HOW ACCELERATOR OPERATIONS DOES BUSINESS AT JEFFERSON LAB

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ABSTRACT

The accelerator is staffed 24 hours a day by the MCC Operations Group. Shift rotations are for seven days on shift, followed by seven days off shift, of which three days are spent on off-shift activities. Personnel spend 70% of their time on shift and 30% off shift. The off-shift time is utilized for meetings, training and individual projects. Individual projects can consist of hardware or software development, training, documentation development or other areas of interest, depending on the individual.

Figure 1: Aerial View of Jefferson Lab

JEFFERSON LAB CONTROL SYSTEM

The Control Systems at Jefferson Lab are based on the Experimental and Industrial Control System (EPICS). EPICS uses a client/server model and provides communication between computers distributed around the Jefferson Lab site. At Jefferson Lab, EPICS is used for control and monitoring of the Continuous Electron Beam Accelerator, the experimental halls and the Free Electron Laser (FEL). The EPICS configuration for the accelerator utilizes Motorola VME boards as IOCs and HP-UX Workstations for high level control, data archiving, retrieval and visualization and operator interfaces in the control room.

OPERATIONS DATA

Laboratory mission:
Jefferson Lab's mission is to provide forefront scientific facilities, opportunities and leadership essential for discovering the fundamental nature of nuclear matter, to partner with industry its advanced technology, and to serve the nation and its communities through education and public outreach, all with uncompromising excellence in environment, health and safety.

Type of accelerator:
Recirculating Linac Machine utilizing Superconducting Electron Accelerating Technology

Maximum energy (GeV):
5.5

Maximum current (uA):
180

Commissioning date:
1994

Number of staff in MCC Operations Group:
21

Type of maintenance program:
Preventative/Opportunistic

Number of Operators per shift:
3 (1 Crew Chief and 2 operators)

Percentage of time Operators operate:
70%

Years of experience for operators:

Total Mean:	3.9
Total Median:	2.8
Crew Chief Mean:	6.9
Crew Chief Median:	7.5
Operator Mean:	2.3
Operator Median:	2.3

A new operator typically has a physics background or US Navy nuclear power training.

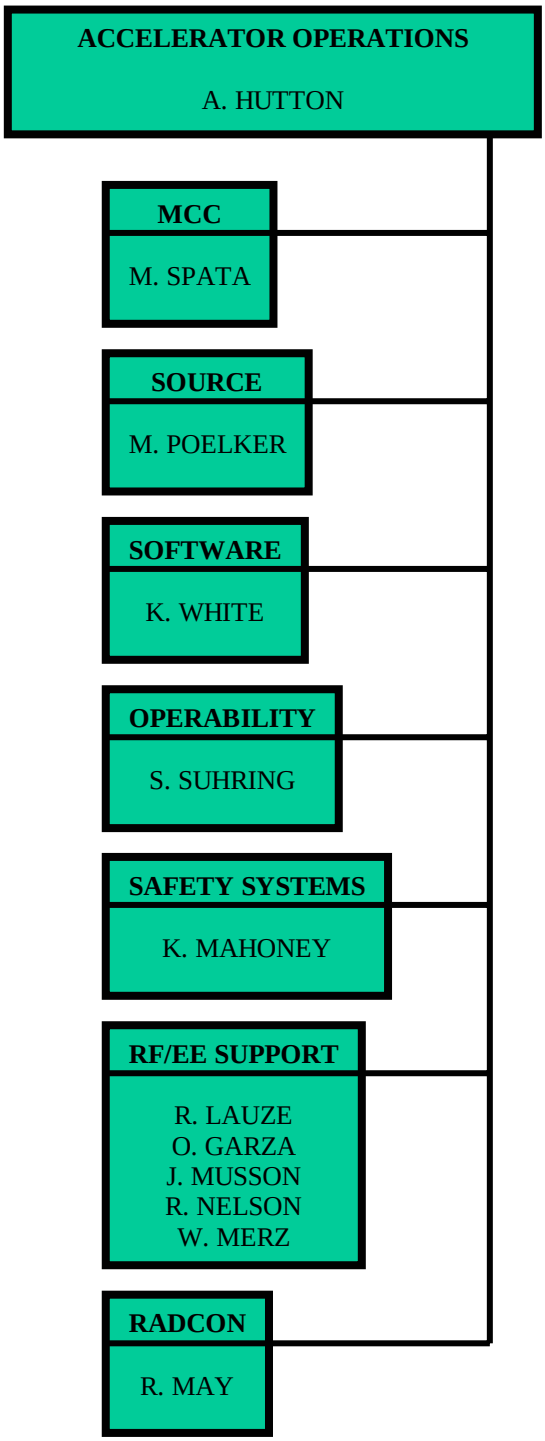
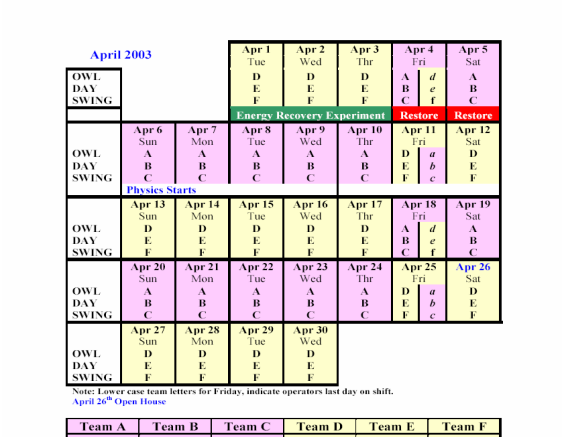


