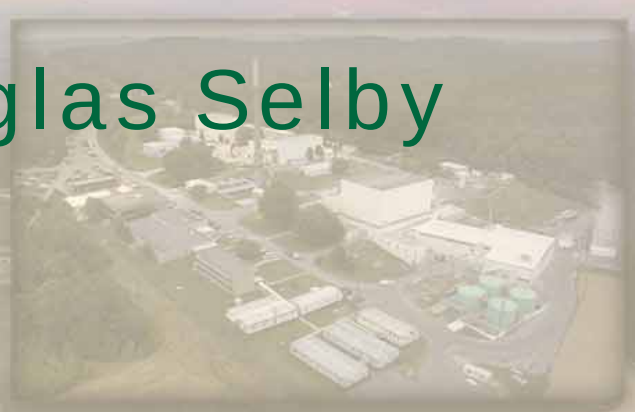
Status of the High Flux Isotope Reactor Cold Source Project

Ken Morgan and Douglas Selby



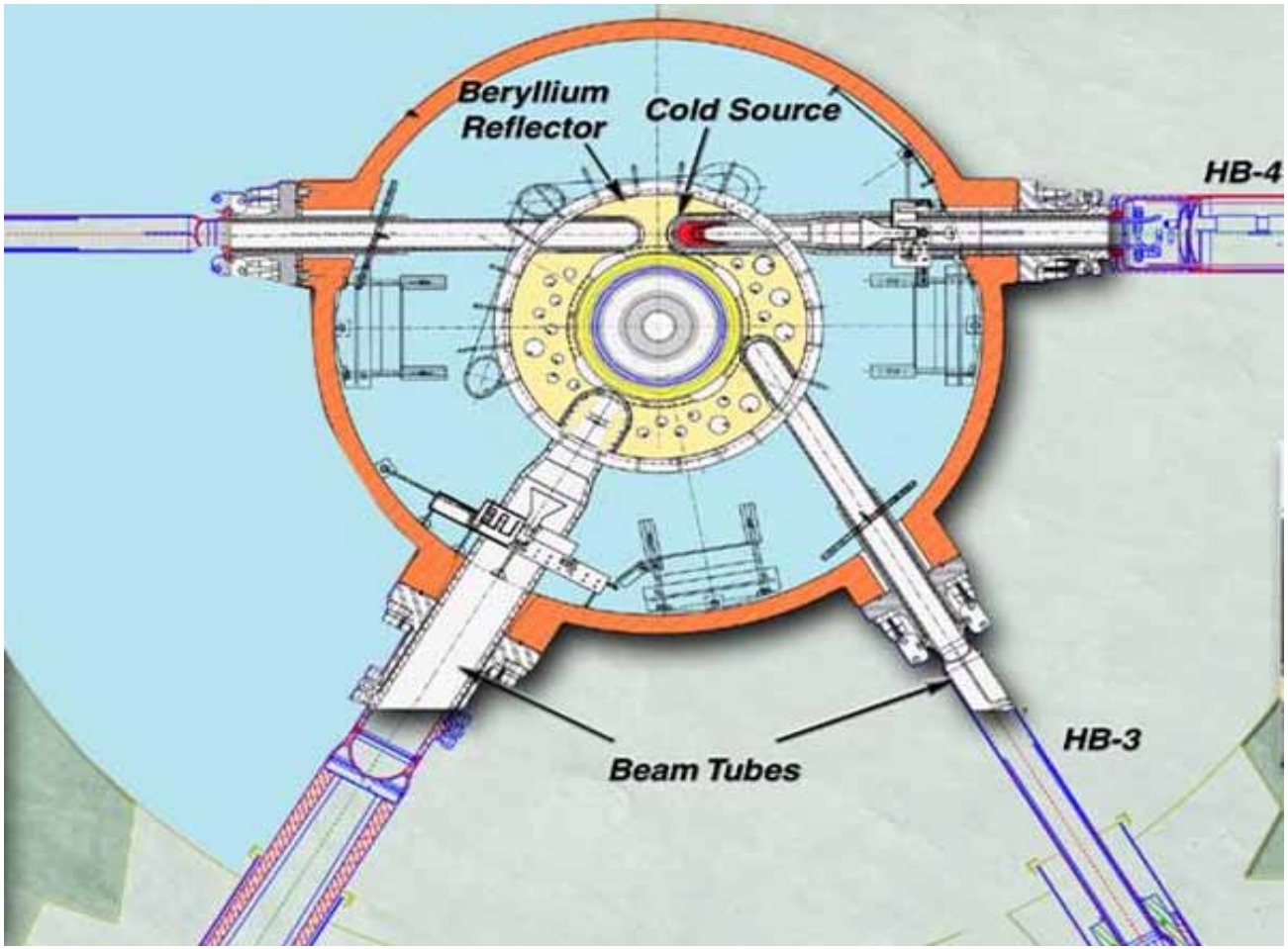
March 13, 2007

OAK RIDGE NATIONAL LABORATORY
