

An Overview of SLAC Cryogenic Activities

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CryoOps 2004

What Do We Do ?

- This talk will answer a frequent question:

There are cryogenics at SLAC?

- Cryogenics at SLAC involve:
 - Large scale He refrigerator operation in support of BaBar & other experiments
 - Support of the SLD LAr calorimeter
 - Polarized Gun cooling
 - Site wide He Gas system
 - LN₂ delivery
 - Design and construction support for small scale experiments (EXO, cavity lights, pulsed SC)

What Do We Do ?

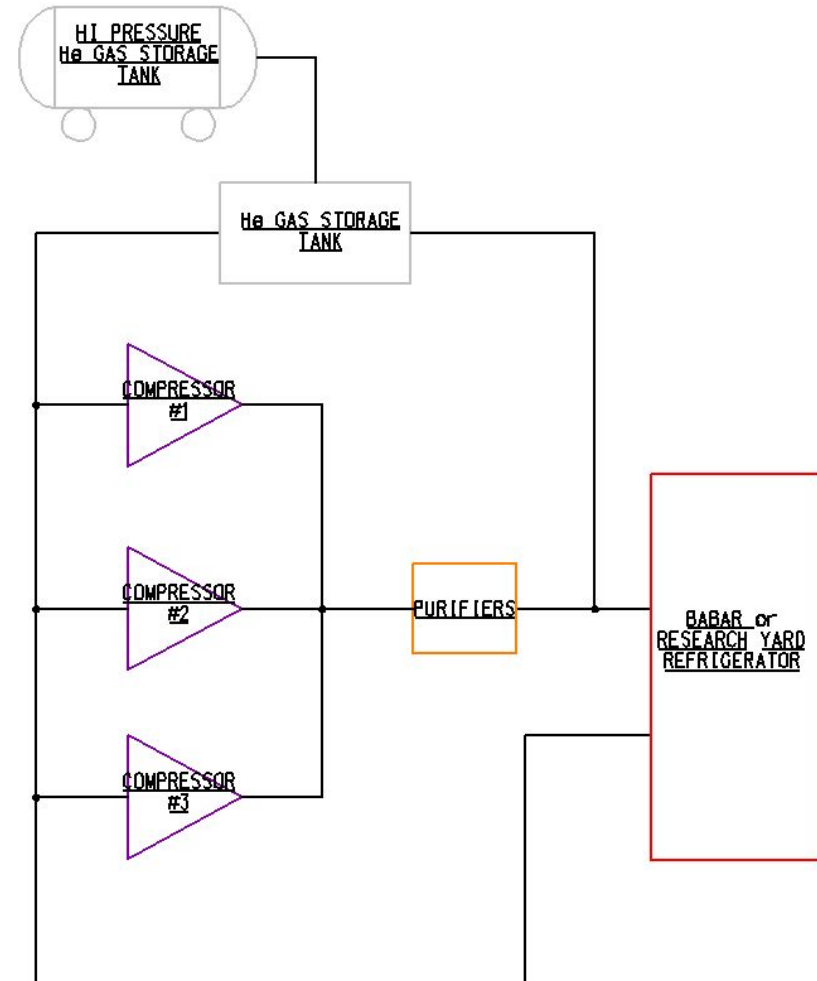
- The SLAC Cryogenics Group also carries out a number of “noncryogenic” tasks
 - Design , construction & installation of specialized beam line components (collimators, vacuum systems, beam pipes, ovens, magnets)
 - Design, construction & repair of specialized electronics for experiments.
- This talk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