Figure 2: Accelerator Operations Department

CONTROL ROOM CONFIGURATION

Figure 3: Machine Operations Consoles

Figure 4: Safety System Operator Console



April 2003

	Apr 1 Tue	Apr 2 Wed	Apr 3 Thr	Apr 4 Fri	Apr 5 Sat
OWL	D	D	D	A / *d*	A
DAY	E	E	E	B / *e*	B
SWING	F	F	F	C / *f*	C
	Energy Recovery Experiment			Restore	Restore

	Apr 6 Sun	Apr 7 Mon	Apr 8 Tue	Apr 9 Wed	Apr 10 Thr	Apr 11 Fri	Apr 12 Sat
OWL	A	A	A	A	A	D / *a*	D
DAY	B	B	B	B	B	E / *b*	E
SWING	C	C	C	C	C	F / *c*	F
	Physics Starts						

	Apr 13 Sun	Apr 14 Mon	Apr 15 Tue	Apr 16 Wed	Apr 17 Thr	Apr 18 Fri	Apr 19 Sat
OWL	D	D	D	D	D	A / *d*	A
DAY	E	E	E	E	E	B / *e*	B
SWING	F	F	F	F	F	C / *f*	C

	Apr 20 Sun	Apr 21 Mon	Apr 22 Tue	Apr 23 Wed	Apr 24 Thr	Apr 25 Fri	Apr 26 Sat
OWL	A	A	A	A	A	D / *a*	D
DAY	B	B	B	B	B	E / *b*	E
SWING	C	C	C	C	C	F / *c*	F

	Apr 27 Sun	Apr 28 Mon	Apr 29 Tue	Apr 30 Wed
OWL	D	D	D	D
DAY	E	E	E	E
SWING	F	F	F	F

Note: Lower case team letters for Friday, indicate operators last day on shift.
April 26th Open House

Team A	Team B	Team C	Team D	Team E	Team F

Figure 5: Operator Monthly Shift Schedule

An accelerator day begins at 2300 and ends at 2259. This period is divided into 3 distinct shifts:
Owl Shift (2300 – 0700)
Day Shift (0700 – 1500)
Swing Shift (1500 – 2300)
Each MCC Control Room crew consists of a Crew Chief and two or three operators.
Shifts for the operators and Crew Chiefs are staggered by one hour, with the operators starting shift one hour later than the Crew Chiefs (0000, 0800, 1600).

PROGRAM DEPUTY

The Program Deputy (PD) is a Jefferson Lab staff member appointed to serve for two-week periods. During the two-week period, the PD is responsible for the accelerator program for all shifts. The PD conducts the Daily Summary meeting and communicates with all shifts on a daily basis.

The Program Deputy (PD) develops a shift plan for each shift, detailing the program plan, any operating limits, special test plans and any other pertinent information for that shift.

The PD develops the Weekly Summary detailing Goals for the previous and upcoming week. The Weekly Summary contains details of the performance for the previous week.

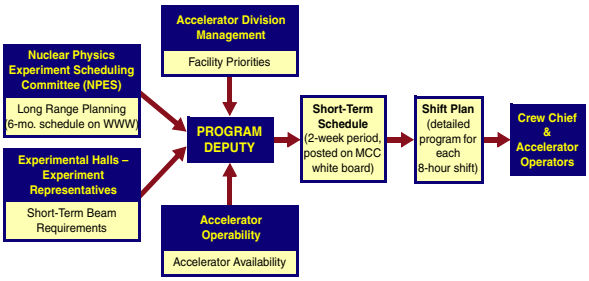


Figure 6: Inputs to PD planning.

