

# Accelerator Status Report

**Michael McCaughan**

Hall A/C Summer 2020 Meeting

July 17, 2020

The logo for Jefferson Lab, featuring the text "Jefferson Lab" in a bold, sans-serif font. A red swoosh underline is positioned beneath the word "Jefferson".




U.S. DEPARTMENT OF  
**ENERGY**

Office of  
Science



# JLAB Pandemic Response Plan

Level	Characteristics	Triggers for PAT Activation/MEDCON Levels	Key Actions
6 	Widespread pandemic throughout the United States		<ul style="list-style-type: none"> <li>- Brief senior management as the situation merits.</li> <li>- Recommend safe suspension of operations to plan ahead and preserve site safety and work preservation.</li> <li>- Communicate with DOE BEMT.</li> <li>- Continue close communications with the state health department; surrounding county administrators and emergency managers; and local health care providers.</li> </ul>
5	Outbreak at specific site/facility or the nearby community	The pandemic disease of interest has occurred to a Jefferson Lab employee, user, or contract employee.	<ul style="list-style-type: none"> <li>- Activate appropriate approved plans and briefs senior management.</li> <li>- Work in conjunction with Virginia Public Health authorities to implement local mitigation strategies.</li> <li>- Ensure close communications with the state health department, surrounding county administrators and emergency managers, and local health care providers for coordinated response.</li> <li>- Communicate with DOE BEMT. Provide guidance to senior management regarding maintenance of essential Laboratory functions.</li> <li>- If disease severity merits, senior management will determine whether to release non-essential members of the workforce.</li> <li>- If needed, IT will activate a remote communications plan with the workforce.</li> <li>- Work with Occ. Med. to ensure distribution of disease-appropriate vaccine, medications, and PPE to essential workforce.</li> <li>- Intensify employee education on personal protective measures.</li> <li>- Public Relations will ensure maintenance of communications to employees, stakeholders, and the community to include news releases, web sites, and other methods of communications as appropriate.</li> </ul>
Post Pandemic: Return to normal operations; perform a phased restart (see Emergency Management Plan). Consider disinfection protocols as needed.			<b>Worker Pandemic Protection and Response Plan</b> Rev. 0 Reviewed: March 13, 2017

Emergency Management Pandemic Response Plan: <https://www.jlab.org/eshq/emergmgt>

# Medcon 4/5 Social Distancing Directives:

## Procedure to govern control room Operations under Medcon 4/5 restrictions:

- 6' social distancing maintained
- Phased turnovers
- Sanitation of work stations – to include distancing, cleaning, and dedicated SSO.
- Sweep procedure & survey modifications.

**Expect delays – Please be patient**



## MEDCON 4/5 Social Distancing Directives

**Document Number:** MCC-PR-01-011

**Revision Number:** Rev. 1; June 3, 2020

**Technical Custodian:** Paul Vasilauskis

**Estimated Time to Perform:** Not Applicable

### Procedure Overview

This document describes specific social distancing requirements for MCC and LERF Control Room personnel when operating under MEDCON 4 or MEDCON 5 restrictions.

**WARNING:** It is JLab policy that no activity—including the execution of the accelerator program—is so urgent or important that standards for safety or health are compromised; in other words, safety first. As a JLab employee you are empowered to—without reprisal—stop any work you feel is unsafe. This “stop work” policy is an expectation and responsibility, and extra vigilance is important

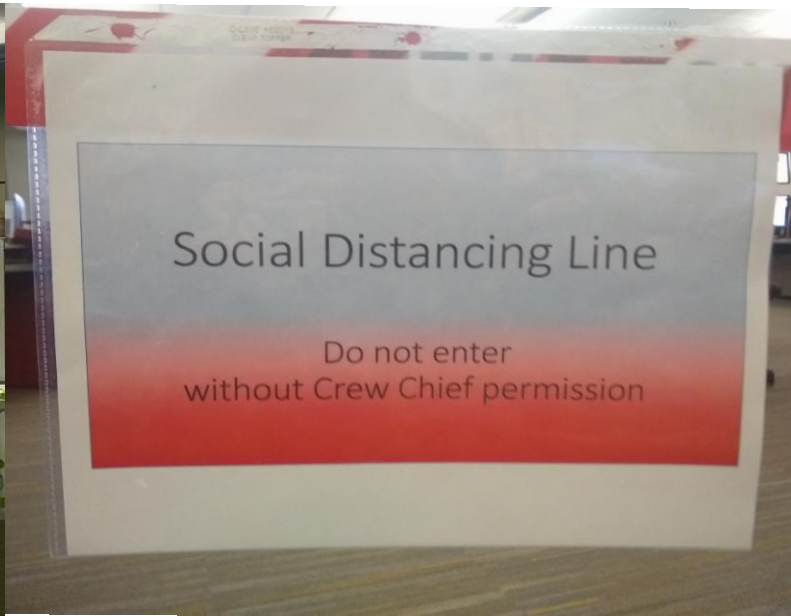
[http://opsdocs.acc.jlab.org/ops\\_docs/online\\_document\\_files/MCC\\_online\\_files/MEDCON4-5\\_social\\_distancing\\_directives.pdf](http://opsdocs.acc.jlab.org/ops_docs/online_document_files/MCC_online_files/MEDCON4-5_social_distancing_directives.pdf)



# Pandemic Response (Cont.)

## Augmented policy initiatives:

- .Additional PPE requirements (100% masking in control room)
- .6'+ social distancing remains in effect
- .Single person processing for ingress/egress from machine segments to maintain social distancing.
- .Sweep delays and PSS logic modified to accommodate the above policy and process sweepers in/out one-by-one
- .Isolation of control rooms from unnecessary traffic for risk prevention
- .Other measures as outlined in various OSPs/Procedures/etc.



