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# **Cryogenic Test Facility**

## UIM Shutdown Overview

# Talk Outline

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- Organization/Personnel
- Shifts
- Scope/Overview
- Detailed Operations Scope
- Detailed Mechanical Scope
- Detailed Controls Scope
- Detailed Electrical Scope
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# Background

CTF facility was commissioned in 1988 to support testing the original CEBAF cryomodules. It has continued supporting the TestLab for more than 28 years.

The facility has a capacity of 800W at 35K (Cold Box #1), 750W at 4K (Cold Box #2), 10g/s at 2.1K (Cold Box #4). The distribution system delivers cryogens to the Cryomodule Test Cave, the Vertical Test Area, and a new un-finished extension will provide cryogens to the Injector Test Cave. The capacity available to each area depends on the total load which cannot exceed the capacity of the plant.

Cold box #1 and #2 use reciprocating expansion engines that require periodic maintenance including engine rebuilds, seal changes, and also require periodic tune-ups to ensure maximum performance.

Cold box #4 uses a two stage liquid ring pump and variable speed blower to provide 2K pumping. It requires periodic maintenance to ensure maximum performance.

Facilities Management negotiated a funding source that could provide money to upgrade and improve maintenance for older facilities such as CTF. Cryogenics worked with Facilities to develop an approach to spend some of this money on improvements at the CTF using a least-impact-to-12GeV-and-LCLS2 approach because of the engineering and design manpower limitations.

# Background (continued)

CTF UIM project has been ongoing for almost 3 years

- Phase 1:** Worked with Facilities Management to design and install a building addition that included additional machine space for expansion and a separate control room.
- Phase 2:** Wrote specification and purchased new 4.5K cold box. Linde L280 was purchased as compromise between cost, available UIM funds, and market availability. It is comparable in capacity to cold box #2. The original plan was to use it to ultimately replace CB2 because of its age and high maintenance reciprocating expanders
- Phase 3:** Specified and purchased PLC hardware, 19" racks, cabling, and cable tray and conduit to replace the CAMAC control system and reusing as much of the original boxes and cable as possible to save money
- Phase 4:** Installation was planned in two steps. The first included pre-fabrication and installation of piping up to final tie ins and pre-building the 19" control racks. The second step included a long shutdown to allow final piping tie ins, complete overhaul of the control system, and commissioning and testing of the new cold box and placing it online with CB2 in reserve
- Phase 5:** When it became obvious LCLS2 would be negatively impact this project we revised the plan to begin moving ahead with installation of all possible non-invasive pieces of the new control system in parallel with the operating plant. This lead to additional expenditures for boxes, cable, and conduit and tray and a redesign of the planned electrical interconnections because we had to install the new system in parallel with the operating CAMAC system instead of removing it first.
- Phase 6:** LCLS2 project became more sensitive to any down placing this project in jeopardy of missing critical milestones and losing contingency money that could be used for other projects. It was renegotiated to perform a best effort to complete the installation of the new cold box, complete the new control system installation, and push off cold box and commissioning and testing into the future until the project could tolerate the interruptions. It also pushed off removal of the old CAMAC hardware, cable, and boxes until after the project is over.

# Safety

- Toolbox meetings will continue to be held every day before work begins
- Employees responsible to monitor their activities and those around them and ensure everyone is doing their best to work safely
- If unexpected conditions arise then stop and reassess job
- If you don't understand a task stop and get help
- Wear proper PPE for the area and jobs assigned
- Inform work coordinator if you are untrained to perform assigned tasks
- Some of the types of work you should expect in the area
  - Cutting, welding, grinding, and lifting of pipe and supports
    - Chapter 6120 Portable Hand Tool Safety
    - Chapter 6120 Hot Work
    - Chapter 6141-6147 Material Handling
    - Chapter 6620 Personal Protective Equipment
    - Chapter 6640 Hearing Conservation
  - Scaffolding
    - Chapter 6132 Ladder and Scaffold Safety
    - Chapter 6131 Fall Protection
  - Electrical and controls work
    - Chapter 6200 Electrical Safety
    - Chapter 6110 Lock, Tag, Try
  - Leak Checking and Pressure Testing
    - Pressure systems, TOSP's, and stay out zones
  - Outside work

# Safety (continued)

## Typical areas that need special attention

- Hazardous energy sources (pressure, vacuum, power)
  - Primary work coordinator is responsible for system configuration
  - Ensure systems are de-pressurized and/or de-energized before task begins
  - Follow EH&S LOTO procedures as required
- ODH (building will remain ODH 1)
  - Requires training and multiple personnel in continuous contact
- Ladders
  - Requires training
  - Use correct ladder for the task
  - Do not improvise (stop task and get the right ladder)
- Scaffolding
  - Scaffolding will be used to access some mechanical and electrical work areas
    - Must be trained (class last week. Another planned this afternoon)
    - Scaffold must be checked and certified it was installed correctly
- Welder grounding (diodes are sensitive to stray currents)
  - Ensure grounding is approved by electrical engineer
- PPE
  - Hand and eye injuries are very common
  - Use PPE required for each task (eye protection, gloves, safety shoes, etc.)