Program Deputy Shift Plan

Date: January 23, 2003

Shift: Day

Program Deputy

Scheduled Program(s) for the Shift

Scheduled Program	Number of Hours	Hall with Priority (X)	Experiment #
Hall A	6		e01-012
Hall B	6		e1
Hall C	6	X	g0

Scheduled Program	Number of Hours
Accelerator Beam Studies	2
Accelerator Restoration	
Accelerator Configuration Change (ACC)	
Accelerator Scheduled Off (Maintenance)	

Figure 7: PD Shift Plan

PD Weekly Summary Page 1 of 5

PROGRAM DEPUTY:

DATE (from): January 15, 2003

DATE (to): January 22, 2003

PROGRAM

PRECEDING WEEK:

- Hall C (g0): 3 pass, 40 uA polarized beam, 3.026 GeV (Priority Hall)
- Hall B (e1): 2 pass, 15 nA polarized beam, 2.036 GeV
- Hall A (E01-012): 4 pass, 12 uA polarized beam, 4.016 GeV
- Hall A (E01-012): 5 pass, 12 uA polarized beam, 5.006 GeV (Thursday swing)

UPCOMING WEEK:

- Hall C (g0): 3 pass, 40 uA polarized beam, 3.026 GeV (Priority Hall, Friday owl)
- Hall B (e1): 2 pass, 15 nA polarized beam, 2.036 GeV
- Hall B (e1): 2 pass, 15 nA polarized beam, 3.056 GeV
- Hall A (E01-012): 5 pass, 12 uA polarized beam, 5.056 GeV

HALL WITH BEAM DELIVERY PRIORITY

- Hall C through Friday owl
- Hall A

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PROGRAM GOALS (last week)

MUST:

- Deliver 3 pass, 40 uA polarized beam at 3.026 GeV to Hall C (done)
- Deliver 2 pass, 15 nA polarized beam at 2.036 GeV to Hall B (done)
- Deliver 4 pass, 12 uA polarized beam at 4.016 GeV to Hall A (done)
- Deliver 5 pass, 12 uA polarized beam at 5.006 GeV to Hall A (done)
- Demonstrate parity quality beam for G0 (ongoing)

SHOULD:

- Continue stabilization injector RF phases work (ongoing)

LIKE:

- Update new BCM firmware

PROGRAM GOALS (upcoming week)

MUST:

- Deliver 3 pass, 40 uA polarized beam at 3.026 GeV to Hall C (through Friday owl)
- Deliver 2 pass, 15 nA polarized beam at 2.036 GeV to Hall B
- Deliver 3 pass, 15 nA polarized beam at 3.056 GeV to Hall B
- Deliver 5 pass, 12 uA polarized beam at 5.056 GeV to Hall A
- Demonstrate parity quality beam for G0

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SHOULD:

- Cut over and commission the new BCM (Tuesday)
- Update new BCM firmware

LIKE:

-

AVAILABILITY SUMMARY

Table 1: Beam to Halls for the Preceding Week (Monday 2400 – Monday 2400)

	Sched. Program (hours)	Accelerator Availability (%)	Acceptable Beam in Use (%)	Hall Availability (%)
Hall A	160	73.4	57.8	89.3
Hall B	160	67.9	56.7	91.8
Hall C	160	57.5	46.5	83.4

Table 2: Accelerator-Specific Activities for the Preceding Week (Monday 2400 – Monday 2400)

	Scheduled	Actual
Accel. Beam Studies	8	6.0
Accel. Restoration	0	0.0

Figure 8: PD Weekly Summary

ELECTRONIC LOGGING

Jefferson Lab utilizes an electronic log for log entries problem reporting with links to most required information needed by operators during beam delivery.

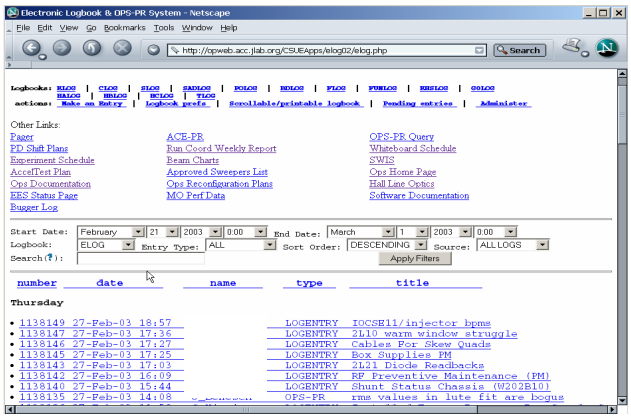

Figure 9: Electronic Log

TRAINING

Jefferson Lab has developed several simulators to allow operators experience in performing critical machine operations. The Safety System Simulator is an example of this. We place a great emphasis on allowing newer operators to perform procedures even though a more senior operator might perform the action more rapidly. An essential duty of the Crew Chiefs is to provide training of the operators. Safety is strongly emphasized during a new operator's training.

