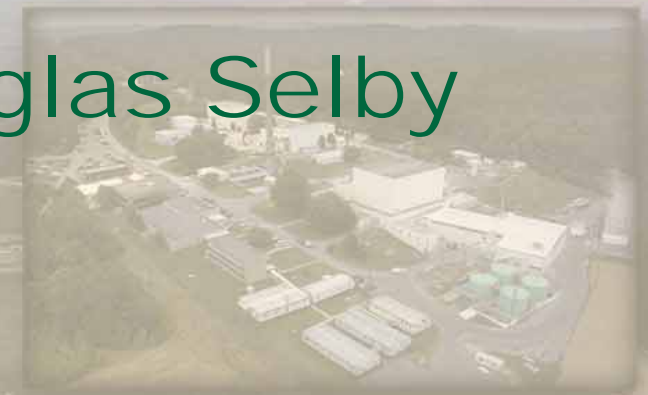


# Status of the High Flux Isotope Reactor Cold Source Project

Ken Morgan and Douglas Selby



March 13, 2007

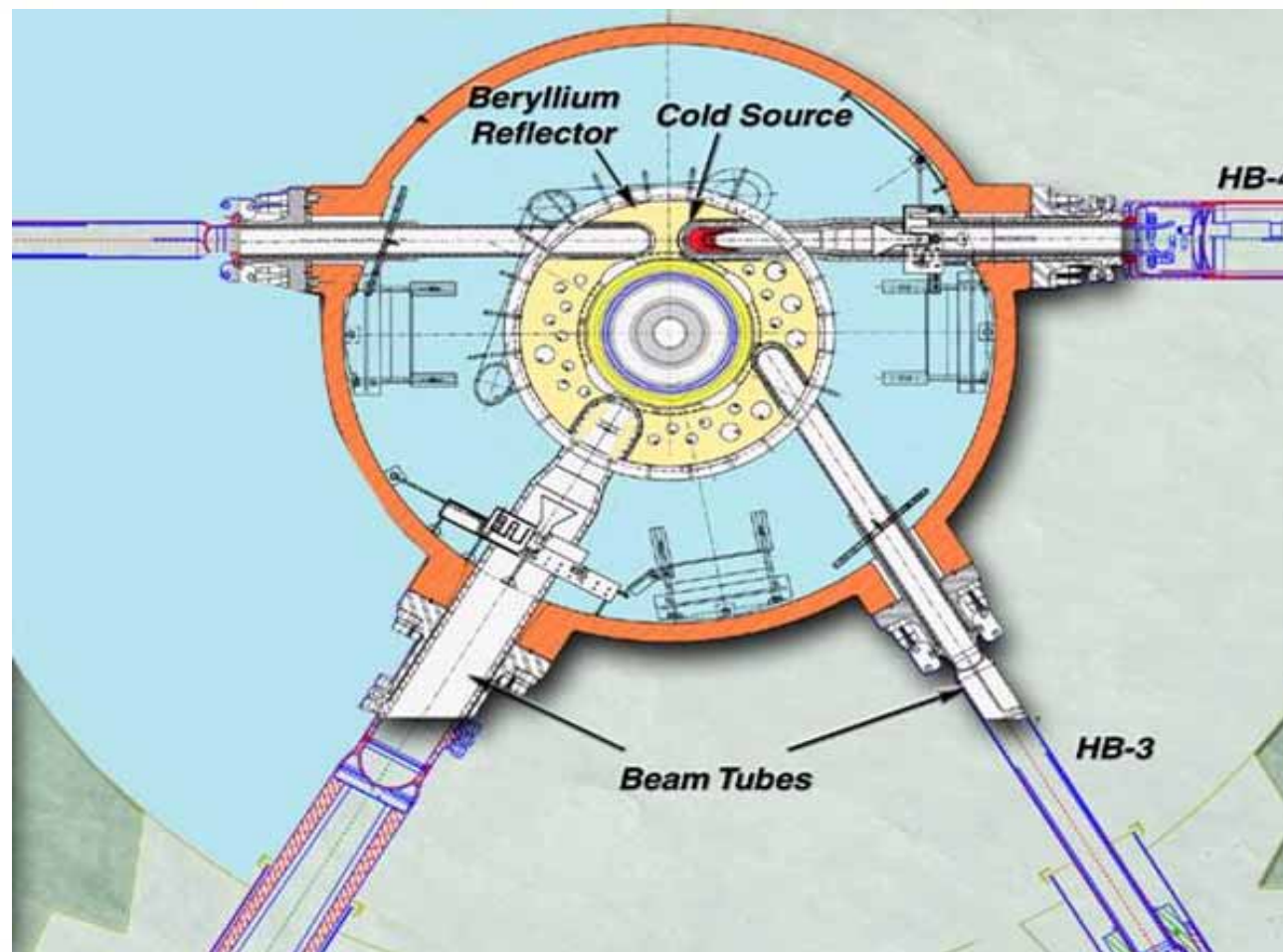


# The HFIR Cold Source Design Concept is Based on Three Key Decisions

- **Hydrogen was chosen as the moderator material**
- **Forced circulation of hydrogen was chosen as the means to assure cooling of the hydrogen and moderator vessel**
- **Decision was made to operate in the supercritical gas mode to avoid 2-phase conditions during cool-down, warm-up, and most off-normal transient conditions**



