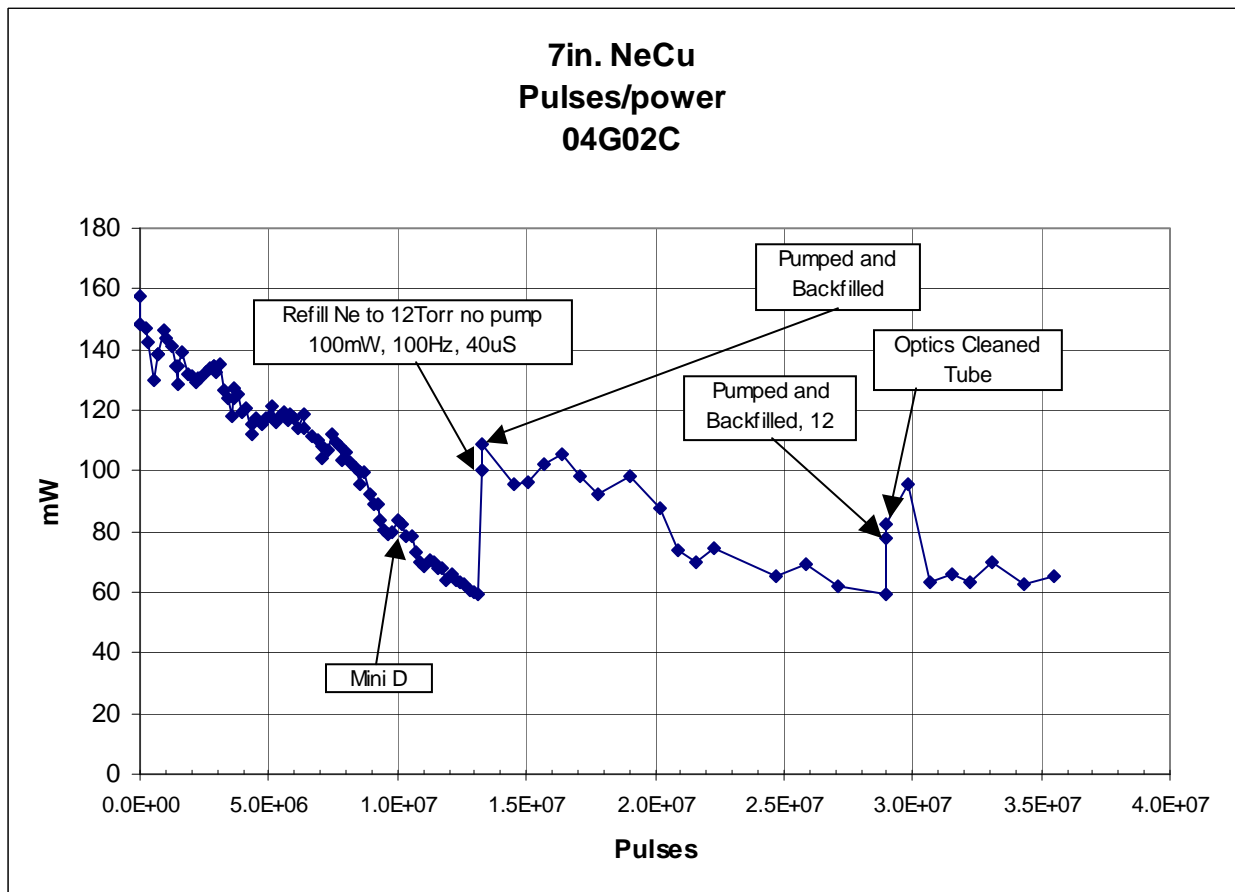


## Laser Lifetime

The issue of laser lifetime is of utmost importance in making our deep UV lasers commercially viable. We believe that in order to be commercially viable, the laser needs to operate in field use for over one year without service or other intervention. In order to accomplish this, the mode of operation of the laser needs to be integrated with the application in such a way as to maximize lifetime. We have come to understand that the best model for lifetime of our lasers is based on the number of pulses rather than the number of hours. Our simplest laser (the Series 30) has a hands-off lifetime between 10 and 15 million pulses. The larger and more complex Series 70 laser has a hands-off lifetime between 30 and 50 million pulses. The ultimate lifetime of both laser tubes is about 5x to 10x these lifetimes but optics cleaning is required at the end of each “hands-off” period. The figure below show an ongoing lifestest of a Series 30 NeCu laser operating at 248nm running at 2Hz. Note the initial specified output power for a new NeCu30 is 50mW. As you can see the laser is still above new spec. at over 13M pulses, at this point the laser was put back on the station and refilled with Ne. The power increased to over 2times Spec. power and continued on test. At over 28M pulses the Laser was again put back on the process station, this would simulate a return from the field and repair at the Factory.



To measure the lifetime in the terms of a typical detection application, it is important to minimize the number of pulses used to accomplish a data set. We have developed a family of optical and electronic Gated Integration detector modules and methods to gate a PMT or Photo Diodes or array of PMT/PD detectors in synchronism with the laser pulses and collect the native fluorescence/phosphorescence/Raman emission in each spectral bandpass determined by filters in front of each PMT/PD detector. The output of each PMT/PD is integrated in a storage capacitor and digitized after an integration period typically equivalent to the length of the laser pulse. The sensitivity of the detection can be accomplished by selection of the gain of the PMT, which is related to PMT voltage, the integration period, and the capacitance of the integration capacitor. If the sensitivity is too high, the integration time can be reduced which will linearly increase the laser lifetime.

	<b>Series 30</b>	<b>Series 70</b>
Hands-off lifetime	10-15 million pulses	30 – 50 million pulses
Ultimate tube lifetime	200 million pulses	200 million pulses

**Lifetime Improvement**

We are working to improve the fundamental lifetime of the laser tube, which is related to optical contamination and Bore erosion. The ultimate lifetime, being over 200 million pulses, is adequate for many applications at sample rates over 20 Hz. However, we cannot give a timeline for these improvements. The lifetimes above represent the current state of our lasers.