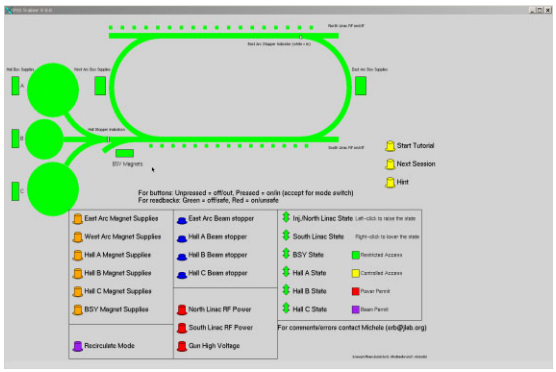

Figure 10: Safety System Operator Simulator

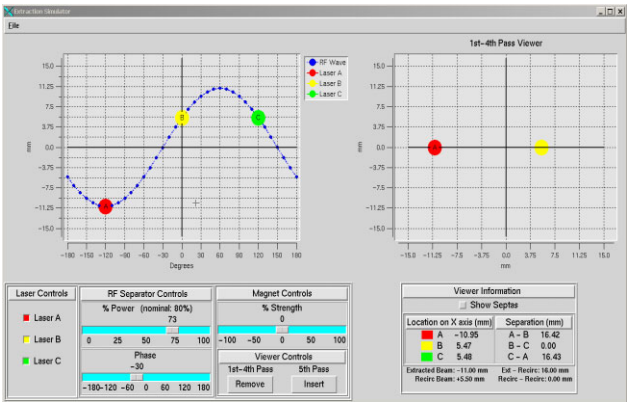

Figure 11: RF Separation Simulator

TROUBLESHOOTING

Coordination and communication between Operations staff and support personnel are essential to ensure a timely resolution of any equipment or software issues. Part of the training of operators is troubleshooting and analysis to aid support personnel in identifying the source of a problem. Our EES Group has developed a troubleshooting flowchart to help ensure problems are investigated in an organized fashion and to ensure the proper personnel are contacted.

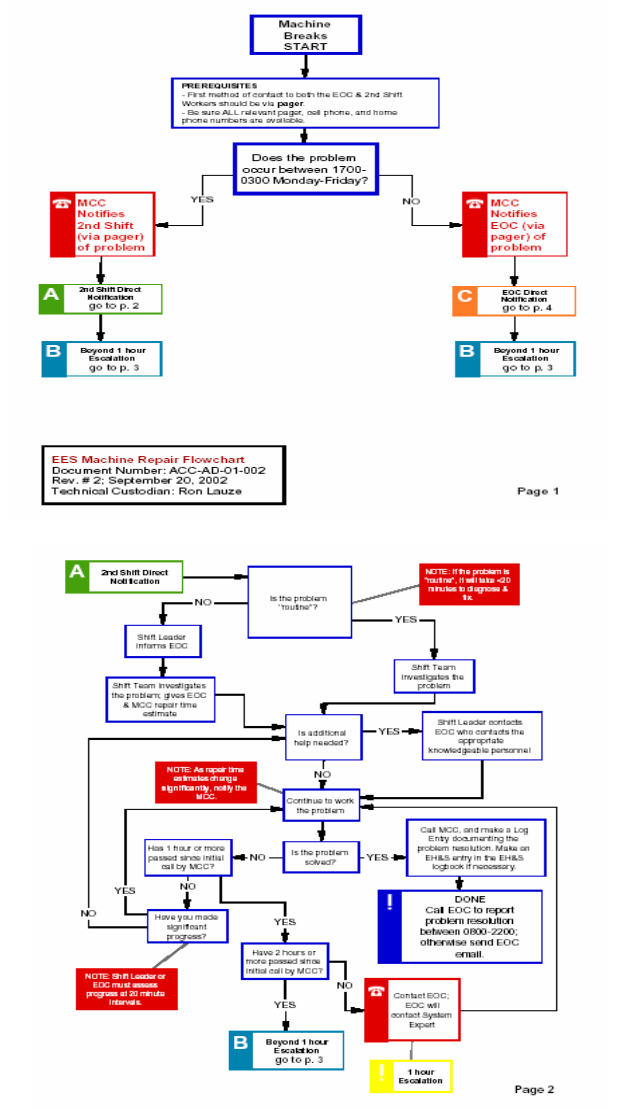

Figure 12: Excerpt from EES Troubleshooting Flowchart