Cryogenic Operations at SLAC

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CryoOps 2006

What Do We Do ?

- Cryogenics at SLAC involve:
  - Large scale He refrigerator operation in support of BaBar & other experiments
  - Polarized Gun cooling
  - Site wide He Gas system
  - LN_2 delivery
  - Design, assembly & operation of the ILC superconducting quadrupole test cryostat
  - Engineering & assembly support of the Enriched Xenon Observatory (EXO) experiment
  - Engineering & Design assistance on other ILC components (FNAL bayonet box, ILC interconnect box, ILC cryogenic system)
  - Small scale experiments (SCRF and Cavity lights)
  - SLD/LAC has been shutdown since last year

What Do We Do ?

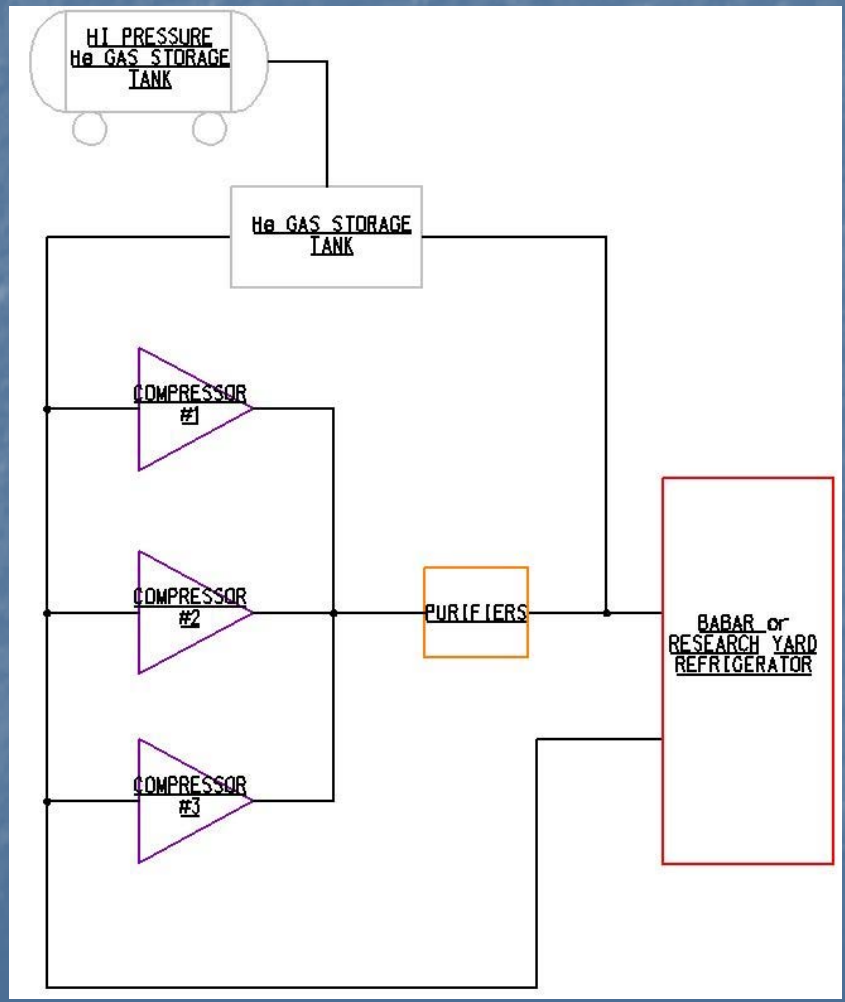
- The SLAC Cryogenics Group also carries out a number of “noncryogenic” tasks
  - Design , construction & installation of specialized beam line components (collimators, vacuum systems, beam pipes, ovens, magnets)
  - Design, construction & repair of specialized electronics for experiments.
- This talk will stress the cryogenic activities

Large Scale Refrigeration

- 2 He refrigerator/liquefiers in operation
  - BaBar (Linde)
  - Research Yard Refrigerator (CTI/Sulzer 4000)
- These systems share a common set of helium compressors: the Central Helium Facility (CHF)

