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**THE NATIONAL IGNITION FACILITY (NIF)  
AND THE  
ISSUE OF NONPROLIFERATION**

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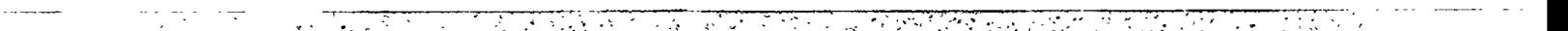
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# **THE NATIONAL IGNITION FACILITY AND THE ISSUE OF NONPROLIFERATION**

## **PURPOSE OF THIS REPORT**

On June 29, 1994, Congressman Ronald Dellums requested that the Secretary of Energy resolve the question of whether the National Ignition Facility (NIF) will aid or hinder U.S. nonproliferation efforts before proceeding with substantial budgetary commitments to construct NIF. In response, Secretary O'Leary committed the Department of Energy's Office of Arms Control and Nonproliferation, which has no programmatic responsibility for the NIF, to examine its nonproliferation implications. This report has been prepared to support that commitment.

## **PUBLIC PROCESS**

Congressman Dellums requested that public participation be an essential part of the Department's decision-making process. As a result, the Department arranged for a series of public meetings surrounding the production of this study, including meetings on the outline for the study, as well as meetings on the substance of the study itself.

### **Public Meetings on the Outline for the Study:**

The Department held three public meetings on the outline for the study to ensure that the DOE study would adequately address all of the issues of concern to the public. Two meetings were held in California, one in Oakland on January 24, 1995, and one in Livermore on March 9-10, 1995, and one meeting was held in Washington, DC, at DOE/Forrestal on January 30, 1995. The public was also invited to submit written comments on the outline.

Originally, the study was conceived as a technical analysis of the impact of NIF on the ability of proliferators to develop nuclear weapons, as well as the ability of U.S. weapon scientists to develop new weapons. However, as a result of public meetings held on the outline, the study has been broadened to include the impact of NIF on arms control and nonproliferation policy goals, including the impact on Comprehensive Test Ban Treaty (CTBT) negotiations and on the Treaty on the Non-Proliferation of Nuclear Weapons (hereinafter referred to as the Nuclear Nonproliferation Treaty or NPT).

### **External Expert Review and Interagency Coordination:**

Following public meetings on the outline, members of the Department's Office of Arms Control

and Nonproliferation wrote the draft study, "The National Ignition Facility and the Issue of Nonproliferation." Since some of the research proposed for NIF is classified, sections of the original draft of the study were classified secret/restricted data so that all of the possible research topics on NIF could be examined for proliferation impact. To assure the public that the technical conclusions of the unclassified draft study are consistent with the technical findings of the classified material, the Department invited a group of high-level external reviewers to examine the classified material and the unclassified draft study for accuracy, objectivity and completeness. The reviewers, listed in Appendix I, represent a broad spectrum of views and expertise. After the Department integrated reviewers' comments into this study, each of the reviewers concluded that the reader is in no way at a disadvantage in judging the validity of this study by virtue of not having had access to the classified material and that this study adequately addresses all the issues relevant to this topic. Although the views represented in this report are those of the Office of Arms Control and Nonproliferation and not necessarily those of the reviewers, each reviewer contributed in formulating the conclusions and recommendations of this study.

Congressman Dellums also requested that the Department consult formally and informally with other responsible agencies of the U.S. Government. We coordinated the draft study with the Arms Control and Disarmament Agency, the Arms Control Intelligence Staff of the Central Intelligence Agency, the Office of the Secretary of Defense, and the Department of State Bureau of Political-Military Affairs.

#### **Public Meetings on the Draft Study:**

After receiving comments from the external reviewers and from other U.S. government agencies, the Department revised the draft study and released it to the public on August 25, 1995. Public meetings were held on the substance of the draft study on September 21, 1995 in Washington, DC at DOE/Forrestal, and in Livermore, CA on September 28, 1995. The study was then further revised as appropriate. A compendium of public comment and Departmental responses is attached as Appendix III of this study. This final study, including the three appendices, serves as a basis for the Secretary's decision as to whether the NIF aids or hinders U.S. nonproliferation efforts.

### **FINAL CONCLUSIONS**

The conclusions of the Department of Energy's Office of Arms Control and Nonproliferation are as follows:

- (1) The technical proliferation concerns at the National Ignition Facility (NIF) are manageable and therefore can be made acceptable.
- (2) The NIF can contribute positively to U.S. arms control and nonproliferation policy goals.

**Therefore, it is the conclusion of this study that the NIF supports the nuclear nonproliferation objectives of the United States.**

## **BACKGROUND:**

- The National Ignition Facility (NIF), the next step proposed by the Department of Energy in a progression of Inertial Confinement Fusion (ICF) facilities, is expected to reach the goal of ICF capsule ignition in the laboratory.
- NIF will create higher energy density conditions than have been achieved in existing laboratory facilities. Experiments at these conditions would have significant value for maintenance of weapons physics proficiency, the future of energy production, and basic science.
- As part of a broader Science-Based Stockpile Stewardship program, a primary interest of the Department of Energy in NIF is to preserve the core intellectual and technical competencies of the U.S. in nuclear weapons science during a nuclear test ban regime, as directed by the President, and without new weapons development and production.
- International interest and participation in unclassified experiments at NIF and U.S. classified experiments on weapons-related physics at NIF give rise to concerns about horizontal proliferation (spread of nuclear weapon capability to states other than the declared nuclear weapon states) and vertical proliferation (increases in numbers of nuclear weapons or warheads, or development of new types of nuclear weapons (advanced weapon concepts)).
- Any ICF facility raises generic issues of proliferation because some of the computer codes that are used to predict behavior of an ICF target have much in common with codes used to design boosted primaries and secondaries and because ICF activity increases the size of the community of international scientists who are knowledgeable about some of the basic physical processes that occur in nuclear weapons.
- Because NIF will be the most advanced ICF facility in the world, reaching energy densities that are closer to regimes achieved in nuclear weapon explosions, the proliferation concerns of NIF in particular must be examined carefully.
- Proliferation concerns are examined in this report under the assumption that the Comprehensive Test Ban Treaty (1) is truly comprehensive (not a threshold test ban treaty); (2) promotes the vital interest of the United States in curbing the further proliferation of nuclear weapons; and (3) does not place nuclear energy release limits on ICF experiments, in accordance with current U.S. policy.

## TECHNICAL PROLIFERATION CONCERNS:

### Vertical Proliferation:

- NIF is a research facility which will allow U.S. weapons scientists to conduct meaningful, although small, laboratory scale experiments that explore some of the basic physics processes that occur in nuclear weapons and refine already existing computer codes that model these processes. When applied to the U.S. nuclear weapons program's past nuclear test data, these models are useful to the United States for maintaining confidence in weapons that have been tested.
- However, NIF cannot proof-test any nuclear device and therefore cannot act as a replacement for full-up nuclear testing in the stockpiling of any nuclear weapons.
- While it is technically feasible for U.S. weapons scientists at NIF to research some of the basic physics of advanced nuclear weapon concepts on a small laboratory scale, nuclear testing would be needed to develop and place into the stockpile new warhead designs or advanced weapon concepts which we would be confident are reliable.

### Horizontal Proliferation:

- Two factors will mitigate the risk of horizontal proliferation from NIF for all countries:
  - U.S. classification restrictions will preclude access to information from NIF that could be specifically useful for weapons development.
  - ICF data is of substantially less value for weapons purposes to states not having access to full-scale nuclear weapon test data.
- It is important to note that the kind of high energy density information that will be available at NIF is already being openly published by other countries as well as the United States.
- The utility of NIF and, for that matter, any other ICF facility to other countries for the development of nuclear weapons depends upon the type of weapon pursued:
  - ICF technology lacks relevance to the development of non-boosted fission devices.
  - For proliferators who have the capability to develop or actually possess simple fission weapons and are seeking to develop boosted primaries or thermonuclear weapons, ICF technology could be of indirect value in helping develop a cadre of scientists knowledgeable about some of the relevant physics and who could

improve their codes in some areas. However, no ICF experiment is possible that will provide data required to ensure that a specific boosted primary or thermonuclear secondary will indeed work as designed.

- More advanced proliferators who already have the capability to develop thermonuclear weapons or actually possess such weapons would have a greater understanding of the physics involved in thermonuclear weapons development and could make better use of ICF data to provide code benchmarking with some relevance to the design of secondaries. ICF activities could also maintain a cadre of knowledgeable scientists. Again, however, no ICF experiment is possible that will provide data required to ensure that a specific secondary will indeed work as designed.

## RECOMMENDATIONS TO MANAGE PROLIFERATION CONCERNS AT NIF:

### Vertical Proliferation:

- The U.S. must assure the American public and other countries that NIF is not contributing to vertical proliferation:
  - The goal of the U.S. Stockpile Stewardship program is to maintain the safety and reliability of the U.S. nuclear weapon stockpile without nuclear testing and without new weapons development and production.
  - The Administration and the Congress can ensure that the weapons laboratories are not engaging in research and development at NIF that encourages vertical proliferation.
  - Specific openness measures, especially regarding classified experiments (estimated at 20% of total experiments), should be implemented at NIF, such as:
    - Public discussion of the technical capabilities of NIF and types of nuclear weapons information that can be obtained from NIF experiments generally;
    - A published roster of planned unclassified and classified experiments;
    - Review of classified research by outside scientific and policy experts;
    - Release of certain information about the purposes of some experiments.
  - International collaboration at NIF on unclassified experiments and the consequent on-site presence of scientists from around the world will further enhance openness and transparency at NIF.
  - The need for openness measures at NIF will need to be balanced against the competing need to protect sensitive information about classified experiments which would be of value to potential proliferators.

Horizontal Proliferation:

- Screening procedures must be implemented at NIF to prevent NIF from directly contributing to horizontal proliferation, for example:
  - Denying conduct of experiments on NIF by uncleared persons that have obvious or specific nuclear weapon development applications. This can be accomplished by:
    - Review of proposals for experiments by a team of U.S. government experts in classification, weapons design and proliferation and/or a cleared group of scientists;
    - Open scientific review to ensure that the proposed experiment has scientific merit.
  - Exclusion of researchers from certain categories of countries (e.g., non-adherents of the Nuclear Nonproliferation Treaty (NPT), states which have unresolved International Atomic Energy Agency (IAEA) safeguards compliance issues, or other countries that the United States suspects are developing nuclear weapons)

**Through implementation of transparency measures and access screening procedures, the proliferation concerns at NIF can be successfully managed and therefore can be made acceptable.**

## POLICY CONCLUSIONS

### NIF and the Comprehensive Test Ban Treaty:

- NIF does not undercut the objectives of the Comprehensive Test Ban Treaty (CTBT).
  - NIF experiments cannot serve as a functional substitute for a nuclear explosive testing program banned by a CTBT.
  - Key to U.S. willingness to negotiate a CTBT and live under its provisions is its ability to exercise a nuclear stockpile stewardship program in the absence of nuclear testing.
  - This Administration is not planning to develop new types of nuclear weapons or advanced nuclear weapon concepts. Thus, NIF will not be used for that purpose. Furthermore, a program to develop any new nuclear weapons would be visible to Congress.
- The issue of NIF has not slowed multilateral CTBT negotiations.
  - Many nations agree with the U.S. that ICF should not be prohibited under a CTBT. ICF programs are being pursued by both nuclear weapon states and non-nuclear weapon states parties to the Nuclear Nonproliferation Treaty (NPT).

### NIF and the Nuclear Nonproliferation Treaty (NPT):

- NIF, as part of Stockpile Stewardship, will provide a supportive role for U.S. negotiation of and adherence to a CTBT and thereby will allow the United States to meet its most immediate commitment under the 1995 NPT Extension Conference Disarmament Principles -- completion of negotiations on a CTBT no later than 1996.
- Although a primary purpose of NIF is to maintain a U.S. cadre of expertise in physics relevant to nuclear weapons, its substantial energy and basic science applications will be shared with appropriate scientists from around the world, thereby making NIF operations consistent with Article IV of the NPT.

### NIF and Regional Proliferation Incentives:

- Incentives to develop nuclear weapons are driven first and foremost by regional security instabilities.
- Other countries' perceptions of whether nuclear weapons are valuable are strongly shaped by the overall international security environment. The overwhelming message sent by the U.S. commitment to deep reductions in its nuclear weapon stockpile is a rapidly decreasing emphasis on the value of nuclear weapons as instruments of U.S. national security.

### NIF and a Nuclear Arms Race:

- The bilateral nuclear arms race has ended. This is reflected in the goals of the Stockpile Stewardship Program.
  - NIF experiments cannot provide a means of proof-testing new warhead designs.
  - Openness measures and Congressional oversight will help assure that NIF is not contributing to vertical proliferation.

**The National Ignition Facility can contribute positively to U.S. arms control and nonproliferation policy goals.**

## **BACKGROUND ON THE NATIONAL IGNITION FACILITY**

### **What is the National Ignition Facility?**

The National Ignition Facility, or NIF, is an Inertial Confinement Fusion (ICF) facility and a key component of the U.S. Stockpile Stewardship Program. NIF will produce momentarily, within a laboratory, conditions approaching those inside the sun and other stars. This is achieved at NIF by using the intense energy output of large lasers to create thermonuclear reactions inside a tiny capsule containing deuterium and tritium. This is the basis for inertial confinement fusion (ICF) as a potential source for commercial energy production. Similar but more energetic conditions also are created by the explosion of a thermonuclear weapon, but on a much larger scale. NIF would allow scientists to perform small laboratory-scale experiments to study some of the fundamental physical processes that occur during detonation of such weapons. However, NIF cannot proof-test any nuclear device and therefore cannot act as a replacement for full-up nuclear testing in the development and stockpiling of any nuclear weapons. It is the multi-use nature of NIF that gives rise to concerns about the impact that the NIF project might have on U.S. arms control and nonproliferation efforts.

