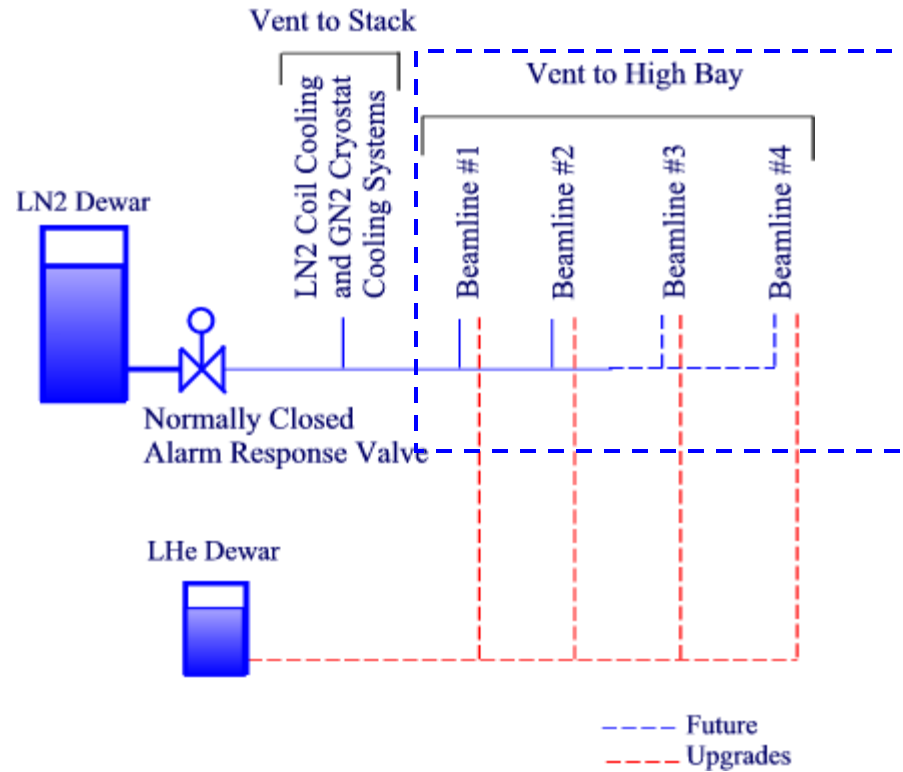
- WBS621
  - C-Site 9200-gallon LN2 tank
  - WBS-622 Coil LN2 circulation pump skid
  - WBS-623 LN2 supply to Cryostat
  - Test Cell Air monitoring system
- WBS622
  - Coil LN2 distribution manifold
  - HVAC exhaust

# Design Plans (WBS-621 LN2 supply)



- This is very straightforward.
- Flow rates, heat loads and pressure drops are already reasonably well known.
- Design will incorporate flow diagrams, and isometric piping drawings. Detailed component drawings will be minimal. This will allow many elements of the design of the system to proceed without requiring the “final” parameters.
- When final requirements for flow rates, heat loads and pressure drops are available, the components shall be procured, assembled and installed.

# SIMPLIFIED LIQUID CRYOGEN DISTRIBUTION



The cryogen distribution system makes full use of legacy equipment at C-Site. The 9200 gallon LN<sub>2</sub> dewar is ready for service. The helium off-load gear exists but requires general overhaul.