# Organization

- Department Leader: Jonathan Creel
- Engineering and Design Group Leader: Kelly Dixon
- Division Safety Officer: Will Oren
- EH&S Liaison: George Perry
- Building 57 (CTF) Safety Warden: Mark Thompson
- Primary Project Work Coordinator
  - Thilan Wijeratne (Mat Wright)
    - Monitor safety, overall planning and coordination of work including operations, mechanical, and electrical teams
- Operations Work Coordinator
  - Alicia Saringer (Mat Wright)
    - Monitor safety, coordinate operations system tasks and communicate with the primary project coordinator and support teams
      - Hunewill, Scott Thompson, Domangue, Stephens,
- Mechanical Work Coordinator
  - Scott Thompson (Dano Oprisko)
    - Coordinate mechanical system modifications and communicate with primary project work coordinator and support teams
      - Oprisko, Troy, Fuentes, Conlin, Roy,
- Controls Work Coordinator
  - Buddy Carlton (Sasa Radovic)
    - Coordinate control system modifications and communicate with primary project work coordinator and support teams
    - Jon Barbour, Mark Thompson (Yarrington, Biezer, Evans as needed)

# Work Shifts

- Work shifts will vary according to planned needs
- Work days will be Monday through Sunday for some tasks/crews
- Work shifts will vary according to planned needs but not more than
  - 10 hours Monday-Friday
  - 8 hours Saturday and Sunday
- Breaks are required mid morning, lunch, and mid afternoon
- Coordinators should plan complex or difficult tasks earlier in the day to ensure people are at peak performance
- Let your work coordinator know if you become fatigued
- Let your work coordinator know as soon as possible if you can not work your shift so that other arrangements can be made
- Schedule will be modified as required to compensate for safety and technical issues



# Scope Overview

- CTF Shutdown 17 Feb through 9 Apr (Dewar full)
- Actual work duration is shorter because shutdown includes plant warmup, cleanup, and cooldown/fill
- Goals
  - Complete new cold box #3 physical installation
  - Complete CAMAC to PLC controls upgrade in Bldg. 57
  - Install strategic flanges for future GPP work
  - Install connection for HDIce gas return
- Not included in this shutdown work
  - CB3 commissioning and testing
  - Controls upgrade for junction box, Test Cave, or VTA
  - Removal of old wiring, conduits, CAMAC, racks, etc.
- Ongoing work
  - Finalizing detailed shutdown daily work schedule
  - Finalizing shutdown procedures
  - Having this pre-shutdown briefing
- Scope and schedule can change as work progresses



# Detailed Operations Scope

- Operations team responsibilities
  - Shutting down and securing the plant
  - Warming up the plant including the LHe Dewar efficiently
  - Securing carbon beds and purifiers
  - Pumping shell and utube insulating vacuums
  - Cleaning and preparing purifiers for restart
  - Rebuilding expanders as required
  - Cleaning up the plant after the work is complete
  - Cooling down and restart the plant
  - Filling the Dewar
  - Restart TestLab operations

# Detailed Mechanical Scope

- UIM
  - Remove Dewar flex utubes
  - High pressure header modifications
  - D4 (primary supply from cold box modifications)
  - CB2 LN2 Utube
  - D5 (primary supply to user modifications)
  - D8 (vapor return from LHe Dewar to CB3)
  - Install utubes
  - Perform leak checks and pressure tests
- UITF
  - Connect 4” recovery line for HDIce
- GPP
  - Add flanges to low pressure and clean gas lines
  - Add flanges to high pressure and clean gas lines
- Repairs
  - Kinney water leak (if feasible)
  - LN2 vacuum jacket leak (if feasible)