# Early Decision Was Made to Install Cold Source In HB-4 Beam Tube

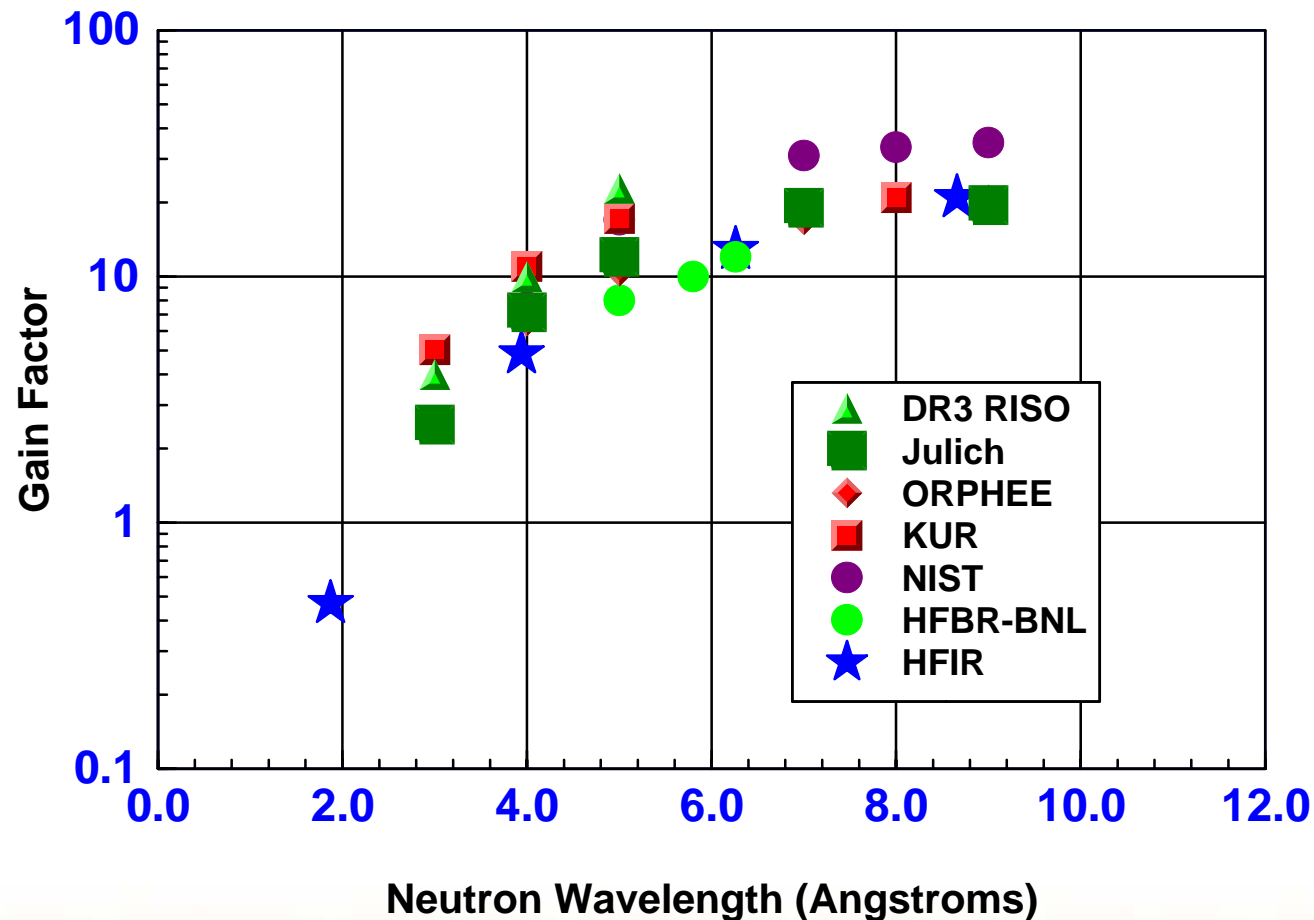


# Principle Design Parameters

<b><u>Normal Operating Parameters</u></b>	<b><u>Value</u></b>
<b>Effective Hydrogen Temperature</b>	<b>21 K</b>
<b>Hydrogen Pressure</b>	<b>14 – 15 bar</b>
<b>Nominal Hydrogen Mass Flow Rate</b>	<b>0.072 kg/s</b>
<b>Total Hydrogen Mass in Loop</b>	<b>5.4 Kg</b>



# Comparison of Calculated HFIR Cold Source Gain Factors with Measured Gain Factors at Other Hydrogen Cold Source Facilities



# Refrigeration System Has Functioned for Several Years with a 30% Design Margin

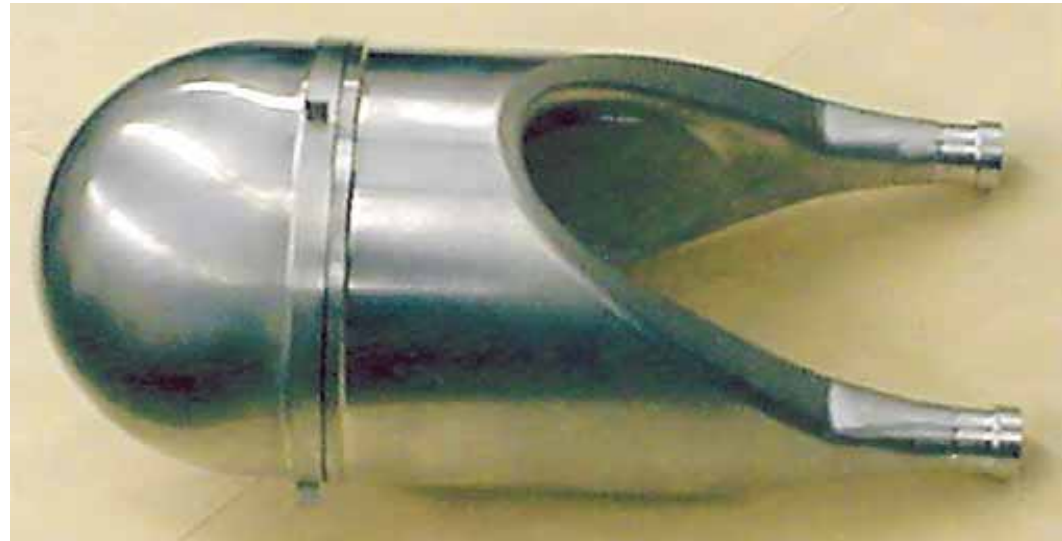


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Performance Measures  
12/21/2006



# The Moderator Vessel Is the One Component that Sees High Radiation Fields and Thus High Heat Loads

- Moderator vessel is made from 6061-aluminum.
- Vessel is fabricated in two pieces out of a solid piece of aluminum.
- Vessel has been tested up to 1.5 times the design pressure which is twice the operating pressure.
- Prototypic weld has been tested to failure at over 10 times the operating pressure.



