TOOLS DEVELOPED BY OPERATORS

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Abstract

To do a good job, you need good tools. Operators at Jefferson Lab play a very important role in software tool development. Working in the machine control center, operators use computers to control the accelerator every day. This means that operators have first-hand experience and know exactly what they need to run the machine. In addition to providing valuable information to the Software Group, the operators write the code for new software tools that will meet their needs.

Introduction

Jefferson Lab has a very large distributed computer control system. Accelerator operators are responsible for the safe and efficient operation of the accelerator and its subsystems, the delivery of high quality beam to the experimental nuclear physics program, and maintaining accurate records of accelerator subsystems and control room activities. The primary job of operators is to run the accelerator from the control room. But they also have up to 30% of their total working hours to do side projects. Operators can pick any project they like, including troubleshooting, planning and performing maintenance and upgrades to accelerator subsystems, and developing accelerator control system programs. The group leader can also assign projects to operators. Some operators are involved in software development. The software tools developed by operators make operating the accelerator easier and more efficient.

Software Development

Operators spend 70% of their time in the control room. During this period they run the accelerator, delivering beam to the experiment halls. The operators use the remaining 30% of their time to work on their favorite projects.

Tcl/Tk is a very popular programming language used by the operators. C and C++ are also used. Operators can learn programming skills on their own or take classes to build up their skills.

Tools developed include semi-automated and automated procedures, which save time and reduce human error; software interlocks that monitor the machine at all times and turn off beam when parameters are beyond limits; small, handy scripts, that help operators get the job done easier and faster; and an end-of-shift report that gives a summary of the shift.



Figure 1: Jefferson Lab is in Newport News, Virginia



Figure 2: Jefferson Lab



Figure 3: Jefferson Lab Control Room

	ynamicTOOL5.adl									_ 🗆 ×
		Angle = -9.20		GENERAL	TOOLS T	EST SCR			04Mar03	15:52:36
Hall	Beam Mode		Laser Atte	nuators Cl	osed ChopSt	ep Choppe	s S	lit Position Ope	n Beam	Current
А 📧	BEAM SYNC ONLY 💷 💽	Down	300 300		0.100	0 57.90	- 1	8.00 🖸	0.00	0.0
_						Hall A Mas	ks:		NPS BCH	HALLA BON
В 🛤	BEAM SYNC ONLY -	Down	600 600	2 2 1	0.500	0.8.00		8.00 0	0.01	0.00
						Hall C Mas	ks:		2024A	fop nA
Св	BEAM SYNC ONLY 💷 💽	Down	120 120	1 2	0.100	0		8.00 0	0.00	-0.03
	Master Mode	Dumplin's		SD TR	ID	BCM	: [[]]		HPS BOM	HALLO BOM
BS	BEAM SYNC ONLY 💷	45mev	EArc	SD TR	IP OL	02 0.00			ast FB C	
s La	ser Control 🔳	Faraday Cu	ip #2			0.00		Sys Off On	-Standby-	RFOR RFON
-	Inter OUT	BLMs Unlos		Set-Up: 495.		eset rb	0.00	Comm OK	Reset D	AC OK
Laser Sh & Power				5 Pass 5			Loss -wes	BPM Les Page		Search
Xstage		0-2uA 0.0		03 5005,63 3	21 12		-MAD	Saturation S/W	Mode Re	E FABRI
Ystage		II PI	Hall	A Hall B	Hall C BS		CryOff	Neg SE	E Norm Op:	S Norm
ROT 1/2 WAVE	0 5250			0.0126	178.000	75.100	-	Clexbau	C FFON SLOW	Coebug
			A3	3.8861 Horiz		0106A Ve	tical		d Optics Lo	
~	Voltage Control	NONE	MS	0.0126	Ini Tran				ast FB C	
Bypass	OFF ON Street of the second	TwiddlePF	RO	0.0629	MHD			Sys Off On	-Standby-	RFOT RFON
HV Fine Set	fion con kettie	INJ Magnets Locks		Horiz		0101A Ve	tical	Comm OK	Reset D	ACOK
MANUAL	AUTO 0.00009 KV	East 1 0 1	West A1	0.1026	-22.910	16.290		BPM Les Hat		Search
Off mode HV Ena	0.490 KV	OutAlFilters -	OR OLL	3-Lase	r / PB RF	Not Nomin	al		Mode R	
HV En		OutAlfilters 🖃	1A SLM Filters		PreBun	Inhibit	FF	Mag SE	E Norm Op	S Norm
HV O		2only 🖬	2A Fillers	DFF ON	OFF ON	No Warning:	Pa I	QExpert	O FFON SLON	Debug
Reset HV	INLKS C-HUINLKS	Seed Current	5	atten	🖌 fvd-j	pwr req-p	nr	Standan	d Optics Lo	aded
NHIBIT	CW Permissive	RF Co DC Out	Ð	Pre-Buncl	-146.3	dBm watts 0.50	KeV		-Hairs 📃	Locks
				Fre-Bunci	161	THE REAL PROPERTY IN		Comp. 1	01	Insumption and income

Figure 4: This screen has all the basic controls for beam delivery and is maintained by Operations.