U. S. DEPARTMENT OF ENERGY

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**

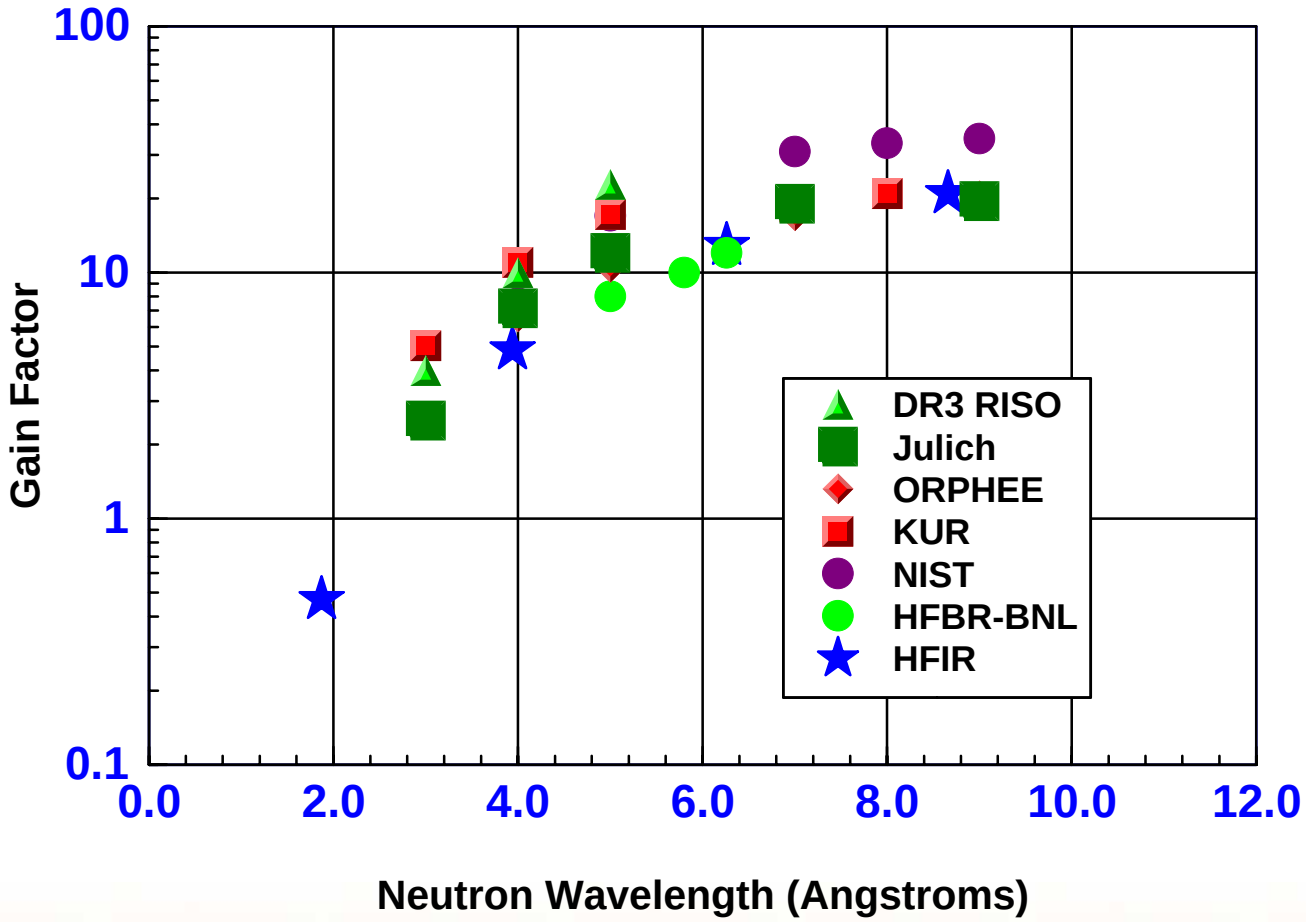
Early Decision Was Made to Install Cold Source In HB-4 Beam Tube