Central Helium Facility

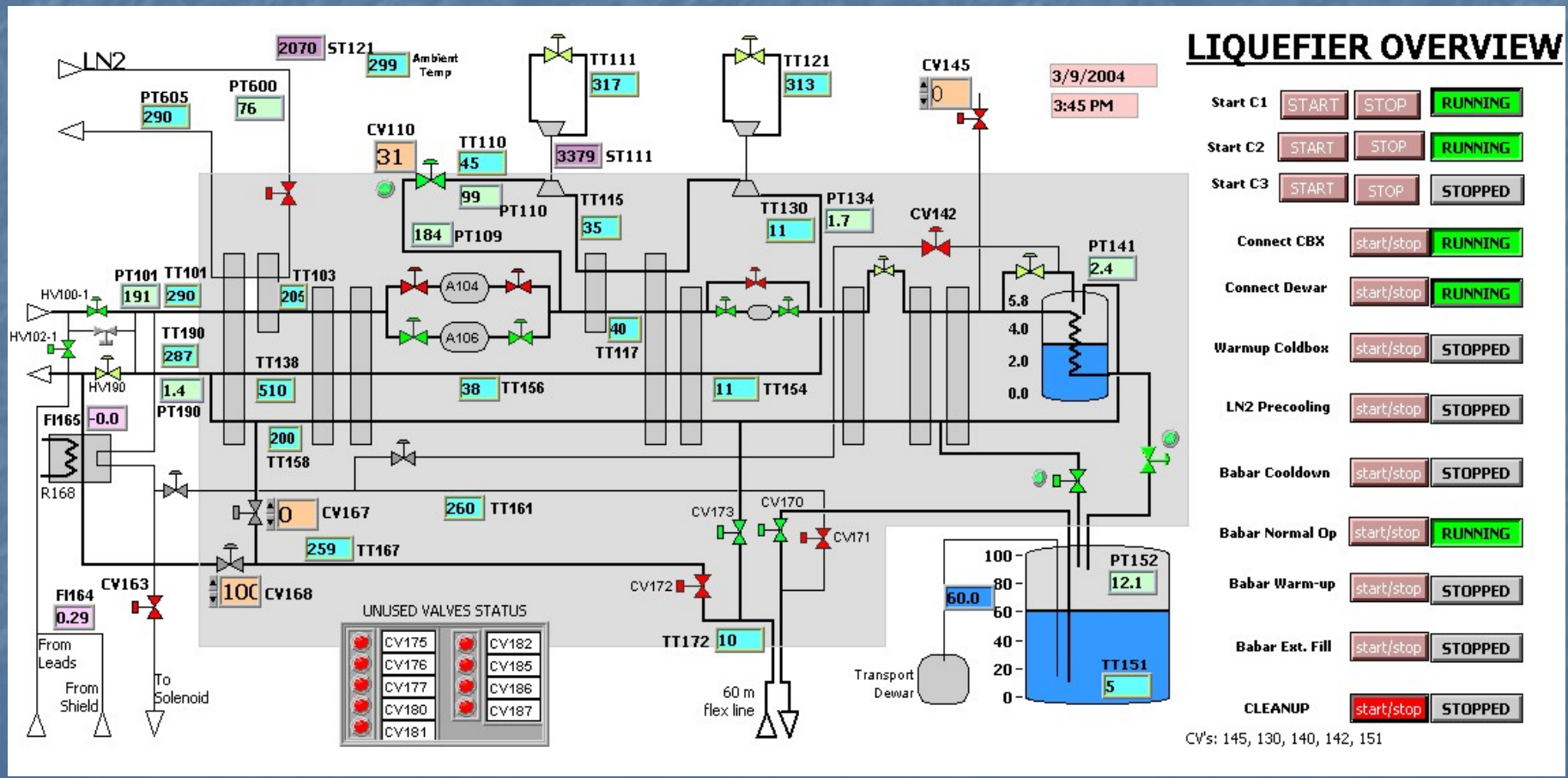
- 3 Sullair screw compressors
  - One 100 g/s
  - Two 50 g/s
- Any compressor can be tied to any refrigerator
- Centralized gas management & cleanup
- Centralized PLC and LabView control system



