TOOLS DEVELOPED BY OPERATORS

Yan Wang, Jefferson Lab 12000 Jefferson Ave, Newport News, VA 23606

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.

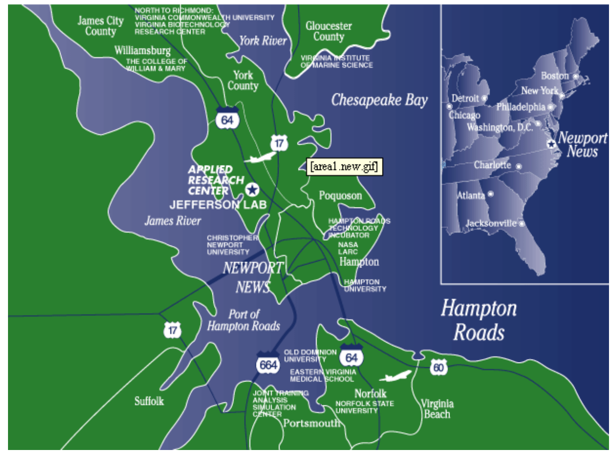

Figure 1: Jefferson Lab is in Newport News, Virginia

Figure 2: Jefferson Lab

Figure 3: Jefferson Lab Control Room

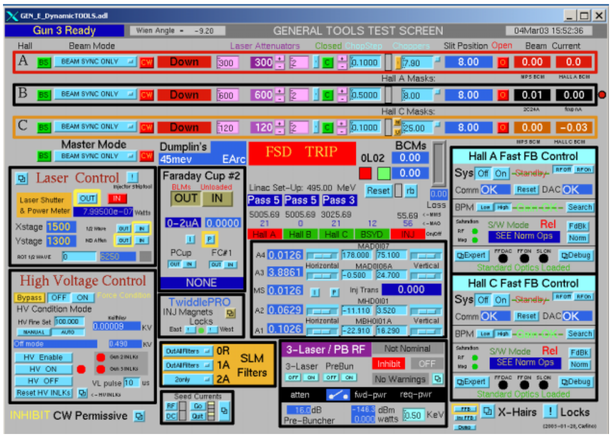

Figure 4: This screen has all the basic controls for beam delivery and is maintained by Operations.

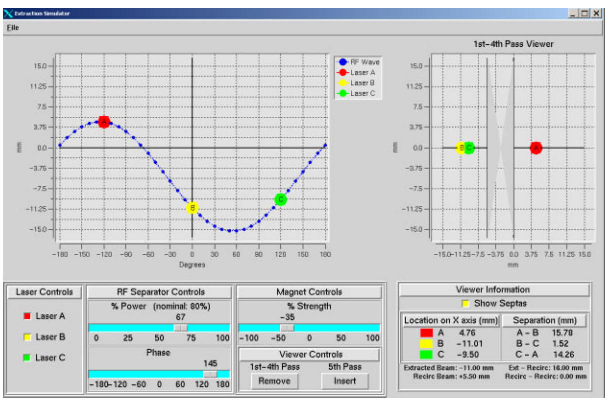

Figure 5: This simulator helps operators understand how to separate beam into Experiment halls by adjusting RF separator magnitude and phase.

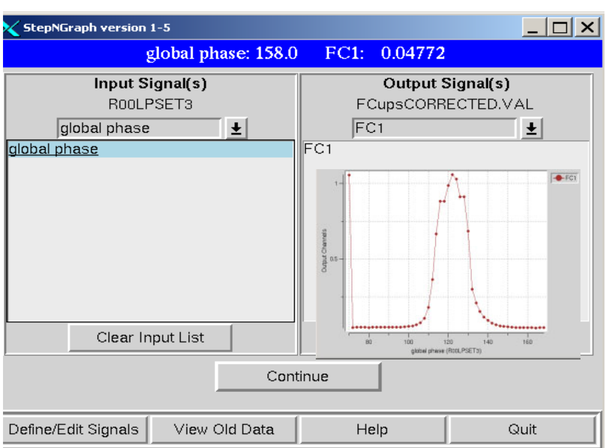

Figure 6: This script allows operators to graphically view how one parameter affects another. Usually operators use it to optimize an output while adjusting parameters.

