

CEBAF Status

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> JLAB January 22, 2014

Accelerator Operations Department



Outline

Commissioning Plan Execution

- Beam transport to date
- Highlights to date

Ingredients

3 Issues



5 Summary



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January 22, 2014 2/ 17



Beam transport to date





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January 22, 2014 3/ 17

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- New injector chicane commissioned and on design.
- North Linac C100s engaged and accelerating electrons for the first time.
- North Linac maximum energy gain to date(Wednesday): **1025MeV**
 - 12GeV Goal: 1100MeV/linac
- New 1S region (first spreader) transported beam without any issues.
- Modified Arc1 transported beam without any issues.





Outline

Commissioning Plan Execution

2 Ingredients

- Complete 12GeV Installation
- Hot Check Out
- Establish Stable 2K Cryogens

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January 22, 2014 5/ 17



Completion of 12GeV installation

Last element in CEBAF installed!!!

Lognumber 3258869. Submitted by bfreeman on Thu, 11/14/2013 - 14:12.

Logbooks:

ELOG

Well....not counting the YB in 1S that was taken out. This means that everything that was taken out for refurbishment has been installed at least once

R. Taylor and M. Weihl





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New Hot Checkout (HCO) Process and Tool

Development of a new HCO process and tool driven by the startup after the six-month down.

Features of the new HCO process and tool include:

- Edit, review and approval of system checklists
- Tracking at the individual element level not at a system level.
- All groups involved with an element have to sign-off that the element is ready, in an ordered sequence
 - Element installed and hooked up properly
 - 2 Element under vacuum
 - 3 Element aligned
 - Element control cables installed
 - Element software checked
- Database driven web reports available for easy access to element status.





Hot Check Out: Status Reports





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Establishing Stable 2K Cryogens



- 12GeV CEBAF requires almost twice the LHe cooling capacity of 6GeV CEBAF.
 - One Helium Liquifier (CHL) and 2K cold box per linac
 - Equivalent load with half the volume, dynamics have changed
- New CHL2, 12GeV project
- Recommission the original 4GeV CEBAF 2K cold-box (SCM); SCM has not been used in over ten years.
- 6GeV workhorses CHL1 and cold box (SCN) remain as part half of the system.



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- Stable 2K Cryo commissioning is still on-going. CEBAF is at 2K and beam commissioning activities officially started mid-Dec (about 5 weeks late). Cryogens are reasonably stable. CHL trips do occur and the recovering from a trip (pumpdown) is still a learning process. An additional 1.5weeks was lost over winter break in order to park the CHLs in a stable configuration during the break.
- HCO Duration Directly coupled to the late arrival of 2K cryogens (needed to complete the RF-power/SRF HCO items). Completion of HCO has taken much longer than originally estimated.
- RF Calibration Beam based calibration of the Injector and North Linac RF gradient has revealed a 10% difference (in a bad way) in the RF calibration.



January 22, 2014 10<u>/ 17</u>



Beam commissioning plan consists of:

- Identify a beam destination (inline dump, 1R dumplette, 2R dumplette, Hall-A,
- Complete HCO to that destination.
- Transport beam to that destination.
- Calibrate diagnostics
- Calibration High Level Applications (orbit locks, energy locks,)
- Explore beam physics issues (energy scaling, emittance growth, ...).
- Finalize configuration.





Commissioning Schedule: FY14

SAD: Scheduled Accelerator Down Acc: Beam Commissioning periods

Accl:now \rightarrow Feb-06 Goal is to establish one-pass beam to the 2R dumplete with a linac energy gain of 2.2GeV/pass (12GeV CD-4A deliverable).

• CD-4A 12GeV Project deliverable date is Dec. 2014

SADI:Feb-06→Mar-04 Finish commissioning the injector full cryomodule R100, PSS certifications, Arc power supply hook-up, multi-pass HCO,...

AccIIa:Mar-04 \rightarrow Apr-04 3-pass spin-up with beam to Hall-A.

SADII:Apr-04 \rightarrow Apr-11 Upper arc power supply hook-up and check-out. Complete HCO to Hall-D, 5.5pass.

AccIIb:Apr-11 \rightarrow May-02 5.5pass spin-up to Hall-D tagger vault.