# Start-up Schedule

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## Recovery Plan\*:

**Task view:** [www.jlab.org/accel/ops/ganttproject/2020/2020\\_CovidRecovery-tasks.html](http://www.jlab.org/accel/ops/ganttproject/2020/2020_CovidRecovery-tasks.html)

**Gantt:** [www.jlab.org/accel/ops/ganttproject/2020/2020\\_CovidRecovery-chart.html](http://www.jlab.org/accel/ops/ganttproject/2020/2020_CovidRecovery-chart.html)

## Covid-19 Machine Recovery ATLis:

<http://opsweb.acc.jlab.org/CSUEApps/atlis/task/20836>

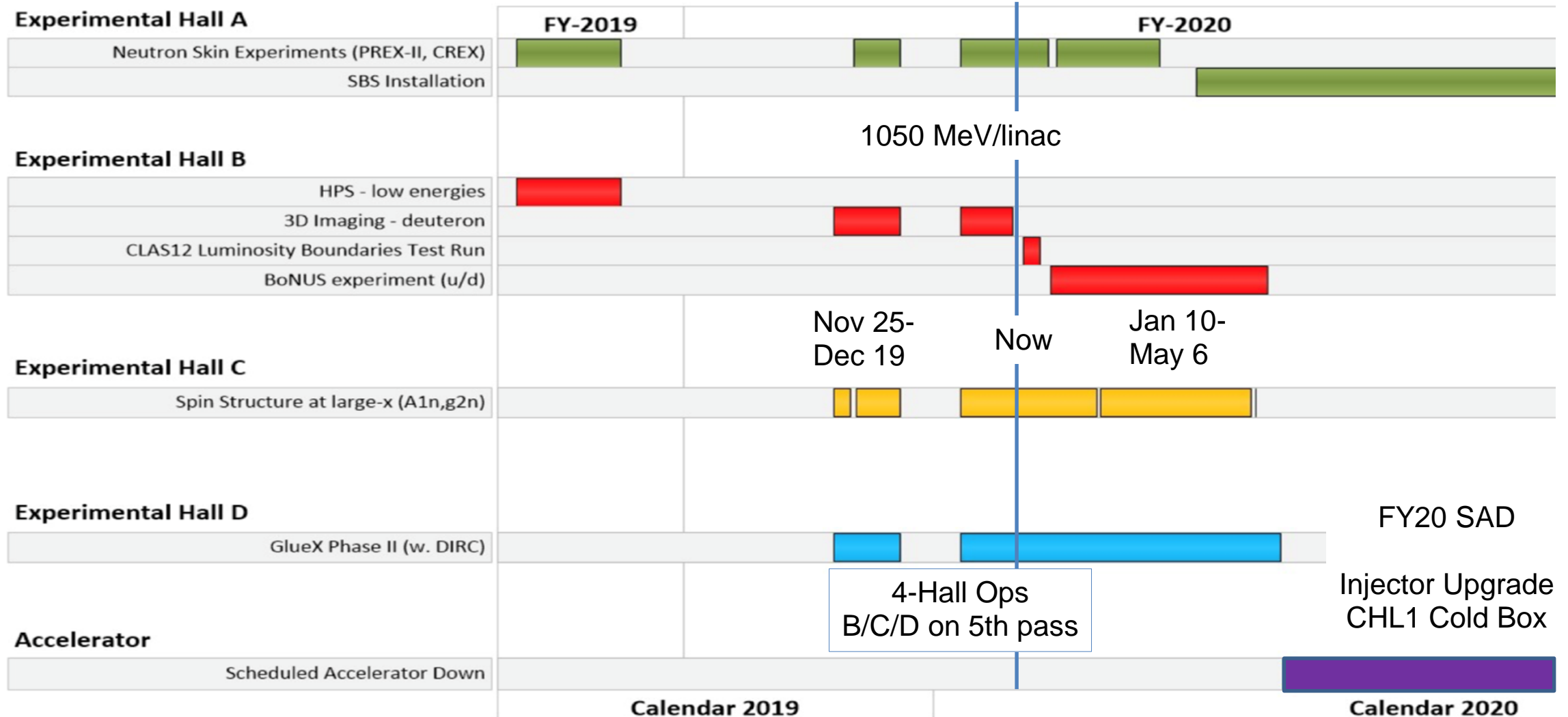
**MCC Whiteboard:** <http://accboard.acc.jlab.org/>

**SAD / Maintenance Calendar:** <https://accweb.acc.jlab.org/calendar/>

\*All links on ACC web, and require 2-factoring into site.