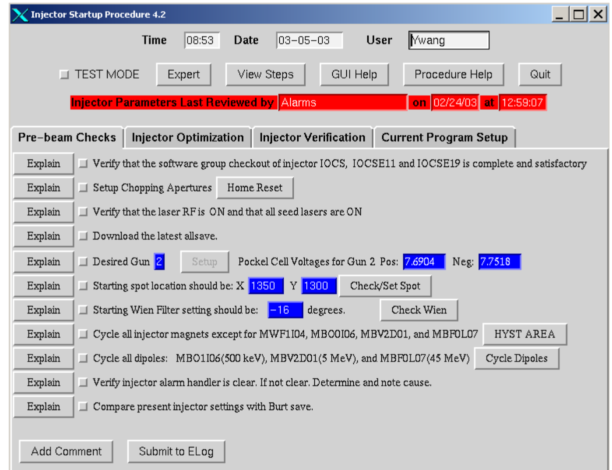

Figure 7: This script does injector pre-beam check, optimization and verification.

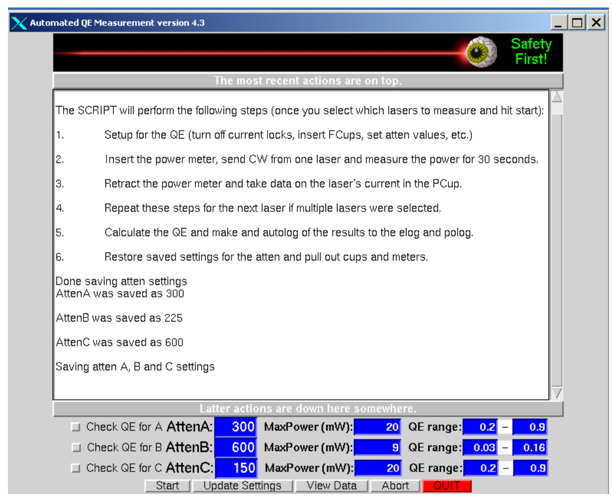

Figure 8: This script measures quantum efficiency for three lasers.

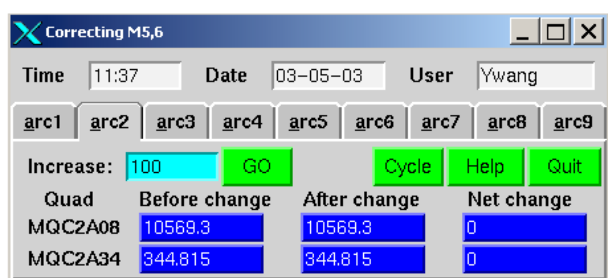

Figure 9: This script adjusts magnet settings for optics tuning.

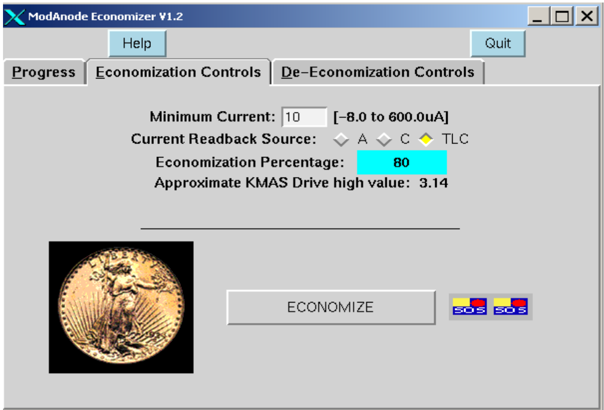

Figure 10: This script lowers the available drive power to the RF cavities by raising the ModAnode voltage, which saves electrical power and extends klystron lifetime.

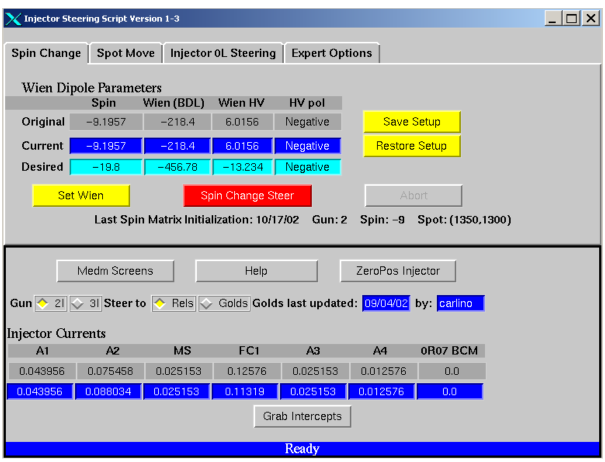

Figure 11: This script does spin angle change, laser spot move and beam orbit steering in the injector.

