

# CRS Report for Congress

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## **The National Ignition Facility: Management, Technical, and Other Issues**

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in a nuclear weapon, although the total energy output would be at least a million times less than that of a weapon. The principal goals of NIF are to improve understanding of the physics of specific aspects of weapon behavior, to validate improved computer simulation codes,<sup>6</sup> to evaluate the impact of defects discovered in the stockpile, to simulate the effects of nuclear explosions on systems, and to help maintain the core of "intellectual and technical competency" of the U.S. nuclear weapons program. NIF is also expected to have several civilian scientific applications. DOE hopes that NIF will be able to demonstrate fusion ignition as an important step toward harnessing fusion energy for the production of electric power (inertial fusion energy or IFE).

### **NIF Project Schedule and Cost Overruns – Chronology**

When the NIF project first appeared in the DOE budget request for FY1996, its total project cost (TPC) — construction plus associated project costs — was reported as \$1.074 billion including construction and design costs (total estimated costs or TEC) of \$842.6 million. A completion date of the third quarter, 2002 was also given. In the FY1998 budget request, DOE reported the total project cost of NIF to be an estimated \$1.196 billion including construction and design costs of \$1.05 billion and \$146 million in associated project costs. The increase was a result of DOE's decision to stretch the project out by one year to a completion date of the third quarter, 2003. These figures remained unchanged through the FY2000 budget request, and no mention was made of any possible difficulties in meeting those targets. A hint of some problems, however, could be seen in the detailed project description accompanying the FY2000 request. DOE reported that total construction and design cost estimates increased over the previous DOE estimate, but those changes were compensated by a decrease in contingency funds from 12.6% of the total estimated costs (the original contingency factor was 15%) to 7.6% of the total estimate. At this point, the project was less than 50% complete, and the size of the remaining contingency funds appeared to be quite low for a project this complex.

In March 1999, a preliminary assessment by NIF project officials at Lawrence Livermore National Laboratory (LLNL) determined that there were major potential problems with NIF construction that threatened to increase substantially project costs.<sup>7</sup> LLNL staff attempted over the next several months to see if the additional cost could be accommodated within total project costs already approved, but did not notify DOE until June 1999, when it reported these problems to NIF project staff at DOE Headquarters. It was not until August 1999, however, that the Secretary of Energy was informed. At that point, LLNL reported that the project cost would increase by about 20–30% and completion would be delayed by 12 to 18 months. LLNL stated that the cause of the cost increase was that assembly of the laser system

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<sup>6</sup> As weapon codes are changed, they need to be validated to ensure that they are accurately modeling weapon processes. In the past, nuclear weapons tests were the primary means of accomplishing this validation. Without tests, the codes will have to be checked by seeing how well they describe the phenomena that occur during operation of the stockpile stewardship experimental facilities such as NIF.

<sup>7</sup>U.S. Department of Energy, *Energy Department Announces Major Changes to Improve National Ignition Facility Management and Accountability*, News Release, March 24, 2000, [<http://www.doe.gov/news/releases00/marpr/pr00084.htm>]

infrastructure was considerably more complicated than anticipated.<sup>8</sup> An important contributor to this added complexity was the difficulty in maintaining NIF's stringent cleanliness requirements during assembly. Officials at LLNL determined that the lab did not have the capability to meet these more complex assembly requirements and must contract for them. According to LLNL, securing those services through the contract process was the primary source of the added cost and time to completion.

Upon learning of the potential cost overruns, the Secretary of Energy requested an internal review of the project to determine the source of the problems. A special task force of the Secretary of Energy Advisory Board (SEAB) was set up to investigate management and technical problems at the project. In addition, the University of California (UC), which manages LLNL under contract to DOE, also initiated a review by a special committee of the UC President's Council. The Council was set up to advise the UC President on matters about the three DOE labs managed by UC — LLNL, Los Alamos National Laboratory, and Lawrence Berkeley National Laboratory. A third study focusing on technical issues was carried out by the Technology Resource Group of the NIF Council, an advisory group internal to LLNL.

The SEAB<sup>9</sup> and UC<sup>10</sup> reviews both confirmed that the assembly and installation of the NIF laser system would be more difficult and rigorous, and would require a cleaner environment than originally anticipated. They both concluded that the original approach of having the assembly done by an operating contractor and LLNL personnel while relying extensively on LLNL management would not succeed. Rather, an outside contractor with experience in clean assembly of large, complex systems and management of large engineering projects would be needed.<sup>11</sup> As a consequence, a significant increase in cost and time-to-completion would result.<sup>12</sup>

The NIF technical review found a number of potential technical issues that if not resolved could seriously compromise the operation of NIF.<sup>13</sup> Foremost is the possibility that the optics facing the laser target — the final optics assembly — would not be able to handle the laser energy intensities needed to achieve ignition. Both the UC and SEAB reviews agreed with that assessment.