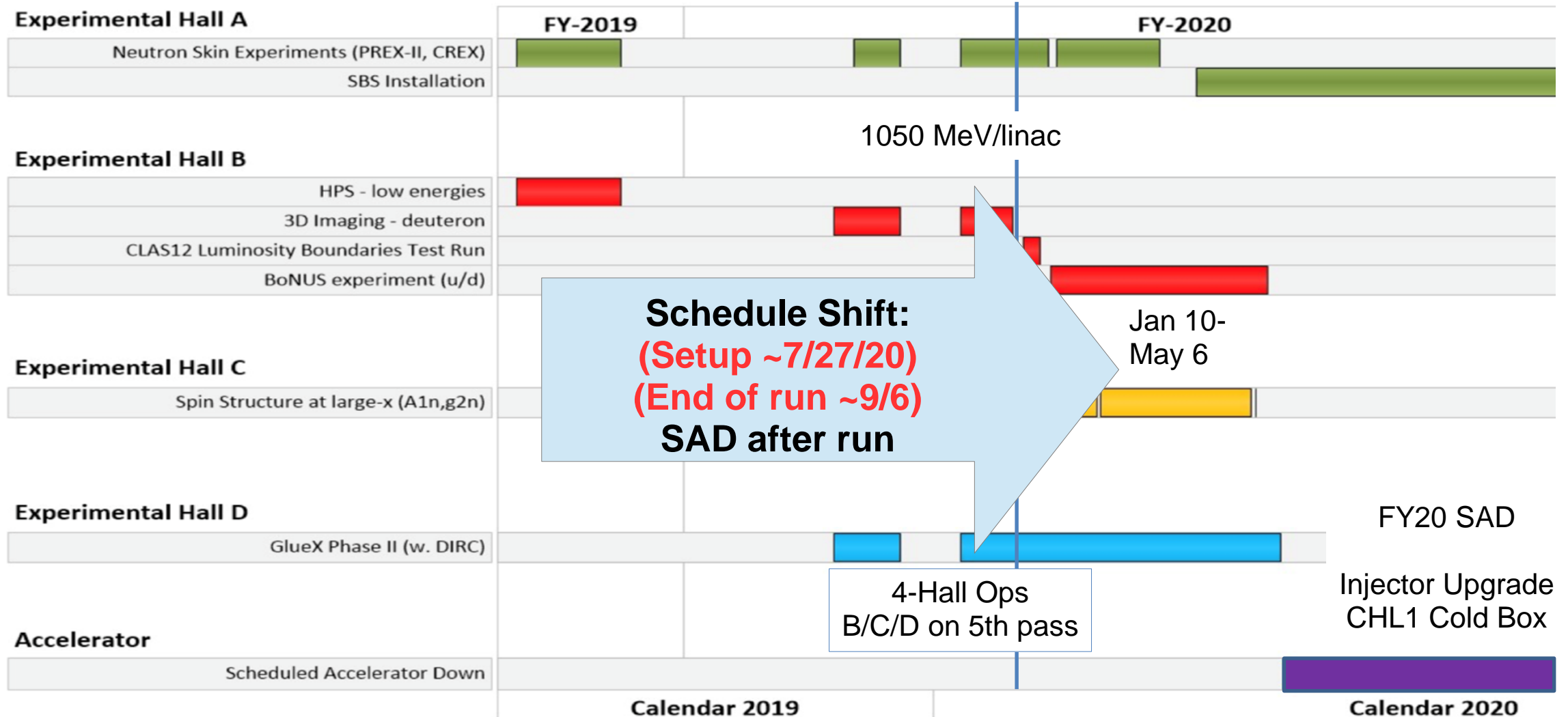
# Big Picture on Schedule

[https://www.jlab.org/exp\\_prog/experiment\\_schedule/2019/20190912.3.pdf](https://www.jlab.org/exp_prog/experiment_schedule/2019/20190912.3.pdf)