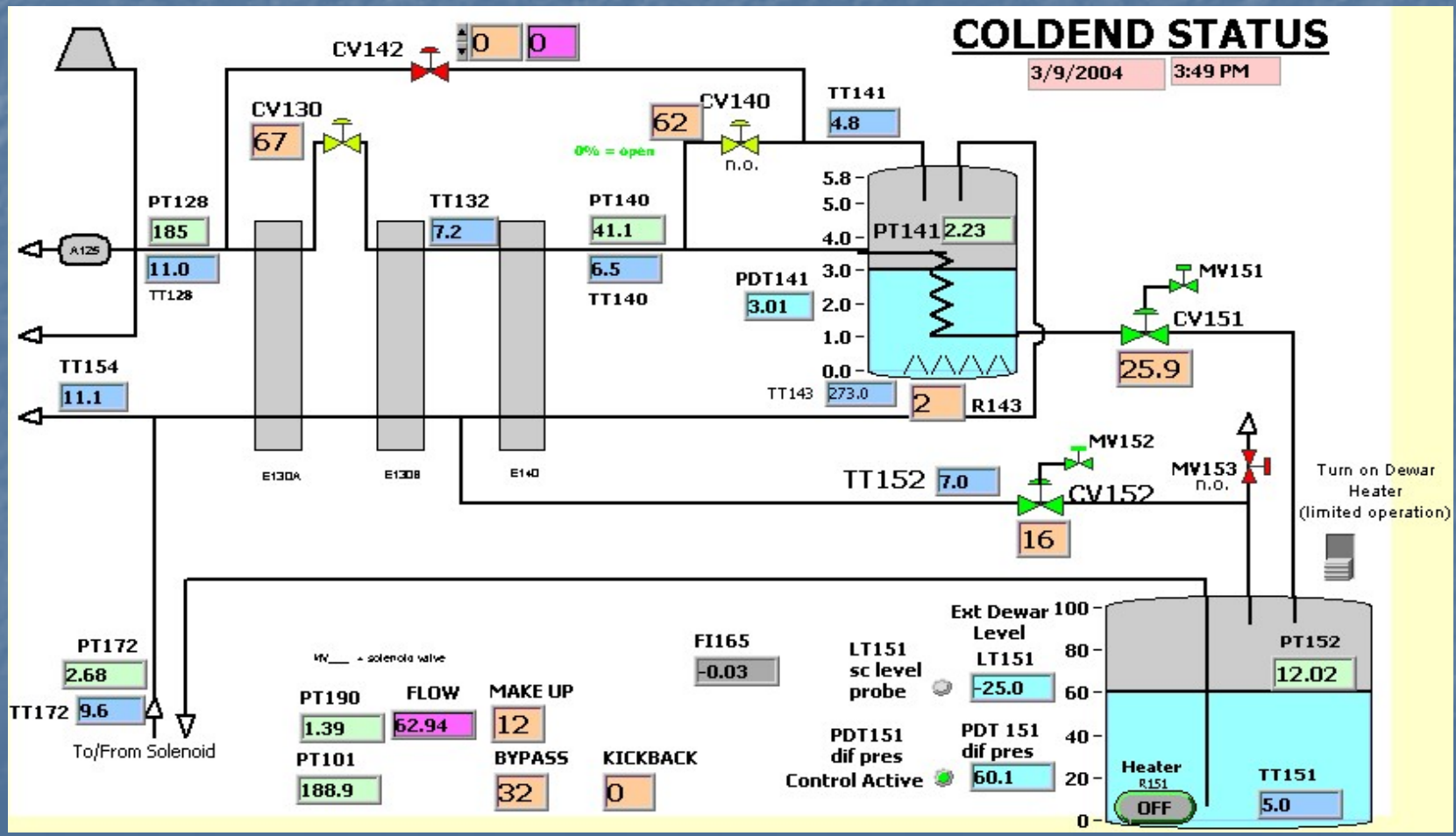
BaBar Refrigerator & Solenoid

- Superconducting Solenoid (1.5 T, 4597 A, 27 MJ)
- A critical component of the BaBar detector
- Operates continuously ~ 10 months/year
- Availability is the key issue (~99%)
- Cooled by 800 W (@100 g/s) Linde refrigerator
- The plant has a significant amount of excess capacity

