NEWSLINE

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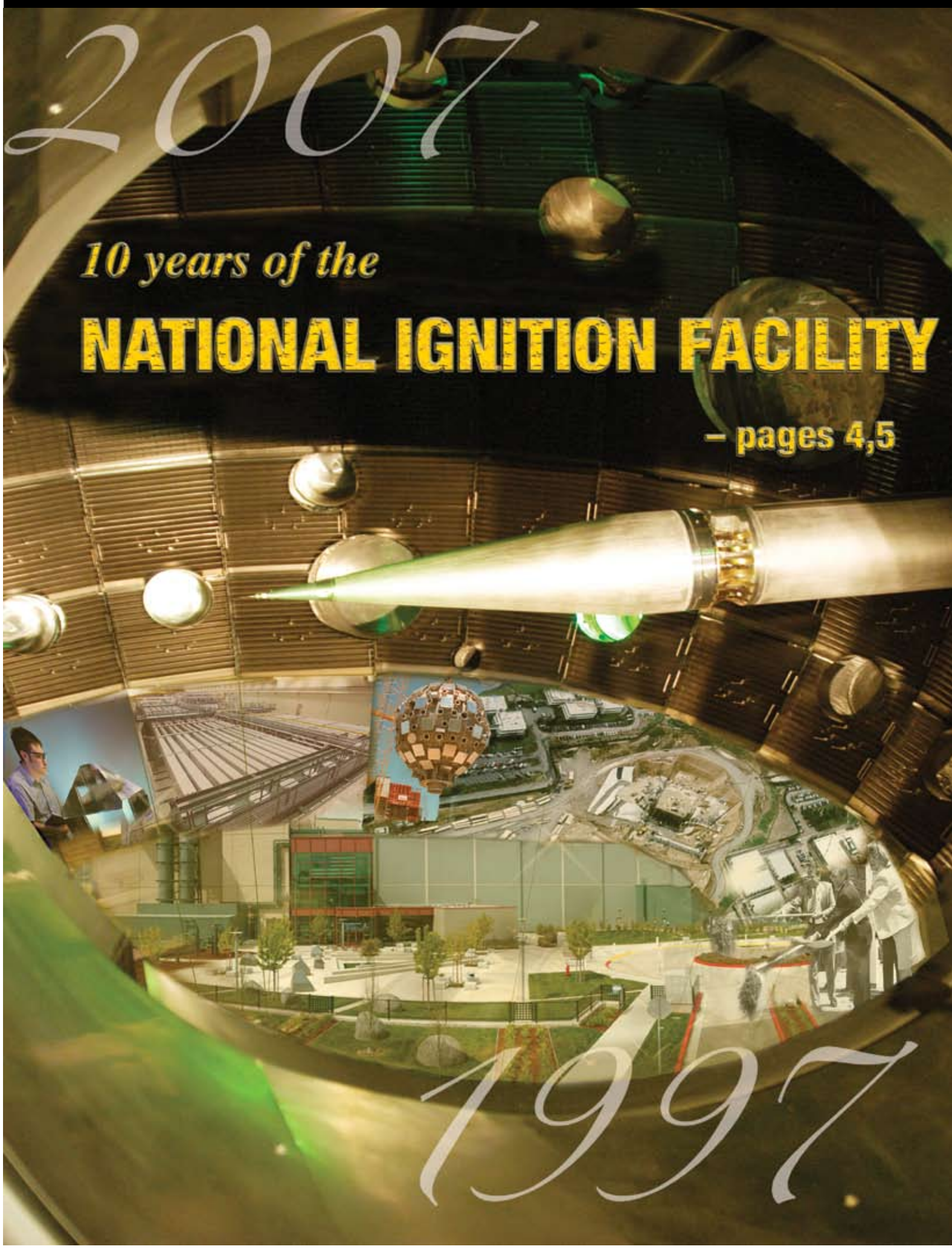

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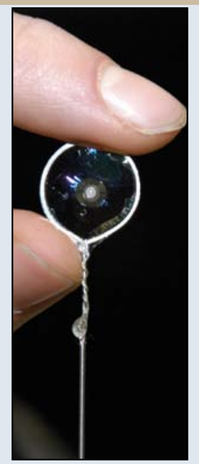


The National Ignition Facility turns 10

By Bob Hirschfeld
Newsline staff writer

With little fanfare, the National Ignition Facility (NIF) last month marked its tenth year since its original groundbreaking.

On May 29, 1997, Secretary of Energy Federico Peña, Lab director Bruce Tarter, and Congresswoman Ellen Tauscher turned a ceremonial shovelful of dirt — as more than 2,000 employees and invited guests looked on.

"NIF will unleash the power of the heavens to make Earth a better place," said Peña. "Our nation depends on continued leadership in science and technology. Today we move one step closer to a better future."

Tauscher said NIF would be "an excellent example" of how the national labs will work with the private sector to develop an alternative energy source as well as future technologies.

Harold Smith, Assistant to the Secretary of Defense said, "NIF marks a creative step toward meeting the needs of national security."

The audience included representatives from the University of California and other universities and industrial partners, as well as British and French collaborative institutions.