### **NIF and Stockpile Stewardship:**

In a July 3, 1993 radio address, President Clinton extended the moratorium on U.S. nuclear testing in the interest of U.S. nonproliferation goals. At the same time, he stated that "to assure that our nuclear deterrent remains unquestioned under a test ban, we will explore other means of maintaining our confidence in the safety, the reliability, and performance of our own weapons." He directed the Department of Energy and the Department of Defense to formulate a program - the Science-Based Stockpile Stewardship (SBSS) program - which would accomplish this goal without underground nuclear testing.

The Science-Based Stockpile Stewardship program requires the continued use of selected existing facilities and programs as well as a limited set of new facilities, strengthened integration of program areas, and a long term commitment to support these programs. The National Ignition Facility (NIF) is one of the facilities proposed for construction under the Stockpile Stewardship Plan.

Both the U.S. Congress and the President have directed the Secretary of Energy to ensure that the stewardship program preserves the core intellectual and technical competencies of the U.S. in nuclear weapons without nuclear testing and without new nuclear weapons development and production. NIF contributes to the mission of Stockpile Stewardship through supporting the examination of some of the basic physical processes involved in nuclear weapons operation and by retaining and attracting talented scientists and engineers.

Compared to the Nova facility currently operating at Lawrence Livermore National Laboratory, the National Ignition Facility will reach 40 times greater energy and allow experiments to be performed in larger and more complex geometries and at higher temperatures and densities. In the absence of nuclear testing, scientists will attempt to approximate using computer code models the performance of an integrated nuclear device. The Accelerated Strategic Computing Initiative is the stewardship program element designed to improve U.S. computational capability. Experimental facilities such as NIF which, whether ignition is achieved or not, can address without nuclear testing some of the physics that controls the behavior of nuclear weapons, will be used to validate and benchmark these codes. The NIF is the stockpile stewardship facility that comes closest to the high energy density regime that relates to nuclear weapon secondaries and some aspects of boosted primaries than any other Stockpile Stewardship facility. While the Atlas facility could address some issues related to secondaries and boosted primaries, it cannot reach NIF's high energy densities and temperatures. Furthermore, only NIF offers the promise of thermonuclear ignition.

### **NIF for Commercial Energy and Basic Science:**

NIF will be used as a multipurpose, multi-use facility. NIF is designed to achieve thermonuclear (fusion) ignition in small fuel-containing capsules and to produce more fusion energy output than laser energy input with enough driver energy. Demonstration of fusion ignition and energy gain is a necessary step in development of inertial confinement fusion (ICF) for commercial energy. Successful research on ICF may lay the foundation for utilization of fusion as a nuclear energy source in lieu of fission. This would enhance nonproliferation efforts, since nuclear fusion would not produce plutonium and would not involve enrichment, reprocessing, or other technologies with greater proliferation potential.

The unique properties of NIF are attracting a broad spectrum of interest from the international scientific community for basic scientific applications. Although diverse programs of scientific research have been conducted at large lasers in the United Kingdom, France, Germany, and Japan, information on equivalent research in the U.S. has been restricted because of past substantial classification requirements on much of the research and development associated with the inertial confinement fusion (ICF) program. Recent changes in U.S. classification guidelines have modified the atmosphere for research at NIF, with the result that U.S. scientists are scoping out a program of basic and applied research that could be accomplished openly at the NIF. Potential areas of study include:

- Inertial Fusion Energy:** Commercial energy production is a long term goal of ICF in the United States and many other countries.
- Astrophysics:** Primordial nucleosynthesis, stellar evolution, stellar fusion, hydrodynamic flow, and instabilities in supernovae.
- Hydrodynamics:** Fluid flow at extremely high velocities and densities.

- Material properties: Equations of state, radiative properties of matter, viscosity of materials. Data obtained in these areas are important for inertial confinement fusion, astrophysics, planetary physics, and hydrodynamics.
- Plasma physics: The luminous matter in the universe is mostly composed of plasma. NIF will produce hot dense plasmas, large and homogeneous enough to permit detailed characterization of a variety of plasma properties.
- Radiation sources: Intense pulses of x-rays, coherent amplified x-rays (x-ray lasers), gamma rays, and intense neutron pulses. Such radiation has many practical applications: studies of radiation absorption and other material properties, x-ray sources for heating materials to provide appropriate conditions for other experiments, and the production of x-ray lasers. Two commercial applications of x-ray lasers are lithography for increased computer chip capacities and holography for biomedical applications.
- Radiative properties: Atomic structure of matter, diagnostics of the plasma state, and numerous other applications.
- Other potential applications: Non-linear physics, geophysics, other atomic physics applications, and optical physics and instruments.

## TECHNICAL ANALYSIS OF PROLIFERATION IMPLICATIONS:

### A. Overview:

#### How Does a Thermonuclear Weapon Work?

Modern thermonuclear weapons consist of two stages: a *primary* stage (fission trigger) and a *secondary* stage (fusion). The purpose of the primary is to produce x-rays to implode the secondary to ignition conditions. The secondary is the stage that produces high yields for modern U.S. strategic weapons -- typically hundreds of kilotons (kt). The primary contains a subcritical pit of fissile material, generally plutonium, surrounded by a layer of chemical high explosive (HE). The HE is detonated, burns rapidly, and compresses the pit. The implosion of the pit increases the density of the fissile material to super criticality, leading to a fission chain reaction and rapid heating. X-rays from the hot exploding primary are then channeled by a radiation case to the secondary where they implode the secondary.

To increase their efficiency, modern primaries can employ a process called *boosting*. In boosted primaries the pit contains deuterium and tritium (DT) gas that is compressed and heated. The DT gas undergoes fusion producing copious quantities of energetic neutrons that flood the compressed pit. The extra burst of neutrons causes significant additional fission reactions that "boost" the primary yield to a much higher value. If the primary fails to boost properly, its yield may be inadequate to drive the secondary resulting in weapon failure.

#### The Stockpile Stewardship Mission:

In 1993, President Clinton directed the Department of Energy to maintain the safety, reliability, and performance of the remaining post START II nuclear arsenal without nuclear testing. This Stockpile Stewardship mission requires the means to evaluate existing weapons and could entail certifying rebuilds or re-manufactures of existing weapons for safety and reliability as they age.

To advance the goal of concluding a Comprehensive Test Ban Treaty at the earliest possible date and to secure the strongest possible treaty, President Clinton announced support for a "zero" yield treaty on August 11, 1995. In making this announcement, the President also established the "concrete, specific safeguards that define the conditions under which the United States can enter into a CTBT". Of the six safeguards outlined, the first two relate to the stockpile stewardship program:

- "A) Conduct of a Science-Based Stockpile Stewardship program to ensure a high level of confidence in the safety and reliability of nuclear weapons in the active stockpile, including the conduct of a broad range of effective and continuing experimental programs.

- B) Maintenance of modern nuclear laboratory facilities and programs in theoretical and exploratory nuclear technology which will attract, retain and ensure the continued application of our human scientific resources to those programs on which continued progress in nuclear technology depends".

Although a primary role of NIF in Stockpile Stewardship will be to maintain the core intellectual and technical competency of the U.S. in physics related to nuclear weapons in a more generic sense, NIF could also provide specific data to improve the predictive power of computer codes relevant to some of the processes that take place in secondaries, and perhaps in boosted primaries. Specific classified experiments can indirectly examine some aging phenomena, such as phenomena that could affect radiation flow and radiation-driven implosions. For example, an experiment has been done on the Nova laser to validate a code which was then used to assess an age-related defect. NIF with its higher energy densities would allow more realistic conditions for such assessments.

### **Vertical Proliferation and New Nuclear Weapons**

The term 'vertical proliferation' in this study refers to increases in the numbers of nuclear weapons or warheads or the development of new nuclear weapons. A new nuclear weapon would typically involve a substantially new warhead design concept or advanced weapon concept (a new type of nuclear weapon). Advanced weapon concepts could include such concepts as enhanced electromagnetic pulse weapons, nuclear directed energy weapons including microwave weapons, and enhanced radiation weapons. The United States is now in an era of no new nuclear weapon development and of rapid dismantlement of nuclear weapons and warheads. The purpose of stockpile stewardship - to maintain the safety and reliability of remaining U.S. nuclear weapons without nuclear testing - is not considered vertical proliferation. By the same token, repackaging an existing design to add additional safety features or to remedy an aging defect should not be considered to be development of a new nuclear weapon since it does not involve a new warhead design concept or an advanced weapon concept.

### **Approach of Technical Analysis Section:**

Areas of research at NIF include research needed to achieve ignition, research related to developing inertial confinement fusion (ICF) as an energy source, research in basic science, and research for weapons-related science. This technical analysis will explore the broad spectrum of potential research that could be done at the NIF and analyze each area for its potential vertical and/or horizontal proliferation impact. Present classification guidelines were reviewed to distinguish what would be available to U.S. weapons scientists as opposed to that available to other scientists, including those from foreign countries. Finally, numerous issues were explored related to what the U.S. could do with information gained from the NIF and what other countries could do. This study assumes, in its analysis of vertical proliferation on the part of the United States, that all of the other proposed U.S. stockpile stewardship facilities are also available.

One goal of the NIF is to demonstrate fusion ignition and burn in small laboratory capsules--a major scientific and technological undertaking that makes use of some of the same basic physics used for thermonuclear weapons. Research at NIF would involve matter at conditions of temperature and density that come closer to those of thermonuclear weapons than any other existing laboratory facility. The quest to achieve fusion ignition and burn at NIF involves some of the same basic physical processes as those for thermonuclear weapons and requires mastery of physics issues similar to those encountered in such weapons. What is different is that NIF achieves these conditions only over a very tiny volume--for example, approximately one millionth to one ten-millionth the volume of a nuclear weapon secondary. Furthermore, only a few individual weapon-relevant processes can be studied at NIF in each experiment.

Since only "microscopic" (on a laboratory scale much smaller than actual weapon size) physics experiments can be performed at NIF, NIF will not be able to perform proof-testing of any nuclear device nor can it substitute for an integrated test of weapon performance. NIF could provide some input data that could be used in the calculations of a prototypical device, but there would be few, if any, past nuclear test data that could be directly compared to the calculations for development of a new type of nuclear weapon. Although NIF may provide some help in extrapolating the calculated results to past test data for some subset of phenomena, it would be problematic for all others. Thus, because the volume of material that can be investigated on NIF is about one millionth the volume of a secondary and because NIF cannot integrate all processes, NIF will have no role to play in direct performance testing of a new type of nuclear device, or, by the same token, any nuclear device. An integrated test of an entire nuclear weapon device is impossible on NIF. As a result, NIF or a similar facility will not be able to replace nuclear testing by the U.S. or any other state in the confident development and stockpiling of new nuclear warhead designs.

Also, the physical processes for obtaining ignition and burn are different for ICF capsules than for nuclear weapons. The burn of nuclear weapon fusion fuel is typically driven by exploding fissile material. However, efforts to achieve ICF capsule ignition and burn at the NIF will not make use of any fissile material. While ideas for experiments at NIF using minuscule masses of fissile material could be conceived, such experiments could not be performed at the NIF without a physical upgrade to NIF and further National Environmental Policy Act (NEPA) process, and there is currently no intention on the part of the Department to pursue these experiments. It should be mentioned in this context that physics experiments involving small amounts of heavy material (e.g. depleted uranium) may be considered for the NIF as it is presently designed and are likely to be possible without the need for further NEPA process. Such experiments would provide, for example, scientific data on issues like mix of such materials into burning fusion fuels with no possibility of obtaining criticality.

The same fusion processes occur during NIF target ignition as in a nuclear explosion, but they occur in a nuclear weapon on a much larger scale and simultaneously with other competing processes. Accounting for the interaction between competing processes and extrapolating many orders of magnitude to nuclear weapon size is a daunting task which would be extremely difficult without using computer codes based on decades of nuclear weapon test data on the weapon types

being studied.

What NIF will do for the United States, and what other NIF-like facilities could do for other nuclear weapon states, is allow meaningful, albeit small laboratory scale, experiments that explore some of the basic physics processes involved in weapons operation. On NIF, these processes are studied in isolation rather than in the complicated environment of a nuclear weapon explosion. The experiments will provide data that can be used to improve computer codes that model the physical processes occurring in a nuclear explosion. Such assessments are useful to evaluate the impact of individual unanticipated changes due, for example, to aging or remanufacture for a weapon that has been tested, but are much less useful for a new weapon that has not been tested.

## **B. Vertical Proliferation:**

### **What Weapons Science do U.S. weapons scientists believe is technically possible on NIF?**

This section will explore, within classification guidelines, what U.S. weapon scientists believe is technically possible at the NIF for weapons science. Although this represents a summary of the thinking of a broad variety of technical experts over a period of many years, it is always possible that some new or substantially different ideas for research in weapons science may arise in the future.

The weapons-related research possible on NIF spans the following topics:

- I. Radiation flow
- II. Properties of matter
- III. Mix and hydrodynamics
- IV. Using ignition for weapons science
- V. X-ray laser research
- VI. Computer codes
- VII. Weapons effects

Not all work which is technically possible at NIF would be done. Some areas of research are speculative and ultimately may prove unfeasible, impractical, or undesirable. For example, experiments on nuclear directed energy weapon concepts, while technically possible to explore in the first phase of NIF operation, are not planned since the Department is not developing new types of nuclear weapons.