Principle Design Parameters

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

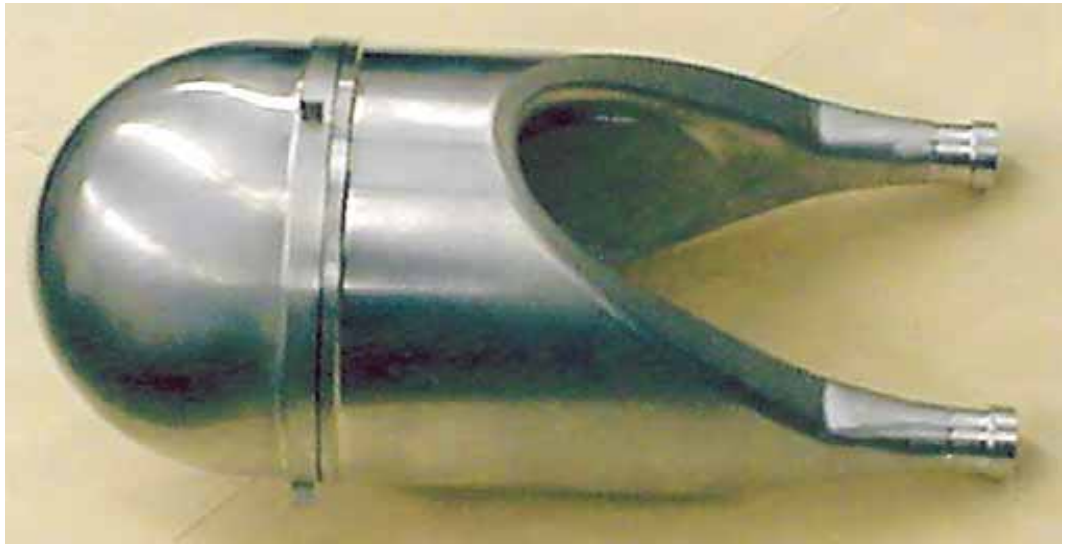
Comparison of Calculated HFIR Cold Source Gain Factors with Measured Gain Factors at Other Hydrogen Cold Source Facilities