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<sup>8</sup>Personal communication, David Crandall, United States Department of Energy, Oct. 20, 1999.

<sup>9</sup>Secretary of Energy Advisory Board, U.S. Department of Energy, *Interim Report of the National Ignition Facility Laser system Task Force*, January 10, 2000. (Hereafter called the SEAB Laser Task Force.)

<sup>10</sup>University of California, *Report of the University of California President's Council National Ignition Facility (NIF) Review Committee*, November 18, 1999, [<http://labs.ucop.edu/internet/nr/nr112399.html>]. (Hereafter called the UC President's Council.)

<sup>11</sup>UC President's Council, 3.

<sup>12</sup>SEAB Laser System Task Force, 3.

<sup>13</sup>Lawrence Livermore National Laboratory, Technology Resource Group of the NIF Council, *NIF Technology Review*, Nov. 4, 1999. [<http://www.nrdc.org/fpprog.html>]

In response to the management problems uncovered by the SEAB and UC reviews, the Secretary of Energy in March 2000, announced several changes in the project structure: an Associate Director of NIF reporting to the LLNL director was established; UC established a special panel of the President's Council charged with oversight of the NIF project; a headquarters NIF project office was established; the NIF project was made part of the DOE Project Management and Oversight function — mandated by Congress — that will provide an on-site DOE contractor with expertise in large, complex project management; and important decisions about NIF had to be approved by the DOE Deputy Secretary before funding is provided.<sup>14</sup> In making this announcement, the Secretary reiterated his belief that while the NIF project has had serious problems with its management, the science underlying NIF "remains sound."<sup>15</sup>

On May 3, 2000, the Secretary of Energy announced a new budget and schedule for NIF.<sup>16</sup> He stated that DOE would increase funding for NIF by \$95 million for FY2001 to a total of \$169.1 million for construction. In addition, the NIF funding requirements would increase from \$100 million to \$150 million for FY2002 depending on the results of the new baseline, then scheduled for completion in August 2000. DOE did not ask for additional funding for FY2001, but proposed shifting funds from other sources within the department. It was further stated at the press conference accompanying the DOE announcement that most of the funds would come from LLNL.<sup>17</sup> The new schedule announced by the Secretary would have the first batch of laser beams in operation by 2004 and the entire facility completed by 2008, nearly five years past the original date. That completion date would be well beyond the first estimates of the delay cited above.

On June 1, 2000, DOE delivered an interim report to Congress containing a new plan for NIF with a revised cost estimate and schedule.<sup>18</sup> In this plan, NIF would have a total project cost (TPC) of \$2.12 billion, would provide first laser light at the end of FY2004, and would reach the full 192 -beam facility late in FY2008. Cost increments would be \$95 million for FY2001 and \$150 million for FY2002 over the original plan (\$74.1 million for FY2001 and \$65 million for FY2002). In addition to the TPC, DOE also included costs that are directly related to NIF that had not previously been counted as part of the NIF project but had been included in the Inertial Confinement Fusion (ICF) program. These costs, estimated to be \$833.1 million at the time of the FY1998 baseline, were now estimated to be \$1.137 billion. Therefore, the total NIF cost estimate in the June 1, 2000 document were \$3.26 billion compared to the original baseline estimate of \$2.03 billion, a cost overrun of \$1.23 billion or about 60%.

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<sup>14</sup>U.S. DOE March 24, 2000, News Release.

<sup>15</sup>U.S. DOE March 24, 2000, News Release.

<sup>16</sup>U.S. Department of Energy, *Secretary Richardson Settles on a New Budget Schedule for National Ignition Facility*, News Release, May 3, 2000.

<sup>17</sup>Tarun Reddy, "New NIF plan calls for delay in facility's opening, more funding," *Inside Energy/ with Federal Lands*, McGraw-Hill, May 8, 2000, 3.

<sup>18</sup>Letters to Senator Pete V. Domenici and Representative Ron Packard from Bill Richardson, Secretary of Energy, June 1, 2000. [[http://www.dp.doe.gov/dp\\_web/news\\_f.htm](http://www.dp.doe.gov/dp_web/news_f.htm)]

As the basis for this interim report, on May 30, 2000, the Director of LLNL delivered a letter to the Secretary of Energy providing a certified estimate for a revised cost and schedule baseline for NIF.<sup>19</sup> The letter noted that LLNL as directed by DOE had developed a detailed plan for completing the project as rapidly as possible. Under this plan, the first laser light ( 8 beams) would be obtained at the end of FY2003 and the full 192 beams would be operational at the end of FY2006. In each case, two years later than originally planned. The total project cost of this new plan was estimated at \$1.95 billion. Funding increases of \$150 million for FY2001 and \$240 million for FY2002 over the original plan would be required.