Only some of the possible research topics (category IV and VII primarily ) require that NIF achieve ignition. A discussion of the weapon physics research, when combined with the civilian research, forms the basis for what is technically possible at NIF and its potential vertical proliferation impact.

A description of each weapons research area follows:

- I. **Radiation flow:** X-radiation emitted by the primary supplies the energy to implode the secondary in all U.S. stockpiled weapons. Understanding the flow of this radiation is important for predicting the effects on weapon performance due to changes that might arise over time. Uncertainties in the physics and the mathematical formulation for radiation flow contribute to the present degree of disagreement between theoretical models of radiation flow and the results of past underground tests. NIF experiments can be done in which radiant energy is monitored as it flows through well-defined, fixed geometries.

A major aim of an experimental radiation flow program at the NIF is to understand the range of applicability of computer models and to obtain data that would allow their refinement in the absence of testing. Radiation flow experiments have been performed in microscopic geometries at the Nova laser. At NIF, higher temperatures are anticipated, and with 40 times the energy of the Nova laser, radiation flow conditions should be closer to those in a weapon. This would permit experiments to be performed in larger, more complicated geometries than at the Nova laser, although still several orders of magnitude smaller than in a real weapon. While the conditions anticipated in NIF experiments would allow research in physical regimes closer to those existing in weapons radiation channels, the actual conditions are still different. Consequently, the results must still be extrapolated or scaled by calculations to compare them with underground test data, and improve the models derived from those tests.

- II. Properties of matter: Two properties of matter that are important at the high energy densities of a nuclear explosion are equation of state and opacity. The equation of state is the relationship among a material's pressure, density, and temperature expressed over wide ranges of these variables. Opacity is a fundamental property of how radiation is absorbed and emitted by a material. The correct equation of state is required for the accurate solution of any compressible hydrodynamics problem, including weapons design. Radiation opacities of very hot dense matter are critical to understanding the radiation flow in a nuclear weapon.

Large lasers can access regions of extreme pressure and temperature. Experiments at the Nova laser have generated the highest pressures ever measured in a laboratory, although still much less than the maximum encountered in nuclear weapons. NIF is expected to generate high enough pressures to access conditions more relevant to imploding secondaries. Also, the large energy of NIF will lead to more accurate experiments, since sample sizes will be substantially larger than those on the Nova laser.

Because the matter in a nuclear explosion is so dense and hot, it has been virtually impossible to make relevant laboratory measurements of opacity. Consequently, nuclear test data and theoretical models of opacity provide a knowledge base that still has many uncertainties for predicting weapon performance. Methods have been developed for measuring plasma opacities at the Nova laser in a fairly narrow temperature and density regime and for some of the elements directly applicable to weapons. NIF will allow significantly higher temperatures and will provide opportunities to study elements more directly applicable to weapons, such as depleted uranium. (As mentioned above, physics experiments involving small amounts of heavy material (e.g. depleted uranium) may be considered for the NIF as it is presently designed and may be possible without further National Environmental Policy Act (NEPA) process.) It should then be possible to make direct connection to opacity experiments previously conducted at the Nevada Test Site, and should greatly improve opacity modeling codes for calculating weapon performance. Even with these improved codes, however, U.S. nuclear weapon scientists would not be able to develop new nuclear weapons with confidence in the absence of testing.

- III. Mix and hydrodynamics: Hydrodynamic instabilities and the mixing of heavy material with low-density thermonuclear fuels degrade the yield of weapons. Repeated radiochemical measurements in nuclear tests have confirmed such mixing. Unfortunately, the growth of hydrodynamic instabilities into mix is a highly non-linear, chaotic process. There is presently no computer simulation of mix that can predict with complete confidence mixing in weapons. In fact, it is generally recognized that only comparing designs and analyzing past nuclear test data can provide a designer with a tolerable level of confidence in interpreting and applying mix models.

The Nova laser is currently being used to investigate the basic physics of some types of hydrodynamic instabilities. However, energy available from Nova limits the size and the time scale of evolution of mixing to much less than that of a nuclear weapon. NIF should allow studies of mixing more relevant to weapons conditions.

- IV. Using ignition for weapons science: Attaining ignition at the NIF would likely open new research topics in weapons science. ICF capsules can be modified from the baseline design to study a number of weapons physics issues on a small laboratory scale, provided the modified capsules ignite and burn. These experiments will require extensive design calculations and would be conducted only after ignition is achieved. If ignition were achieved, U.S. weapon scientists, by using ICF capsules, may be able to study physics related to some phases of boosting. Also, they could study the deleterious effects of hydrodynamics and mix on certain weapons processes and further enhance weapon codes as a result. Since these experiments would be conducted with ICF capsules that operate differently from existing primaries or secondaries, sufficient information could not be garnered from ICF experiments to allow confident development of a new nuclear weapon design. The ability to study the comprehensive physics issues that apply to any weapon, whether similar to current designs or advanced designs, is tenuous, and extrapolating to a functioning new warhead from any scaled NIF data, even with ignition, would not be reliable.

Questions have been raised regarding the applicability of NIF to concepts for pure fusion weapons. For two reasons, NIF would not be sufficient to develop a pure fusion weapon: (1) NIF targets are much too small to be a weapon; and (2) the driving mechanisms and conditions that would be required for a deliverable pure fusion weapon are entirely different than those required for ICF. The fundamental problems in developing the most complicated part of a pure fusion weapon, namely, the driver, have to do with high explosive-driven hydrodynamics, hydrodynamic instabilities and magnetohydrodynamics on a much larger scale.

- V. X-ray Laser Research: Livermore Laboratory has an on-going laboratory x-ray laser research effort at the Nova laser for peaceful applications, which is expected to continue on the NIF. Since NIF should be able to attain higher energy X-ray lasers than those achievable on Nova, this opens up the possibility that laboratory X-ray lasers can be developed at NIF that are better suited to perform X-ray microscopy, holography on

biological samples or for X-ray lithography for micro-chip manufacturing.

X-ray lasers have military applications as well as peaceful ones. For example, the results of NIF experiments could provide data for comparison with codes and could be used to further interpret the results of past underground experiments on nuclear-pumped x-ray lasers, but nuclear testing would be necessary to demonstrate that an actual X-ray laser weapon or any other nuclear directed-energy weapon will work as designed. The lasing schemes to be used for peaceful applications are not direct analogues of the nuclear-weapon pumped X-ray laser.

Questions have been raised about the applicability of NIF to the study of some principles of other nuclear driven directed energy weapon concepts such as electro-magnetic pulse (EMP) and microwave weapons. Experiments on nuclear directed energy weapon concepts, while technically possible to explore in the first phase of NIF operation, are not planned. The Department is not developing new types of nuclear weapons. Even from a strictly technical standpoint, experiments on directed energy weapon concepts are considered highly speculative and NIF would only be able to play a very limited role in addressing some of the physics aspects of such weapons, and then, only on a small laboratory scale.

In conclusion, research on X-ray lasers has multiple applications and therefore, it would be unwise to restrict peaceful research in this area in the interest of preventing weapon development. A program to develop any advanced new nuclear weapons at NIF through a series of experiments would be visible to Congress.

- VI. Computer Codes: The development of nuclear weapons has depended heavily on use of complex computer codes and supercomputers. The codes encompass a broad range of physics including motion of material, transport of electromagnetic radiation, neutrons and charged particles, interaction of radiation and particles with matter, properties of materials, nuclear reactions, atomic and plasma physics, and more. In general, these processes are coupled together in complex ways applicable to the extreme conditions of temperature, pressure, and density in a nuclear weapon and to the very short time scales that characterize a nuclear explosion.

ICF research requires codes that have some similarities to codes used in nuclear weapons research. However, the very small time and-space scales inherent in ICF experiments mean that certain approximations usually employed in standard weapons calculations are not valid. ICF targets will require more accurate computer models in some areas than those useful for weapons. Conversely, some models needed for weapons calculations are not needed for ICF. More time-consuming computations will be needed to adequately represent the physics and develop the engineering requirements needed for ICF ignition.

Code development for ICF, especially as applied to NIF, can assist nuclear weapons science in two ways: providing improved computational methods and physics models (i.e.,

those with improved computational accuracy or the ability to study three-dimensional effects) to address weapon design problems; and designing microscopic weapons physics experiments to be conducted at NIF.

- VII. Weapons effects: Nuclear weapons effects used to be investigated by exposing various kinds of military and commercial hardware to the radiation from actual nuclear explosions. These tests were generally conducted in tunnels at the Nevada Test Site and were designed so that the hardware was exposed only to the radiation from the explosion and not the blast. Based upon the data obtained, the equipment was "hardened" to reduce its vulnerability during nuclear conflict.

Without nuclear testing, radiation must be simulated in laboratory research facilities and by numerical calculations. The NIF is currently expected to provide radiation at energies in parts of the X-ray spectrum not available from other facilities and, as such, it would be a valuable complement to the present set of tools for weapons effects. Without ignition, there are several proposals for X-ray production using NIF lasers that may produce X-ray environments of interest for nuclear weapons effects simulation. If ignition is achieved, calculations indicate a significant number of warm X-rays should be possible, substantially more than with present simulators.

Ignition would also provide significant quantities of energetic neutrons that are important to determine the vulnerability of a weapon. The energetic neutrons could in turn be used to produce gamma rays which are also used for studying weapons effects. The neutron output might be enhanced by use of neutron multipliers created by using, for example, a subcritical assembly of fissile material. However, since such multipliers use fissile material, such experiments could not be performed at the NIF without physical upgrade to NIF and further NEPA process, and there is no intention on the part of the Department to pursue these highly speculative experiments.

While many weapons effects applications apply to situations in space or the atmosphere in connection with a conjectured anti-ballistic missile battle involving nuclear interceptors, there have also been many studies involving ground coupling, collateral damage and electro-magnetic pulse effects. NIF will also be able to generate significant shock waves and to cause irradiated matter to reach extreme conditions of temperature and pressure, producing data needed for scaled studies of the effects of shocks and mixing produced by nuclear and conventional explosions. Further study would be needed to consider many of the practical issues required for designing a useful capability for such weapons effects at the NIF, if that were deemed desirable.

### **C. MANAGING THE VERTICAL PROLIFERATION CONCERN AT NIF:**

Some experiments at NIF (approximately 20% of total experiments) will, of necessity, be classified. Classified guidelines for ICF research are discussed in Appendix II. This will make it difficult for the United States to avoid arousing suspicions that the NIF is being used to design new, advanced thermonuclear warheads, and thereby appearing to contribute to vertical proliferation and a new arms race. Countering such suspicions will be one of the chief challenges facing operators of NIF.

There are several ways in which the United States can assure the American public and other countries that NIF is not contributing to vertical proliferation.

- (1) Approval and funding commitments from the U.S. Executive Branch and the Congress are required throughout the weapon research and development process. The Administration and the Congress can ensure that the weapons laboratories are not engaging in research and development at NIF that encourages vertical proliferation or contravenes U.S. policy.
- (2) Section 3152 of P.L. 103-337, entitled "Approval for Certain Nuclear Weapons Activities", requires the Nuclear Weapons Council, through the Secretary of Energy, is required to submit to the Congressional Defense Committees a report, in classified form, which describes all of the activities conducted by the DOE during that fiscal year, or planned to be conducted in the next fiscal year for "the study, development, production, and retirement of nuclear warheads". This report shall include a description of "the degree to which such activity or study is consistent with United States policy for new nuclear warhead development or warhead modification and with established or projected military requirements." Thus, Congress will retain necessary access to ensure that the NIF is not being used for the development of new nuclear weapon types.
- (3) Unilateral Openness Measures at NIF:

In planning for NIF operations and experiments, the Department of Energy is considering unilateral openness measures that would help avoid misperceptions about NIF's purposes, capabilities and activities. The goal of these measures is to reassure both the U.S. public and other nations that the NIF is not being used to develop new types of nuclear weapons and to build public confidence that research undertaken there is not contributing to proliferation.

Specific measures relating to classified experiments will also be valuable. Possible measures might include:

- Public discussion of the technical capabilities of NIF and types of nuclear weapons information that can be obtained from NIF experiments generally;
- A published roster of planned unclassified and classified experiments;

- Review of classified research by outside scientific and policy experts; and
- Release of certain information about the purposes of some experiments.

International collaboration at NIF on unclassified experiments means that the NIF will be populated by non-cleared and non-U.S. scientists much of the time. It would seem implausible that the United States would choose such an open facility at which to develop innovative new nuclear weapons. This will go far to enhance openness and transparency at NIF as well as build confidence internationally that the NIF is being used for the stated Stockpile Stewardship purposes and that work at NIF is of high scientific value.

The need for openness measures at NIF will need to be balanced against the competing need to protect sensitive information about classified experiments which would be of value to potential proliferators.