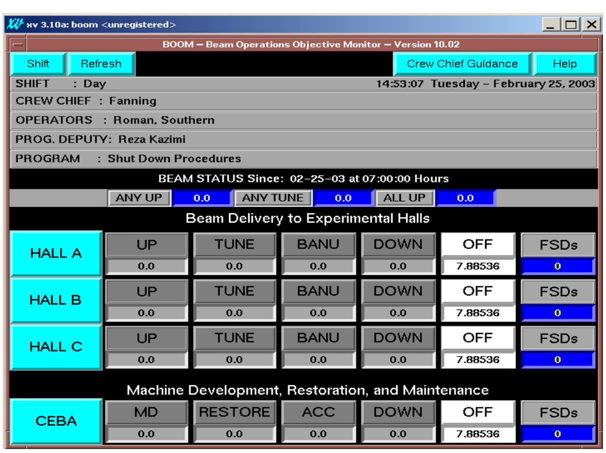

Figure 12:The Beam Operations Objective Monitor monitors, records and characterizes the accelerator beam status.

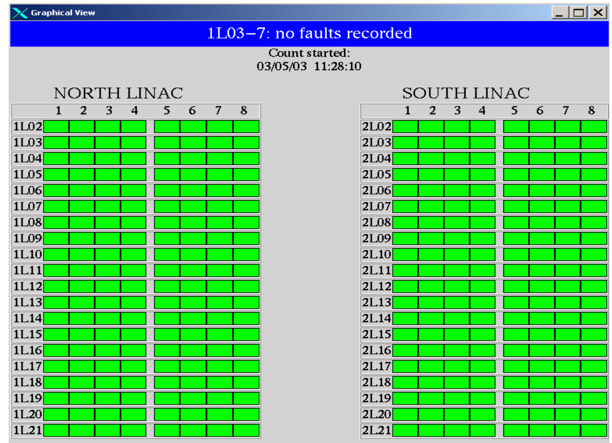

Figure 13: There are more than 300 RF cavities in the linacs. This RF fault counter provides the history of cavity trips, which gives Ops very useful maintenance information.

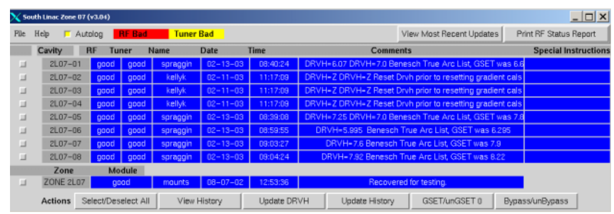

Figure 14: Operators use this script to bypass/un-bypass RF cavities and update/view cavity history file.

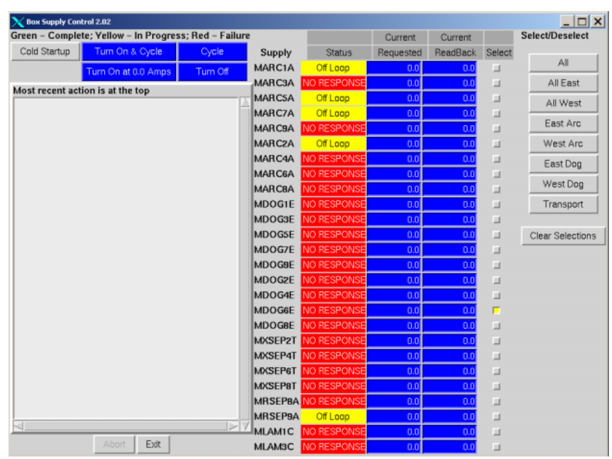

Figure 15: This script cycles the box supply magnets in the machine.

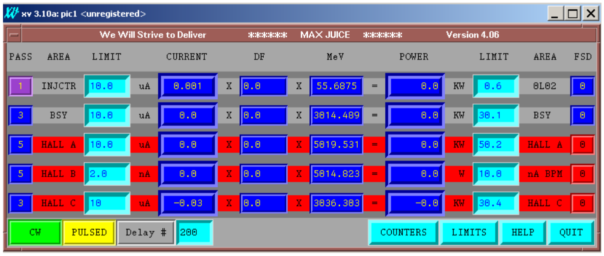

Figure 16: MAXJUICE provides Operations with a software interlock to protect the accelerator from excess energy deposition. When the limit is exceeded, the beam is turned off.

*Work supported by the U.S Department of Energy, contract DEAC05-84ER401050