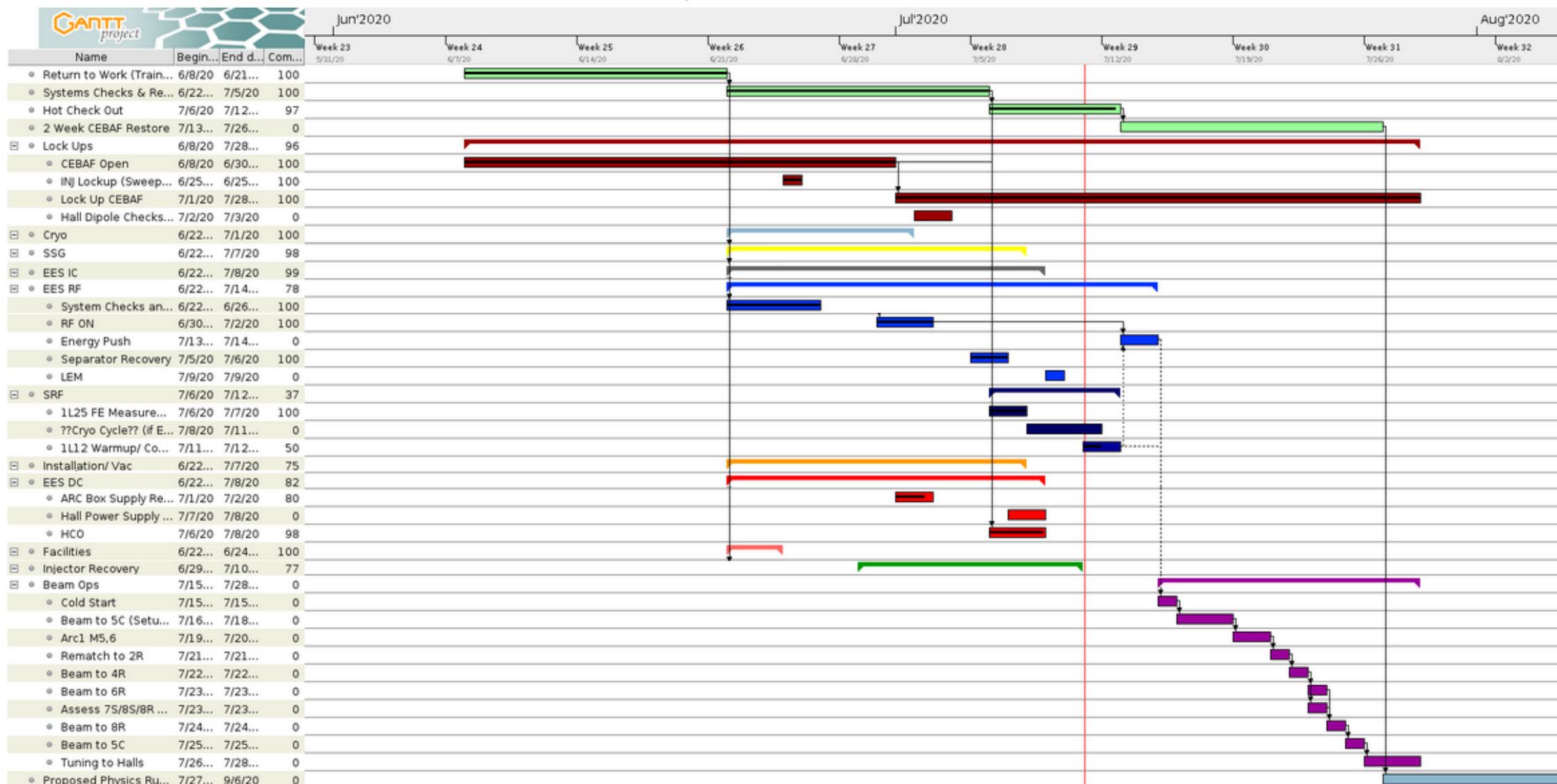


# Big Picture on Schedule

[https://www.jlab.org/exp\\_prog/experiment\\_schedule/2019/20190912.3.pdf](https://www.jlab.org/exp_prog/experiment_schedule/2019/20190912.3.pdf)



# Accelerator Recovery (Gantt\*)



\*[https://www.jlab.org/accel/ops/ganttproject/2020/2020\\_CovidRecovery-chart.html](https://www.jlab.org/accel/ops/ganttproject/2020/2020_CovidRecovery-chart.html)



# SAD Calendar:

<div> <div>SAD Calendar</div> <div>Scheduled Accelerator Down</div> <div> <div>Login</div> <div>SU</div> </div> </div> <div> <div> <div>&lt;&lt;</div> <div>Week 30 2020</div> <div>&gt;&gt;</div> </div> <div> <div>View</div> <div>ATLis</div> <div>Work Map</div> <div>Help</div> </div> <div>CEBAF</div> </div> <div> <div>Key</div> <div> <div>Good Plan</div> <div>Lock Up</div> <div>Subset</div> </div> <div> <div>Tentative Plan</div> <div>Utility Interruption</div> <div>New/Changed</div> </div> <div> <div>Major Event</div> <div>Radcon Group</div> <div>LERF</div> </div> <div> <div>Incomplete Task</div> <div>Special Support</div> <div>ATLis Task</div> </div> </div>								
		Sun	M	T	W	T	F	Sat
30		2020-07-19	20	21	22	23	24	25
	Owl	PD: Oren	PD: Oren	PD: Oren	PD: Oren	PD: Oren	PD: Vasilauskis	PD: Vasilauskis
	Day	☞ <b>Restore</b> Beam to 5C	☞ <b>Restore</b> Arc1 M5,6  ☞ LCLS-II 4K tests ☞ ^LCLS-II 8 Cav Run	☞ <b>Restore</b> Arc1 M5,6 CUP repairs  ☞ LCLS-II 4K tests	☞ <b>Restore</b> Rematch to 2R ☞ XAC raster HCO ☞ XA dump exit pipe ☞ LCLS-II 4K tests	☞ <b>Restore</b> Beam to 4R  ☞ LCLS-II 4K tests	☞ <b>Restore</b> Beam to 6R 7S B-comm setup  ☞ LCLS-II 4K tests	☞ <b>Restore</b> Beam to 8R  ☞ LCLS-II 4K tests
	Swing					Hall lockup ☞ DC Pwr chks		
31		2020-07-26	27	28	29	30	31	01
	Owl	PD: Oren	PD: Oren	PD: Oren	PD: Benesch	PD: Benesch	PD: Benesch	PD: Benesch
	Day	☞ <b>Restore</b> Beam to 5C ☞ LCLS-II 4K tests	☞ <b>Restore</b> Hall Setup ☞ LCLS-II 4K tests	☞ <b>Restore</b> Hall Setup	☞ <b>Restore</b> Hall Setup	<b>Physics</b>	<b>Physics</b>	<b>Physics</b>
	Swing							
32		2020-08-02	03	04	05	06	07	08
	Owl	PD: Benesch	PD: Benesch	PD: Benesch	PD: Benesch	PD: Benesch	PD: Benesch	PD: Benesch
	Day	<b>Physics</b>	<b>Physics</b>	<b>Physics</b>	<b>Physics</b>	<b>Physics</b>	<b>Physics</b>	<b>Physics</b>
	Swing							
33		2020-08-09	10	11	12	13	14	15
	Owl	PD: Benesch	PD: Benesch	PD: Benesch	PD: HyeKyoung Park	PD: HyeKyoung Park	PD: HyeKyoung Park	PD: HyeKyoung Park
	Day	<b>Physics</b>	<b>Physics</b>	<b>Physics</b>	<b>Physics</b>	<b>Physics</b>	<b>Physics</b>	<b>Physics</b>

# SAD Calendar (Cont.)

## SAD Calendar

Scheduled Accelerator Down

<< Week 34 2020 >>

[View](#) [ATLIS](#) [Work Map](#) [Help](#)