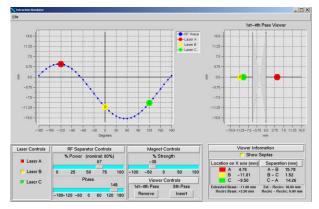


Figure 5: This simulator helps operators understand how to separate beam into Experiment halls by adjusting RF separator magnitude and phase.

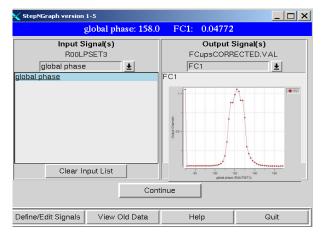
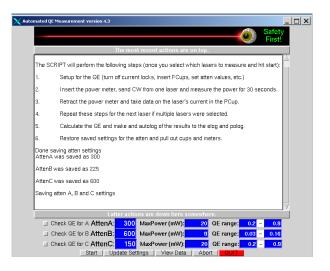
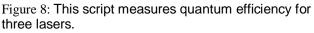


Figure 6: This script allows operators to graphically view how one parameter affects another. Usually operators use it to optimize an output while adjusting parameters.

X Injector Startup Procedu	ure 4.2
	Time 08:53 Date 03-05-03 User Wwang
💷 TEST MODE	E Expert View Steps GUI Help Procedure Help Quit
Injector Para	ameters Last Reviewed by Alarms on 02/24/03 at 12:59:07
Pre-beam Checks In	njector Optimization Injector Verification Current Program Setup
Explain Urify that	t the software group checkout of injector IOCS, IOCSE11 and IOCSE19 is complete and satisfactory
Explain 🔲 Setup Cho	ppping Apertures Home Reset
Explain 🔲 Verify that	t the laser RF is ON and that all seed lasers are ON
Explain 📃 Download	i the latest allsave.
Explain 🔲 Desired G	Jun 2 Setup Pockel Cell Voltages for Gun 2 Pos: 7.6904 Neg: 7.7518
Explain 🔲 Starting sp	pot location should be: X 1350 Y 1300 Check/Set Spot
Explain 📃 Starting W	Vien Filter setting should be: -16 degrees. Check Wien
Explain 🔲 Cycle all in	njector magnets except for MWF1I04, MBC0I06, MBV2D01, and MBF0L07 HYST AREA
Explain 🔲 Cycle all di	dipoles: MB01106(500 keV), MBV2D01(5 MeV), and MBF0L07(45 MeV) Cycle Dipoles
Explain 🗌 Verify injer	ctor alarm handler is clear. If not clear. Determine and note cause.
Explain 🔲 Compare p	present injector settings with Burt save.
Add Comment	Submit to ELog

Figure 7: This script does injector pre-beam check, optimization and verification.





Correcting N	15,6			_ 🗆 ×
Time 11:37	7 Date	03-05-03	User	Ywang
<u>a</u> rc1 <u>a</u> rc2	<u>a</u> rc3 <u>a</u> rc4	<u>a</u> rc5 <u>a</u> rc6	<u>a</u> rc7	<u>a</u> rc8 <u>a</u> rc9
Increase:	100 GC	o Cy	cle I	Help Quit
Quad	Before change	e After chang	je 🗌	Net change
MQC2A08	10569.3	10569.3)
MQC2A34	344.815	344.815)

Figure 9: This script adjusts magnet settings for optics tuning.



Figure 10: This script lowers the available drive power to the RF cavities by raising the ModAnode voltage, which saves electrical power and extends klystron lifetime.

