Maintenance Planning and Execution

Mario Giannella

RAD Maintenance Integration Manager

Accelerator Advisory Committee

January 2012





Yearly Schedule

Run Schedule for FY 2012

Nun	UCII							-				-				-				-		-	
	Oct		Nov	┛╻	Dec		Jan		Feb	┛┡	Mar		Apr	┛┟	Мау		June		July	┛╹	Aug		Sept
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	Ac	celerat	or Physics	s				Optio	nal Maint	tenance	Periods			Machine	Downtime	e Major	Periods	Mainte	nance/Up	ogrades)		
	Ace	celerat	or Startup	Rest	ore			Neutr	on Produ	uction		•		Schedule	d Mainter	nance			Holid	ay	t.	20	A 127

2 Managed by UT-Battelle for the U.S. Department of Energy



Weekly Maintenance (Tuesdays) During Run Period (Three Flavors)

- 1. Optional Limited Maintenance Shift 2 per month:
 - Maintenance Shift 8 am 4pm, immediately after Neutron Production
 - 1 recovery 8 hr. shift allocated
 - Avoid entry into Radiation Areas if possible
 - Time limited for necessary Radiological Cool-down & Surveys, Magnet LOTO
 - If little or No pressing Maintenance needs:
 - Partial Day Maintenance
 - Accelerator Physics Studies
 - Neutron Production





Weekly Maintenance (Tuesdays) During Run Period (Three Flavors)

- 2. Full Maintenance Shift
 - (8am-4pm) Preceded by Neutron Production 1 per month
 - 2 "Recovery Shifts" allocated
 - Same start-up schedule constraints as a used "Optional Day", more recovery time allowed for "Deeper" maintenance
- 3. Full Maintenance Shift
 - (7am-3pm) Preceded by Accelerator Physics 1 per month (Possible early start for Target / Instrument Maintenance or on Backup Systems)
 - Much lower average beam currents during AP allow for some Radiological Cool-down time
 - 6am Early Start for Radiological Surveys and Magnet LOTO
 - Typically used for Ion Source Replacement and Startup, Preventative and Corrective Maintenance
 - 2 "Recovery Shifts" allocated



Recovery Time from Maintenance Shift

Full Maintenance	Maintenance	Recovery	AP	Unscheduled	total	
Days	time	Time	Time	Down Time	hours	notes
Schedule (hours)	8.0	8.0	8.0	0	24.0	Looking at 24 hour transition period
FY 10 and FY 11 Average	7.0	5.1	11.1	0.9	24.0	
wrt scheduled time	-1.0	-2.9	3.1	0.9		
FY 10 and FY 11 Median	8.0	5.7	10.9	0.4		

- 5.1 / 5.7 hrs Average / Median recovery time from FULL Maintenance Shift
- Even Less for Limited Maintenance Shifts
- 16 hours are scheduled difference is given to Accelerator Physics or Neutron Production ("Easier to Give Back than to take away")



Semi-Annual Maintenance Periods

- 2 Extended Maintenance Periods per year
- Typical Pattern:
 - ~ 3 days Accelerator Physics after Neutron Production Ends
 - ~ 6 weeks down (not counting holidays)
 - ~ 1 week Startup / Accelerator Physics before Neutron Production Begins
- Target Changes (currently 2 per year)
- Upgrades e.g. Larger Ring Injection Dump Beamline Aperture (prior), New Stripper Foil Changer Mechanism (future)
- Extended Repairs and Preventive Maintenance



Yearly Schedule

- Reasons for possible future changes
 - Target changes needed > 2 per year
 - Long (~4 ½ month) run period too long for instrument personnel (constant Experiment preparation and turnaround)
 - Consolidate Weekly maintenance shifts into less-often, longer 2-day shutdown (less shutdown / startup overhead, more total useful maintenance hours per month)
 - Aging equipment may need more Preventive Maintenance to maintain Reliability >90%
 - Longer Summer shutdown (2-3 months) to save money in the peak power charge months