CEBAF

Key

Good Plan

Tentative Plan

Major Event

Incomplete Task

Lock Up

Utility Interruption

Radcon Group

Special Support

Subset

New/Changed

LERF

ATLIS Task

		Sun	M	T	W	T	F	Sat
34		2020-08-16	17	18	19	20	21	22
	Owl	PD: HyeKyoung Park	PD: HyeKyoung Park	PD: HyeKyoung Park	PD: HyeKyoung Park	PD: HyeKyoung Park	PD: HyeKyoung Park	PD: HyeKyoung Park
	Day	Physics	Physics	Physics	Physics	Physics	Physics	Physics
	Swing							
35		2020-08-23	24	25	26	27	28	29
	Owl	PD: HyeKyoung Park	PD: HyeKyoung Park	PD: HyeKyoung Park	PD: TBD	PD: TBD	PD: TBD	PD: TBD
	Day	Physics	Physics	Physics	Physics	Physics	Physics	Physics
	Swing							
36		2020-08-30	31	01	02	03	04	05
	Owl	PD: TBD	PD: TBD	PD: TBD	PD: TBD	PD: TBD	PD: TBD	PD: TBD
	Day	Physics	Physics	Physics	Physics	Physics	Physics	Physics
	Swing							
37		2020-09-06	07	08	09	10	11	12
	Owl	PD: TBD	PD: TBD Physics End?	PD: TBD Physics End	PD: TBD			
	Day	Physics C100 LLRF algorithm tst	The SAD will be populated once the lab wide schedule is better known. See link in comments.	Radcon Surveys	S&A Re-survey	S&A contrl re-survey	S&A contrl re-survey	
	Swing							

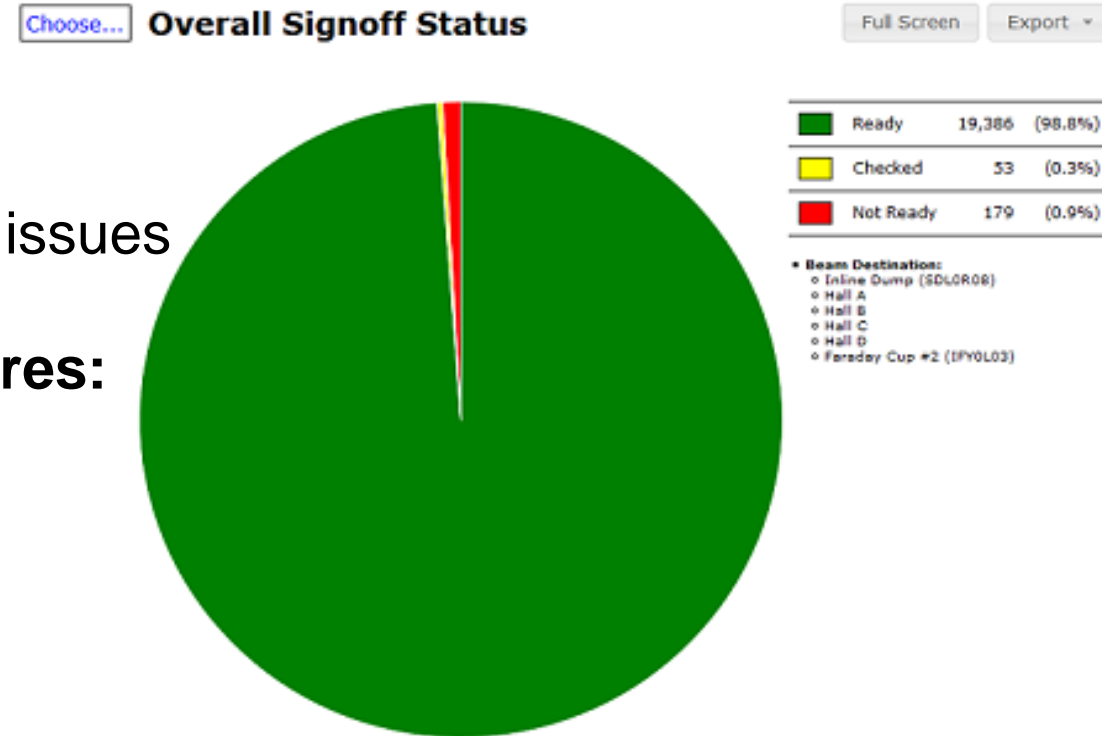
# Features of Start-up:

## Full Hot Check-out process executed:

- Proceeded under Covid OSPs with extra PPE, distancing, and many staff working shifted schedules to help minimize contact.
- Many hardware failures – EES has been very busy with repairs
- Progress has been very expedient; despite many issues

## Operations encouraged to rely heavily on procedures:

- Few month shutdown
- Setup being modified, as are many procedures.
- People are 'rusty'
- Proceed with an abundance of caution
- Encourage others to do the same
- (e.g. Target changes, Ion Chamber Calibrations, Etc.)
- Be vigilant!