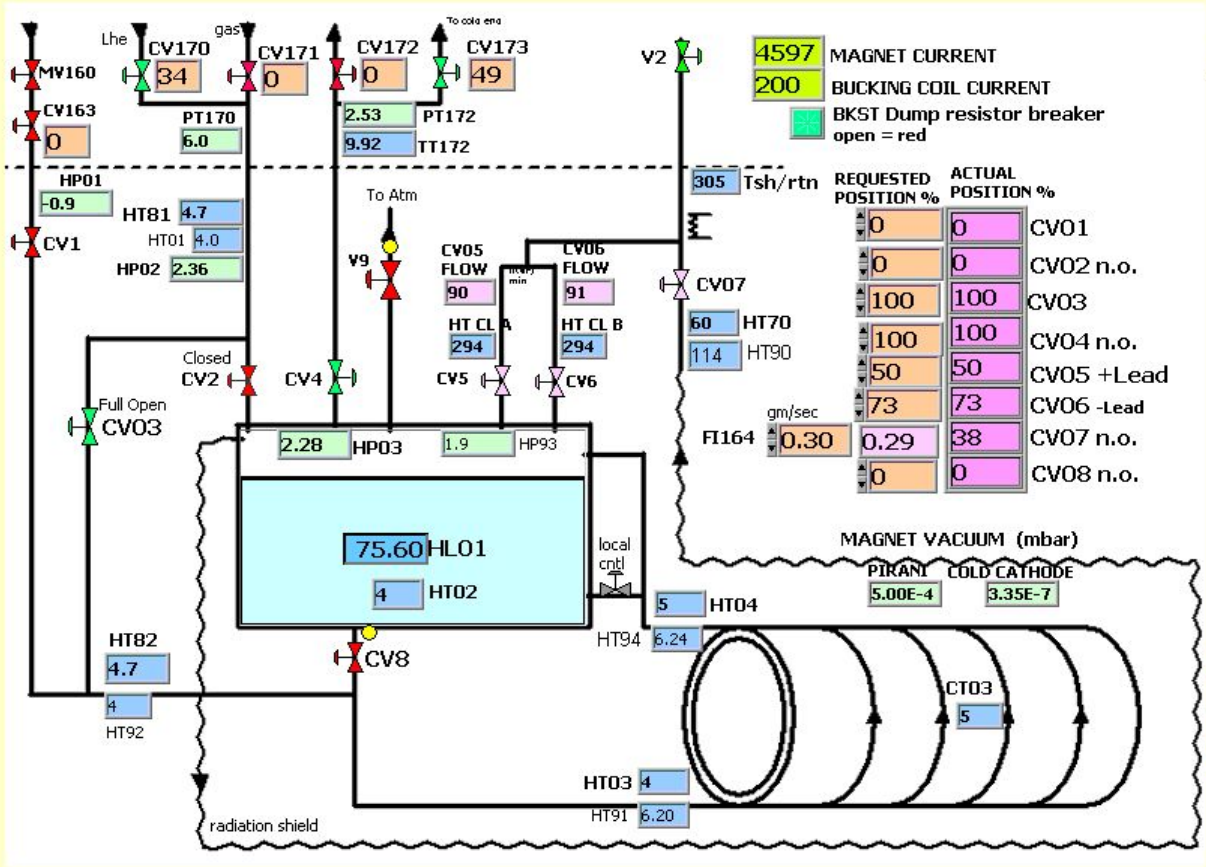
BaBar Refrigerator & Solenoid



BaBar Refrigerator & Solenoid



BaBar Refrigerator & Solenoid



MAGNET OVERVIEW

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LIQUEFIER VALUES

CV167	CV168		TT167
0	100		259.4