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

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.**

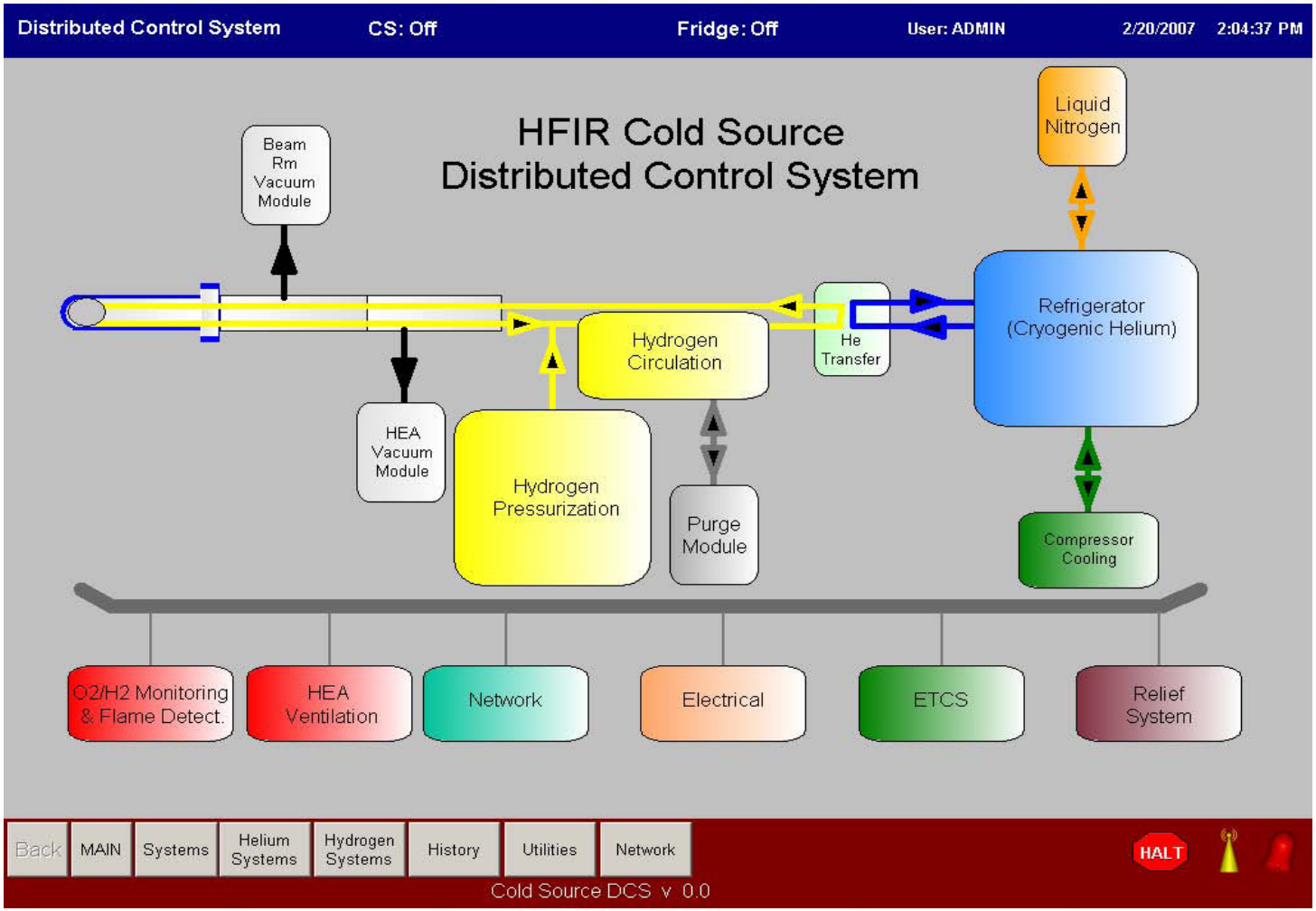
HFIR Cold Source Safety Guiding Principles