Long Semi-Annual Maintenance Periods: Planning Resources

- "DataStream" Maintenance Management System
 - Interactive Reports by Resource (e.g. Research Mechanics, Welders, Riggers, etc.), Group (e.g. Electrical), Team (e.g. HVCM, Power Supplies, Power Distribution, etc.), Task Leader, Area, etc.
 - Typically focus on tight resources:
 - Electrical Research Mechanics (~15)
 - Mechanical Research Mechanics (~15)
 - Vacuum Technicians (~5)
 - Riggers/Operator (3, shared with HFIR and ORNL)
 - Tight Budget: Overtime Limited to critical needs



Report: Requested RM Man-Hours

Date Created	Work Order 🔻	Description	Activity_Comments	Status	Tot Man Hours	Act Hrs Remainir	ng	Scheduled Start Date	Scheduled End Date	Type	Priority	Mil
04-JAN-12	1306425	Beamline 11 hydraulic manifold in the Shutter Drive Equipment Room.	Comment 1 Replace manifold on beam line 11 shutter drive hydraulic system. Adjust shutter stroke times to exceptable times. Operate shutter and inspect for any other problems.	Approved For Planning	12		<u>12</u>	03-FEB-12	31-MAR-12	Routine	High	-
30-DEC-11	1306403	Beamline 11A POWGEN Bush Pump Repair	-	Released	8		<u>8</u>	30-DEC-11	30-JAN-12	Breakdown	High	-
29-DEC-11	1306392	Walk Through/Sample of HEBT SB, RTBT SB, Ring SB , RID SB and Target DI Room	Comment 1 Perform routine daily walk through. Verify resistivity is being maintained within designated parameters. Verify pump skid is operating normal with proper suction & discharge pressure. Verify pump oil level is correct. Perform "Daily Log" on filter skid. Take time to observe the overall condition of the pump room area and for any signs of other equipment problems such as poor lighting or lights not operating, ground water, controls not working properly, etc. Note any unusual odors, sound or noise corning from other equipment in the pump room.	Released	100	1	00	29-DEC-11	05-FEB-12	Routine	High	-
< Order Activit	y Report 1115924	ASE_Target Moderators Hydrogen Rupture Disks Five Year Replacement	filings' from entering the system. A saw maybe used on the Outlet side of the rupture disk. Protect System Openings from the introduction of foreign material. Remove the existing rupture disk RD_6105 (RD00031) from the system.	Released	4	ı	<u>4</u>	22-DEC-11	29-FEB-12	Preventative Maintenance	High	-

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Long Semi-Annual Maintenance Periods

- Growing Maintenance needs for Growing Number of Operational Neutron Instrument Beamlines
- Expanding Preventative Maintenance needs for aging equipment
- Equipment Upgrades for enhanced Operation have decreased, but still need upgrades to replace obsolete / lessreliable equipment
- Tasks are Deferred according to Priority and man-hours available for tight Resources
- Any previously Deferred Maintenance has increased Priority
- Review during weekly Planning and Maintenance meeting



Planning Overview Schedule Developed

- Transitions from/to:
 - Neutron Production
 - Accelerator Physics
 - Maintenance times for Front End, Instruments, Target, Accelerator
 - Equipment on/off/testing (HVCM/RF, MPS, Magnets, Cryogenics Transitions, etc.)
 - Front End Running Beam to MEBT BS
- LOTO
- Personnel Protection System Certifications
 - Access restrictions
 - Equipment to be controlled off (with Radiation Safety Hold lock and tag)
 - Equipment to be turned on/off (PPS enable/disable testing)
- Outages:
 - Electrical
 - Water Cooling
 - HVAC, Air Handlers
 - Global Controls (Timing, Network, Servers, etc.)