CV161	CV162	PT161	TT161
0	0	52	259.8

12.02 PT152 -0.03 FI165

1.31 PT190 52.23 R143

Transfer Line (Magnet End)

3.8 MTavg 9.68E-4

0.00 MTavg K/hr

1.0 MTGrad Trip Pts: (55/57K)

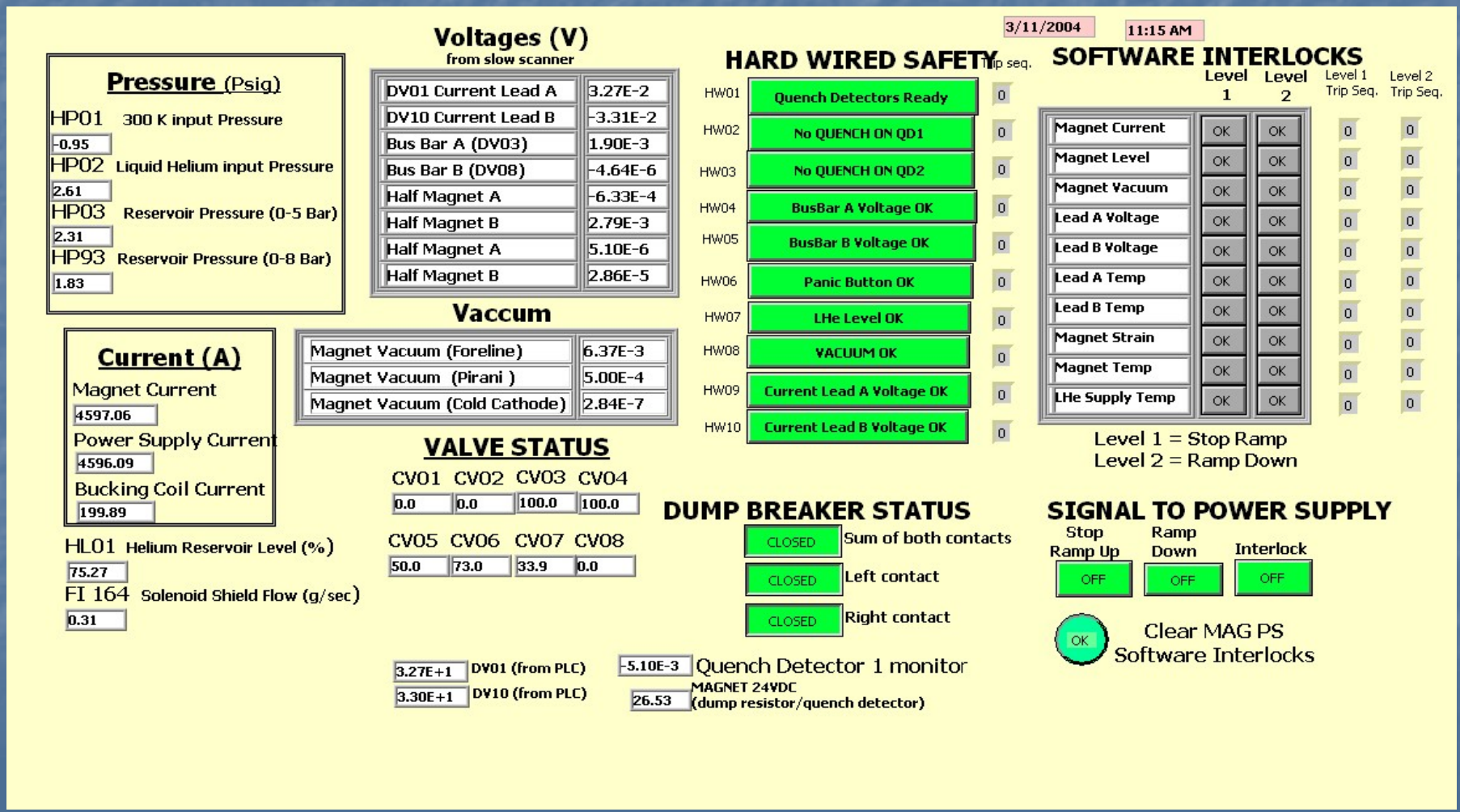
-0.2 Delta T Trip Point 45K (MTavg-HT92)