- **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**

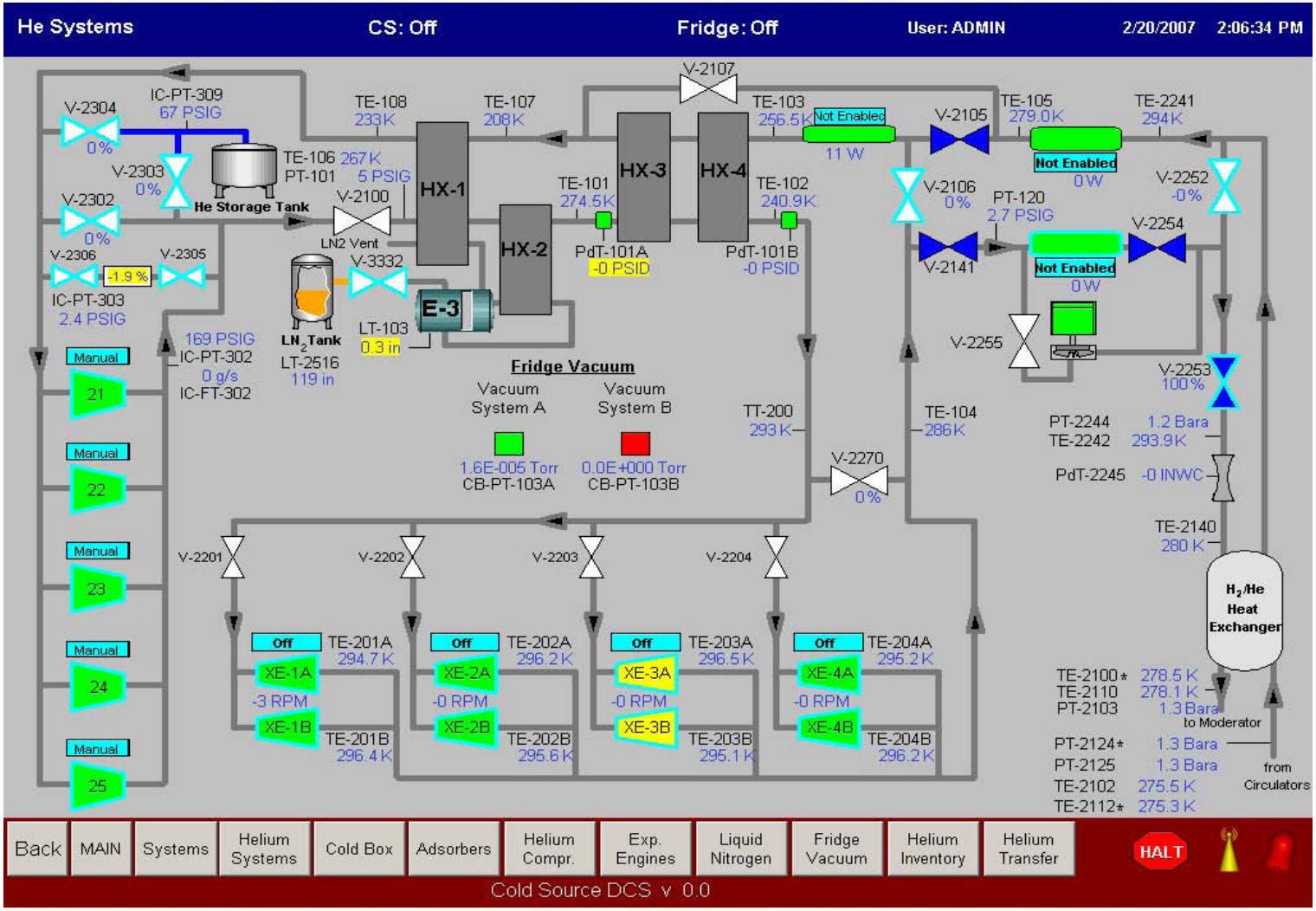
HFIR Cold Source Control System is Interfaced With the Reactor Control System Through Three Reactor Scrams to Protect the Cold Source

