LAWRENCE
LIVERMORE
NATIONAL
LABORATORY

LLNL-JRNL-427458

Livermore Lab's giant laser system will bring star power to Earth

E. Moses

April 8, 2010

Discover Livermore Business Journal

Disclaimer

<u>Article for Livermore Business Journal – 3/19/10</u>

Livermore Lab's giant laser system will bring star power to Earth

In the 50 years since the laser was first demonstrated in Malibu, California, on May 16, 1960, Lawrence Livermore National Laboratory (LLNL) has been a world leader in laser technology and the home for many of the world's most advanced laser systems. That tradition continues today at LLNL's National Ignition Facility (NIF), the world's most energetic laser system. NIF's completion in March 2009 not only marked the dawn of a new era of scientific research – it could also prove to be the next big step in the quest for a sustainable, carbon-free energy source for the world.

NIF consists of 192 laser beams that will focus up to 1.8 million joules of energy on a bb-sized target filled with isotopes of hydrogen – forcing the hydrogen nuclei to collide and fuse in a controlled thermonuclear reaction similar to what happens in the sun and the stars. More energy will be produced by this "ignition" reaction than the amount of laser energy required to start it. This is the long-sought goal of "energy gain" that has eluded fusion researchers for more than half a century. Success will be a scientific breakthrough– the first demonstration of fusion ignition in a laboratory setting, duplicating on Earth the processes that power the stars.

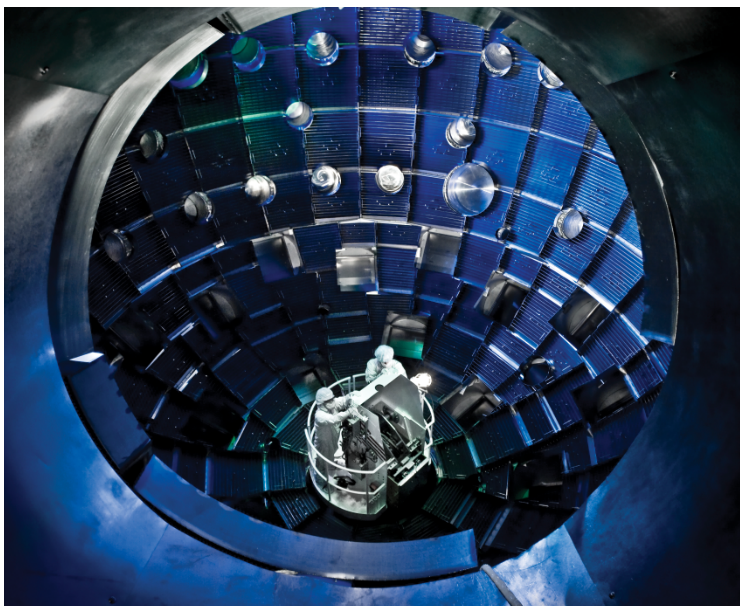
This impending success could not be achieved without the valuable partnerships forged with other national and international laboratories, private industry and universities. One of the most crucial has been between LLNL and the community in which it resides. Over 155 businesses in the local Tri-Valley area have contributed to the NIF, from industrial technology and engineering firms to tool manufacturing, electrical, storage and supply companies. More than $2.3B has been spent locally between contracts with nearby merchants and employee salaries. The Tri-Valley community has enabled the Laboratory to complete a complex and far-reaching project that will have national and global impact in the future.

The first experiments were conducted on NIF last summer and fall, successfully delivering a world-record level of ultraviolet laser energy — more than 1.2 million joules — to a target. The experiments also demonstrated the target drive and target capsule conditions required to achieve fusion ignition. When ignition experiments begin later this year, NIF's lasers will create temperatures and pressures in the hydrogen target that exist only in the cores of stars and giant planets and inside thermonuclear weapons. As a key component of the National Nuclear Security Administration's Stockpile Stewardship Program, NIF will offer the means for sustaining a safe, secure and reliable U.S. nuclear deterrent without nuclear testing. NIF is uniquely capable of providing the experimental data needed to develop and validate computer models that will enable scientists to assess the continuing viability of the nation's nuclear stockpile.