## **D. HORIZONTAL PROLIFERATION**

### **Technical Factors That Mitigate Utility of ICF for Proliferation:**

There are a number of technical factors that make it difficult for proliferators to apply information openly available through publication of data from any ICF facility directly to the development of nuclear weapons:

- ICF technology lacks basic relevance for a first generation fission device.
- An ICF capsule is not a nuclear weapon secondary and ignition and burn in ICF capsules proceed quite differently from that in thermonuclear secondaries. Strategic thermonuclear secondaries having very large yields operate very differently than ICF capsules.
- ICF capsules are extremely sensitive to details in the path to ignition. The energy generated by a nuclear weapon primary which is available to implode the secondary is approximately 100,000 times the energy required for ICF capsules. Also, ignition in ICF capsules proceeds differently than ignition of the boost gas in primaries. Thus, information on ICF capsule ignition adds little that is useful for weapons design by a proliferator.
- Although conditions of energy density anticipated for NIF and some foreign facilities are closer to those in nuclear weapon explosions than other ICF facilities, the energy involved is still many orders of magnitude less, i.e., factors of one millionth to one ten-millionth. Also, the volume to be studied at the NIF is one millionth to one ten-millionth the volume of a thermonuclear secondary. Extrapolating the results from a "microscopic" experiment to the size of a full-scale nuclear device without past nuclear test data is extremely difficult. Even for the nuclear weapon states with access to nuclear test data, such extrapolation is not straightforward.
- Because of the large difference in scale and method of ignition between an ICF capsule and a nuclear weapon, mix models developed for ICF capsules may be inappropriate for nuclear weapons. It can never be clear from laboratory ICF research alone just what mix modeling and information is relevant or applicable to nuclear weapons design. To make that connection, it would be necessary to have mix data from nuclear weapon tests.
- Although experimental data on light weight materials at NIF could be used indirectly to improve some opacity codes for heavier materials, these data are far less useful than detailed spectral information on heavier materials which would remain classified.

Factors such as the small size of an ICF capsule and differences in how secondaries and ICF capsules ignite make unclassified ICF research not directly useful for potential proliferators. Utility of ICF data would be greatly enhanced if the proliferator already possessed sophisticated computer codes and access to data from past nuclear tests. Furthermore, it should be noted that

scientists in other high energy density fields such as astrophysics and plasma physics, who have a need for high energy density calculations, are beginning to publish openly, both in the United States and in other countries, information of the type that NIF will produce. Therefore, the most important technical means of preventing nuclear proliferation relate more directly to nuclear weapons, such as controlling production of fissile material, preventing the spread of classified information about nuclear weapons design and nuclear weapon test data, prohibiting nuclear weapon testing, and preventing espionage.

### **Proliferation by Other States:**

Proliferation by other countries as a result of access to ICF or unclassified NIF data is best examined according to the level of a country's capability in the area of nuclear technology. The categories below reflect the nuclear weapon development path taken by the United States. It is likely, but not guaranteed, that proliferators would follow a similar path. If proliferators followed a different path, these categories are still useful as indicators of technical sophistication. Some states may attempt to preserve the option to "break-out" of non-nuclear weapon state status by, among other actions, acquiring large amounts of fissile material through reprocessing and maintaining a cadre of scientists who understand the physics that relate to nuclear weapon secondaries and some aspects of boosted primaries under the guise of working on a legitimate peaceful nuclear activity such as ICF. Some have termed this phenomenon "latent proliferation". Hence, the categories listed below relate to a state's capability to develop a certain type of nuclear weapon technology, rather than necessarily already possessing such weapons. The term 'proliferator' would imply that a country has a willful intent to use a given capability to develop nuclear weapons or has already done so. States may be divided into four categories, according to the level of a country's nuclear-technological capability:

1. Entry-level proliferators that seek the capability to develop simple, unboosted fission devices, or to actually develop such weapons;
2. Second-level proliferators who possess the capability to develop simple fission devices, or who actually possess such weapons, and who may seek the capability to reduce fissile material use and improve weapon yield and delivery capability, possibly by means of boosting;
3. Advanced proliferators with the capability to design and field boosted or unboosted primaries, or who already possess such weapons, and who seek the capability to develop thermonuclear weapons or to improve them; and
4. Declared nuclear weapon states with the capability to (a) conceive, design, and produce thermonuclear weapons with state-of-the-art yield-to-weight ratios and (b) conceive and design nuclear explosives for directed-energy or other advanced weapon purposes.

What follows is an analysis of the potential utility of ICF data to each category of proliferator:

### **Value of ICF to Category One Countries**

In seeking to develop simple, unboosted fission devices, entry-level proliferators in Category One would have to be able to assemble adequate fissile material into a critical mass. This could be accomplished by using propellants to drive one sub-critical mass into another sub-critical mass (gun assembled device) or by using high explosives to compress the material (implosion device).

Most of the information associated with development of simple fission devices is understood at levels significantly more sophisticated than the estimates used in the 1940s. Such information is readily available in the open literature and is widely disseminated. A state in a pre-Category One or Category One status would optimize the investment of its resources in improved hydrodynamics associated with high explosives and fissile material compression and an improved capability to produce neutron generators. These issues are unrelated to NIF and ICF.

If a Category One proliferator conducted ICF experiments using heavy metals such as depleted uranium, he could gain limited data that might help him evaluate radiation transport and opacity codes and improve his calculations of the explosion phase. However, these improvements would have a very minor impact on the performance of his weapons.

Thus, ICF technology lacks basic relevance for developing a first generation fission device, the simplest and most common route for proliferation. A Category One proliferator would find NIF to be of virtually no value. Other factors are of greater importance in providing what would be required to become a Category One proliferator, or to move to Category Two.

### **Value of ICF to Category Two Countries**

A Category Two state possesses the capability to develop a simple single-stage device, or has already done so, and would seek devices with higher yield-to-weight ratios and more efficient utilization of fissile material. A longer-range plan to develop thermonuclear secondaries would lead such a state to consider how to improve the properties of its primaries by producing more yield in smaller masses of material. Boosting provides a way to achieve these goals, but requires the proliferator to possess more advanced technological skills than required for development of a simple fission device.

The U.S. moved very quickly into boosted primary designs by nuclear testing in the early 1950s using technology considered rudimentary today. The current state of available knowledge and available computers and computer codes is considerably better than in the 1950s.

Research in ICF could provide a Category Two state with a cadre of knowledgeable individuals who could enhance computer codes related to weapons design activities associated with equations of state, instability and mix at interfaces, deuterium-tritium (DT) implosions, and DT burn. NIF and, to a lesser degree, other openly available ICF might help a Category Two state discover significant errors in its codes. Thus, ICF or unclassified NIF data could be of indirect value in helping develop and maintain a cadre of knowledgeable people under the guise of a legitimate scientific activity.

However, because of the great complexity of the boost process and the difference between the regimes in ICF and of fissile compression of DT gas (temperature, pressure, scale size, mix, etc.), it is highly unlikely that the results of ICF experiments would help ensure that a specific device will indeed boost as designed. Indeed, ICF data including those from NIF would not be necessary for a Category Two proliferator to develop a boosted primary. While proliferant nations may not choose to require such a level of confidence, it remains true that only nuclear explosive tests could verify the performance of optimized designs beyond simple fission weapons.

### Value of ICF to Category Three proliferators

A Category Three proliferator would have the capability to field unboosted or boosted primaries with a variety of yields and intended applications, or actually possesses such weapons. In order to predict correctly primary explosion output, it would need a full cadre of individuals skilled in neutron transport, criticality, shock hydrodynamics, implosion phenomena, instability and mix, equation of state for various fuels, thermonuclear burn, and radiation transport. To pursue secondary designs, a Category Three proliferator would require improved capabilities in X-ray transport, equation of state, and thermonuclear reactions.

The thermonuclear warheads developed by the U.S. and USSR in the 1950s were huge, heavy and designed for delivery by large aircraft rather than missiles. It was through an extensive nuclear testing program that thermonuclear warheads were made lighter and more deliverable. Without nuclear testing, it is probable that a proliferator would not be able to develop a highly deliverable thermonuclear weapon, but depending upon his motivations for developing the weapon, the proliferator may not require long-range deliverability. A modern, sophisticated proliferator with access to ICF computer codes and today's computer workstations would have far more tools for designing a secondary than the U.S., U.K. or USSR had in the 1950s or France and China in the 1960s. Furthermore, many of the basic concepts have been declassified. Regardless of access to the NIF or any other ICF facility, one cannot rule out that a technologically advanced country would be able to field a very conservatively designed thermonuclear weapon that would present a credible threat without nuclear testing. However, without nuclear test data, it would be very difficult for a proliferator to minimize the amount of fissile material in the weapon (which may be highly desirable if his access to fissile material is limited) while remaining confident in its reliability.

An ICF program could allow a Category Three proliferator to maintain a knowledgeable cadre of individuals under the guise of a legitimate scientific activity. This could assist an advanced industrialized nation to preserve its option to develop somewhat more rapidly thermonuclear weapons if it so decided. ICF data could be used for the improvement of computer codes for radiation transport and hydrodynamics and studies of radiation flow might help a Category Three state discover that there are gross errors in its codes. However, extrapolating these to nuclear weapon regimes would be uncertain. Past nuclear test data would be of great advantage. ICF data would not provide the capability to calculate and benchmark thermonuclear fuels, which is very important for the development of an efficient thermonuclear weapon. No ICF experiment is possible that will provide a proliferator with the data required to ensure that a specific secondary will indeed work as designed. However, as for a Category Two proliferator, a Category Three proliferator also may not require a high level of confidence in its weapons.

A Category Three proliferator could be sophisticated enough to gain some benefit from ICF experiments that is relevant to some physics aspects of advanced designs, such as enhanced radiation weapons. Again, however, his ability to study enough of the physics issues that apply to these weapons is limited, and extrapolating to a functioning warhead from scaled ICF data would be extremely tentative without past nuclear test data. NIF cannot proof-test any nuclear weapon design.

#### **Value of ICF to Declared Nuclear Weapon States:**

The final category consists of the five declared nuclear weapons states: the United States, the United Kingdom, France, Russia, and China. These states have explored a wide range of nuclear weapons designs including a variety of unboosted and boosted primaries, secondaries, and for some of the countries, preliminary investigations into advanced weapon designs, such as nuclear directed-energy designs. The principal tool used by these states to verify the performance of their weapons has been nuclear testing. In the absence of testing, the historical database possessed by these countries from their past nuclear tests will be the most significant factor in maintaining their stockpiles.

In this context, the principal value of NIF to the U.S. Stockpile Stewardship program will be in helping to maintain a knowledgeable scientific cadre and to continue to verify the validity of calculational methods and databases. Under a test ban, only computer calculations will be able to approximate the operation of an entire nuclear weapon. ICF research has value in helping to maintain nuclear weapon expertise and to validate calculational methods.

It may be possible that some of the micro-physics regimes of directed-energy nuclear weapon concepts could be investigated on a facility like NIF. However, the energy required to prove that a full-scale nuclear directed-energy weapon would work as designed is many orders of magnitude over what is attainable at NIF. Experience has shown that simple scaling will probably not apply over such a large range. Nuclear testing using near-full scale versions of a device would be

necessary for any of the nuclear weapon states to develop nuclear directed-energy weapons with any confidence. Even with such testing, the U.S. was unable to develop an X-ray laser weapon within the time and resources provided.

### **Conclusions:**

This discussion of four categories of states illustrates that the value of ICF or unclassified NIF data for nuclear weapons depends on the level of technical sophistication in the nuclear weapon-related technology of a given state and access to a nuclear test database. In general, without access to data from nuclear tests, ICF or unclassified NIF data would be of very limited utility to proliferators.

**E. MANAGING THE HORIZONTAL PROLIFERATION CONCERN AT NIF:**

There is an inherent tension within the Treaty on the Non-Proliferation of Nuclear Weapons (hereinafter referred to as the Nuclear Nonproliferation Treaty or NPT) itself between, on the one hand, sharing technology and information on peaceful uses of nuclear energy and, on the other, preventing the spread of technology and information that could be used to develop nuclear weapons. While Article IV of the NPT obligates its parties:

*"to facilitate... the fullest possible exchange of equipment, materials, and scientific and technological information for the peaceful uses of nuclear energy",*

Article I obligates the nuclear weapon states:

*"not to transfer to any recipient whatsoever nuclear weapons or other nuclear explosive devices or control over such weapons or explosive devices directly, or indirectly; and not in any way to assist, encourage, or induce any non-nuclear weapon State to manufacture or otherwise acquire nuclear weapons or other nuclear explosive devices, or control over such weapons or explosive devices".*

In judging the proliferation risk of the NIF, it should be recognized that tensions implied by the overall NPT regime apply to the NIF as well. Examining whether the NIF is on balance a benefit or a detriment to the nation's nuclear nonproliferation efforts should not reopen the existing nonproliferation bargain. The United States must balance these competing obligations in its operation of NIF as well as its other nuclear research facilities.

Any ICF facility raises concerns about proliferation because some of the computer codes that are used to predict behavior of an ICF pellet have much in common with codes used to design boosted primaries and secondaries and because ICF activity increases the size of the community of international scientists who are knowledgeable about some of the basic physics processes that occur in nuclear weapons. Access to such information is already being provided internationally through legitimate scientific research and ICF development for science and energy. Research at facilities in Japan, Germany and Russia is being published in the open literature. University scientists throughout the world are developing sophisticated computer codes for ICF and other basic sciences, such as astrophysics, and that are similar in principle to some of the codes or models used in nuclear weapons calculations.

Recognizing the openness of foreign ICF programs and the positive value of openness as an obligation under Article IV of the NPT, the Department of Energy has recently declassified a great deal of the ICF program, with the exception generally of classified computer codes, calculational results using those codes, and experimental data above certain thresholds. Appendix II summarizes key changes in DOE classification guidance and the weapon related research that remains classified. This increased openness directly applies to the NIF and generates a signal that

a great deal of the research at NIF will be carried out as an international cooperative program.

The DOE review of ICF classification (*Inertial Confinement Fusion Classification Review Final Report*, U.S. Department of Energy, Washington, DC HQ DP20.9001770, March 19, 1991) attempted to eliminate restrictions on information relevant to energy applications of ICF and to foster open cooperation. The review was conducted in conjunction with other U.S. government agencies, and the proliferation potential of ICF data was a key factor in determining what information could be released. As a result of the review, new ICF classification guidance was released (*Classification Bulletin, Declassification of Inertial Confinement Fusion Information (U)*, U.S. Department of Energy, Washington, DC, OACOK-93-027, 1994), opening up a substantial amount of research which had been previously classified by the U.S. but published by other countries, despite U.S. diplomatic pressures.