# The Hydrogen Transfer Module Supplies Hydrogen Inventory Control

- Hydrogen storage tank contains most of the hydrogen when the system is warm, but is at low pressure when the cold source loop is in normal cold operation mode.
- Hydrogen additions to the closed system will be made out doors at the tank using hydrogen bottles.
- A hydrogen qualified pressurizer pump will be used to raise the pressure of the hydrogen prior to its injection into the primary hydrogen loop.





# HFIR Cold Source Safety Guiding Principles

- Cold source shall not have a significant negative impact on the reactor or reactor safety systems
- Cold source shall not have a significant impact on the risk to on-site personnel
- Cold source shall be self protecting

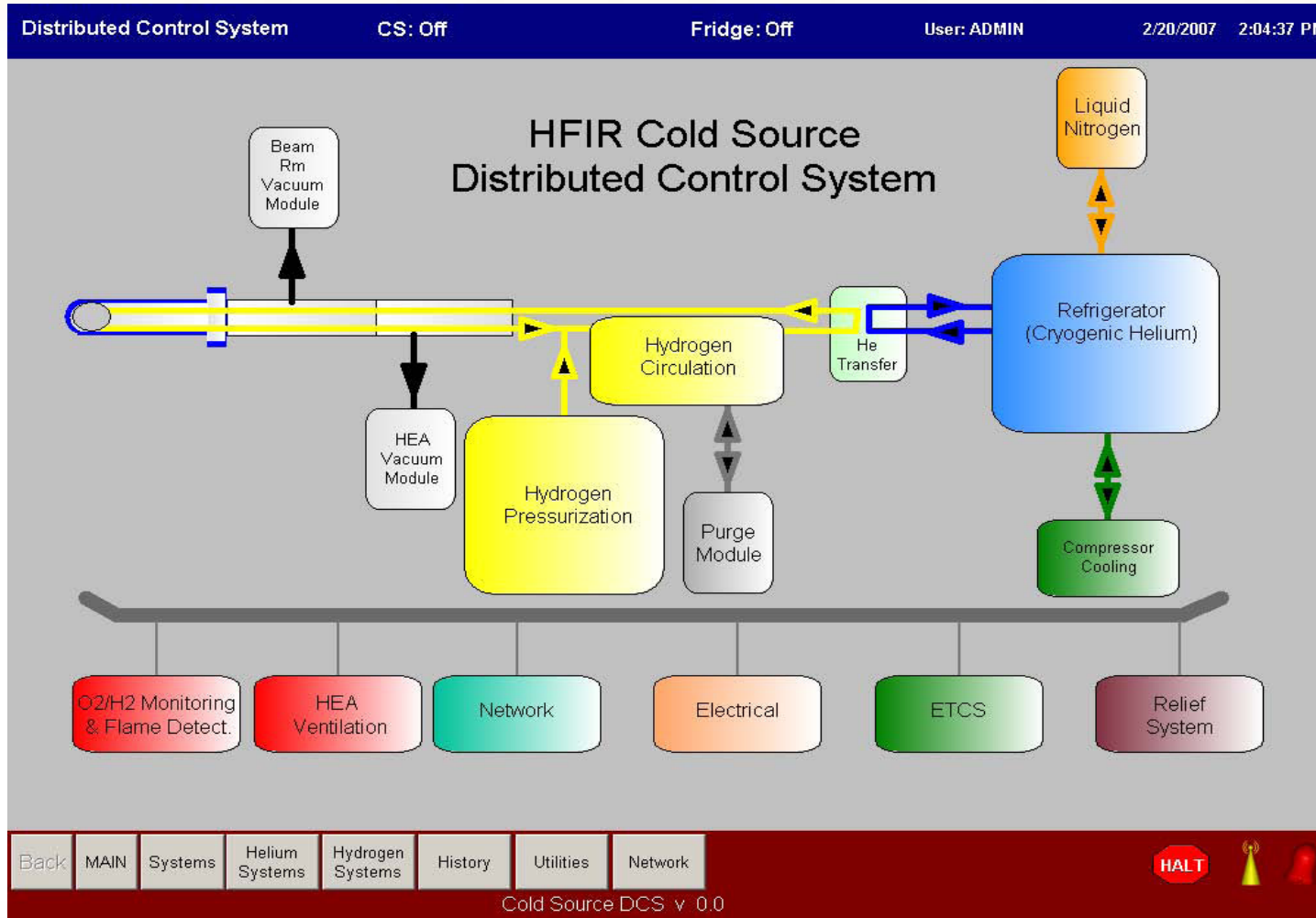


# HFIR Cold Source Control System is Interfaced With the Reactor Control System Through Three Reactor Scrams to Protect the Cold Source

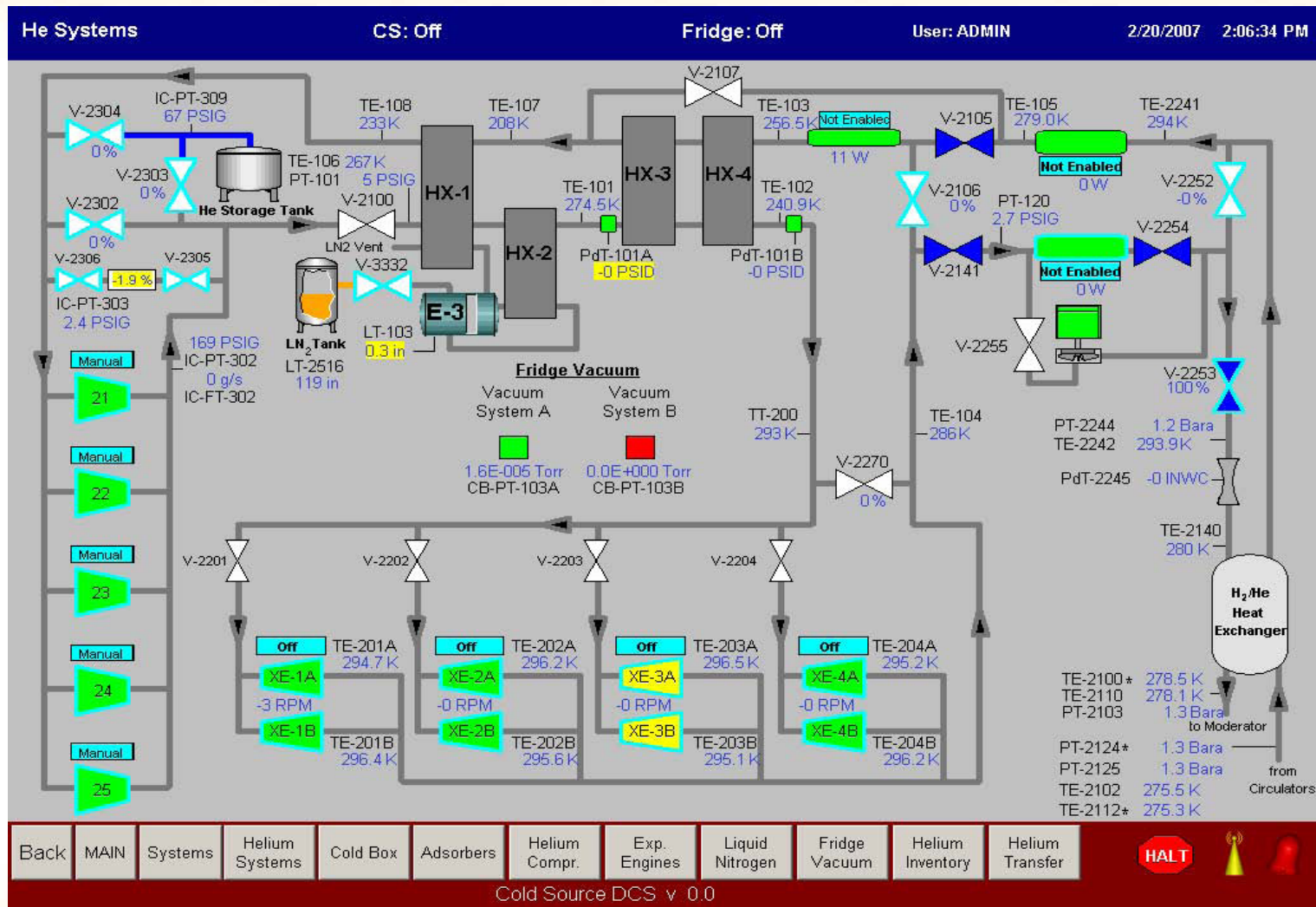
- Low hydrogen flow events
- High hydrogen temperature events
- Loss of hydrogen inventory (low hydrogen pressure) events