# Detailed Controls Scope

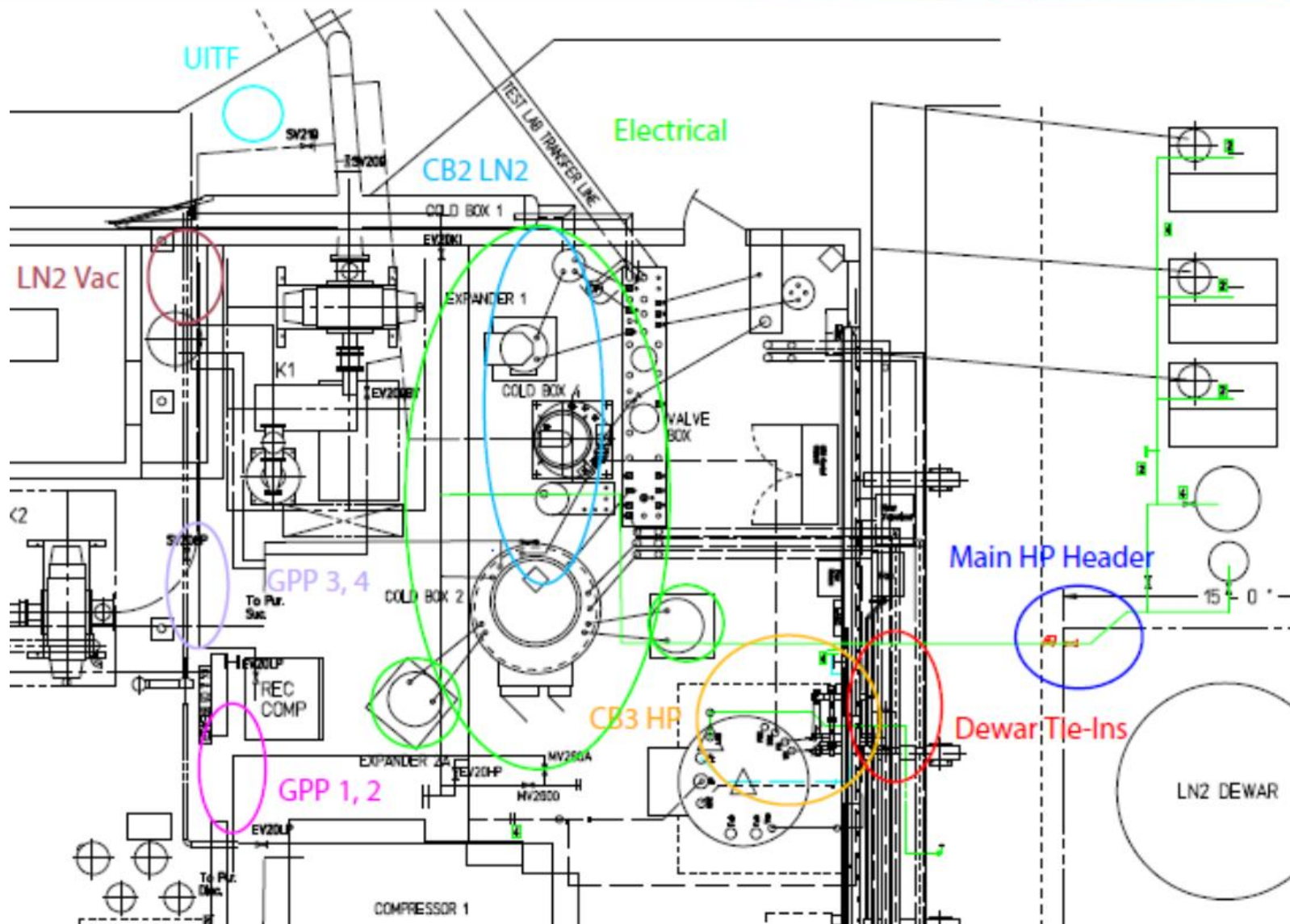
- Transitioning from CAMAC to PLC
- Using Allen Bradley ControlLogix PLC and library code modules
  - Similar to installations for SNS, CHL1 compressors, SC1 and SC2 cold boxes, CHL2 compressors and 4.5K cold boxes, Hall D refrigerator, Hall B magnets, Hall C magnets, FRIB, and LCLS2
- Move instrumentation and valve controls that could not be moved while plant was operating
  - Warm Gas Management
  - Cold Box #1 and Expander #1
  - Cold Box #2 and Expander #2A and #2B
  - Recovery Gas Management
  - LHe and LN2 Dewars and warm gas tanks
  - Valve Box
  - Install additional heaters in LHe Dewar for later CB3 testing

# Detailed Electrical Scope

- Relocate 480V conduit and Jbox over CB3
  - This Jbox prevents installation of the cold box #3 utubes
  - Facilities management electricians will install some preliminary conduit and wire before the shutdown
  - Facilities management electricians will relocate box on 17-18 Feb
  - During this work some of the panels, lights, and receptacles will be off