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

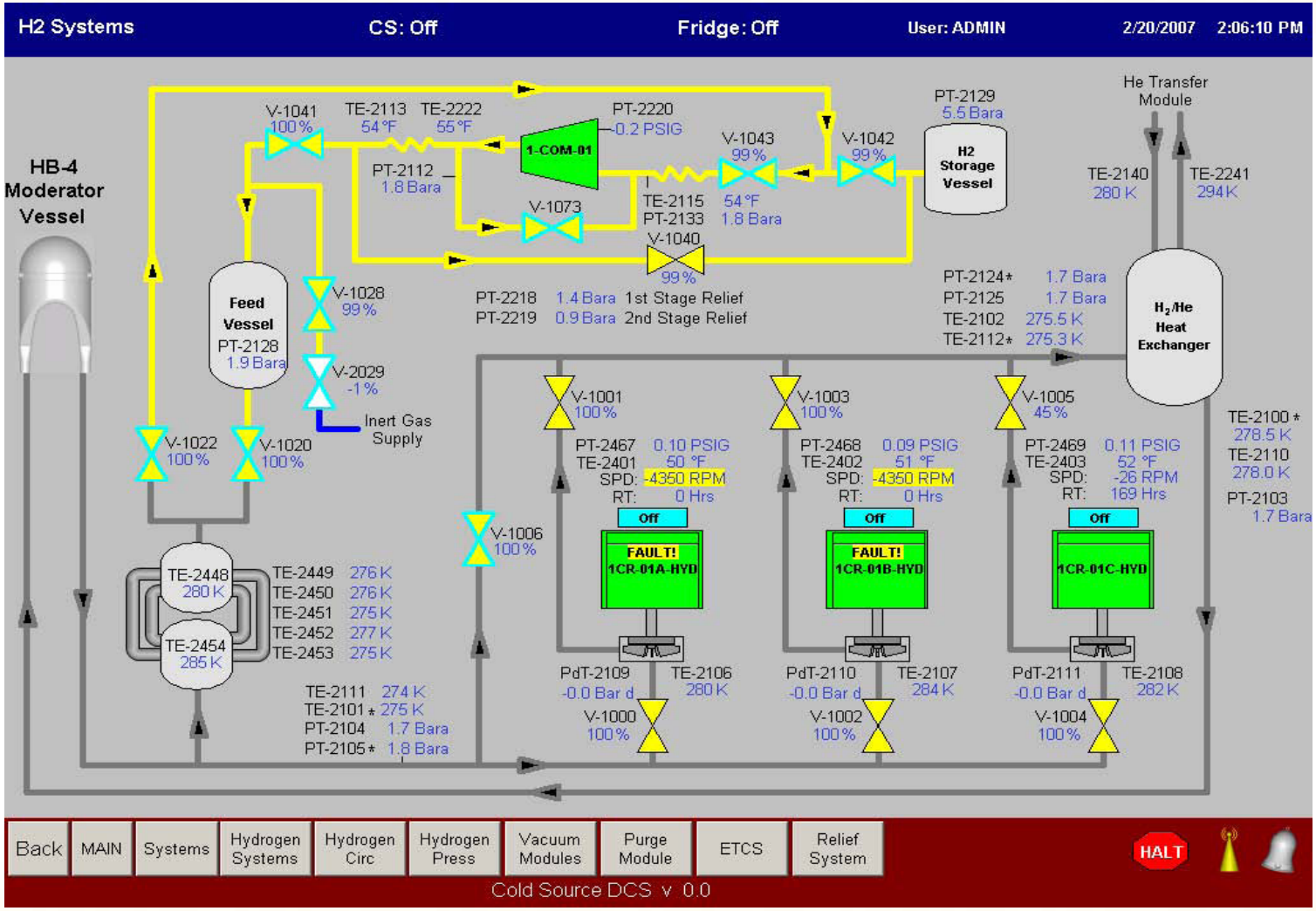
HFIR Cold Source Control System Menu Page