# HFIR Cold Source Control System Menu Page



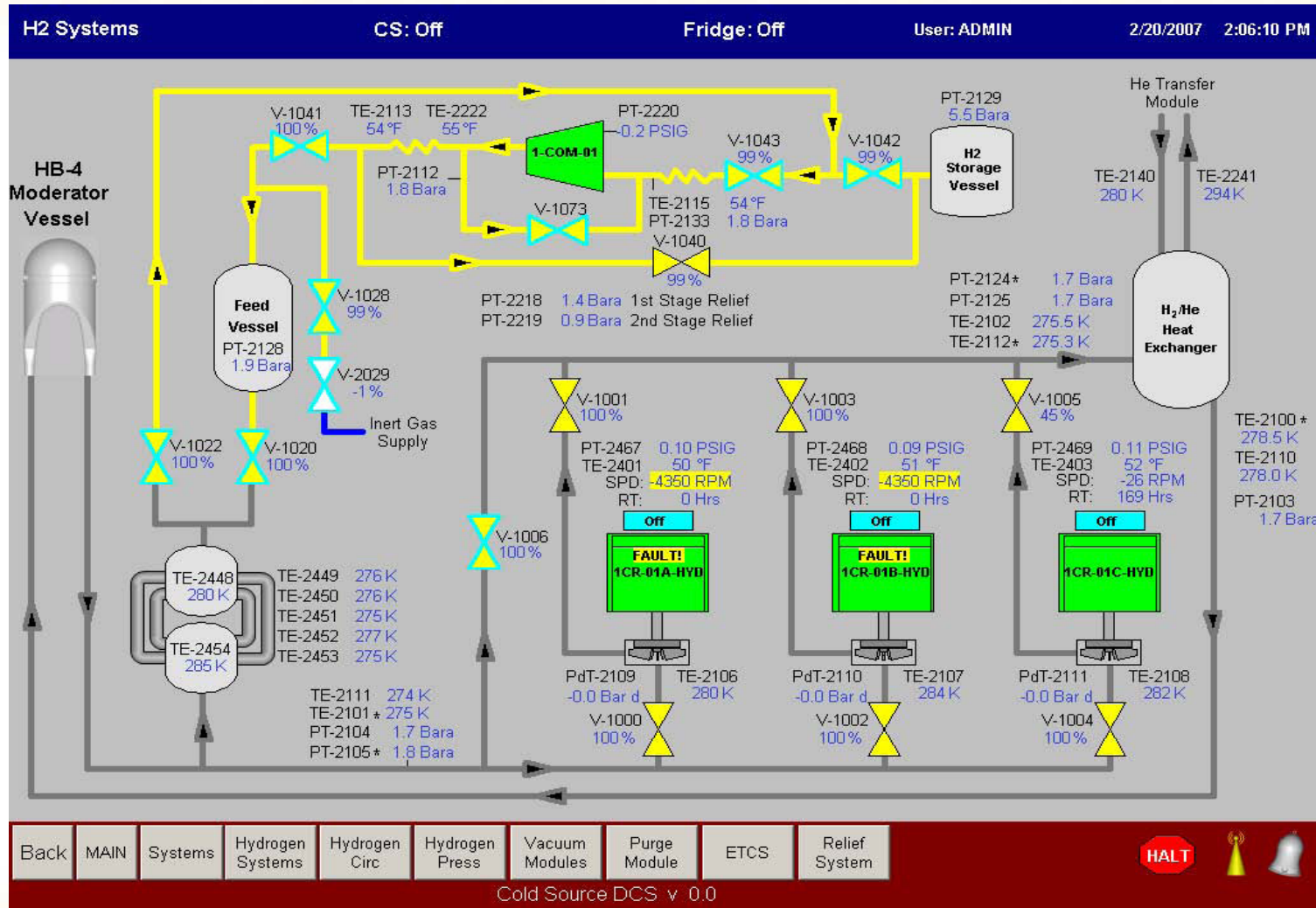
# Cold Source Refrigerator Control Page