# Map



# Proposed Schedule

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
	13-Feb	14-Feb	15-Feb	16-Feb	17-Feb	18-Feb	19-Feb
OPS Tasks	Lower Dewar Level	Lower Dewar Level	Lower Dewar Level	Lower Dewar Level Have 2 empty gas tanks Prep for work tomorrow	Shutdown CTF	Warm-up	Warm-up
Welding Team 1					U-Tubes Valves P&I's?		
Welding Team 2					Kinney Water Leak? Header or Branch? Can this be done while the electrical work is being done?		
Electrical Team 1					Warm gas mgmt	Warm gas mgmt	Valve box
Electrical Team 2							
Electricians					Move E-box over CB3		
Week 1	20-Feb	21-Feb	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb
OPS Tasks	Warm-up 2A rebuild	Warm-up 2B rebuild	Warm-up Kinney 1 Pressure Switch	Warm-up	Warm-up Shut off recovery and LN2	Warm-up	Warm-up
Welding Team 1			Work on D4 will start when dewar warms up				
Welding Team 2	HP Header	HP Header	CB3 HP (bolting)	GPP 1	GPP 1		
Electrical Team 1	Valve box	Valve box	CB1	CB1	Exp1	Exp1	Exp1
Electrical Team 2							
Week 2	27-Feb	28-Feb	1-Mar	2-Mar	3-Mar	4-Mar	5-Mar
OPS Tasks	Purifier Regen How if LN2 is off? Portable Dewars? Recovery Off LN2 Off	Purifier Regen Recovery Off LN2 Off	Purifier Regen Recovery Off LN2 Off Exp 1 rebuild	Purifier Regen Recovery Off LN2 On?	Purifier Regen Recovery Off LN2 On?		
Welding Team 1	D4	D4	D4	D4	D4	D4	D4
Welding Team 2	CB2 LN2 U-Tube	CB2 LN2 U-Tube	LN2 Vac repair	GPP 2	GPP 2		
Electrical Team 1	Recovery gas mangt	Recovery gas mangt	CB2	CB2	CB2	Exp2A	Exp2A
Electrical Team 2	Install heaters in LHe Dewar						
Week 3	6-Mar	7-Mar	8-Mar	9-Mar	10-Mar	11-Mar	12-Mar
OPS Tasks	Recovery off LN2 On			Clean-Up GPP	Recovery On LN2 On		
Welding Team 1	D4	D5	D5	D5	D5	D8	D8
Welding Team 2	GPP 4	GPP 3	GPP Pressure test so recovery can be turned back on	UITF 4" Flange			
Electrical Team 1	Exp2B	Exp2B	Dewar LHe	Dewar LN2			
Electrical Team 2							

# Proposed Schedule (continued)

Week 4	13-Mar	14-Mar	15-Mar	16-Mar	17-Mar	18-Mar	19-Mar
OPS Tasks							
Welding Team 1	D8	D8	D8	D8	D8	D8	D8
Welding Team 2							
Electrical Team 1							
Electrical Team 2							
Week 5	20-Mar	21-Mar	22-Mar	23-Mar	24-Mar	25-Mar	26-Mar
OPS Tasks							<i>All controls and piping work must be completed by this date</i>
Welding Team 1	D8	Pressure Test	Pressure Test	Pressure Test	Pressure Test	Pressure Test	Pressure Test
Welding Team 2							
Electrical Team 1							
Electrical Team 2							
Week 6	27 Mar	28 Mar	29 Mar	30 Mar	31 Mar	1 Apr	2 Apr
OPS Tasks	Clean-Up	Clean-Up	Clean-Up	Clean-Up	Clean-Up	Clean-Up	Clean-Up
Welding Team 1	Pressure Test	CB3 LN2					
Welding Team 2							
Electrical Team 1							
Electrical Team 2							
Week 7	3 Apr	4 Apr	5 Apr	6 Apr	7 Apr	8 Apr	9 Apr
OPS Tasks	Cool-down CB2	Cool-down CB2	Cool-down CB2	Fill-Dewar	Fill-Dewar	Fill-Dewar	Fill-Dewar
Welding Team 1							
Welding Team 2							
Electrical Team 1							
Electrical Team 2							

- Things that could effect the restart date
  - Safety
  - Unexpected technical issues
  - Reassignment of critical work force members



# Summary

- Primary goal is to complete the project safely
- Secondary goal is to complete the project on schedule
  
- Let the work coordinators know if you notice any problems as soon as possible
- Let the work coordinators know if you notice any opportunities as soon as possible

# Question or Comments

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