The LLNL Director noted, however, that such increases would likely have a "negative impact" on the rest of the stockpile stewardship program. As a result, he provided other estimates that would not require such large initial funding increases. Those estimates, however, were not developed in a detailed, bottoms-up manner, as was the plan noted above, but were determined by estimating the effects of stretching out that plan. When this stretched-out plan was presented to the NIF Program Review Committee (NPRC), a group formed as part of the management reforms instituted by DOE, the Committee expressed its dissatisfaction with the LLNL cost-estimate methodology. Further it was concerned about how well the stretched-out plan would meet the requirements of the stockpile stewardship program (SSP) to certify the readiness of the nation's nuclear stockpile. As a result, LLNL created a new plan that meets the funding increase limits imposed by DOE for the next two years (as reported by the Secretary of Energy in March 2000) and would meet the SSP certification requirements. This plan was the basis of the June 1, 2000 interim report.

Because the June 1, 2000 estimate had not undergone a detailed, bottoms-up review, DOE did not consider that it was adequate to fulfill the congressional requirement for a revised baseline. This review was completed in August 2000, and DOE delivered the revised baseline to Congress on September 14, 2000.<sup>20</sup> The new cost estimate is \$2.248 billion for the TPC and \$1.2 billion for associated program activities giving a total of \$3.448 billion or \$1.42 billion above the original baseline. Of this amount, \$1.46 billion will have been spent by the end of FY2000. According to the new baseline, first light (eight of the planned 192 beams) would be achieved in FY2004 and the project would be completed by FY2008.

DOE also submitted to Congress on June 27, 2000, an FY2001 budget amendment requesting budget authority for FY2001 for an additional \$95 million for NIF to come from other Stockpile Stewardship programs and \$40 million to be reallocated from the FY2001 Readiness in Technical Base and Facilities originally planned for NIF operational support. This amendment, which would have added \$135 million in budget authority to the original FY2001 request of \$74 million, was rejected by the House and Senate authorization and appropriations committees. DOE, however, reiterated the request in the September 14, 2000 revised baseline. As

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<sup>19</sup>Letter to the Secretary of Energy from the Dr. Bruce Tarter, Director, Lawrence Livermore National Laboratory, May 30, 2000. [[http://www.dp.doe.gov/dp\\_web/news\\_f.htm](http://www.dp.doe.gov/dp_web/news_f.htm)]

<sup>20</sup>Letters to Senator Pete V. Domenici and Representative Ron Packard from Bill Richardson, Secretary of Energy, September 14, 2000. [[http://www.dp.doe.gov/dp\\_web/news\\_f.htm](http://www.dp.doe.gov/dp_web/news_f.htm)]

noted below, most of this request was approved by the House-Senate conference on the FY2001 DOE appropriations bill, although with significant provisos.

On April 6, 2001, the NNSA of DOE delivered a report to Congress responding to the certification request contained in the FY2001 Energy and Water Development Appropriations Act (see below for details).<sup>21</sup> DOE was required to submit this report in order to receive the remainder of the FY2001 appropriation for NIF. In the letter accompanying the report, the Administrator of the NNSA recommended that the NIF proceed with the full complement of 192 beams. He also certified that the project was on schedule and budget as set forth in the revised baseline. The Administrator stated that a Workshop had been held to consider alternatives to a 192-beam facility and had concluded that full-scale NIF was the best course for meeting the Stockpile Stewardship program requirements. The Workshop concluded that any construction path that paused the project at fewer than 192 beams and then completed the project would cost more than proceeding directly to the full 192 beams. The Administrator also noted that a five-year plan for the SSP is currently under development and will be submitted to Congress after completion of the President's national security strategic review.

The Administrator also concluded that the High-Energy-Density Physics (HEDP) program within the SSP should not only include a 192-beam NIF, but also the Omega laser at the University of Rochester and the Z-machine at Sandia National Laboratory. As for the latter, the Administrator stated that the proposed refurbishment of that facility was promising but that it would not be a replacement for NIF. Finally, the Administrator emphasized the importance of NIF in attracting and training new scientific and technical personnel to the HEDP program.

In a related action, the Secretary of Energy announced on April 5, 2001, that DOE would not make any changes in the design, construction, or operation of NIF as a result of a supplemental environmental impact statement (SEIS).<sup>22</sup> The SEIS was carried out as a result of the uncovering of capacitors containing PCBs during excavation for the NIF.