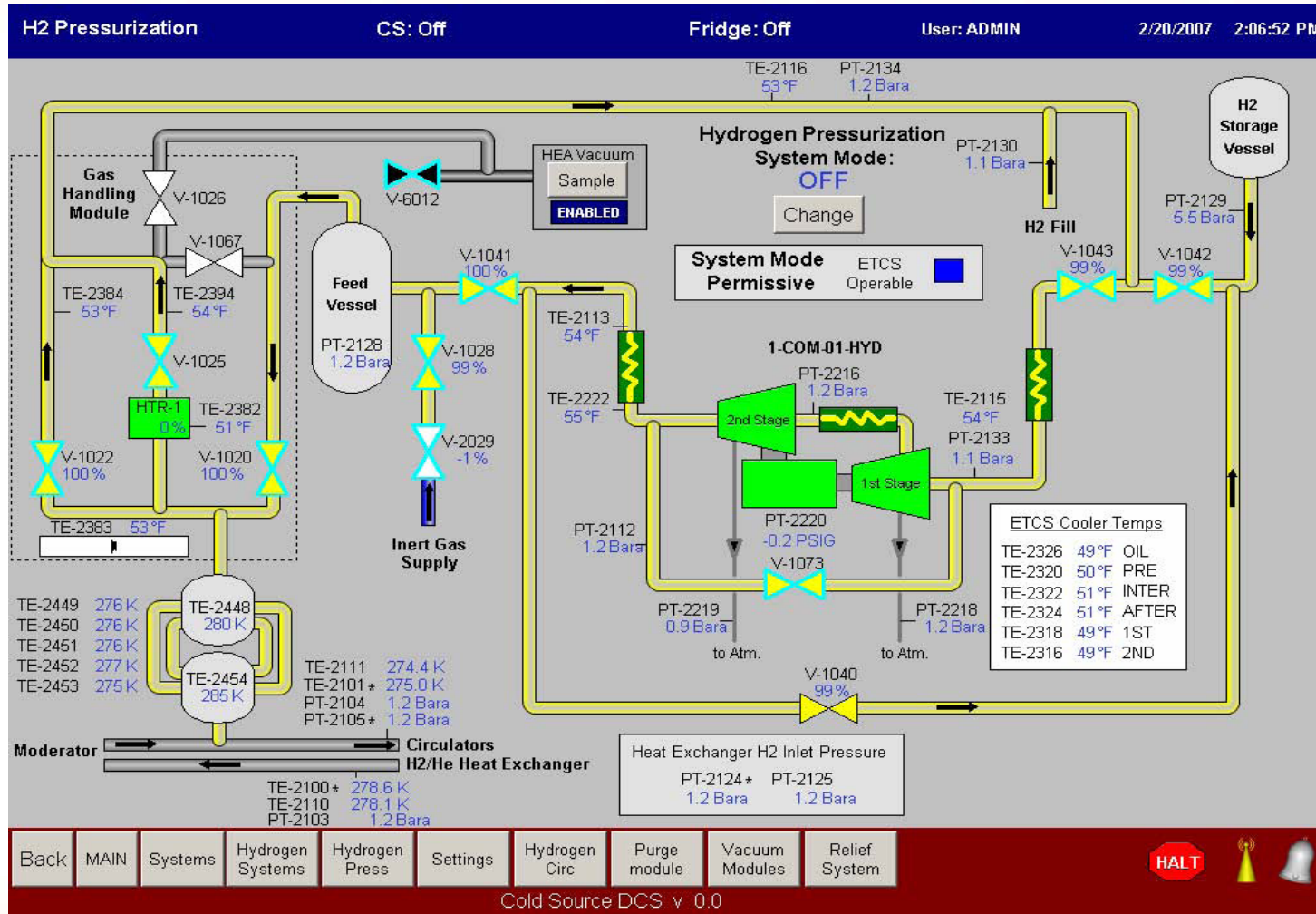
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# Cold Source Main Hydrogen Control Page