At the same time, the Department of Energy is committed to operating the NIF in a way which minimizes any proliferation risk. Several measures will be important to implement at NIF in this regard; for example:

(1) Restrict Access to NIF for Certain Foreign Scientists:

While the NPT encourages peaceful cooperation, U.S. nonproliferation policy discourages nuclear cooperation with non-NPT parties and with those parties which are not complying fully with their NPT or their safeguards obligations. Collaboration on unclassified research at NIF can be limited to scientists who are from countries with impeccable nonproliferation credentials. Researchers can be excluded who are from certain categories of countries (non-adherents of the Nuclear Nonproliferation Treaty, states that have unresolved International Atomic Energy Agency (IAEA) safeguards compliance issues, or other countries that the United States suspects are developing nuclear weapons). Also, limits on access to specific parts of the facility could be placed on certain participants.

(2) Screening procedures for Proposed Experiments:

Department of Energy classification policy defines the basic dividing line between what U.S. weapons scientists could do, and what other scientists could potentially do or discover in the open scientific literature from unclassified research at the NIF. U.S. classification guidelines will restrict the kind of information that can be released from NIF experiments and the kind of experiments that can be performed by unclassified and non-U.S. scientists. This places severe limits on the weapons-related utility of NIF for non-U.S. scientists (see Appendix II). However, it should be recognized that as other international ICF programs advance to the level of NIF, our classification of certain information can serve only as a temporary stop-gap to the flow of high energy density data to other countries. The United States may decide to invest more diplomatic capital in the quest to prevent ICF codes and other information that relate directly to weapons regimes from

being published by other countries.

A proliferator's intention to attempt to use NIF data for nuclear weapons purposes might be evidenced by:

- the use of certain materials such as fissile material or certain fusion fuels at special conditions of temperature and density;
- the proposed experiment's relation to weapon computer codes;
- a states' access to past nuclear test data;
- specific weapons applications;
- the proposed experiment's relation to weapon effects.

Denying conduct at NIF of these categories of experiments that have obvious or specific nuclear weapon development applications can be accomplished by:

- Review by a team of U.S. government experts in weapons design, classification and proliferation and/or a cleared group of scientists;
- Open scientific review to ensure that the experiment has scientific merit.

The United States should be active in encouraging these types of screening procedures at ICF facilities in other countries.

## POLICY ISSUES

### A. IMPACT ON COMPREHENSIVE TEST BAN TREATY (CTBT) NEGOTIATIONS

The United States government is committed to conclusion of a Comprehensive Test Ban Treaty (CTBT) at the earliest possible date. Key to U.S. willingness to negotiate a CTBT and live under its provisions is its ability to exercise a nuclear stockpile stewardship program in the absence of nuclear testing. To advance the goal of concluding a Comprehensive Test Ban Treaty at the earliest possible date and to secure the strongest possible treaty, President Clinton announced support for a "zero" yield treaty on August 11, 1995. In making this announcement, the President also established the "concrete, specific safeguards that define the conditions under which the United States can enter into a CTBT". Of the six safeguards outlined, the first two relate to the stockpile stewardship program:

"A) Conduct of a Science-Based Stockpile Stewardship program to ensure a high level of confidence in the safety and reliability of nuclear weapons in the active stockpile, including the conduct of a broad range of effective and continuing experimental programs.

B) Maintenance of modern nuclear laboratory facilities and programs in theoretical and exploratory nuclear technology which will attract, retain and ensure the continued application of our human scientific resources to those programs on which continued progress in nuclear technology depends."

The National Ignition Facility, in its twin roles of maintaining the reliability of U.S. nuclear weapons by studying the relevant physical regimes that relate to nuclear weapon secondaries and of attracting and maintaining talented scientists and engineers, directly supports Safeguards A and B and thereby, can contribute positively to meeting the President's conditions for U.S. participation in a global CTBT.

On August 11, 1995, President Clinton elaborated that the United States is pursuing a zero-yield test ban treaty. Consistent with its 1975 statement at the first Nuclear Nonproliferation Treaty (NPT) Review Conference, the United States does not consider inertial confinement fusion to be a nuclear explosive device under the meaning of the NPT, and accordingly any nuclear energy release from experiments at the NIF should not be considered a "nuclear explosion" of any yield under the CTBT.

The CTBT will impede development of nuclear weapons by preventing nuclear testing. NIF will not undercut this objective. NIF cannot be used to develop and proof-test any nuclear warheads and NIF experiments cannot be used as a functional substitute for a nuclear explosive testing program. Furthermore, from a policy standpoint, this Administration is not planning to develop any new types of nuclear weapons.

A prohibition on ICF research would garner minimal international support, and some outright opposition. During the CTBT negotiations, several countries such as Iran and Indonesia

proposed that the CTBT ban any experiments related to nuclear weapons maintenance or development, including for example, computer simulations. India has tabled language that the CTBT ban "any release of nuclear energy caused by the assembly or compression of fissile or fusion material by chemical explosives or other means..." (India, CD/NTB/WP.244, dated June 29, 1995). However, ICF programs are being pursued by nuclear weapon states and non-nuclear weapon states parties to the Nuclear Nonproliferation Treaty (NPT). The Germans and Japanese as well as other nations have substantial investments in ICF technology for peaceful purposes, and France is planning to build a large megajoule laser facility in Bordeaux.

## **B. IMPACT ON THE TREATY ON THE NON-PROLIFERATION OF NUCLEAR WEAPONS (NPT)**

### **Treaty on the Non-Proliferation of Nuclear Weapons (NPT) Background:**

The foundation of the Treaty on the Non-Proliferation of Nuclear Weapons (hereinafter referred to as the Nuclear Nonproliferation Treaty or NPT) is the agreement among the five nuclear-weapon states and the non-nuclear weapon states party to the Treaty, whereby the nuclear weapon states promise to refrain from transferring nuclear weapons to other nations and the non-nuclear weapon states forswear acquisition of such weapons. The nuclear weapon states further promise to cooperate with the non-nuclear weapon states in development of applications of nuclear energy for peaceful purposes (Article IV), and the non-nuclear weapon states agree to place their civil nuclear activities under full-scope safeguards administered by the International Atomic Energy Agency (IAEA) to ensure that nuclear materials are not diverted to weapons. Finally, each of the parties is bound to pursue negotiations in good faith on effective measures to end the nuclear arms race and achieve total nuclear and general and complete disarmament (Article VI). The Treaty, which entered into force in March 1970, was extended indefinitely in May 1995.

### **History of ICF and the NPT:**

At the first NPT Review Conference in 1975, the Swiss expressed concern that the NPT might affect ICF research in non-nuclear weapon states. At that time, the United States made the following statement:

*"Certain questions have been raised by the delegation of Switzerland related to the development of a potential source of energy, and its relation to the NPT. As we understand it, the question related to research which has been reported, involving nuclear reactions initiated in millimeter-sized pellets of fissionable and/or fusionable material by lasers or by energetic beams of particles, in which energy releases, while extremely rapid, are designed to be, and will be non-destructively contained within a suitable vessel. On the basis of our present understanding of this type of energy source, which is still at an early stage of research, we have concluded that it does not constitute a nuclear explosive device within the meaning of the NPT or undertakings in IAEA safeguards agreements against diversion to any nuclear explosive device."*

No NPT party objected to this statement regarding ICF and the NPT at the time nor since, although some NPT parties have proposed Comprehensive Test Ban Treaty (CTBT) language that could be considered to cover ICF as a prohibited activity under a CTBT.

### **Article VI: Nuclear Arms Control and Disarmament:**

Article VI of the NPT calls for all of the parties to the NPT to undertake "to pursue negotiations

in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a Treaty on general and complete disarmament under strict and effective international control." At the 1995 NPT Extension Conference, the non-nuclear weapon states weighed the evidence presented by the nuclear weapon states that the latter were implementing their obligations under Article VI. On the whole, the non-nuclear weapon states welcomed the actions taken by the United States and Russia to reduce nuclear arsenals.

Although consensus was reached that a majority of NPT parties supported indefinite extension, states party to the treaty also established a list of "Principles and Objectives for Nuclear Non-Proliferation and Disarmament." In this document, all states party to the treaty agreed to (1) completion of negotiations on a CTBT no later than 1996; (2) immediate commencement and early conclusion of a convention banning the production of fissile material for nuclear weapons or other nuclear explosive devices; and (3) determined pursuit by the nuclear weapon states of systematic and progressive efforts to reduce nuclear weapons globally, with the ultimate goal of eliminating those weapons.

Successful implementation or pursuit of these arms control and disarmament goals will have the greatest impact in shaping other countries' perceptions of the U.S. commitment to Article VI. In that regard, most countries are closely watching negotiations on a CTBT and consider such a treaty to be one of the most important indicators of compliance with NPT Article VI on the part of the nuclear powers. Indeed, CTBT is the first deadline that the nuclear weapon states need to meet under the NPT Disarmament Principles. Thus, by facilitating U.S. adherence to a CTBT, NIF would make a positive contribution to U.S. adherence to the first of the NPT Disarmament Principles.

Some have claimed that NIF's role in maintaining the U.S. nuclear arsenal, along with other Stockpile Stewardship facilities, is inconsistent with Article VI's obligation to achieve nuclear and general and complete disarmament. However, if the confidence that each nuclear weapon state has in its arsenal is adequately maintained by stewardship instead of testing, then the nuclear weapon states may be more likely to reduce numbers of weapons than without such confidence. NIF and other Stockpile Stewardship programs are designed to provide to the United States this necessary confidence. NIF thereby contributes positively to U.S. arms control and nonproliferation policy goals by allowing the United States to sign and abide by a zero-yield CTBT and by providing the United States continued confidence in its weapons to allow for further reductions and meet its Article VI obligations.

#### **Article IV: Sharing Peaceful Uses of Nuclear Energy:**

Article IV commits NPT parties to facilitate the "fullest possible exchange of...scientific and technological information" related to peaceful uses of nuclear energy. This commitment was included in the NPT at the insistence of non-nuclear weapon states that were concerned that they would suffer scientific and technological disadvantages compared to the nuclear weapon states.

The extent to which nuclear weapon states have or have not fulfilled this commitment has been discussed at each of the NPT Review Conferences, where this issue has taken on a diplomatic significance second only to the arms control and disarmament commitments of Article VI.

NIF will be used to investigate a wide range of basic scientific problems unrelated to weapons research, such as commercial energy, astrophysics, biotechnology, and optics. While the classified nature of some NIF experiments would preclude operation of this facility by an international agency, international collaboration on peaceful research is possible for approximately 80% of currently envisioned NIF experiments. Thus, operation of NIF will be consistent with the Article IV obligations of the United States. However, peaceful nuclear cooperation would stop short of collaborating with states, which, while parties to the NPT, are clandestinely seeking to acquire nuclear weapons.

### C. IMPACT ON VERTICAL PROLIFERATION AND A NUCLEAR ARMS RACE

The term 'vertical proliferation' is defined in this study as increases in the numbers of nuclear weapons or warheads, or the development of new types of nuclear weapons (advanced weapon concepts). The term was originally intended to contrast this phenomenon with "horizontal proliferation," the spread of nuclear weapons to states that had not previously possessed them. While a 'nuclear arms race' requires at least two nuclear weapon state competitors, vertical proliferation could be carried out by a single state. While building more weapons of a tested design would not require nuclear testing, qualitative advances in nuclear weaponry -- such as the development of new types of nuclear warheads -- typically have required nuclear testing. In the absence of testing, the United States is not developing new types of nuclear weapons, but is dismantling nuclear weapons at as fast a rate as possible given safety considerations. The purposes of stockpile stewardship - to maintain the safety and reliability of remaining U.S. nuclear weapons without nuclear testing - is not considered vertical proliferation.

At the 1995 NPT Review and Extension Conference, the United States, as well as a number of other NPT parties, took the position that the nuclear arms race has ended. The United States held that a number of recent actions supported that proposition, including the elimination of most tactical nuclear weapons, drastic reductions of strategic nuclear weapons, detargeting of U.S. nuclear forces, and pursuit of a comprehensive nuclear test ban treaty. This position was debated in Main Committee One (reviewing parts of the NPT preamble, Article I, II and VI) at the NPT Extension Conference with some states arguing that the nuclear arms race had merely abated rather than ended. An issue was raised regarding use of stockpile stewardship activities under a test ban to improve nuclear weapon design (i.e., statement by Mr. Wiranata-Atmadja (Indonesia) made to Main Committee One on May 5, 1995, NPT/CONF.1995/MC.I/SR.8).

Concerns have also been raised by members of the public that the NIF will contribute to a revival of the arms race and to vertical proliferation by being used by the United States to develop new generations of advanced nuclear weapons that other states will also seek. This is not the case. In the absence of nuclear testing, the United States is planning to maintain the safety and reliability of its nuclear arsenal testing without new nuclear weapon development nor production. This mission cannot not be considered vertical proliferation. Openness measures applied to NIF, as suggested in the section entitled, 'Managing Vertical Proliferation Concerns at NIF,' should help allay both public and international concerns.

Other nuclear weapon states, such as France, are also planning to help maintain their arsenals, as well as a cadre of experts in the physics that relate to nuclear weapons, by building their own NIF-like facilities. As stated above, a new design for any nuclear warhead cannot be proof-tested at NIF, nor any similar facility built by another nuclear weapon state.