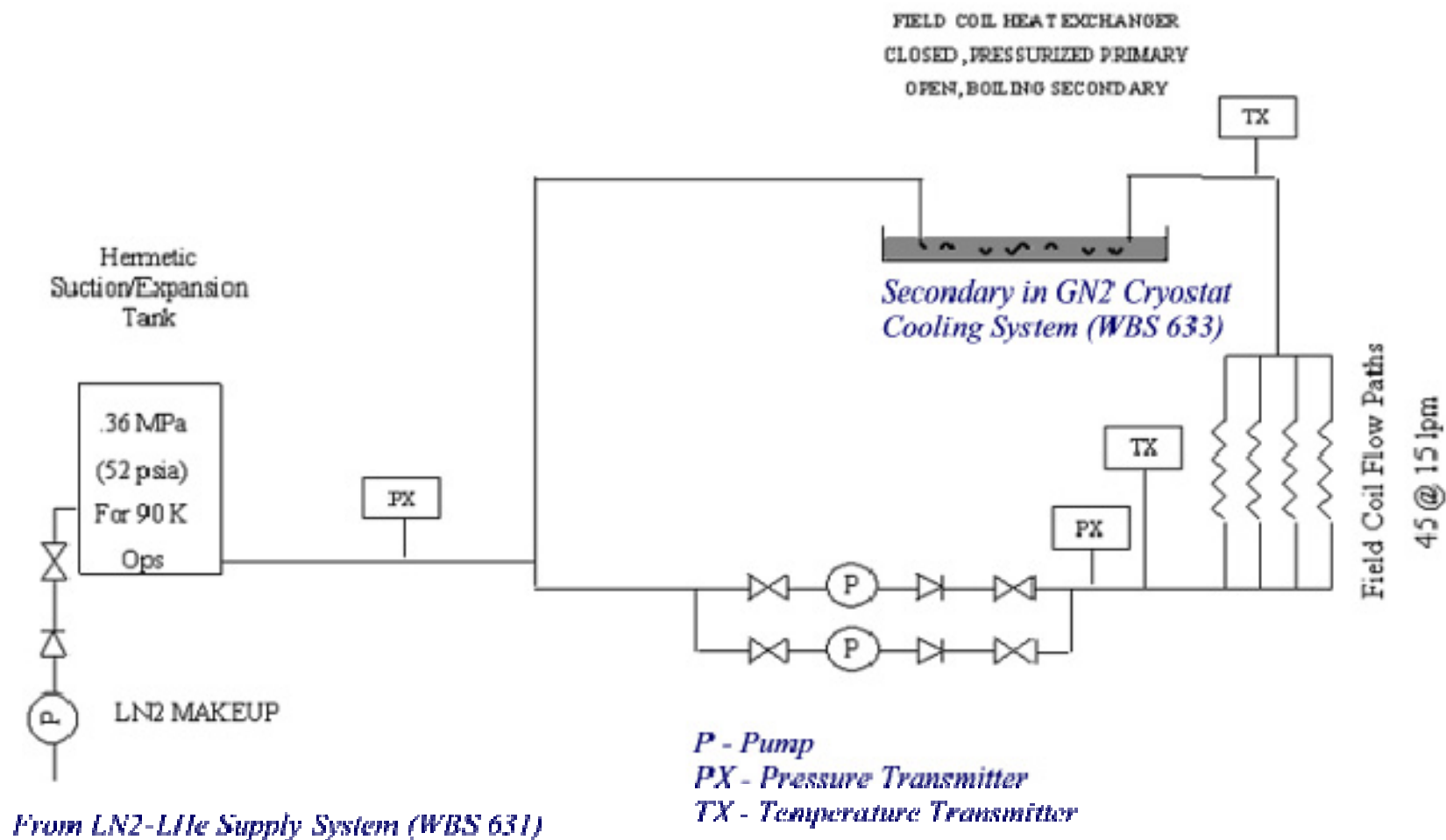
# Design Plans (WBS-622 Coil Cooling)



- A pressurized, LN<sub>2</sub> heat removal loop is planned for the field coils.
- The prototype for this loop was operated for the coil testing.
- A scaled up version of the Coil Test Facility's pump skid is required to support full field magnet requirements.
- WBS-622 scope provides system capable of removing ~50 MJ in a 15 minute recovery interval (about 56 kW avg.)

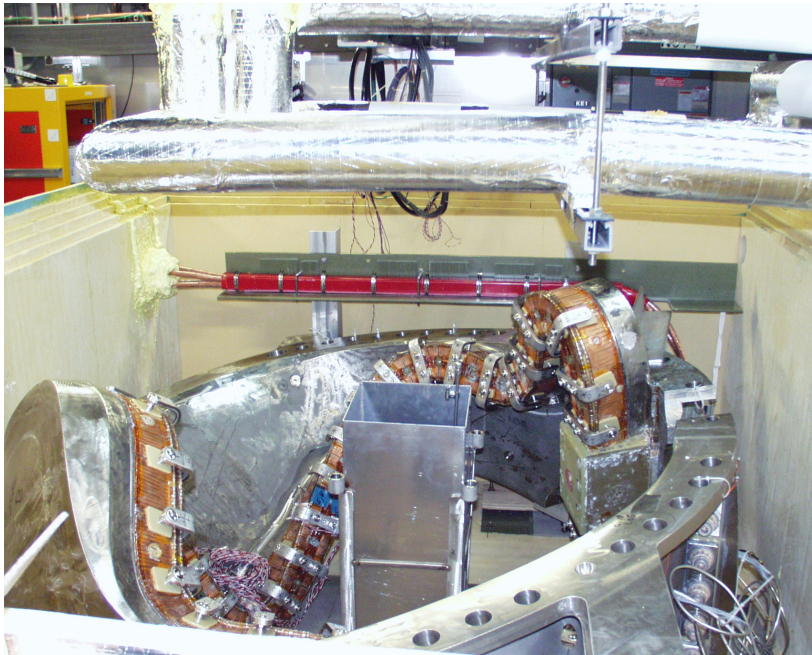


# Simplified Coil Cooling Circuit





# Design Plans (WBS-622 Coil Cooling)



- The C1 coil was cooled to the point that single phase liquid flow was established in the winding pack's coolant channels
  - A success!
  - The single phase flow approach is validated
  - Technical risk is low

# Summary

- WBS-621 LN2 supply
  - Sizing of piping is straight forward
  - Based on identified (calculated) heat loads, the capacity of existing C-site LN2 tank 9200 (gallon) is adequate.
  - Off-the-shelf components are used.
- WBS-622 Pressurized LN2 cooling for coils
  - Coil testing cooling loop validates design.
  - Full power coil heat loads have been calculated.
  - Required flow rates and pressure drops have been calculated.
  - LN2 delivery system can be sized to accommodate requirements
  - Standard industrial products make up the system.