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FY14 Gannt view

Index	Nome		Nata		Chart	End	Completion	2014	Feb 2014		Mar 2014	Apr 2014	May
index	Name		Note		Start	Eng	completion	13 20 2	03 10 17	24 (03 10 17 24 3	07 14 21 :	28 05 1
9	Accelerator Period I: 2.2GeV	0	The goal of t	0	Mon 2013-12-02 08:00	Thu 2014-02-06 04:00	39%	_		4			
9.2	🚍 Spin up 1pass beam to 2R				Tue 2013-12-10 08:00	Sun 2014-02-02 00:00	56%		• -				
9.2.3	Ream to End of North Linac		Section 3.2 o	0	Tue 2014-01-14 08:00	Wed 2014-01-15 20:00	100%	-		1			
9.2.3.1	Establish Tune Beam 1S du	0	Section 3.2	0	Tue 2014-01-14 08:00	Wed 2014-01-15 20:00	100%	1					
9.2.4	🚍 Beam to the 1R dumplette		Section 3.2 o	0	Wed 2014-01-15 20:00	Wed 2014-01-22 08:00	95%						
9.2.4.1	Establish Tune Beam to 1R	0	Section 3.2	0	Wed 2014-01-15 20:00	Thu 2014-01-16 08:00	100%	B					
9.2.4.2	Diagnostic Calibrations		Section: 3	0	Sat 2014-01-18 08:00	Sun 2014-01-19 08:00	100%	<u>۲</u>					
9.2.4.3	Tool and Configuration Fi	0	Section 3.2	0	Sun 2014-01-19 08:00	Sun 2014-01-19 20:00	100%	<u>*</u>					
9.2.4.4	Raise the gradient: Engag	0	Section ???	0	Sun 2014-01-19 20:00	Wed 2014-01-22 08:00	80%	Le <u>m</u>					
9.2.5	🕶 Beam to End of South Linac		Section 3.3 o	0	Thu 2014-01-23 08:00	Fri 2014-01-24 20:00	0%			Т			
9.2.5.1	🚍 Establish Tune Beam 2S du	0	This task t	0	Thu 2014-01-23 08:00	Fri 2014-01-24 20:00	0%	1		Т			
9.2.6	🚍 Beam to the 2R dumplette		Section 3.3 o	0	Fri 2014-01-24 20:00	Sat 2014-02-01 04:00	0%	-	<u>-</u>	Т			
9.2.6.1	Establish Tune Beam to 2R	0	Section 3.3	0	Fri 2014-01-24 20:00	Sat 2014-01-25 08:00	0%	Н		Т			
9.2.6.2	Beam based measurements		Section 3.3	0	Sun 2014-01-26 04:00	Mon 2014-01-27 04:00	0%						
9.2.6.3	Tool and Configuration Fi	0	Section 3.3	0	Mon 2014-01-27 04:00	Mon 2014-01-27 16:00	0%	5		Т			
9.2.6.4	Raise the gradient: Engag	0	Section 3.3	0	Mon 2014-01-27 16:00	Sat 2014-02-01 04:00	0%						
9.2.7	🚍 Establish 2.2GeV/pass beam	0	Section 3.3.5	0	Sat 2014-02-01 04:00	Sun 2014-02-02 00:00	0%	н	-	T			
9.2.7.1	Establish 2.2GeV/pass bea	0	Section 3.3.5	0	Sat 2014-02-01 04:00	Sun 2014-02-02 00:00	0%		1				
9.3	Acc-I Schedule Contingency				Sun 2014-02-02 20:00	Thu 2014-02-06 00:00	0%		L	T			
9.4	Termination Tasks		Terminate Bea	0	Thu 2014-02-06 00:00	Thu 2014-02-06 04:00	0%		La l				
10	🕶 12GeV CEBAF Commissioning				Thu 2014-02-06 04:00	Fri 2015-06-12 01:00	0%			Ŧ			
10.1	SAD I		Tasks for t	0	Thu 2014-02-06 04:00	Tue 2014-03-04 04:00	0%		+	÷			
10.2	🚍 Accelerator Period II: E>1	0			Tue 2014-03-04 04:00	Fri 2014-05-02 04:00	0%		<u> </u>	14.			-
10.2.1	3-pass spin up (BSY)				Tue 2014-03-04 04:00	Tue 2014-03-11 05:00	0%						
10.2.2	Hall-A Detector Checkout				Tue 2014-03-11 05:00	Fri 2014-03-14 17:00	0%			Т	եր		
10.2.3	1/2/3 pass Magnet/Optics c	0			Fri 2014-03-14 17:00	Fri 2014-03-28 17:00	0%				L		
10.2.4	AccII pre-SADII Schedule C	0			Fri 2014-03-28 17:00	Fri 2014-04-04 06:00	0%			Т	<u>ب</u> را		
10.2.5	SAD-II		SAD-II one we	0	Fri 2014-04-04 06:00	Fri 2014-04-11 02:00	0%			Т	Ļ	_	
10.2.6	5.5-pass spin up to D				Fri 2014-04-11 02:00	Fri 2014-04-25 02:00	0%			Т		Line	
10.2.7	4/5/5.5 pass Magnet/Optics	0			Fri 2014-04-25 02:00	Fri 2014-05-02 02:00	0%						\$ -
10.2.8	Accil Schedule Contingency				Fri 2014-05-02 02:00	Fri 2014-05-02 04:00	0%					Ę	*I
10.3	May 2014 Power Meter Readin	0	All CEBAF sys	0	Thu 2014-05-01 08:00	Thu 2014-05-01 08:00	0%					•	•



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January 22, 2014

13/17

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AccIII:Sep. 19 \rightarrow Dec. 22 2014 First photons into Hall-D. 5.5pass optics studies.