V3 -0.252 HP03-PT172

BaBar Refrigerator & Solenoid

- Hardware & software interlocks protect the magnet from damage due to quenching
  - Software interlocks ramp magnet down or prevent ramp up of current
  - Hardware interlocks cause dump breaker to open and magnet to fast discharge
- As we have gained more experience some interlocks have been changed or removed to improve reliability

BaBar Refrigerator & Solenoid



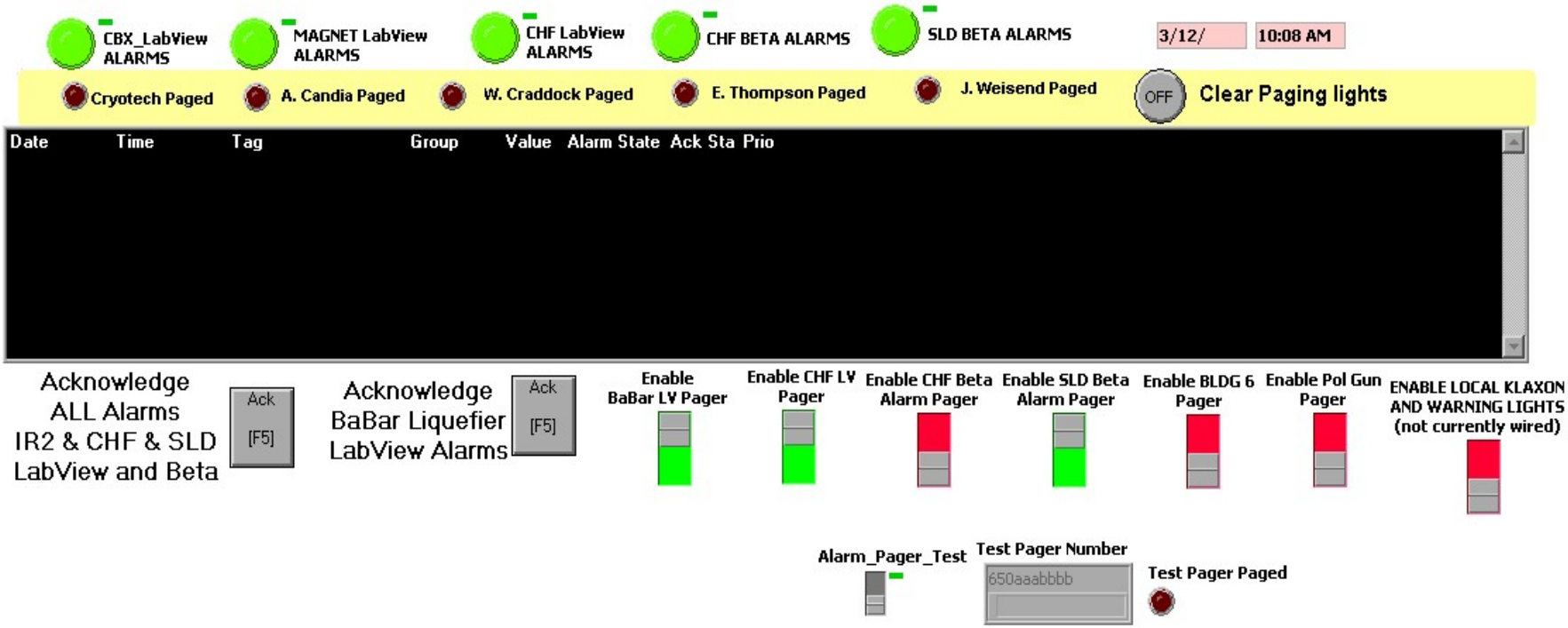
Control Systems

- The Babar Refrigerator & Solenoid as well as the CHF Compressors are controlled by a set of 3 Programmable Logic Controllers (AB SLC 500/4)
- The PLCs run a ladder logic program (RSLogix)
- Operator control is carried out on Win XP PCs running LabView
- The PLCs are tied to each other and PCs via a proprietary network (DH+)
- Critical control components are on UPS backup

Control Systems

- The controls include an automated alarm & paging system
- Alarms can be acknowledged via telephone
- All control screens are available on the web for remote monitoring (but not control) http://cryocon2.slac.stanford.edu:8080/

Control Systems



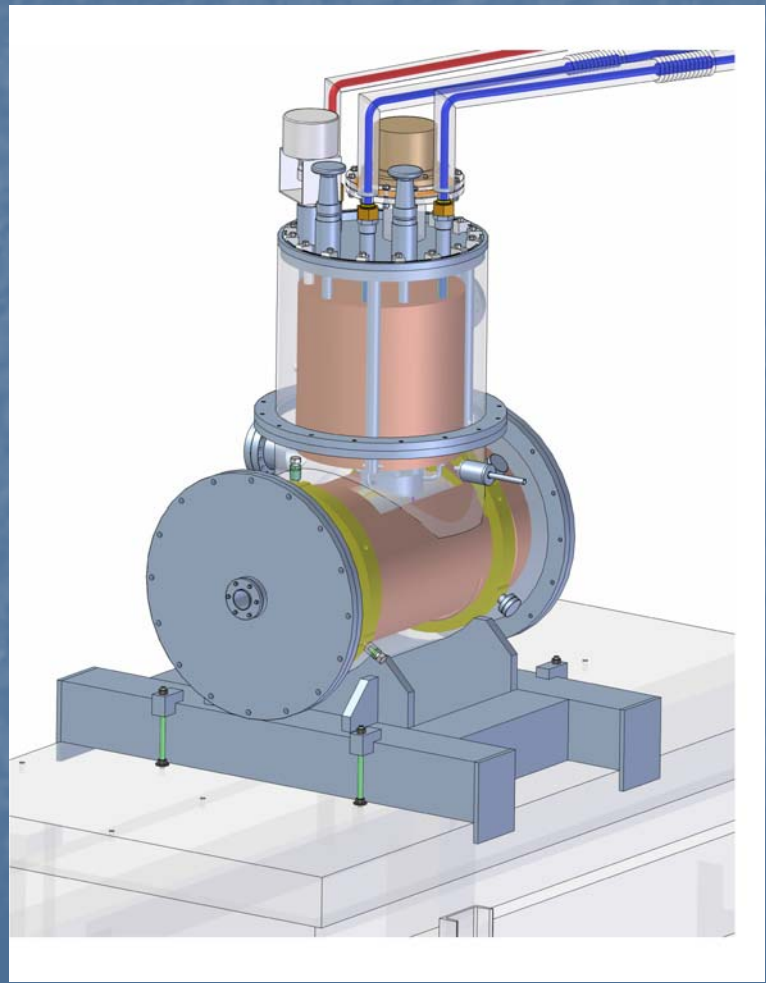
Research Yard Refrigerator Facility

- A CTI/Sulzer 4000 Plant
- Can provide > 1 kW refrigeration @ 4.2 K or >1.2 kW refrigeration @ 16 K
- Most recently used in the E158 LH_2 target experiment (2000 – 2003)
- Available to support future experiments with refrigeration or LHe
- Analog controls with LabView monitoring