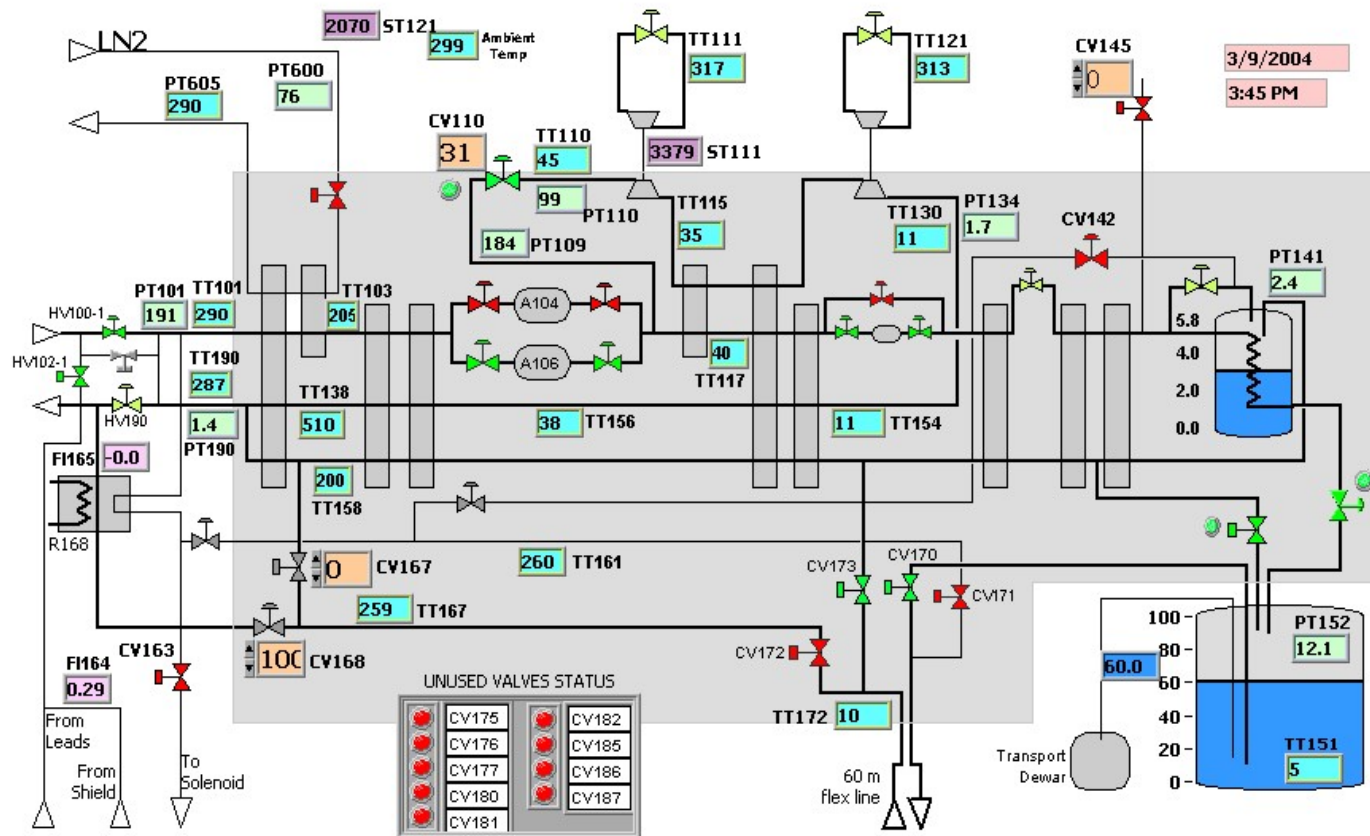
- 3 Sullair screw compressors
 - One 100 g/s
 - Two 50 g/s
- Any compressor can be tied to any refrigerator
- Centralized gas management & cleanup
- Electronics & Controls have been recently upgraded
- Centralized PLC and LabView control system



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



LIQUEFIER OVERVIEW

Start C1	START	STOP	RUNNING
Start C2	START	STOP	RUNNING
Start C3	START	STOP	STOPPED
Connect CBX	start/stop		RUNNING
Connect Dewar	start/stop		RUNNING
Warmup Coldbox	start/stop		STOPPED
LN2 Precooling	start/stop		STOPPED
Babar Cooldown	start/stop		STOPPED
Babar Normal Op	start/stop		RUNNING
Babar Warm-up	start/stop		STOPPED
Babar Ext. Fill	start/stop		STOPPED
CLEANUP	start/stop		STOPPED