# Cold Source Hydrogen Feed and Pressure Control Page



# One of Five Cold Source Annunciator Panels

Annunciator Panel 3      CS: Off      Fridge: Off      User: ADMIN      2/20/2007 2:13:17 PM

ANN-061	ANN-062 <b>H2 CIRCULATOR DP LO</b> CSA-3134, 35, 36	ANN-063 <b>H2 CIRCULATOR ENCLOSURE PRESS ABNORMAL</b> CSA-3142	ANN-064 <b>H2 CIRCULATOR FAULTED</b> CSA-3133	ANN-065 <b>H2/HE HTX H2 DELTA TEMP LO</b> CSA-3137	ANN-066 <b>H2/HE HTX H2 INLET PRESS ABNORMAL</b> CSA-3127
ANN-067 <b>H2/HE HTX H2 OUTLET TEMP ABNORMAL</b> CSA-3131	ANN-068 <b>H2 CIRCULATION SYSTEM SENSOR FAULT</b> CSA-3143	ANN-069 <b>MODERATOR H2 RETURN PRESS ABNORMAL</b> CSA-3126	ANN-070 <b>MODERATOR H2 RETURN TEMP HI</b> CSA-3130	ANN-071 <b>GHM RELIEF TEMP LO</b> CSA-3124	ANN-072 <b>GHM SAMPLE LINE TEMP ABNORMAL</b> CSA-3121
ANN-073 <b>H2 FEED VESSEL MOISTURE HI</b> CSA-3152	ANN-074 <b>H2 COMPR OIL PRESS LO</b> CSA-3108	ANN-075 <b>H2 COMPR INLET PRESS LO</b> CSA-3108	ANN-076 <b>ETCS CIRC PMPS DISCH FLOW ABNORMAL</b> CSA-3462	ANN-077 <b>HE COMPR DISCH PRESS ABNORMAL</b> CSA-3224	ANN-078 <b>HE COMPR SUCTION PRESS ABNORMAL</b>
ANN-079 <b>HE COMPR FLOW LO</b> CSA-3226	ANN-080 <b>H2 COMPR H2 INLET TEMP LO</b> CSA-3108	ANN-081 <b>HE FLOW PATH NOT ESTABLISHED</b>	ANN-082 <b>CB ADSORBER DP HI</b> CSA-3229	ANN-083 <b>CB ADSORBER TEMP HI</b>	ANN-084 <b>CALORIMETER TEMP HI</b>
ANN-085 <b>FUSE 122, 123, 124 OR 125 BLOWN</b> CSA-3232	ANN-086	ANN-087 <b>VACUUM SYSTEM FAILED</b>	ANN-088 <b>COLD BOX VACUUM ABNORMAL</b> CSA-3234	ANN-089 <b>VACUUM SYSTEM VALVE ALIGNMENT ABNORMAL</b>	ANN-090 <b>HE COMPR FAILED TO START</b>

Acknowledge Page      Reset

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Back MAIN Systems Active Annun. Annun. Log Disable / Enable

Cold Source DCS v. 0.0

HALT 🔔 🔊



## Present Status of Cold Source

- All equipment has been installed, tested, and is in the process of being declared operable
- Hydrogen has been loaded into the system and cooled to as low as 16.5 K with a maintainable stable steady-state condition
- All testing with in-line heater representing reactor heat load has been completed
- DOE Operational Readiness Review is scheduled for April 9
- If all goes well, reactor startup with functional cold source should be in May