Fermilab/SMTF Cryogenic Bayonet Can Design

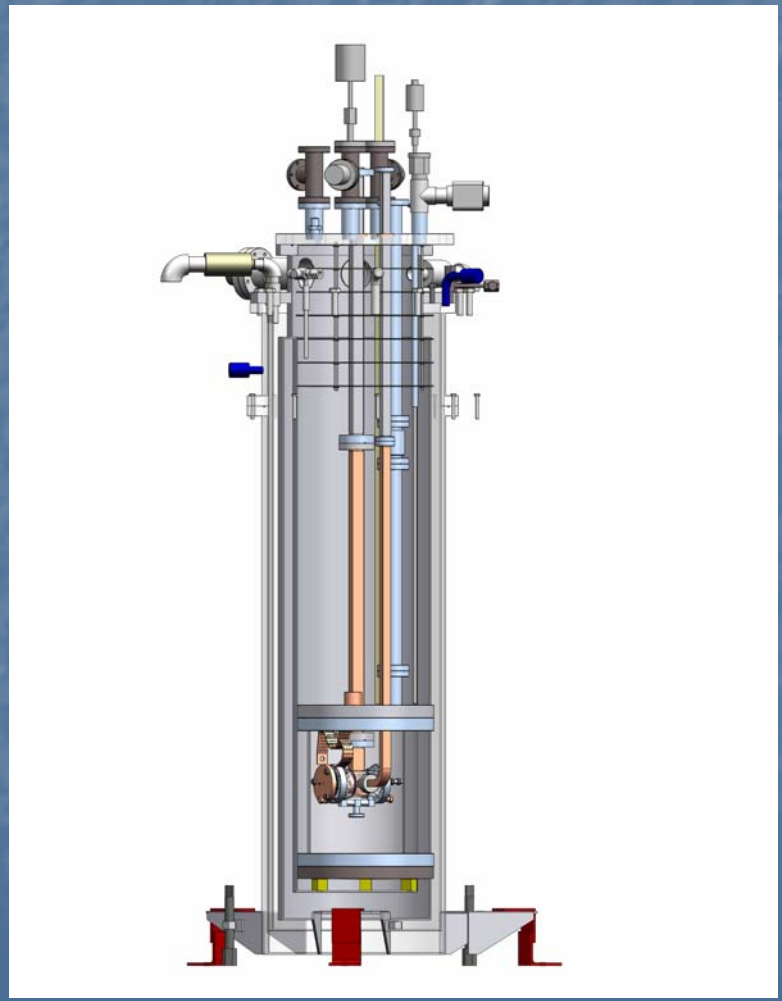
ILC Quadrupole Test Cryostat

- Designed & built at SLAC
- Warm bore allows measurement of magnetic center
- Designed to fit prototype Ciemat quadrupole
- Test cryostat can be adapted for ILC quad designs
- Design complete, construction underway
- 1st cold test planned for August with 1st magnetic measurements somewhat later
- Cryogenic operations will be done by SLAC cryo group



SCRF Test Stand

- Experiment measures RF critical fields in superconducting materials
- Project is a collaboration between SNS & SLAC
- Cryostat was designed by SLAC
- Low power tests have been done. 1st High power tests using x band (11.4 GHz) Klystron are underway



Enriched Xenon Observatory (EXO)

- Experiment is a search for neutrinoless double beta decay – discovery would help determine neutrino mass
- Phase 1 uses 200 kg of liquid Xe^{136} (~165 K)
- SLAC Cryogenics group is assisting with the integration of the cryogenics system including pumps, transfer lines, vacuum systems and electronics

Staffing

- 21 people in the SLAC cryogenics group
  - Continuous operations support for the cryogenic systems (BaBar, LN_2 He gas, Polarized gun)
    - This year we went to no shift work : 8 hours onsite M-F + remote monitoring – 6 Cryotechs (Change from 2004)
  - Design & construction support for both cryogenic and non cryogenic equipment
  - Cryogenic, mechanical, electronic & software engineering capabilities
  - Provides significant support to SLAC safety programs
- Part of the larger Conventional & Experimental Facilities Dept.

CEF Conventional and Experimental Facilities

JOHN CORNUELLE
OPERATIONS DIRECTOR

JOHN WEISEND
DEPARTMENT HEAD

BURL SKAGGS
DEPUTY DEPARTMENT HEAD

PERRY ANTHONY
DEPUTY DEPARTMENT HEAD

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FLICK, Irene
ADAIR, Lisa
FLYNN, Vickee
SMITH, Michelle

STAFF
BOWER, Gary
BOYCE, Richard
FIEGUTH, Ted
WALZ, Dieter

CONSTRUCTION OVERSIGHT & SAFETY
GROUSSMAN replacement
JONES, Richard F.
PFEFFERKORN, J
SHERRY, Thomas J.