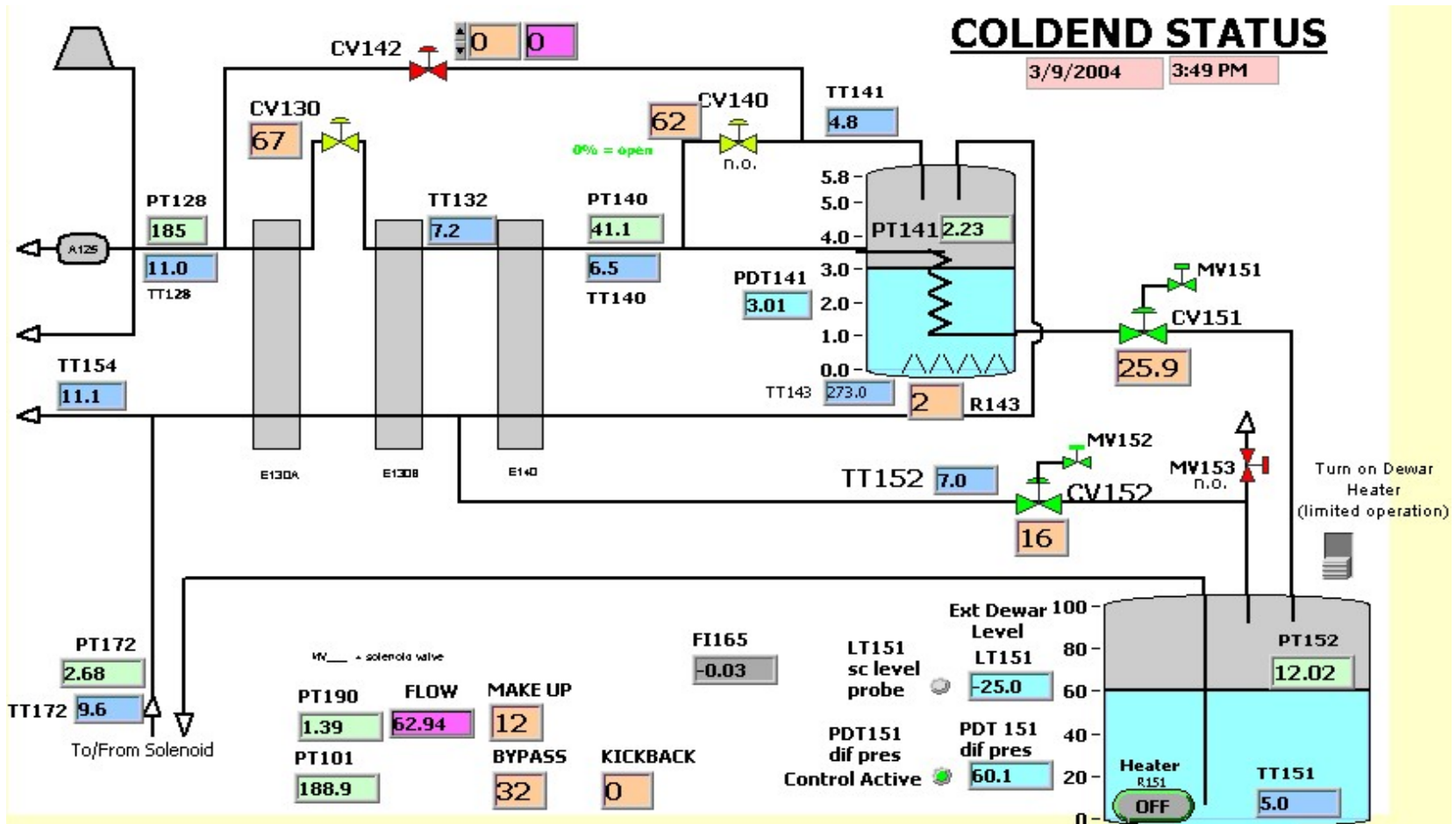
CV's: 145, 130, 140, 142, 151

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BaBar Refrigerator & Solenoid