Overview e.g. Week 0: Transition from Operations to Maintenance





Overview e.g. Week 3: Transition to Beam to MEBT Beam Stop Running

Jan 9, '12 - Jan 15, '12

Monday	Tuesday	Wednesday		hursday	Friday	Saturday
	9 10	Mark 0	1	12	13	
		Week 3	Beam Off -			
	Beam Off - Front End, 19.6 days		Install Ion	rannoi, rno aayo	Beam to MEBT B	eam Stop (FE PPS Mode), 4.6 c
	Front End Maintenance, 16 days		Source, 0.4			
			1			
	FE Magnets OFF, 20 days	i		0.55 4 4 4	FEI	Magnets ON, 17.6 days
	REO HVCM / RE Off. 20 days		MEBIRF	OFF, 34.6 days	PEO	U/CM / RE ON 14 days
	RFQ HVGW/ RF OII, 20 days		-		RFQ.	TV CIVI / KF ON, 14 days
			DTL / CCL HVC	M / RF Off, 34.6 days		
				-		
			SCL HVCM	/ RF Off, 34 days		
		1	Electrical Device Mar			
			Linac Magn	ets Off 34.6 days		
			Ring Magne	ets Off, 41.7 days		
			RTBT Magn	nets Off, 41.7 days		
			Linco Tunnol	Assess 20.6 days		
			HEBT Tunne			
			Ring Tunnel			
			RTBT Tunne			
RFQ (wall) Chiller	Maintenance, 15 days					
RFQ (vane) Chiller	Maintenance, 15 days	N/C	Water Outage	Vvater Outa	Water Outage HERT COWS 1 day	ts, 10 days
Water Outage QMCS - CCL1&2 hoses in	Water Outage - RN -01 . 1 day	Water Outage - HEBT SB HS-01, 1 day	Water Outage	REMPISSINUI (0123) day days	Water Outage - Ring CCWS, 0.5 days	
tunnel, 1 day	Water Outage - RN -02, 1 day	Water Outage - RN-03, 1 day	ji ann an agun agu a		Water Outage - RTBT CCWS, 1 day	
			Khatron/Linco AH k	(LO2 Outogo (CCL) 1 do	Khustran // inco AH KL 02 Outogo (SCL 1 10)	
			Klystron/Linac AH-	(L-02 Outage (CCL), 1 d a	Klystron/Linac AH-KL-03 Outage (SCL 1-10), Klystron/Linac AH-KL-04 Outage (SCL	
Linac MUA-LN-01 Outage, 1 day	Linac AH-LN-01/02/03/04 (in Tunnel) Outage	Linac Smoke Exhaust Fan Outage, 1 day	10-23), 1 day		10-19), 1 day	
)	· · · · · · · · · · · · · · · · · · ·	
	Dower Outogo CLLSS2 Substation (CT	Dower Outogo CIL SS2 Substation				
	Fans), 1 day	(Condensor and Hot Water Pumps), 1 day		Power Outage - K	-2LIPS2 2 days	
		1	_	i ower outage it	2 201 02, 2 00/0	
	RS Holds on 65 kV 16 dave					
	No Holds of 65 KV, 10 ddys	1	RS Holds on HE			
			RS Holds o	n HVCM, 21 days		
			Remove			
13 Managed by UT-Battelle			RFQ HVCM RS			
for the U.S. Department of F	Inergy	Presentation	Hold, 0.3			
the close operation of L		r resontation_				