A decade later, NIF construction is now more than 90 percent complete, with 80 of its 192 beams operational. Already, NIF has demonstrated the ability to produce 1.7 megajoules of infrared laser energy, establishing its ability to achieve 4.2 million joules in the infrared when all beams are activated. NIF has also completed experimental demonstrations that show its ability to meet all of its ultraviolet light specifications.

NIF has already conducted significant experiments, and by next year at this time will begin target chamber experiments with hundreds of kilojoules of energy, more than 10 times greater than have ever been reached before.

The project is on schedule for completion in mid-2009, with the first attempts at achieving thermonuclear burn beginning the following year. Ultimately, NIF's beams will be focused on a 2-mm fuel pellet for a few billionths of a second, creating a tiny thermonuclear burn similar to what happens deep inside the sun. It's a major scientific accomplishment that has never been achieved under controlled conditions in a laboratory.

Preparations for user collaborations are under way as part of the National Ignition Campaign.

Tarter, who is now the Lab's Director Emeritus, last week recalled the groundbreaking event, saying, "It's been both gratifying and rewarding to watch the progress NIF has made over the past decade. Despite the ups and downs, the project is now very close to becoming one of the most extraordinary scientific facilities ever conceived and built."

He added, "I look forward with great anticipation to see its valuable contributions to pure science, fusion, and the nation's weapons program. Without a doubt, NIF's next few decades will prove to be remarkable."

Ed Moses, associate director for NIF Programs, offered his congratulations to everyone involved: "The NIF project shows the unique capability of the Lab to marshal forces across a broad range of scientific, engineering and administrative areas to build one-of-a-kind capabilities for our nation and the world."

Counterclockwise from top left: Prototype NIF target; cleanroom workers inspect a plasma electrode Pockels cell (PEPC) assembly; target chamber being hoisted into NIF building in 1999; checking potassium dihydrogen phosphate (KDP) crystal; one of NIF's two laser bays, which house 96 beams each; upper portion of 10-meter-diameter target chamber; aerial view of construction in January 1998; groundbreaking ceremony that featured Lab Director Bruce Tarter (left), Secretary of Energy Federico Peña and Congresswoman Ellen Tauscher; workers inspect target positioner extended to center of target chamber.

The Mercury laser: Paving the way for the next step

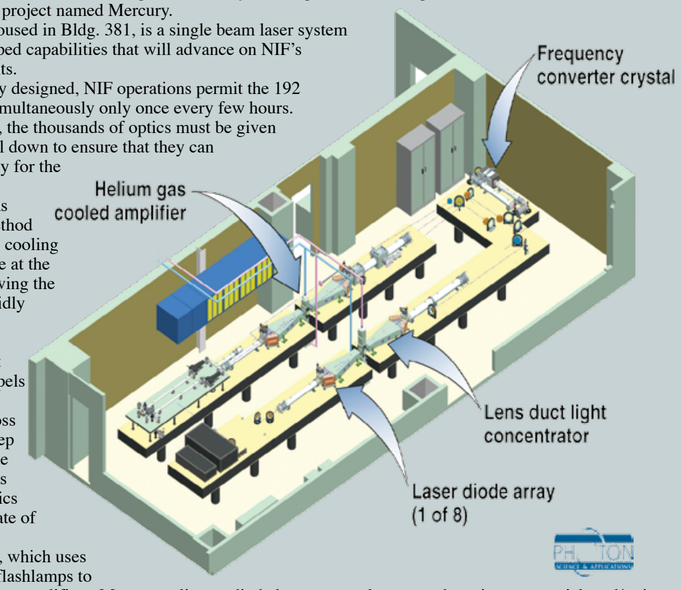
Concurrent with the National Ignition Facility and its goal of achieving thermonuclear burn, is another ambitious laser project named Mercury.

Mercury, housed in Bldg. 381, is a single beam laser system that has developed capabilities that will advance on NIF's accomplishments.

As currently designed, NIF operations permit the 192 beams to fire simultaneously only once every few hours. After each shot, the thousands of optics must be given a chance to cool down to ensure that they can operate correctly for the next shot.

Mercury has developed a method of continuously cooling the optics, while at the same time allowing the laser to fire rapidly over extended periods.

The current technology propels high-velocity helium gas across the optics to keep them cool, while laser pulses pass through the optics at a sustained rate of ten per second.



Unlike NIF, which uses seven-foot tall flashlamps to energize the laser amplifiers, Mercury relies on diode lasers — analogous to those in commercial read/write CD players — which give off three times less heat than flashlamps.

Mercury's beam is amplified as it passes through slabs of specially grown ytterbium-strontium flouroapatite crystals, as opposed to NIF's neodymium-doped phosphate laser glass. More advanced amplifier media, such as transparent ceramics, are also being developed.

At this point, Mercury has been able to run continuously for several hours (270,000 shots), firing ten times per second at over 50 joules per shot, each shot lasting just 15 nanoseconds (billionths of a second).

The project, which began in 1996 and funded through the Laboratory Directed Research and Development (LDRD) office, has already been awarded three R&D 100 Awards, most recently for developing a unique frequency conversion crystal. Earlier awards were for the original design of Mercury's diode array, and for its Pockels cell, a unique light-switching technology.

The long term goal is a laser system capable of NIF's energy output, Mercury's ability to rapidly fire shots, and innovations that will enable the laser beam's ultimate destination: the rapid ignition of targets for electrical power generation.

– By Bob Hirschfeld