## **Congressional Actions – 106<sup>th</sup> Congress**

In September 1999, the House Science Committee requested an investigation of the NIF project by the General Accounting Office (GAO). The GAO review, released in August 2000, concluded that

“NIF’s cost increases and schedule delays were caused by poor Laboratory management, which included weaknesses in planning, budgeting, and project

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<sup>21</sup>Letter from John A. Gordon, Administrator of NNSA to The Honorable Dennis J. Hastart, Speaker of the House of Representatives, April 6, 2001. This letter and the accompanying documents were obtained at [[http://www.dp.doe.gov/dp\\_web/news\\_f.htm](http://www.dp.doe.gov/dp_web/news_f.htm)]. At this time, however, the document is no longer on that website.

<sup>22</sup>U.S. Department of Energy, National Nuclear Security Administration, “Record of Decision for the Final Supplemental Environmental Impact Statement for the National Ignition Facility,” *Federal Register*, 60, No. 66, (April 5, 2001) 18078.

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## Lineup of Legislation

### Natural Outlook, Summer 2003

## The TCEQ's playbook grows with new responsibilities, laws to implement

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The Legislature added new duties to the TCEQ's role of overseeing air and water quality and waste management. The agency has already begun analyzing new laws and preparing for rule making. About 120 bills that passed during the regular session affect the agency.

The legislation that will attract a great deal of attention is the measure restoring funding to the Texas Emissions Reduction Plan, which is critical to bringing the state into compliance with federal air quality standards. With a new appropriation, TERP projects will expand rapidly (see [Back on the Technology Track](#)).

Below are other highlights of environmental bills passed by the 78th Legislature.

### **Air Quality**

**Emissions testing (SB 1159).** This air quality measure allows areas in Texas participating in early action compacts to initiate programs to curb vehicle emissions. The early action compact is a voluntary plan designed to bring a metropolitan area into compliance with the new federal 8-hour ozone standard. Participating areas may ask the state to approve a local emissions testing program for cars and trucks. The Austin, San Antonio, and Tyler-Longview-Marshall areas are eligible to initiate the program.

With emissions testing, which is already in place in 14 counties in the Houston and Dallas areas, cars and trucks are examined during annual safety inspections for excess emissions or problems with emissions control equipment. Vehicles failing the test are required to undergo repairs.

**Aggregate facilities (HB 1287, HB 555, SB 1272).** Several bills addressed the location and operating standards of aggregate facilities, such as concrete crushers and concrete batch plants. These operations

are associated with construction or demolition projects and can emit a considerable amount of dust. The legislation addresses which aspects of concrete crushing may take place within one-quarter mile of a school, residence, or place of worship--and how the distance will be determined.

Concrete batch plants will be exempted from the contested case hearings process when built to enhanced operating standards that reduce air emissions. A public meeting will be required to take testimony from the neighboring public. Facilities not meeting the enhanced standards remain subject to contested case hearings.

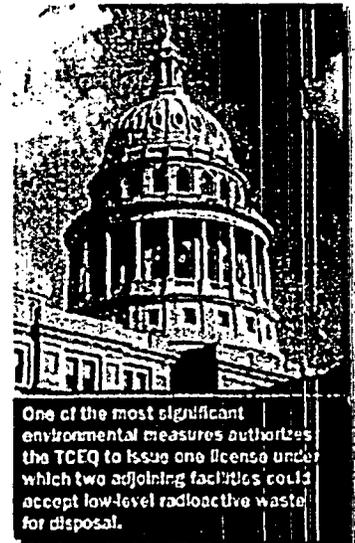
### Waste Management

**Low-level (HB 1567, HB 1678).** One of the most significant environmental measures authorizes the TCEQ to issue one license under which two adjoining facilities could accept low-level radioactive waste for disposal. One licensed site could receive waste from commercial generators in Texas, Vermont, and Maine, and a separate facility could accept waste from federal facilities, primarily the Department of Energy.

While Texas is responsible for managing the low-level radioactive waste generated within its own borders, it entered a federal compact in 1998, agreeing to provide a disposal facility for the other two states. Maine, however, is in the process of withdrawing from the compact, effective in 2004.

Low-level radioactive waste is a byproduct of medical, research, and industrial activities, as well as nuclear power plant operations.

The TCEQ previously reviewed a licensing proposal for a low-level radioactive waste disposal site. In 1998, the commissioners denied a license to a public agency seeking to operate a facility near Sierra Blanca, southeast of El Paso.



Legislation passed in 2003 marks the first time Texas has opened the door to the possibility of a privately licensed disposal site. The measure also allows, for the first time, the acceptance of low-level radioactive waste from federal facilities.

Under the terms of the law, any private company can submit a license application to the TCEQ, which is subject to several different reviews. Only one private company may be selected to receive a low-level radioactive waste disposal license, which could be located in West Texas. The firm would manage and operate both the commercial and federal waste facilities under the one license. The state would retain title to the waste accepted from commercial generators, and the federal government would retain title to the federal waste.

The legislation limits the volume of waste accepted at the federal

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