🗙 Injector St	eering Script Ve	ersion 1-3					_ 🗆 ×
Spin Chang	e Spot Me	ove Injector	0L Steering	Expert Op	tions		
Wien Dij	ole Parame Spin	Wien (BDL)	Wien HV	HV pol			
Original	-9.1957	-218.4	6.0156	Negative	Save	Setup	
Current	-9.1957	-218.4	6.0156	Negative	Restore	Setup	
Desired	-19.8	-456.78	-13.234	Negative			
Set	Wien	St	oin Change St	eer		ort	
	Last Spi	n Matrix Initia	lization: 10/1	7/02 Gun: 2	Spin: -9	Spot: (1350,1300)	,
						-,	,
	Medm Scree	ans	Help		ZeroPos In	iector	
			(top		20101 00 11		
Gun 🔶 21	🗢 31 Steer t	o 🔷 Rels 🛇	Golds Gold	s last update	d: <mark>09/04/02</mark>	by: <mark>carlino</mark>	
Injector Cu	rrents						
A1	A2	MS	FC1	A3	A4	0R07 BCM	
0.043956	0.075458	0.025153	0.12576	0.025153	0.012576	0.0	
0.043956	0.088034	0.025153	0.11319	0.025153	0.012576	0.0	
			Gra	ab Intercepts			
				D-s de			
				Ready			

Figure 11: This script does spin angle change, laser spot move and beam orbit steering in the injector.

💔 xv 3.10a: boom	<unregistered></unregistered>					_ 🗆 ×					
-	BOOM	4 – Beam Operatio	ns Objective Ma	nitor – Version 1	0.02						
Shift Refresh Crew Chief Guidance Help											
SHIFT : Da				14:53:07 T	uesday – Febr	uary 25, 2003					
CREW CHIEF											
	: Roman, Sout	hern									
PROG. DEPUT											
PROGRAM :	Shut Down Pr										
BEAM STATUS Since: 02-25-03 at 07:00:00 Hours											
ANY UP 0.0 ANY TUNE 0.0 ALL UP 0.0 Beam Delivery to Experimental Halls											
		Beam Deliver	y to Experin	ental Halls							
HALL A	UP	TUNE	BANU	DOWN	OFF	FSDs					
HALL A	0.0	0.0	0.0	0.0	7.88536	0					
HALL B	UP	TUNE	BANU	DOWN	OFF	FSDs					
	0.0	0.0	0.0	0.0	7.88536	0					
HALL C	UP	TUNE	BANU	DOWN	OFF	FSDs					
10.22.0	0.0	0.0	0.0	0.0	7.88536	0					
	Machine	Development	, Restoratio	n, and Main	tenance						
CEBA	MD	RESTORE	ACC	DOWN	OFF	FSDs					
CEBA	0.0	0.0	0.0	0.0	7.88536	0					

Figure 12: The Beam Operations Objective Monitor monitors, records and characterizes the accelerator beam status.

Craphical View	
1L03–7: no fa	ults recorded
Counts	
03/05/03	11:28:10
NORTH LINAC	SOUTH LINAC
1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8
	2L02
	2L03
1L05	2L04
11.06	2L06
	2L07
	21.08
	2L09
	2L10
	2L11
	2L12
	2L12
	2L14
	2L15
	2L16
	2L17
	2L18
	2L19
	2L20
	2L21

Figure 13: There are more than 300 RF cavities in the linacs. This RF fault counter provides the history of cavity trips, which gives Ops very useful maintenance information.



Figure 14: Operators use this script to bypass/unbypass RF cavities and update/view cavity history file.

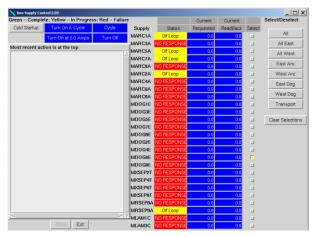


Figure 15: This script cycles the box supply magnets in the machine.

- We Will Strive to Deliver			e to Deliver		NORMAL MAX JUICE NORMAR			lokok:	k Version 4.06					
PASS	AREA	LIMIT		CURRENT		DF		MeV		POWER		LIMIT	AREA	FSD
1	INJCTR	10.0	uÅ	0.001	х	8.0	X	55.6875	-	8.0	KW	0.6	0L82	8
3	BS¥	10.0	uÅ	0.0	X	8.0	X	3014,489	=	8.0	KW	30.1	BSY	8
5	HALL A	10.0	uà	0.0	X	0.0	X	5019.531	-	8.0	KM	50.2	HALL A	8
5	HALL B	2.0	nĂ	0.0	X	0.0	X	5014.823	-	8.0	W	10.8	nA BPM	8
3	HALL C	10	uĂ	-0.03	X	0.0	X	3036.383	-	-8.0	KM	30.4	HALL C	8

Figure 16: MAXJUICE provides Operations with a software interlock to protect the accelerator from excess energy deposition. When the limit is exceeded, the beam is turned off.

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