AcclV:Feb. 13→Jun. 12 2015 Machine restoration/RF separation commissioning. Remaining weeks for Physics.



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January 22, 2014 14/ 17



FY15 Gannt view

WDC Name		Start	End	Effort	Duration	ProjectAccount									
1103	WDS Name		Enu	Enore	Duration	ProjectAccount									Sep
10 = 12GeV CEBAF Commissioning		Thu 2014-02-06	Fri 2015-06-12	25.2	70.1								_		
10.4 - Accelerator Period III: E Various 2-hall operation?		Fri 2014-09-19	Mon 2014-12-22	8.2	13.4			-							
10.4.1	Machine Recovery and Push energy to 2.2GeV/pass	Fri 2014-09-19	Fri 2014-10-03	0.3	2.0	MD_NP	Ь								
10.4.2	1/2/3 pass separation E>1.1GeV/pass	Fri 2014-10-03	Fri 2014-10-10	1.0	1.0	MD_NP	₽ ,								
10.4.3	Beam through HallD line: E>1.1GeV/pass	Fri 2014-10-10	Mon 2014-10-13	0.5	0.5	Spreops_NP	*								
10.4.4	HallD Detector Checkout: E>1.8GeV/pass?	Mon 2014-10-13	Mon 2014-11-03	0.0	3.0	Preops_12GeV	4 00								
10.4.5	5.5 physics beam development: E>2GeV/pass	Mon 2014-11-03	Mon 2014-11-10	1.0	1.0	MD_NP	եր								
10.4.6	10.4.6 Acc-III Schedule Contingency		Mon 2014-12-22	5.4	5.9		4								
10.5	Accelerator Period IV: E>2GeV/pass 2-hall operation	Fri 2015-02-13	Fri 2015-06-12	17.0	17.0					-	_	_	_		
10.5.1	 Restoration and Multiple beam characterization 	Fri 2015-02-13	Fri 2015-04-03	7.0	7.0	MD_NP						1			
10.5.2	Hall-D engineering run/A Engineering (parasitic) run	Fri 2015-04-03	Fri 2015-04-24	3.0	3.0	MD_NP					÷				
10.5.3 THAII-A Physics: First Physics		Fri 2015-04-24	Fri 2015-06-12	7.0	7.0	Research_NP						+			
11 🚍 Physics 12GeV Initial Ops		Fri 2015-09-11	Sat 2016-05-28	2.9	37.1										-
11.1	Physics Period I: E>2GeV/pass	Fri 2015-09-11	Tue 2015-12-22	2.9	14.6										-
11.1.1	Machine restoration	Fri 2015-09-11	Fri 2015-09-18	1.0	1.0	MD_NP									Ь
11.1.2	4/5 pass separation	Fri 2015-09-18	Fri 2015-10-02	1.9	2.0	MD_NP									4
All effort and duration values are in weeks. 24/7 scenario															
	Container Issi Normal Task Milestone														
		UT-duty	period												



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January 22, 2014 15<u>/</u>17



Opportunistic Experiments during Beam Commissioning

- Time available if schedule contingency is not needed, i.e. beam commissioning goes well.
- 2 Commissioning Effort stalled due to machine limitations.
 - Upper pass commissioning stalled due to hardware issues
 - Hall can receive beam on a lower pass
- Parallel activities.
 - ► For example: upper pass commissioning and lower pass experiments.
 - Likely to be inefficient for both efforts.





Summary

The 12GeV CEBAF Beam Commissioning is on-going!

- New HCO process is shown to be worth the effort
 - The hardware is ready for beam tasks
- CHL1 and CHL2 are supporting beam operations
 - Commissioning tasks on both CHLs are on-going.
- Beam based calibration of the RF system has identified a 10% error (in the wrong direction)
 - Ultimate energy reach will be determined by frequent pushes over the next two weeks.
 - ► The 2.2GeV/pass goal might be achieved by the skin of our teeth.
 - Additional SRF/RF work might be needed to establish robust 2.2GeV/pass operations (He processing of weak cavities).
- A large fraction of the scheduling contingency in Accl/Accll (FY14) has been consumed up to this point.
- The commissioning plan is effective





Thank you for the time and attention



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January 22, 2014 18/ 17