# Complicating factors: 2L03

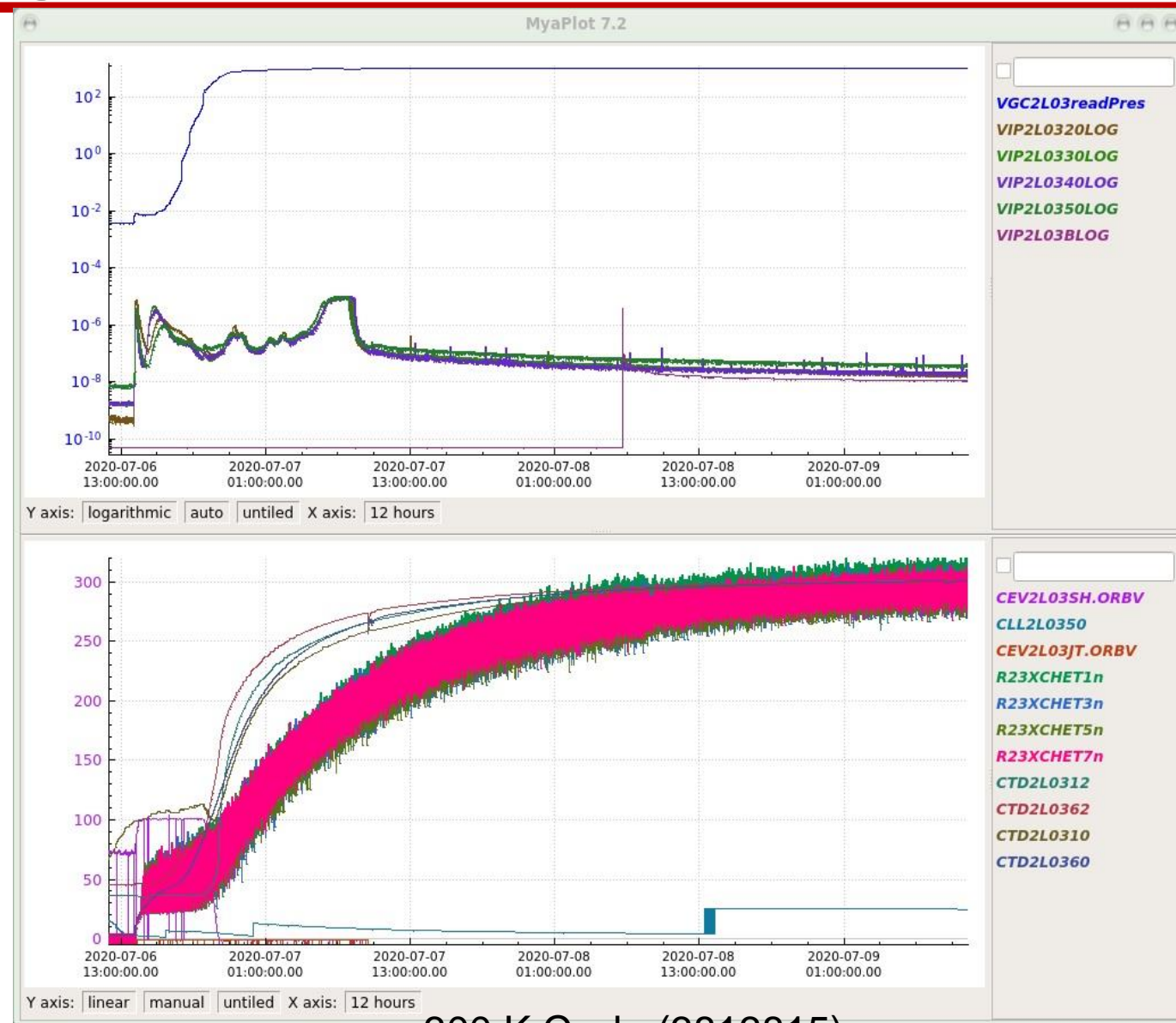
Supplemental insulating vacuum pump installed on 3/24 (3809209)

7/1: Agilent died: high foreline pressures - superfluid leak suspected (3812897) Tuners 1/7 found frozen on 7/2. (3813054)

7/6: All tuners frozen; decision to perform 30K cryocycle (3813216, 3813220, 3813236) – unsuccessful. Continued to room temp. At ~126K tuners were unstuck & significant gas evolved - air ice/leak implied. Can't re-cool module down w/o intervention.

7/9 VIP2L03B [Beamline] pump isolated and removed after failure (3813792)

**Present status:** SL has sufficient head room to live without it. SL LEM successful (3815039) with ~14 faults/shift.



300 K Cycle (3813815)



# Complicating Factors: 1L12

6/12: Pressure rise at A/B pumps & 40 WGIP; appendage pump attached to A pump girder. (3811614)

6/16&17: Further investigated under ATIs 20118 (3811809) revealed  $\mathcal{O}(1e-6)$  leak B ion pump; valved out. A-pump appendage also observed to be spiking.

6/18: New VIP installed on B pump; NEG reactivated. Dedicated turbos added & leak checked on 1L12A/B (3811931/3811861)

6/20: Insulating vacuum pressure rise observed starting 6/17. (3812016) Shield/return u-tubes cold to touch; turbo installed on insulating vacuum. (3812017)

He detected in 1L12 ins vac (6/22: 3812065); VCGs tested good and observed  $3e-4$  Torr insulating vacuum (3813312).  $\mathcal{O}(e-4)$  leak id-ed U.S. beamline O-ring - packed area with 1.5 cans Apiezon-Q sealant (7/11: 3814181/3814185)

Tuners frozen - module cryocycled and pumped out (3814424); WGIP-20 appendage pump replaced. Ion pumps re-established (3814495) – cooled to 4K. Cool down diode 1 found dead; shield not controlling well. JT & outlet temps erratic (3814753/3814796)

Cryo investigated 7/15 finding loose LVDT on JT valve (it slipped) and partially closed RT valve - issues corrected. Module refilled.



# RF Status / Machine Energy:

## Present Status:

- Injector Setup completed
- SL: LEM successfully completed at 1030 MeV/linac @ ~14 trips/shift without 2L03
- NL: Difficulties have been encountered, but we are still planning for success. SRF, Engineering and Ops are working the problem and will continue to do so. (Still aiming for shutdown energy...)

# Shift of the Maintenance Schedule

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Most work is already budgeted, and large tasks like CHL upgrade won't be put off.

Schedule overhead from these larger tasks will permit the planned nested tasks which were already on the schedule due to the overhead.

Examples include:

- ❖ Upgraded cryomodule installation
- ❖ SRF module refurbishment
- ❖ CEBAF Injector / Booster upgrade
- ❖ All routine Preventative Maintenance
- ❖ Other tasks under discussion

**Exact details such as end of down, schedule, FY21 start-up energy are still under discussion by management...**



# Long CY2020 shutdown (May-Dec 2020) – selection of planned activities

## Replace CHL1 cold box

Existing SC1 2K cold box no longer considered reliable due to two cold compressor problems within the last several years and that the replacement parts are no longer available due to obsolescence.

A new sub-atmospheric cold box, SC1R, which hosts five technologically superior, water-cooled compressors and one similar 4K-2K refrigeration recovery heat exchanger, will replace the SC1 cold box.