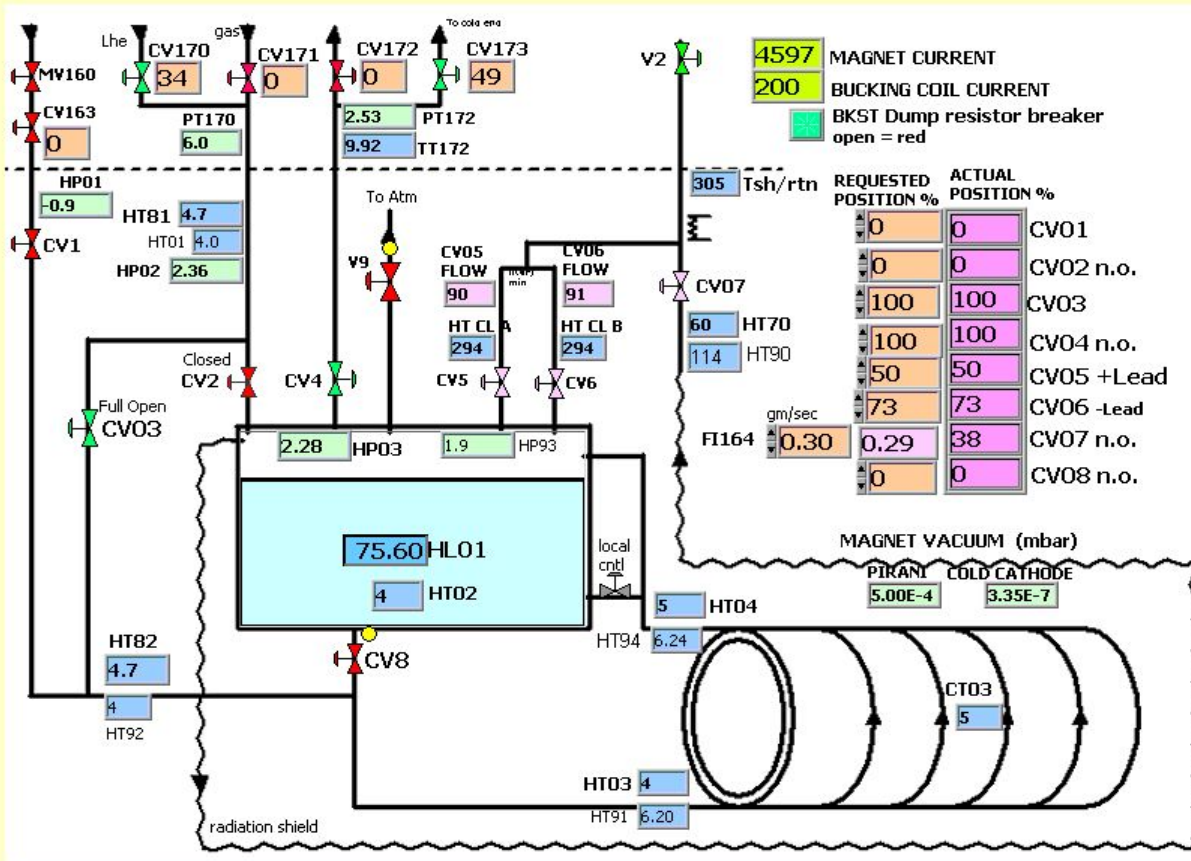


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BaBar Refrigerator & Solenoid



MAGNET OVERVIEW

3/9/2004 3:33 PM

4597 MAGNET CURRENT
 200 BUCKING COIL CURRENT
 BKST Dump resistor breaker
 open = red

REQUESTED POSITION %	ACTUAL POSITION %	Component
0	0	CV01
0	0	CV02 n.o.
100	100	CV03
100	100	CV04 n.o.
50	50	CV05 +Lead
73	73	CV06 -Lead
0	0	CV07 n.o.
0	0	CV08 n.o.

