

Specification for Ultrafast Laser System Upgrade

1.0 Specifications

This procurement is to upgrade an existing femtosecond laser system based on a titanium sapphire regenerative amplifier (RA). The RA system currently consists of a Merlin pump laser (S/N 1220A) and a Spitfire Regenerative Amplifier (S/N 1220B). The current seed laser is a Clark Ninja 5, which has an output power greater than 200 milliwatts, a pulsewidth of 60-70 femtoseconds (fs) and a tuning range from 760 to 840 nanometers (nm). The intent is to upgrade the pump laser, replace the Merlin pump laser, and to increase the RA output pulse energy.

The upgrade will include 1) a new high power (nominally 30 W) diode-pumped, intracavity-doubled Nd:YLF laser to pump the regenerative amplifier that will be "drop-in" compatible, 2) replacement components in the RA, including new compressor and stretcher gratings (which are both 1800 /mm), new Pockels cells (PC) and Pockels cell drivers, and 3) new controlling electronics for synchronizing the PCs to the oscillator and pump laser. A simultaneous requirement is that the compressed pulse at a repetition rate of 1 kHz must have a pulse energy of at least 2 mJ pulse energy, with a pulsewidth that is 100 fs (or ≤ 1.3 times the seed laser, whichever is greater), a time-bandwidth product that is ≤ 1.5 times the transform limit, and minimum acceptable values for the spatial mode quality, contrast ratio, and tunability, as specified below. The successful offeror is required to make any other changes which may be required to enable the system to achieve the specifications for the regenerative amplifier as outlined in paragraph 2.0 below. The laser system must meet or exceed the following minimum specifications:

1.1 Specifications for the diode-pumped, Nd-YLF pump laser:

- a) Wavelength: 527 nm
- b) Repetition rate: 1-10 kHz
- c) Power: ≥ 30 W
- d) Pulse energy: ≥ 30 mJ at 1 kHz
- e) Energy stability: <1% RMS

1.2 Specifications for replacement components of regenerative amplifier

- a) Stretcher and compressor gratings: 1800 /mm
- b) Pockels cells insertion loss: <5% insertion loss

- c) Pockels cell driver rise time: < 1ns
- d) Synchronization Pockels cell jitter: < 1ns

2.0 Specifications for regenerative amplifier

- a) Center Wavelength: 800 nm
- b) Tunability: 760-840 nm
- c) Rep. Rate: 1–5 kHz
- d) Pulse Duration: <110 fs
- e) Energy-per-Pulse (mJ): ≥ 2.0 mJ at 1 kHz
- f) Contrast Ratio (pre-pulse): $\geq 1000:1$
- g) Contrast Ratio (post-pulse): $\geq 100:1$
- h) Energy Stability (% RMS): <1
- i) Beam Diameter: 10 mm
- j) Spatial Mode: TEM₀₀, $M^2 \leq 1.5$
- k) Polarization: linear
- l) Pulse-bandwidth Product: 1.5 times transform limit
- m) Seed laser bandwidth detection and interlock via PC controlling electronics

3.0 Installation and Training

- a. The price of the laser system must include delivery of the instrument to NRL, Washington, D.C., and installation at NRL, Washington, D.C. Installation shall include a demonstration that the instrument is in compliance with the specifications.
- b. At the completion of the installation and demonstration of the specifications, the successful offeror must provide on-location training at NRL for 2 people for a minimum of one day to familiarize the operators with proper operation and care of the instrument.

4.0 Documentation and Warranty

a. A full set of all written documentation customarily provided to the public with a commercial item shall be provided. This shall include one hard copy of all operations and maintenance manual(s) or equivalent as well as copies of any software, and any manuals for the software included with the system, if customarily provided. This documentation must be received at NRL with the system hardware, unless other arrangements are agreed to by the authorized Government representative.

b. The contractor shall offer the Government at least the same warranty terms, including offers of extended warranties, offered to the general public in customary commercial practice. These warranty terms must be included in the system price. The period of the warranty shall begin upon acceptance.

5.0 Trade-in

a. Pricing shall include allowances for trade in of an existing Merlin pump laser (S/N 1220A).