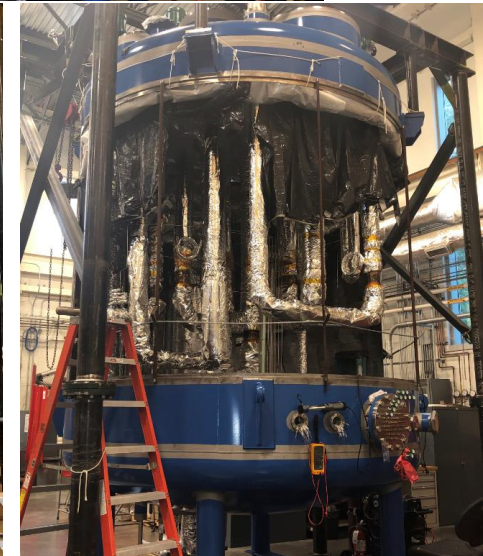
Engineering and design were completed in November 2018. The fabrication started in the early January 2019 at Lab's cryogenic fabrication shop. Fabrication will be complete and ready for installation in the down.

The demolition and removal of the existing SC1 2K cold box will start following FY2020 run. The new 2K cold box will be commissioned following installation.

Cryomodule dance

NL refurbishment

Part 1 of 2 of the injector upgrade for Moller





# CEBAF operational priorities/plans

Reach 12 GeV (5.5 pass) in normal operation – steady progress expected through 2020/2021

Revisit limitations on total current which constrain Halls A and C experiments

High gradient with accelerator reliability isn't good enough due to trip rates and heat loads on the cryogenic system

- These are both directly related to field emission in cryomodules
- Physics prefers steady running to short-term gradient reach with high trip rate

Primary issues to be addressed for high quality physics output:

- Mitigate field emission in cryomodules, reduce trip rates, & reduce downtime

Follow the CEBAF Performance Plan (CPP), already in place

- Addresses critical spares, obsolescence, & energy reach
- Update CPP in FY20 with recent data and accomplishments

Improve cryomodule performance

- Install better cryomodules, reduce particulates in warm sections, monitor field emission induced radiation to understand impact of improvements, assorted development work

Reduce beam losses – better diagnostics, some beam studies

Make shutdown/problem recovery faster and more reproducible through work processes, procedures, and planning

# CEBAF Operations – CPP Energy Reach

Energy reach to be improved yearly through the CEBAF Performance Plan

- Improvements via new C-75 construction and C-100 cryomodule refurbishment
- Goal: full 12 GeV (5.5 pass) operations, with margin, expected ahead of the FY2024 run periods, subject to funding availability
- First refurbished C100 installed met energy gain expectations – highest gradient CM in CEBAF
- Provides further confidence in the plan

Other CEBAF Performance Plan improvements already in place:

Described in "CEBAF Performance Plan Implementation Summary" JLAB-TN-20-012 (R. Michaud)

Procurement of critical spares, replacement of obsolescent components [Camac > VME conversion for example]

Example: Restored klystron inventory allowing cavities to be run at full gradient through klystron replacement, instead of degradation due to cases of klystron weakness or failure

Example: Procured magnet spares reduce unscheduled downtime risks [Lower replacement time when things happen...]

Energy reach optimizations with existing system for high quality physics

Mitigate field emission in cryomodules

RF process cryomodules, reduce particulates in warm sections, monitor field emission induced radiation to understand impact of improvements

Continually monitor and maintain components to reduce trip rates and reduce unscheduled downtime



C100-6R at 1L25

# CEBAF Performance: Understanding and Addressing Field Emission

## Warm girders between CM's (two types)

- ❖ Were not cleaned & assembled UHV particle-free during 12 GeV upgrade by today's standard
- ❖ Replaced with cleaned versions as cryomodules are replaced (5 so far)