LIQUEFIER VALUES

CV167	CV168	TT167
0	100	259.4
CV161	CV162	PT161
0	0	52
12.02	PT152	-0.03
1.31	PT190	52.23
		FI165
		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

3/11/2004

11:15 AM

Pressure (Psig)

HP01 300 K input Pressure
0.95

HP02 Liquid Helium input Pressure
2.61

HP03 Reservoir Pressure (0-5 Bar)
2.31

HP93 Reservoir Pressure (0-8 Bar)
1.83

Voltages (V)

from slow scanner

DV01 Current Lead A	3.27E-2
DV10 Current Lead B	-3.31E-2
Bus Bar A (DV03)	1.90E-3
Bus Bar B (DV08)	-4.64E-6
Half Magnet A	-6.33E-4
Half Magnet B	2.79E-3
Half Magnet A	5.10E-6
Half Magnet B	2.86E-5

HARD WIRED SAFETY

HW01	Quench Detectors Ready	0
HW02	No QUENCH ON QD1	0
HW03	No QUENCH ON QD2	0
HW04	BusBar A Voltage OK	0
HW05	BusBar B Voltage OK	0
HW06	Panic Button OK	0
HW07	LHe Level OK	0
HW08	VACUUM OK	0
HW09	Current Lead A Voltage OK	0
HW10	Current Lead B Voltage OK	0

SOFTWARE INTERLOCKS

	Level 1	Level 2	Level 1	Level 2
	1	2	Trip Seq.	Trip Seq.
Magnet Current	OK	OK	0	0
Magnet Level	OK	OK	0	0
Magnet Vacuum	OK	OK	0	0
Lead A Voltage	OK	OK	0	0
Lead B Voltage	OK	OK	0	0
Lead A Temp	OK	OK	0	0
Lead B Temp	OK	OK	0	0
Magnet Strain	OK	OK	0	0
Magnet Temp	OK	OK	0	0
LHe Supply Temp	OK	OK	0	0

Level 1 = Stop Ramp
Level 2 = Ramp Down

Current (A)

Magnet Current
4597.06

Power Supply Current
4596.09

Bucking Coil Current
199.89

Vacuum

Magnet Vacuum (Foreline)	6.37E-3
Magnet Vacuum (Pirani)	5.00E-4
Magnet Vacuum (Cold Cathode)	2.84E-7

VALVE STATUS

CV01	CV02	CV03	CV04
0.0	0.0	100.0	100.0
CV05	CV06	CV07	CV08
50.0	73.0	33.9	0.0

DUMP BREAKER STATUS

CLOSED	Sum of both contacts
CLOSED	Left contact
CLOSED	Right contact

SIGNAL TO POWER SUPPLY

Stop Ramp Up	Ramp Down	Interlock
OFF	OFF	OFF



Clear MAG PS Software Interlocks

3.27E+1	DV01 (from PLC)	-5.10E-3	Quench Detector 1 monitor
3.30E+1	DV10 (from PLC)	26.53	MAGNET 24VDC (dump resistor/quench detector)

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

CBX_LabView ALARMS
 MAGNET LabView ALARMS
 CHF LabView ALARMS
 CHF BETA ALARMS
 SLD BETA ALARMS
 3/12/ 10:08 AM

Cryotech Paged
 A. Candia Paged
 W. Craddock Paged
 E. Thompson Paged
 J. Weisend Paged
 Clear Paging lights

Date	Time	Tag	Group	Value	Alarm State	Ack	Sta	Prio

Acknowledge ALL Alarms IR2 & CHF & SLD LabView and Beta
 Acknowledge BaBar Liquefier LabView Alarms

Enable BaBar LY Pager
 Enable CHF LV Pager
 Enable CHF Beta Alarm Pager
 Enable SLD Beta Alarm Pager
 Enable BLDG 6 Pager
 Enable Pol Gun Pager
 ENABLE LOCAL KLAXON AND WARNING LIGHTS (not currently wired)

Alarm_Pager_Test
 Test Pager Number
 Test Pager Paged

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 LH₂ target experiment (2000 – 2003)
- Available to support future experiments with refrigeration or LHe
- Analog controls with LabView monitoring

Staffing

- 24 people in the SLAC cryogenics group
 - Continuous operations support for the cryogenic systems (BaBar, LAC, LN₂ He gas, Polarized gun)
 - 20 hours onsite M-F, 12 hours onsite Sa, Su + remote monitoring – 7 Cryotechs
 - 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 Experimental Facilities Dept.