#### **D. IMPACT ON OTHER COUNTRIES' MOTIVATIONS TO ACQUIRE NUCLEAR WEAPONS**

The history of proliferation repeatedly has shown that decisions to develop or acquire nuclear weapons have been driven by specific regional security concerns, political tensions, and/or prestige. Addressing these regional motivations will be key to long-term success in nonproliferation. This was explicitly recognized by President Clinton as part of his Nonproliferation and Export Control Policy announced in September 1993, which stated that progress on regional arms control and nonproliferation is inextricably linked to efforts to "address the underlying motivations for weapons acquisition."

The NIF will have no effect on regional motivations that drive states to acquire nuclear and other mass destruction weapons. By the same token, eliminating NIF would not reduce these motivations.

Other countries' perceptions of whether nuclear weapons are valuable in any context are strongly shaped by the international security environment. The overwhelming message sent by deep reductions in the U.S. and Russian nuclear stockpiles is a rapidly decreasing emphasis on the value of nuclear weapons as instruments of national security. International negotiations on a Comprehensive Test Ban Treaty and on a Fissile Material Production Cut-off strongly reinforce this message.

## APPENDIX I:

### **LIST OF EXTERNAL REVIEWERS OF THE DRAFT STUDY ON THE NATIONAL IGNITION FACILITY AND THE ISSUE OF NONPROLIFERATION (version dated August 23, 1995)**

Dr. Victor Alessi  
Executive Assistant to the Director of the U.S. Arms Control and Disarmament Agency  
Washington, DC

Dr. Ron Davidson  
Director, Princeton Plasma Physics Laboratory  
Princeton, NJ

Dr. Damon Giovanielli  
President, Sumner Associates  
Santa Fe, NM

Dr. Frank von Hippel  
Professor of Public and International Affairs, Princeton University  
Princeton, NJ

Dr. Ray Kidder  
Physicist (ret.), Lawrence Livermore National Laboratory  
Pleasanton, CA

Dr. Bruce Miller  
General Manager, Titan Advanced Innovative Technologies  
Albuquerque, NM

Dr. Wolfgang Panofsky  
Director and Professor Emeritus, Stanford Linear Accelerator Center  
Stanford, CA

## **APPENDIX II:**

### **NEW DOE ICF CLASSIFICATION GUIDANCE FOR NIF**

#### **Key changes in the new classification guidance that impact research at NIF are:**

- All information, experimental and calculational, for laboratory capsules that absorb an amount of energy less than or equal to 10 MJ and whose maximum dimension is less than or equal to 1 cm is unclassified (with some exceptions). Information pertaining to all other laboratory capsules is classified.
- All information pertaining to laboratory ICF hohlraums that reach a peak temperature of 400 eV (electron Volts) or less, either by calculation or experiment, are unclassified (with some exceptions). 400 eV is equivalent to 4.7 million °C.
- Calculations, modeling, and experimental data on hydrodynamic instabilities and mix in unclassified ICF targets are unclassified (that would not reveal other classified information). The association with, applicability to, or actual use of mix data or mix models in nuclear weapons design remains classified.
- All information relevant to the energy applications of ICF, consistent with classification restrictions on targets and hohlraums, is unclassified, except for results of classified codes. For unclassified targets this would include time dependent output spectra of neutrons, gamma rays, x-rays (with some restrictions), fuel atoms, reaction products, and target debris..
- ICF fabrication techniques are unclassified unless they reveal classified target design information or a specific classified weapon design, experiment, or fabrication method.

#### **Classification policy pertaining to all ICF research that remains unchanged is:**

- Target designs that are tailored specifically for weapons or weapons-effects applications remain classified. Output information for targets that have been tailored for weapons effects applications remains classified.
- All information for indirect-drive capsules for which the peak radiation drive temperature is greater than 400 eV remains classified.
- Capsules containing fissile material and certain classified concepts remain classified.
- Calculations or measurements for ICF capsules where classified equation of state or opacity information would be revealed remain classified.

- The results of classified computer codes for ICF capsules remain classified, except for certain time- and spatially-integrated quantities such as yield, gain, neutron, and x-ray output.
- The results of classified computer codes for hydrodynamic instabilities and mix in convergent geometries remain classified.

**Given the above discussion on classification, the following list is exemplary of unclassified research that could be conducted at NIF:**

- Research on DT ignition and burn in ICF capsules up to 1 cm diameter. This is significantly greater than the baseline capsule size designed for the NIF. Significantly larger capsules would require greater energy absorption than NIF could provide. However, capsules intended to address specific nuclear weapon design issues, simulate nuclear weapon outputs, or address specific weapon physics issues would be classified.
- Research on opacities at temperatures less than or equal to 400 eV. However, opacity information particularly applicable to nuclear weapons would remain classified, *i.e.*, for certain materials above certain temperatures and certain spectrally resolved opacity information. Results from calculations that would reveal classified opacity data, and laboratory data, experiments, or designs aimed at obtaining information on weapons physics remain classified.
- Research on hydrodynamic instabilities and mix. However, the association with, applicability to, or actual use of mix data or mix models in nuclear weapons design remains classified.
- Equation of State research. However, measurements or calculations for this research could not reveal classified equation of state information.
- Research on atomic emission and absorption of high-energy-density plasmas. However, spectral data for certain elements, under certain conditions must remain classified, as must certain spectrally resolved opacity measurements.
- Research on the transport of radiation. However, research for clarifying radiation transport issues related specifically to weapons remains classified.
- Research in developing radiation sources or using such sources for other purposes. However, output information for targets that have been tailored for weapons effects applications remains classified.

## APPENDIX III:

### COMPENDIUM OF PUBLIC COMMENT AND DEPARTMENTAL RESPONSES

The public comments summarized in this appendix were made at public meetings held on the outline for the study, as well as meetings on the draft study itself. This section also summarizes written comments received following meetings on the outline as well as meetings on the draft study. Written comments were received by the Department until October 11, 1995. Five public meetings were held in connection with this study: three public meetings on the outline for the study (January 24, 1995 in Oakland, CA; January 30, 1995 in Washington, DC; and March 9-10, 1995 in Livermore, CA) and two public meetings on the draft study (September 21, 1995 in Washington, DC; and September 28, 1995 in Livermore, CA).

The format of this section is as follows:

**(#) Generalized Public Comment (in bold)**

"Sample public comment supporting above" (Last name of commenter, PM/WC #, page #.)

"Sample public comment supporting above" (Last name of commenter, PM/WC #, page #.)

**The Department of Energy response to public comment will be presented in bold in a text box. In some cases, the report has been amended according to public comment and the amended section or sections will be referenced in this box.**

**Public Comment Reference Key:** (For public meetings, page of transcript will be cited. For written comments, page of quote will be cited.)

**Type and Place of Meeting:**

Public Meeting on Study Outline, Oakland, CA  
Public Meeting on Study Outline, Washington, DC  
Public Meeting on Study Outline, Livermore, CA  
Public Meeting on Study Outline, Livermore, CA  
Written Comments on Study Outline  
Public Meeting on Draft Study, Washington, DC  
Public Meeting on Draft Study, Livermore, CA  
Public Meeting on Draft Study, Livermore, CA  
Written Comments on Draft Study

**Date:**

1/24/95  
1/30/95  
3/9-10/95, Vol. I  
3/9-10/95, Vol. II  
9/21/95  
9/28/95, Morning Session  
9/28/95, Evening Session  
Due Date: 10/11/1995

**Code:**

PM1  
PM2  
PM3  
PM4  
WC1  
PM5  
PM6  
PM7  
WC2

## COMMENTS ON NIF AND STOCKPILE STEWARDSHIP:

### **(1) The value of NIF in the U.S. Stockpile Stewardship and Management program is not analyzed:**

"Primary objectives of NIF for stockpile stewardship not fully explained." (Cochran, WC2, p. 1)

The report should weigh the value of NIF for maintaining the safety and reliability of the stockpile against its proliferation implications. (Larkin, WC2, p. 9)

"The NIF is not needed to maintain the existing arsenal under safe conditions as it awaits dismantlement." (M. Kelley, PM3, p. 59)

"If the question is what are the nonproliferation aspects of the NIF, they are negative, they are damaging, quite seriously, by the example, as many people have said. If the question at hand is, we have either the NIF or nuclear explosions, I think nuclear explosions would be more damaging than the NIF... If the question is, is the NIF a necessary price... to prevent nuclear explosions? You need to demonstrate that it's both necessary and sufficient." (Anderson, PM7, p. 172-4)

"The study should articulate a statement of purpose and need...Most importantly, the alleged contribution of NIF to ensuring the 'safety' and 'reliability' of the existing arsenal must be carefully examined." (Western States Legal Foundation, WC2, p. ii)

"I also think they [experiments at NIF] will not contribute to stockpile safety or understanding of the safety questions, such as corrosion, oxidation reduction and water problems. Those are all material problems." (Fulk, PM3, p. 102)

"The study should contain a genuine discussion of alternatives. To avoid turning the Study into a rationalization of a choice already made, and to inform the public and decision makers about the true choices concerning NIF and other facilities, the Study should encompass a range of potential and stockpile and policy requirements, examining the need for NIF and other facilities and their proliferation impacts in each case... DOE will need to examine a range of timelines for reduction toward and achievement of zero [nuclear weapons], with their associated facilities and impacts." (Western States Legal Foundation, WC2, p. ii and 21)

"Unless many of our top weapons designers and policy makers have been misleading us in the past, those weapons can be maintained in a safe and reliable state for the foreseeable future using technology and equipment which already exists." (Western States Legal Foundation, WC1, p. 4)

"The draft study should: provide an honest and fair analysis of how NIF is or is not needed for stockpile 'safety and reliability'... cease claiming that the [Stockpile Stewardship and Management] program doesn't include weapons design and development." (Larkin, WC2, p. 7)

"I find this to be an extremely interesting report because, in part, it seems to me to be a fairly objective evaluation of at least some -- not all, but some of both the vertical and horizontal proliferation impacts of the National Ignition Facility, and I congratulate you on that... it also demonstrates what I might call a political defense of NIF, and I believe that the conclusions of the report, that we should go ahead with NIF, fundamentally do not follow from the information that is presented in the report." (Burroughs, PM7, p. 144)

"Unless discussion includes the question of whether nuclear weapons development is really needed, the hearings, the ultimate report on the NIF, and the DOE itself, will be viewed as a facade for the protection of work on nuclear weapons without benefit of the views of those among the public who differ." (Pilisuk, WC2, p. 3 and WC1, p. 4)

"I believe that curatorship... should be considered as a serious alternative to stewardship..." (Katz, WC2, p.5)

**This study does not attempt to judge the value of the National Ignition Facility (NIF) for stated U.S. Stockpile Stewardship objectives, but instead analyzes the vertical and horizontal proliferation implications of NIF. The contribution of NIF towards U.S. Stockpile Stewardship goals has been described in the DOE/Defense Programs report, "The Stockpile Stewardship and Management Program" (May, 1995) and will be further delineated in the Programmatic Environmental Impact Statement (PEIS) process.**

- (2) **The proliferation implications, both vertical and horizontal, of all U.S. Stockpile Stewardship Facilities put together, should be analyzed in this report. This report, on its own, is not sufficient.**

"The proliferation impact review fails to consider how the National Ignition Facility could be used for nuclear weapons research in combination with other existing and proposed 'Stockpile Stewardship' facilities . . ." (Western States Legal Foundation, WC2, p. 4; also B. Brown, WC1, p. 1; Cabasso, PM4, p. 8; Eldredge, PM2, p. 19-20, PM5, p. 54-55, p. 77, WC2, p. 1; Ericson, PM7, p. 5; Erickson, PM3, p. 162; M. Kelley, PM3, p. 63; Lichterman, PM3, p. 189-190; Mello, WC1, p. 5, Taylor, WC2, p. 3; Zerriffi, PM5, p. 74)

"It simply makes no sense to consider the proliferation impacts of the NIF in isolation. Other nations will not do so in evaluating U.S. intentions." (Western States Legal Foundation, WC1, p. 2)

The PEIS is a poor forum in which to consider the nonproliferation concerns of the entire Stockpile Stewardship Management Program. (Eldredge, PM5, p. 55-56)

"The DOE should not go forward with this proliferation impact study in its current form, but rather should fold it into a broader proliferation impact review which addresses the entire [Stockpile Stewardship and Management] program. In any case, DOE should not make a decision to proceed with NIF pending completion of a programmatic review. If DOE insists on completing a NIF-specific proliferation impact analysis, this review should at minimum provide a kind of 'cumulative impacts analysis.' This would require at least a general assessment of the vertical and horizontal proliferation effects of the NIF in combination with the entire range of stockpile stewardship initiatives, including the impact on the world proliferation climate of an increasingly sophisticated U.S. nuclear test simulation capability." (Western States Legal Foundation, WC2, p. 1 and 8)

**Although this study does not analyze the proliferation implications of each of the other proposed Stockpile Stewardship facilities separately, this study does consider the nonproliferation implications associated with NIF in the context of all proposed Stockpile Stewardship and Management (SSM) facilities. The study, in considering the contribution of NIF experiments to whether the United States could design, develop and place into the stockpile, with confidence, new types of nuclear weapons; assumed that information from all of the other elements of the U.S. stewardship program would also be available. Furthermore, NIF is the only Stockpile Stewardship facility which will be open to international visitors for basic scientific research, and thereby warrants special consideration.**

**(3) NIF, together with the rest of the U.S. Stockpile Stewardship facilities, will allow the United States to develop and place into the stockpile new nuclear weapons.**