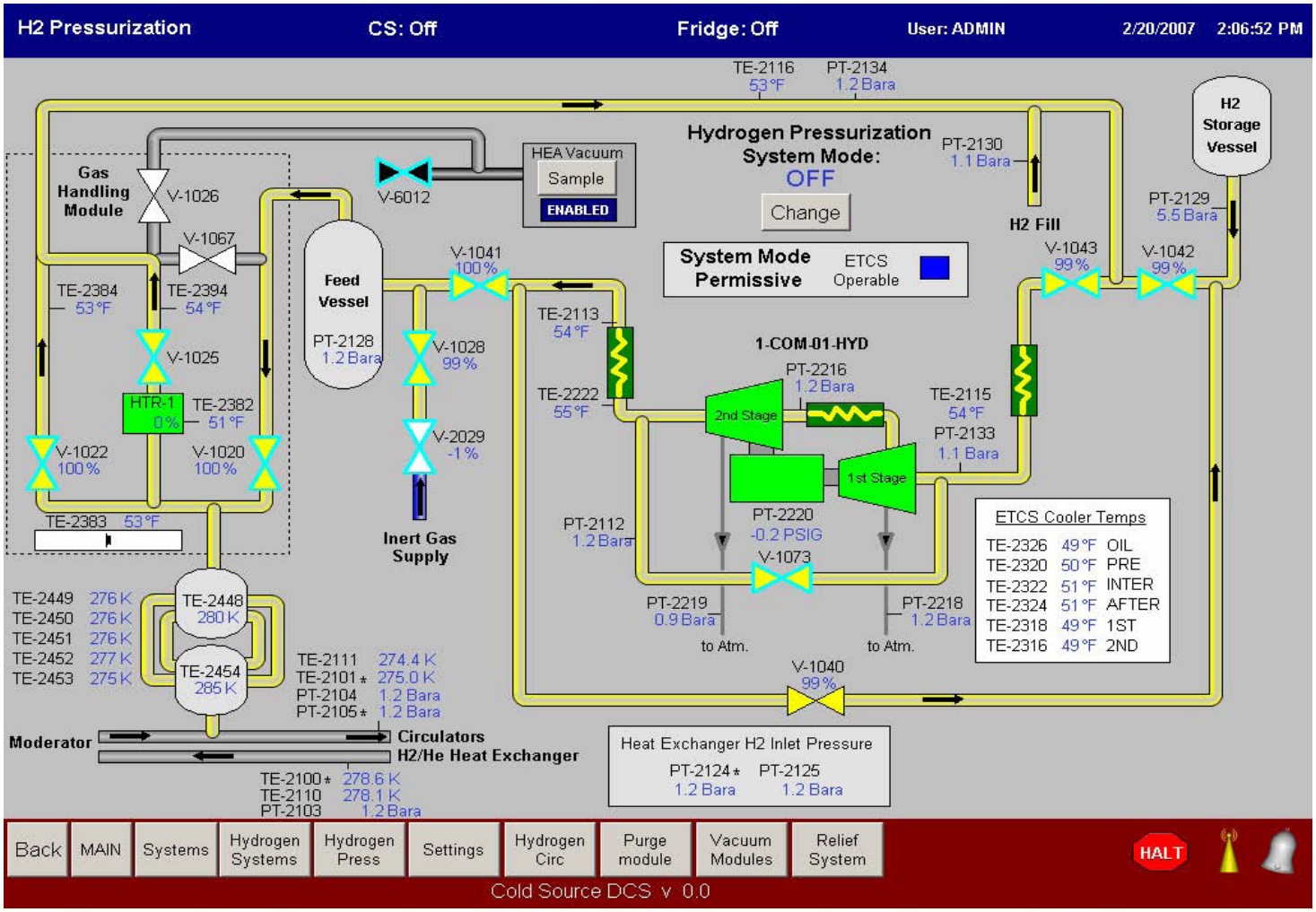
Cold Source Refrigerator Control Page



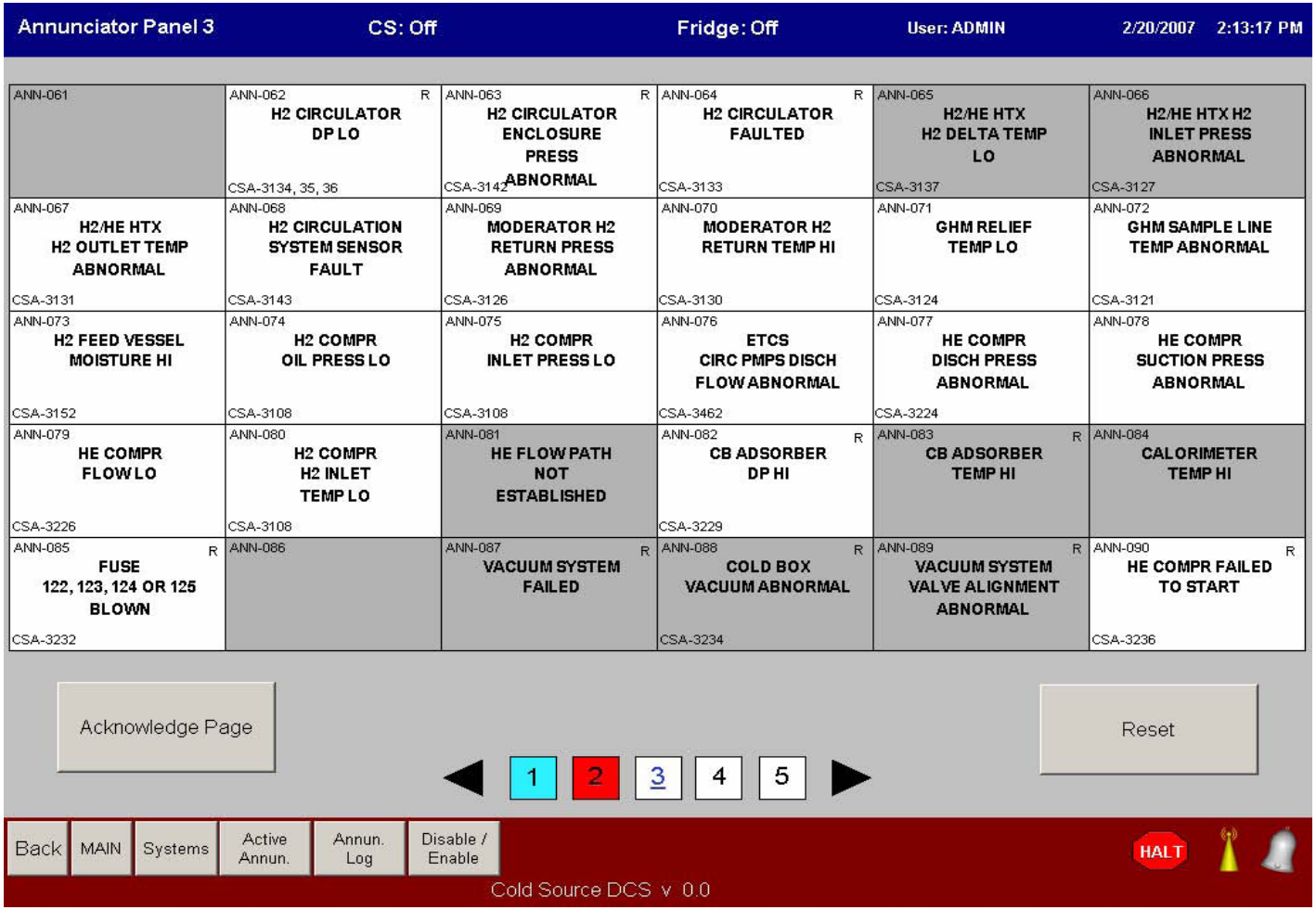
Cold Source Main Hydrogen Control Page



Cold Source Hydrogen Feed and Pressure Control Page



One of Five Cold Source Annunciator Panels



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**