Experiments are being performed to check particulates on replaced girders

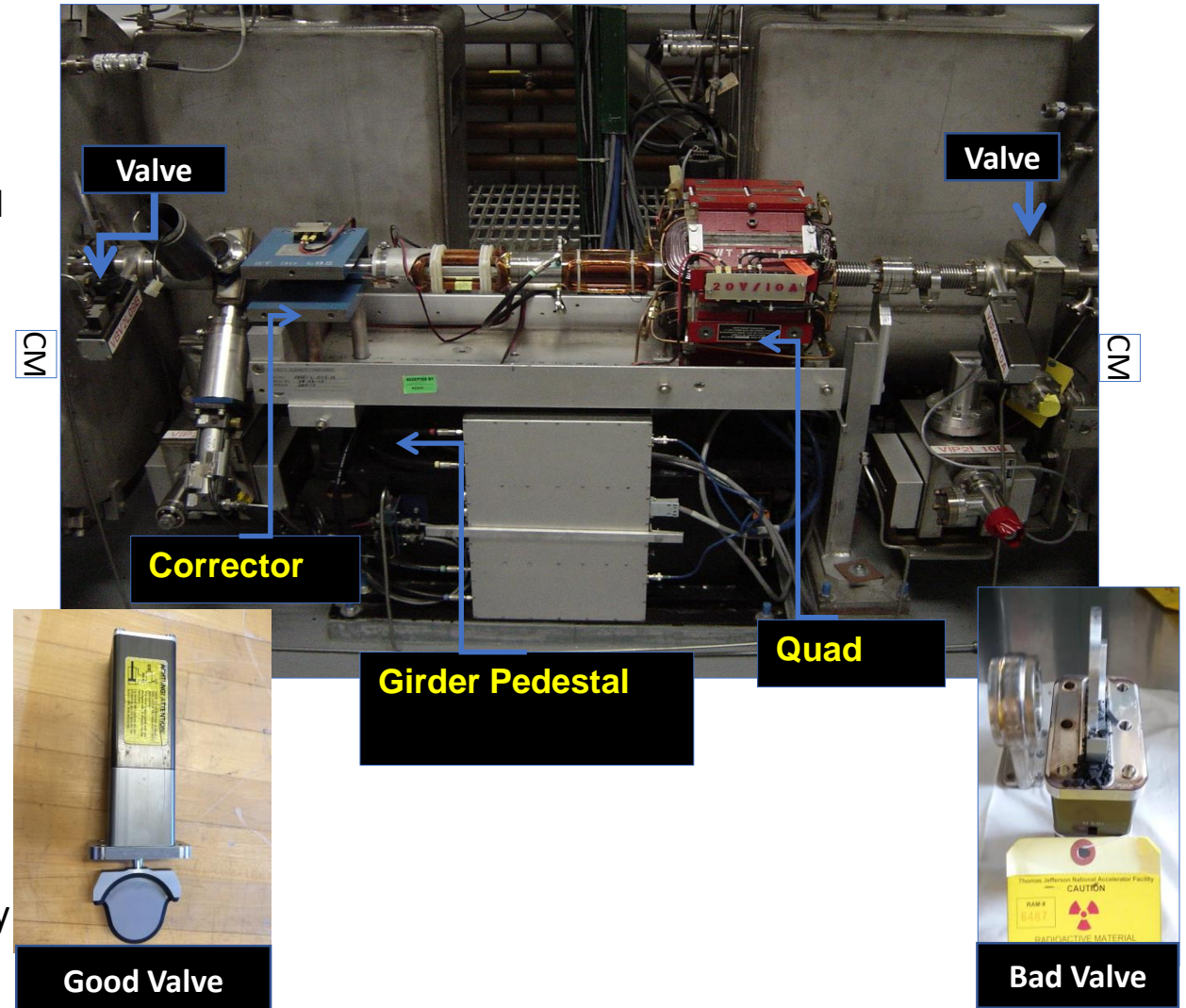
- ❖ Part of an ongoing particulate study, e.g., SRF2019 WETEB2 & TUP030
- ❖ Large particulates (>10  $\mu\text{m}$ ) of metallic, mineral and elastomer/polymer materials found

Girders are in high radiation environment:

- ❖ Valves with Viton seals known to be radiation damaged (see example)

Radiation monitors are damaged/destroyed by the intense tunnel radiation environment

- ❖ Improved photon/neutron detectors planned for FY20
- ❖ Monitoring radiation over time and space will help us to identify field-emission inducing events



# SRF Operations – FY20 CEBAF Maintenance and Energy Reach

## NL Upgrade / Maintenance Plans:

- Replace NL VAT Valves / Cryomodule Beamline O-rings on entire NL (-1L05/7)
- 1L02 / 1L18 Warm window swaps (Poly > Ceramic) [Completing NL]
- Ion pump replacements: 3 beam line pumps + 1L11-40 WG

## Swap out poorly performing cryomodules for refurbished ones:

- .C-75-1 (~Feb 2021)
- .C100-10 refurbishment (~Apr 2021)
- .Complete commissioning (~May 2021)
- .C-75-2 completion (~Fall 2021)
- .Rework removed modules & use for Plasma Processing development

**Covid19 impacts on rate of completing work are unknown. Many activities require use of pandemic PPE**

Clean and replace NL warm girders - replacing bellows as necessary.  
Repair insulating vacuum leaks on cryomodules as located.  
Attempt waveguide vacuum processing of 1L25 zone.

Present plan: 2 parallel SRF teams working – SRF work may affect cryo restart

\*M. Drury, NL Refurbishment presentation, 5/7/20



# FY20 SAD: Injector Upgrade

200 kV gun tested summer FY19

–Main upgrade FY20 SAD: part 1 of upgrade for Moller

Polarized source beam line to be rebuilt

–Two 200 kV Wiens upstream of pre-buncher

–Magnet and vacuum improvements (NEG coating)

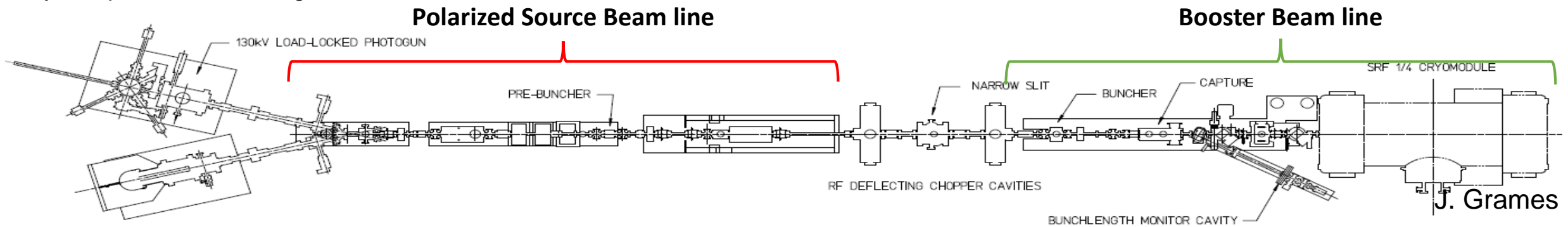
Booster beam line to be rebuilt

–New SRF booster module (replaces existing Capture and Quarter)

–Improved magnets and diagnostics

Detailed component design complete

Layout optimization nearing finalization



# Acknowledgments:

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Significant contributions of slides & content from:

C. Ginsburg (JLUO 2020 Presentation)

B. Freeman / M. Aiken: Scheduling presentations, Gantt, and ATLis tasks

J. Benesch, J. Grames, W. Oren, Y. Roblin, T. Satogata, S. Suhring, P.  
Vasilauskis

B-Team members

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