"NIF, together with other laboratory facilities... will give the U.S. the means to replace underground testing of nuclear weapons with very sophisticated above-ground facilities. These facilities will enable the U.S. to continue research, development, testing and engineering of new nuclear weapons." (Rauch, WC2, p. 1; also Cabasso, PM2, p. 39-40, PM4, p. 12; Erickson, PM3, p. 160; Fulk, PM3, p. 103; Hedgepeth, PM2, p. 17; Lichterman, PM3, p. 187-188; Zimmer, PM2, p. 45-46)

"So I think stockpile stewardship has become a euphemism; what it means is keeping the weapons team together, what it means is designing new weapons." (Olin, PM3, p. 22)

"The knowledge gained with NIF is probably sufficient for new weapon designs, but insufficient for stewardship, which requires simulation capabilities with much higher precision in order to determine the effects of small variations due to aging. In other words, it is impossible to have stewardship accuracy without having new design capabilities." (Hagen, WC2, p. 2)

The DOE and Labs say that "part of our mission of stockpile stewardship is to keep the scientists trained, keep them up to speed, and keep them interested in their work. So to do that, we have to let them go on advancing weapons science and working on nuclear arms development because otherwise they'll get bored. This is a classic case of resistance to a change in mission.... In other words, stockpile stewardship then includes weapons development, weapons R&D." (Larkin, PM7, p. 109-110)

**To assure that the U.S. nuclear deterrent remains unquestioned under a test ban, President Clinton has directed the Department of Energy to preserve a core technical and intellectual competency in nuclear weapons. This core competency will be used to analyze and judge the continuing reliability and safety of the remaining U.S. nuclear weapons. These same intellectual competencies could be used to design new weapons, but most U.S. nuclear weapons experts agree that new types of nuclear weapons could not be placed into the stockpile with a tolerable level of confidence without nuclear testing. Furthermore, with regard to the NIF, the Secretary of Energy has committed to operating the NIF in the most open manner possible consistent with our nonproliferation objectives to assure the public and the international community that NIF is not being used to develop new types of nuclear weapons.**

- (4) Too many modifications to remaining U.S. nuclear weapons through use of the Stockpile Stewardship facilities could lead to less confidence in our weapons.**

"The day may come when the laboratories say, hey, you know, we fooled around with these weapons. We have these fancy new Stockpile Stewardship Facilities. We have fooled around with these weapons, and now ... we just really can't certify their safety and reliability anymore, and the present circumstances have changed, and therefore, we better exercise Safeguard F and go back to nuclear testing. So I would offer the reverse argument, that a very aggressive Stockpile Stewardship program can be detrimental to maintenance of a comprehensive test ban treaty." (Burroughs, PM7, p. 152)

**President Clinton has directed the Departments of Energy and Defense to maintain a safe and reliable nuclear stockpile in the absence of nuclear testing. Meeting our stockpile stewardship and management responsibilities in an era without nuclear testing and without new weapons development will require a new approach. This approach will rely on scientific understanding and expert judgment, not nuclear testing and development of new weapons, to predict, identify, and correct problems affecting the safety and reliability of the stockpile. Through greater scientific understanding and preservation of a core technical and intellectual competency in nuclear weapons, we seek to prevent the need for future U.S. nuclear testing. We have confidence that we will be able to successfully meet this new challenge using the new facilities and enhanced capabilities outlined in the Stockpile Stewardship and Management Program.**

## **NIF's IMPACT ON THE COMPREHENSIVE TEST BAN TREATY (CTBT):**

- (5) **The report claims that NIF facilitates U.S. adherence to a CTBT. This is a political deal, and should be judged as such.**

"I don't think that's an up-front, straightforward way to talk about this political deal. This makes it sound as if, [if] NIF works,...it is going to help somehow with the CTBT... You have to be careful that the deal you're making doesn't have the seeds of even greater dangers and greater problems, and I don't see anything in this report that addresses that possibility." (Larkin, PM7, p. 159-160)

"It is sometimes said in Washington, D.C., if you want to get a Comprehensive Test Ban Treaty, you must allow the DOE to go ahead with its Stockpile Stewardship Program, including NIF. We reject that trade-off." (Burroughs, PM3, p. 50)

"So the fact that a political deal has been struck is alleged to be necessary to the achievement of a CTBT in this country is offered as a reason for why we should go ahead with NIF, there is a circularity in this . . . ." (Burroughs, PM7, p. 149)

**In announcing U.S. support for initiation of Comprehensive Test Ban Treaty negotiations on July 3, 1993, President Clinton stated, "To assure that our nuclear deterrent remains unquestioned under a test ban, we will explore other means of maintaining our confidence in the safety, the reliability, and the performance of our own weapons." In response, the Department of Energy and its National Laboratories developed the Stockpile Stewardship and Management program. To advance the goal of concluding a Comprehensive Test Ban Treaty at the earliest possible date and to secure the strongest possible treaty, President Clinton announced support for a "zero" yield treaty on August 11, 1995. In making this announcement, the President also established the "concrete, specific safeguards that define the conditions under which the United States can enter into a CTBT". Of the six safeguards outlined, the first two relate to the Stockpile Stewardship program:**

- "A) Conduct of a Science-Based Stockpile Stewardship program to ensure a high level of confidence in the safety and reliability of nuclear weapons in the active stockpile, including the conduct of a broad range of effective and continuing experimental programs.**
- B) Maintenance of modern nuclear laboratory facilities and programs in theoretical and exploratory nuclear technology which will attract, retain and ensure the continued application of our human scientific resources to those programs on which continued progress in nuclear technology depends".**

**Rather than a political deal, this is Presidential policy guidance that the Department of Energy is required to implement in order to fulfill the conditions the President requires for the United States to enter into a CTBT.**

**(6) NIF will undermine the Comprehensive Test Ban Treaty.**

"If the DOE can go ahead with designing more nuclear weapons using the NIF facility and other components of the Stockpile Stewardship Program, this will amount to circumventing the Comprehensive Test Ban Treaty, and it will be regarded by other states in the world as not complying with Article VI [of the NPT]..." (Burroughs, PM3, p. 50; also Erickson, PM3, p. 160; Mello, WC1, p. 6)

"The NIF, and its companion AGEX programs, make a sham of any test ban by performing an end-run around the letter of a 'ban' while completely violating its spirit." (Robbins, WC1; p. 2; also Mr. and Mrs. Cox, WC1, p.1)

"NIF could be perceived by others [countries] as a design facility and, therefore, reduce confidence in the CTB." (Zerriffi, PM5, p. 71)

"The test ban is not an end in itself, but a tangible measure of restraint by the nuclear weapon states and an indication of their decreasing emphasis on nuclear weapons. Thus, the value of a CTB would be greatly diminished if functions that until now have been served by nuclear testing were largely or entirely transferred to a new environment -- the NIF." (Nuclear Control Institute, WC2, p. 2)

The CTBT "is a matter of long-term world objectives such as the delegitimation of nuclear weapons. Those objectives would be significantly compromised by 'safeguards' like NIF, just as they were compromised by 'safeguards' in 1963." (Anderson, WC2, p. 7.)

**The Comprehensive Test Ban Treaty (CTBT) will impede the development of new nuclear weapons by preventing nuclear testing. NIF cannot subvert that purpose, and thereby U.S. use of NIF, in maintaining its nuclear stockpile without new weapons development or production, should not undermine confidence in a CTBT. Furthermore, any move to ban inertial confinement fusion (ICF) activities under a CTBT will likely be opposed not only by the other nuclear weapon states, but also by several other advanced industrialized nations participating in the negotiations because they have established ICF programs for peaceful purposes. Consistent with its 1975 statement at the first Nuclear Nonproliferation Treaty (NPT) Review Conference, the United States does not consider inertial confinement fusion to be a nuclear explosive device under the meaning of the NPT, and accordingly any nuclear energy release from experiments at the NIF should not be considered a "nuclear explosion" of any yield under the CTBT.**

**(7) There is inadequate discussion of the nonproliferation aspects of the Comprehensive Test Ban Treaty that bans all nuclear explosions of all nuclear yields, except for inertial confinement fusion explosions in the NIF facilities, on which no upper limit of explosive yield is set.**

"How is inertial confinement fusion technically defined? Is it defined by its stated purpose -- e.g. for peaceful, not military purposes? If so, how is the purpose to be internationally verified? ... Is ignition with the assistance of a small explosion of fissionable material to be allowed under a CTBT? Would substitution of some type of relatively small explosively driven device for the huge pulsed laser system now envisioned in NIF be allowed,

with no limit on yield? How do answers to such questions affect prospects for horizontal or vertical proliferation?" (Taylor, WC2, p. 1)

**On August 11, 1995, President Clinton elaborated that the United States is pursuing a zero-yield test ban treaty. Consistent with its 1975 statement at the first Nuclear Nonproliferation Treaty (NPT) Review Conference, the United States does not consider inertial confinement fusion to be a nuclear explosive device under the meaning of the NPT, and accordingly any nuclear energy release from experiments at the NIF should not be considered a "nuclear explosion" of any yield under the CTBT.**

## **NIF'S IMPACT ON THE NUCLEAR NONPROLIFERATION TREATY (NPT):**

### **(8) U.S. construction of NIF is inconsistent with U.S. obligation to achieve nuclear disarmament under Article VI of the Nuclear Nonproliferation Treaty.**

"... the maintenance of designers and design capabilities for the long term are clearly inconsistent with U.S. obligations under Article VI of the NPT recently reaffirmed at the NPT Extension Conference." (Zeriffi, PM5, p. 71-72)

"In conclusion, I will read a quote from Mexican Ambassador Miguel Marin Bosch, who was the chairman of the CTBT negotiations last year..."The overall impression that the nuclear weapon states give is that of business as usual. The cold war may be over, and, yes, the strategic nuclear competition between the Russian Federation and the United States shows signs of abating, but the relationship of the nuclear weapon states to their own nuclear weapons has not registered the kind of basic change that one might expect. They continue to rely on nuclear weapons and do not seem prepared to give them up for the foreseeable future. Quite the contrary, they are looking for ways to freeze the NPT's dichotomy between the nuclear have's and the nuclear have-nots. This does not bode well for the NPT or nuclear nonproliferation in general." (Cabasso, PM7, p. 131-2).

"Within this kind of an abolition [of nuclear weapons] framework, there is no role for the National Ignition Facility." (Cabasso, PM7, p. 195-196)

"If NIF is maintaining a cadre of nuclear weapons scientists,... [NIF] maintains the ability of the U.S. to vertically proliferate if we so choose to do so." (Eldredge, PM5, p. 61; also Horner, PM5, p. 93; Rogers, PM3, p. 220-221, WC1, p. 1; Zeriffi, PM5, p. 74)

"The definition of 'stockpile stewardship' has been expanded to encompass weapons design work and the full range of 'weapons science' research contemplated for NIF. It is, therefore, misleading and intellectually dishonest to say that NIF is necessary for stockpile stewardship and not weapons development..." (Larkin, WC2, p. 7)

"If NIF and other components of the stockpile stewardship program contribute to the ability of the United States to go ahead with a policy of threatening first use against non-nuclear states, it again will be absolutely incompatible with Article VI of the Nonproliferation Treaty..." (John Burroughs, PM3, p. 52)

"Missing from this [the draft study's] list[ of "the most important means of preventing proliferation"] is perhaps the most important means of them all: preventing nuclear weapons research and development." (Larkin, WC2, p. 13)

**At the 1995 Nuclear Nonproliferation Treaty Extension Conference, NPT parties agreed that the ultimate goal of the international community is nuclear disarmament. Of the three primary "Disarmament Principles" agreed to by all parties at the NPT Extension Conference, the first deadline that needs to be met is conclusion of a Comprehensive Test Ban Treaty by 1996. The United States is committed to concluding these negotiations at the earliest possible date. However, key to U.S. willingness to negotiate a CTBT rapidly and to live under a zero-yield treaty is its ability to exercise a nuclear stockpile stewardship program, as outlined by the President on August 11, 1995. NIF is an important component of this program to maintain confidence in the stockpile. If confidence can be maintained through stewardship instead of nuclear testing, then the nuclear weapon states may be more likely to reduce numbers of weapons than if they did not have such confidence, in the absence of testing. NIF thereby contributes positively to U.S. arms control and nonproliferation policy goals by allowing the U.S. to sign and abide by a zero-yield CTBT and by providing the U.S. continued confidence in its weapons to allow for further reductions and meet its Article VI obligations.**

**(9) Sharing NIF or other stockpile stewardship techniques with other countries including the other nuclear weapon states, is a violation by the United States of Article I of the Nuclear Nonproliferation Treaty.**

The "NIF Report fails to adequately address whether collaboration on NIF will violate [Article I of] the Nuclear Non-Proliferation Treaty. If an undeclared objective of a non-nuclear weapon state's collaboration with the United States on ICF research is to retain a quick thermonuclear weapon design capability, is the U.S. 'assisting... a non-nuclear weapon state to acquire nuclear weapons...?'" (Cochran, WC2, p. 3)

Collaboration among the nuclear weapons states should be considered proliferation. (Kelley, PM6, p. 23)

"Speaking of NPT violations, it's becoming more and more apparent that the nuclear weapon states...have been sharing nuclear weapons information, which they are not supposed to be sharing under other articles of the NPT." (Cabasso, PM7, p. 193-194)

"The obvious question is if the NIF is going to be part of an expanded cooperative program with France, it would seem that NIF is contributing to the vertical proliferation of the nuclear weapon program in France." (Kimball, PM5, p. 21-22)

"The draft states as follows (p.35) 'The United States could encourage the other nuclear weapon states to seek to prevent the purposeful development of advanced weapon concepts at their NIF facilities under a test ban regime.' However, my impression is that the U.S. will not follow up this concept." (Anderson, WC2, p. 5-6)