Along with this vital national security mission, success at NIF also offers the possibility of groundbreaking scientific discoveries in a wide variety of disciplines ranging from hydrodynamics to astrophysics. As a unique facility in the world that can create the conditions that exist in supernovas and in the cores of giant planets, NIF will help unlock the secrets of the cosmos and inspire the next generation of scientists.

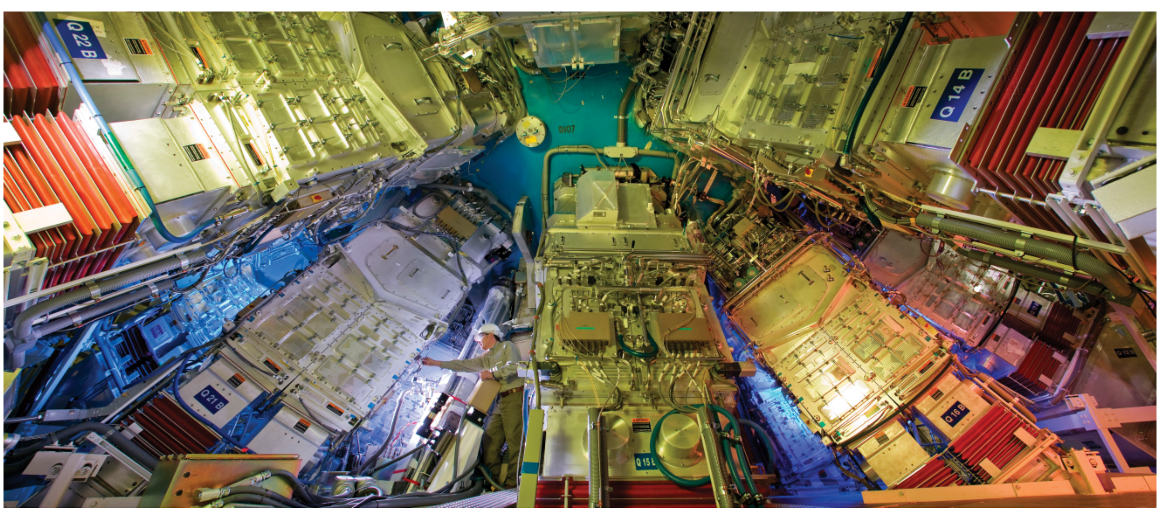
It is NIF's third mission, energy security that has been generating the most excitement in the news media and the international scientific community. The reasons are obvious: global energy demand, driven by population growth and the aspirations of the developing world, already is straining the planet's existing energy resources. Global need for electricity is expected to double from its current level of about two trillion watts (TW) to four TW by 2030 and could reach eight to ten TW by the end of the century. As many as 10,000 new billion-watt power plants will have to be built to keep up with this demand. Meeting this pressing need will require a sustainable carbon–free energy technology that can supply base load electricity to the world.

Successful ignition experiments at NIF can be a springboard for a revolutionary, long-term solution to our energy security – laser inertial fusion energy, or LIFE. An advanced energy concept now under development at LLNL, LIFE will build on the physics and technology developed for NIF to help meet future worldwide energy needs in a safe, sustainable manner without carbon dioxide emissions. LIFE power plants would be inherently safe, use the limitless supply of hydrogen fuel found in the world's oceans, and be capable of supplying base load electricity to the world. By harnessing the universe's quintessential power source, fusion energy, the United States can continue its leadership in game-changing technologies that drive economic competitiveness.



LEFT, technicians enter the 10-meter-diameter NIF target chamber on a specially constructed service system lift.

BELOW, laser beam enclosures connect to the target chamber.



Successful demonstration of ignition and energy gain at NIF will be a transforming event that will solidify fusion's potential as an important energy source. NIF's success and the development of the LIFE technology will be milestones in an exciting scientific journey that will create a lasting legacy of discovery, innovation, and security and allow the nation to reap the benefits of this visionary investment in its future.

This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.