Overview e.g. Week 6: End of Maintenance, Start Equipment Turn-on

		Jan	23, '12 - Jan 29	, '12	
Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
23	24	25	2	6 2	27
		Week 5	Pear Off Tunnel 44.6 days		
Bea	am to MEBT Beam Stop (EE PPS Mode)	9 days	Beam Off - Turner, 44.6 days	Beam to MEB	T Beam Stop (Linac PPS mode), 6 days
	an to MEDT Beam otop (i E i i o mode),	o dayo	Remove DTL RF Waveguide shorts, 0.2 days		
			FE Magnets ON, 17.6 days		
	MEBT RF OFF	, 34.6 days			MEBT RF ON, 10 days
	RFQ HVCM / RF ON, 14 days			RI	-Q HVCM / RF On, 10.5 days
	DTL / CCL HVCM / F	RF Off, 34.6 days			DTL / CCL HVCM / RF ON (One at a time)
				RF	Conditioning Warm Linac (1 HVCM at a tin
	SCL HVCM / RF	Off, 34 days			SCL HVCM / RF ON (one at a tin
			Electrical Power Management Period, 31.5 day	s	RF Conditioning SCL Cavities (1)
	Linac Magnets C	0ff, 34.6 days			Test Run Linac Magnets, 1 day
	HEBT Magnets (Off, 34.6 days			
			Ring Magnets Off, 41.7 days		
			RTBT Magnets Off, 41.7 days		
	Linac Tunnel Acc	ess, 30.6 days		[NO Linac Access, 10 days
i i i i i i i i i i i i i i i i i i i	HEBT Tunnel Acc	ess, 30.6 days			No HEBT Access, 10 days
			Ring Tunnel Access, 37.7 days		
			RTBT Tunnel Access, 37.7 days		
Without Or	Coolir	g Outage - Kicker PFN Heat Exchangers, 11 d	ays		
vvater OL	ater Outage - OMCS PM (DTL & CCL), 3 days			Cryogenics	
Water Outage - Expt Hall / Target TA-01, 1 d	ater outage - Ginoo r M, 5 days			Transition Check Tuners on SCL	
Nater Outage - Exptl Hall / Target TA-02, 1 d				from 4 to 2K, 0,3	
				Pagin	
				Begin turnon of	
				SCL	
				HVCM /	
'ower					
Dutage -					Power Outage - CLO-ATS (all Emergen
I and				PPS Cartification	loads), 0.5 days
existing				Linac/HEBT	
JPS (all IPS and				(part e	
Emergency				continued),	
oads), 0.3				0.5 uayo	
uays				Linac	
				Access	
				0.3 days	
			RS Holds on HEBT Dipoles, 41.5 days	· []	
				HEBT	
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ivianaged by U1-Battelle		D		0.3 days	
for the U.S. Department of Energy		Presentation_r	name		

Meetings for Updates, Adjustments

- Daily (during the extended Maintenance Periods):
 - Plan of the Day (with 2-day look-ahead)
 - Safety
 - Operations Overnight / Weekend report
 - Coordination overview slide
 - Area Coordinators' slides: summarize / coordinate work in each area
 - Technical Group reports
 - Plan of the Eve
 - What went differently than POD, adjustments for next day
 - Systems / Equipment to be monitored overnight
 - Resource Allocation Meeting
- Weekly (before and during Maintenance Period):
 - Planning and Maintenance
 - Area Coordination



For the Current Maintenance Period: Total Number of "Activities" (Note: not all activities equal)











Use of "Specific Assets" for Equipment Tracking





Preventative Maintenance ONLY



RF Systems Target Systems Mechanical Systems Beam Instrumentation Cryogenic Systems Protection Systems Ion Source Controls Electrical Systems Site Services Vacuum Systems Neutron Instrument Systems Survey & Alignment 0.00 0.20 0.40 0.60 0.80 1.00 1.20

Specific Assets (avg)

Specific Assets (avg)

Opportunities for Improvement

- More Efficient/Better-matched Yearly Schedule for Maintenance Needs
- Deferred Maintenance / Tight Resources
- Configuration Control Equipment Tracking / History (working on "Specific Assets")
- Set-up More Regularly Scheduled Predictive/Preventive Maintenance
- We have ~ 120 Task Leaders in ~ 47 "Teams" that create Work Orders
 - Still too many for effective coordination
 - Too many Task Leaders independently asking for Shared Resources
 - Consistency of Work Package
- Identifying Resources needed and working with resource managers to identify "real" estimate hours and people
- Prioritization between Operations / Development / Construction