Experimental Facilities Department

John Weisend, Head

Perry Anthony, Deputy Head

Administration

Vickee Flynn
Charlotte Los Baños
Michelle Smith

Research & Facilities Support Group

Perry Anthony, Manager

Carsten Hast, Assistant Manager

Carsten Hast, Physics and Instrumentation

Carl Hudspeth Terry Tuck

Zen Szalata, Computing & DAQ

Richard Torres, Facilities & Rigging

William Anderson Percy Clay

David Engesser Mike Jimenez

George Bradford [50%] Scot Johnson [50%]

Zorb Vassilian, BaBar

Andrew Hau

Jason Krebs

George Bradford [50%] Scot Johnson [50%]

Engineering

Bill Olson

Staff

Gary Bower
Richard Boyce
Ted Fieguth
Dieter Walz

Cryogenics & Electronics Support Group

John Weisend, Manager

Michelle Smith

Staff

Wes Craddock
Ricky Principe
Ron Rogers
Louis Salerno
(Visitor-NASA)
EunJoo Thompson
Tom Weber

Cryo & Detector Systems Operations

*Arthur Candia,
Head of Operations*

*Mike Racine,
Deputy Head of Operations*

Lester Harwood
Gary Howell
Robert Moore
Wes Muffett
Matt Neibel
Dennis Norris
Freeman Owens
Domingo Sanchez

Electronics

*John Weisend/
Wes Craddock
Supervisors*

Angel Angelov
Ronald Badger
Yic Liang
Alex Kacharovskiy
Patrick Shen
Paul Stiles
Sam Zalog

3/31/2004

Updated 3/31/2004

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EFD Admin Chart.ppt

EFD CRYOGENIC GROUP-MANPOWER SCHEDULE

MARCH'04

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
	M	T	W	TH	F	S	S	M	T	W	TH	F	S	S	M	T	W	TH	F	S	S	M	T	W	TH	F	S	S	M	T	W	
HARWOOD, L.	S	S	S	S	S			S	S	S	S	S			S	S	S	S	S			S	S			N	N	N	N			
HOWELL, G.	S	S	S	S	S			S	S	S	S	S			S	S	S	S	S			S	S	S	S	S				N	N	N
MOORE, R.	S	S	S	S	S			S	S	S	S	S			S	S	S	SL	SL			SL	SL	S	S	S				S	S	S
MUFFETT, W.	N	N	N	N				S	S	S	S	S			S	S	S	S	S			S	S	S	S	S				S	S	S
NEIBEL, M.		S	S		N	N	N	NL		S	S	S			S	S	S	S	S			S	S	S	S	S				S	S	S
NORRIS, D.	S	S	S	S	S			N	N	N	N	N					N	N	N	N			S	S	S	S	S			S	S	S
SANCHEZ, D.	S	S	S	S	S			S	S	S	S		N	N	N	N					N	N	N	N		S				S	S	S

88 HOUR PAY PERIOD

96 HOUR PAY PERIOD

D=DAY SHIFT
N=NIGHT SHIFT

T=TRAINING
L=LEAVE

S=STRAIGHT DAYS

=WEEKEND
 =HOLIDAY

Summary

- Cryogenics plays an important role in the SLAC Research Program.
- The cryogenics group is broadly skilled, experienced and able to adapt quickly to changing research priorities.
- Cryogenic facilities at SLAC have significant capabilities & are continuously upgraded.
- Future challenges include replacing retiring workers with trained people and providing support to the LCLS project.