ELECTRICAL SAFETY SUPPORT GROUP
ANTHONY, Perry
LINEBARGER, Wayne
BURGUENO, George
GUZMAN, Kisha

ENGINEERING & CONSTRUCTION
DAO, Hieu

Line Item & Special Projects
Project Manager TBA
FLICK, Karl
HUANG, Queenie

Engineering, Projects & Tech Support
CHAN, Kingston
ADIKARA, Felix
FOLGER, JoBeth
KAUL, Pran N.
LONGA, Victor
SHIN, Harry K., Jr.
WINSTEAD, James
YANG, Kenneth

UTR Services
FRY, John (Jack) C.
McMAHON, Noel T
STAUDENMAIER, Paul J.
UTR TBA

Electrical Engineering, Projects & Tech Support
JONES, Frederick
AMADOR, Dino
CHOI, John
Electrical Engineer TBA
Electrical Engineer TBA

SLAC Energy Manager
FIEGUTH, Luda

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ROMERO, Bernie G.

Mechanical Utilities
GRYGUTIS, Patrick H.
BLACKWELL, Robert M.
DOMINGUEZ, Jesus
JEGLUM, David C.
LOGAN, James F., Jr.
PERALTA, Jesse
RADAU, Raymond K.
SANCHEZ, Anthony F.
STAUDENMAIER, Paul J.
THUNEN, Peter K.
WEISMANN, James
ZAMORA, Mario

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ANDERSEN, Donald B.
BLOMDAL, John
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McKENZIE, Charles
REGALADO, Jose C.

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CHOATE, William S.
BUTLER Craig J.
GONG, Harry
MANLEY-ARRIETA, Daniel
STRITTMATTER, Michael J.

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BRAUTIGAN, Marvin A.
SOTO, John

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JUSINO, Rodney

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EGAN, Agnieszka (Aga)

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ASTRUP, Erik
GRENDA, Paula
LAUCHNER, Chet F.

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GOMEZ, Rafael
VAZQUEZ, Chico

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GALAYDA, Carolyn

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PEREIRA, Carlos
RUBINO, Ken

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METZGER, Aiden
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HUGHEY, Aries
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KUHN, Ryan
MAGGI, Richard
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DEANDA, Armando
MEDINA, Pedro
PATANGUI, Lambert O.
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VARGAS, Ramona

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ALISIC, Fikret
BROTOIU, Constantin
CATANIA, Brad
CUADRADO, Raimond
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FANGUPO, Lata
McKISSICK, Wynetta

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LIMON, Salvador
POITIER, Sebastian
SALDIVAR, Jesse
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YEUNG, Norman W.
ZINGSHEIM, Robert

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PACHECO, Ronald F.
RENTERIA, Anthony

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DELGADO, Salvador
HUSIC, Ibrahim
SHARMA, Raj
SINGH, Satwinder
SISIC, Sead

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PATEL, Bobby
SANDOVAL, Thomas
STAFFORD, Joseph

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HAST, Carsten
HUDSPETH, Carl

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SZALATA, Zen

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TORRES, Richard
ANDERSON, William
BRADFORD, George 50%
CLAY, Percy
ENGESSER, David
JOHNSON, Scot 50%
LOSKAMP, Lionel

BaBar
VASSILIAN, Zorb
BRADFORD, George 50%
HAU, Andrew
JOHNSON, Scot 50%
KREBS, Jason

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WHITTON, Clifton
GIBBS, Dan
MANUEL, Ray
QUILLON, George

Hoisting & Rigging Inspection
GROUSSMAN replacement

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WEISEND, John

Cryo & Detector Systems Operations
CANDIA, Arthur (Head of Operations)
RACINE, Mike (Deputy)

HARWOOD, Lester
MOORE, Robert
MUFFETT, Wes
NEIBEL, Matt
NORRIS, Dennis
OWENS, Freeman
SANCHEZ, Domingo

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WEISEND, John (Supervisor)
CRADDOCK, Wes (Supervisor)

ANGELOV, Angel
BADGER, Ronald
LIANG, Yic
KACHAROVSKY, Alex
SHEN, Patrick
STILES, Paul
ZALOG, Sam

Staff
CRADDOCK, Wes
PRINCIPE, Ricky
ROGERS, Ron
THOMPSON, EunJoo
WEBER, Tom

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What is the Future of SLAC Cryogenics?

- BaBar Experiment ends in 2008
- ILC work will continue and probably expand (design plus some tests)
- Phase 2 of LCLS may well use superconducting undulators or superconducting magnets in experiments
- EXO will continue and hopefully expand
- Development of a He recovery system for SSRL
- Small scale experiments such as SCRF will continue to require cryogenic support
- Upcoming astrophysics projects such as LSST will require vacuum, cooling and electronics support.

Summary

- The expertise of the cryogenics group and its facilities plays an important role in the current lab program
- It is expected that this role will continue to be important as the research program of SLAC evolves


Conventional
Exp é rimental
EF
FACILITIES


STANFORD LINEAR ACCELERATOR CENTER
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