"What assurance can be given that the French (or U.K.) experiments on NIF, or experiments on a French NIF-like facility built with U.S. support, will not be conducted for weapon development, as opposed to insuring reliability of the existing arsenal?" (Cochran, WC2, p.2)

"Our cooperation with France is clearly vertical proliferation" (Nurmela, WC2, p.1)

**Article I of the Nuclear Nonproliferation Treaty (NPT) prohibits nuclear weapon states from transferring nuclear weapons or nuclear explosive devices or control over such weapons or devices to any state. The sharing of classified information derived from the NIF among the nuclear weapon states is not a violation of Article I of the NPT. The United States has classified collaborations with the British under the U.S.-U.K. Mutual Defense Agreement of 1958 and it is likely that the British and Americans will cooperate on weapon-related research at the NIF. At present, collaboration with France on NIF and on ICF is unclassified. A current U.S.-French joint project concerns the design of each of our large laser facilities. Article I of the NPT also prohibits nuclear weapon states from assisting in any way, encouraging, or inducing any non-nuclear weapon state to manufacture or otherwise acquire nuclear weapons or other nuclear explosive devices, or control over such weapons or devices. With regard to U.S. collaboration with other nations on inertial confinement fusion technologies, these collaborations are also completely unclassified. Inertial confinement fusion has not been considered to be a nuclear explosive device under the meaning of the NPT and a number of non-nuclear weapon state parties to the NPT have ICF programs for peaceful purposes. Unclassified collaboration on ICF with any state is not a violation of Article I of the NPT.**

- (10) **Comments take issue with Report claim that no nation has objected to U.S. understanding that ICF is not a nuclear explosive device under the meaning of the Nuclear Nonproliferation Treaty.**

"In stating that no nation has objected to the U.S. statement [defining ICF as distinct from a nuclear explosion] at the NPT Review Conference in 1975 at the time or since (p.32), the Draft NIF Report is simply wrong. The scope language tabled by India in June 1995, (CD/NTB/WP.244) would prohibit ICF experiments on NIF..." (Cochran, WC2, p. 3)

**The above comment confuses two separate negotiations. In discussing the relation of ICF to the NPT, the draft study asserted that, "No nation objected to this statement [U.S. 1975 Statement at NPT Review Conference on ICF] regarding ICF and the NPT at that time, nor since." During Comprehensive Test Ban Treaty negotiations in Geneva earlier this year, India proposed treaty text which would effectively ban ICF under a CTBT. However, India is not a party to the NPT and the Department has been unable to confirm whether any Indian officials have made statements asserting that ICF should be considered a nuclear explosive device within the meaning of the NPT. To avoid future misunderstanding, this has been clarified in the final draft to state that "No NPT party objected to this statement regarding ICF and the NPT at the time nor since, although some NPT parties have proposed Comprehensive Test Ban Treaty (CTBT) language that could be considered to cover ICF as a prohibited activity under a CTBT." (see page 35 of study).**

## **IMPACT ON REGIONAL PROLIFERATION MOTIVATIONS:**

### **(11) U.S. commitment to the National Ignition Facility sends a negative signal to the rest of the world about U.S. efforts to achieve nuclear disarmament.**

"If we opt to go ahead with this project [NIF], we send a clear signal to other nations of our intention to continue feeding the forces which generate proliferation and nuclear terror for all the peoples of the world." (Rogers, PM3, p. 224)

"I would urge the Administration to think about whether whatever the perceived benefits there are in going forward with the NIF can outweigh the very ambiguous signal that that sends." (Horner, PM5, p. 93)

"The bottom line, what I'm saying about this report is it misses the point... What is the message that a U.S. investment of billions of dollars, a whole slew of new technologies to maintain its nuclear competence sends to the rest of the world?" (Cabasso, PM7, p. 131)

NIF may be seen as a threat by those who distrust the United States and encourage proliferation. (Larkin, PM3, p. 88, WC1, p. 4; Nesbitt, PM3, p. 99-100; Olney, WC2, p. 2)

"The NIF will be viewed by other countries, and especially by potential proliferators, as a very large, expensive commitment to nuclear weapons, and to the eventual possibility of new types of weapons, even though such new types would not rapidly go into the detailed-design phase." (Anderson, WC2, p. 2; also PM3, p. 196-197)

"It would be helpful if your study explored how the non-nuclear nations' attitudes of distrust and suspiciousness, engendered by U.S. policy, will jeopardize efforts to prevent proliferation." (Smick, WC1, p. 1)

The construction of NIF displays a continued U.S. commitment to nuclear weapons that may undermine nonproliferation and disarmament efforts. (Ade, WC2, p. 1; Cabasso, PM2, p. 40; Caseber, WC2, p. 1; Ebersole, WC1, p. 1; Erickson, PM3, p. 161-162, PM7, p. 104; Dr. and Mrs. Fischer, WC1, p. 1; B. Fischer, WC2, p. 1; Frisch, PM3, p. 209; Gould, PM3, p. 155-157; Johnson, PM2, p. 51; Larsen-Beville, PM3, p. 66; Laub and Nurmela, WC1, p. 1; McClintic, WC2, p. 1; Miles, PM3, p. 80-82; Olney, PM4, p. 33, WC2, p. 1; Robbins, WC1, p. 2; Smick, WC1, p. 1; Vance, WC2, p. 1; Zimmer, PM2, p. 48).

"While demanding that other nations abandon their nuclear aspirations, the U.S. is continuing to legitimize nuclear weapons as an instrument of national policy and is imposing an international double standard in an increasingly uncertain world." (Western States Legal Foundation, WC1, p. 1-2; also Robbins, WC1, p. 2)

"[The report] asserts that NIF will have no effect on regional motivations [to develop nuclear weapons], but I wanted to suggest that legitimacy of nuclear weapons as an instrument of policy is a key element to justifying and reinforcing any motivations for acquiring nuclear weapons" (Ericson, PM7, p. 102)

"I'm totally opposed to [NIF] being misused for military nonsense...It's a wrong message out to the world..." (Hagen, PM7, p. 168-169)

"... the perception by other nations that we are continuing to design nuclear weapons systems may speak louder than the reality and they may base their future plans regarding nuclear development on that perception." (Candell, WC2, p. 1)

"The U.S. plans for a permanent nuclear weapons establishment in this country and its uneven handling of relations with other countries are well known to the world community. The non-favored nations feel threatened and will continue to strive for their own nuclear arsenal by whatever methods are available to them, including building nuclear power plants. Our only hope for non-proliferation of nuclear weapons and true national security is an international treaty for total nuclear disarmament." (Nurmela, WC2, p.1)

"I suggest that it is better to describe the future task as curatorship than stewardship, and emphasize the distinction between these two concepts... The chief nuclear danger in the present world is that of proliferation, and stewardship will exacerbate this danger, while curatorship will mitigate it while preserving our existing nuclear forces." (Katz, WC2, p. 1)

**At the April-May 1995 Nuclear Nonproliferation Treaty (NPT) Extension Conference, only a handful of NPT parties expressed concern over stockpile stewardship activities of the nuclear weapon states under a test ban treaty. In the area of arms control and disarmament, the highest priority of the non-nuclear weapon states at the Conference was obtaining a commitment from the nuclear weapon states that conclusion of Comprehensive Test Ban Treaty negotiations was imminent. NIF will contribute to U.S. ability to conduct a stockpile stewardship program which is one of the safeguards that define the conditions under which the United States can enter a CTBT.**

**As the study states, the history of proliferation repeatedly has shown that decisions to develop or acquire nuclear weapons have been driven by specific regional security concerns, political tensions, and/or prestige. Addressing these regional motivations will be the key to long-term success of nonproliferation. This was explicitly recognized by President Clinton as part of his Nonproliferation and Export Control Policy announced in September, 1993, which stated that progress on regional arms control and nonproliferation is inextricably linked to efforts to "address the underlying motivations for weapons acquisition." The U.S. Government, including the Department of Energy, is actively working to promote arms control and confidence-building measures in troubled regions.**

## **COMMENTS ON OPERATION OF THE NIF:**

### **(13) Comments on Openness Measures at NIF:**

"We would like to applaud the recommendations made in this study for greater openness regarding experiments on the NIF. We urge that this openness [regarding experiments on the NIF] apply not only to other members of the research community, but also to the general public. We also urge that this effort towards openness be institutionalized by the Department, and apply to all projects and facilities in the Science-Based Stockpile Stewardship (SBSS) program, not just the NIF." (Eldredge, WC2, p. 1)

"The countermeasures proposed in the draft report do not provide the necessary reassurance.... We urge DOE to mandate an annual report to Congress on weapons and non-weapons activities at the NIF. This report should be unclassified -- with a classified appendix, if necessary -- to ensure that members of the public can obtain information on NIF. We also recommend that DOE establish an oversight board that includes at least one member of the public-interest community." (Horner, WC2, p. 4)

"Most of the specific measures to reduce the tendency of NIF to cause proliferation lack any commitment at all, even for the length of this Administration, much less for years beyond." (Anderson, WC2, p. 4)

"The study treats proliferation as a public relations matter. In its conclusion and discussion of policy, it becomes almost solely occupied with how people can be reassured and suspicions laid to rest." (Larkin, WC2, p. 4)

"The Study should address the inadequacies of the proposed transparency measures.... The draft study states that the DOE is 'considering certain unilateral openness measures...' but admits that these measures are only being 'considered'. The Study should address the expected consequences if NIF is operated without such openness measures in place. Further, the most significant of these measures - published rosters of both unclassified and classified experiments, and outside program review of classified research -- may be very difficult to implement in a manner which imparts confidence to outside observers. The study should address how DOE will provide believable assurances that a listing of classified experiments is complete and its characterization of their nature adequately informative and explain how program reviewers will be found who have both the requisite security clearances and who can truly be considered 'outside' of the U.S. weapons establishment for purposes of imparting international confidence in U.S. intentions." (Western States Legal Foundation, WC2, p. v)

**Secretary O'Leary is committed to operating the National Ignition Facility in the most open manner possible while supporting our objectives of reducing the global nuclear danger. The Department is currently developing a management plan for NIF to meet the recommendations of this report. Throughout NIF construction and operation, the Department will continue to be receptive to public concerns so that the openness plan for NIF is responsive to their needs. In addition, the study explores the proliferation consequences for NIF operation regardless of openness measures in the section of the report entitled, "What weapons science can the U.S. do on NIF".**

**(14) This report places too much stock on the Administration and Congress to prevent new nuclear weapons development at NIF.**

There is no way to ensure that sentiments within Congress and/or the Executive branch will not change to utilize NIF in conjunction with other facilities to develop new weapons. (Eldredge, PM5, p. 80, p. 1; Olney, WC2, p. 1, Zerriffi, PM5, p. 70-71)

"To state that the present policy is not to develop nuclear weapons . . . is really not an adequate answer at all to the problem of vertical proliferation posed by the development of the National Ignition Facility." (Burroughs, PM7, p. 146)

"This means, in essence, that the United States will not allow research that encourages vertical proliferation, unless the United States decides to allow research that encourages vertical proliferation. The reporting measure cited to ensure that Congress is informed about DOE weapons and development activities, (PL 103-337), furthermore appears to call for a classified report, hardly an effective means of informing the public or the international community about actual U.S. capabilities and intentions" (Western States Legal Foundation, WC2, p. 21)

"The main problem with your Draft Study is that its nonproliferation assurances are based on the present political situation without regard for how that may change during the useful life of the NIF. Page 8 of the study states that this Administration is not planning to develop new types of nuclear weapons. But what about a future Administration? By keeping a cadre of scientists together and competent in nuclear weapons design, NIF could speed up production of nuclear weapons in the future. This constitutes Vertical Proliferation." (Dean-Freemire, WC2, p. 1)

**It is important to note the technical limitations of the NIF in this context. The study describes NIF's relatively limited utility in developing some new types of nuclear weapons which would be considered to fuel vertical proliferation. (See the two sections entitled, "Approach of the Technical Analysis Section," and "What U.S. weapons scientists could do on NIF"). The study concludes that NIF could provide some input data to the design of, for example, nuclear directed energy weapons, but would fall far short of being able to proof-test those new types of weapons, even with all of the other Stockpile Stewardship facilities that the United States might have at its disposal.**

**Furthermore, it is expected that approximately 80% of NIF experiments will be unclassified and could involve international scientific collaboration. Thus, the NIF can be populated by non-cleared and non-U.S. scientists much of the time. This degree of openness will be difficult for the United States to reverse, even if U.S. policy changed.**

**In addition, the study has been amended to more fully describe the classified report to Congress required of the Nuclear Weapons Council, through the Secretary of Energy, on nuclear warhead activities. (See page 22 of study.)**

- (15) There is a conundrum between classification and transparency in the report. How can the facility be open and at the same time closed?**

"There are many apparent self contradictions or ambiguities in the study related to the maintenance of both openness and secrecy in the NIF project operations." (Taylor, WC2, p. 3)

"On page 28, the study mentions 'increased openness'. This will make information on nuclear weapons design available to any nation wishing to develop or improve their nuclear weapons." (Dean-Freemire, WC2, p. 1)

**The Department recognizes that there will be tension between openness measures at NIF and the need to keep certain information classified to prevent the spread of nuclear weapon design information to proliferant nations. However, the Department believes that workable solutions to such tension can be developed which meet the twin objectives of openness and reducing the global nuclear danger. DOE/Defense Programs is already developing a proliferation management plan to address some of these issues, and is taking public comment garnered from this process into account in developing the plan.**

**(16) Will fissile material be used at NIF if the Administration changes?**

"The draft indicates that using fissile materials in NIF experiments would open up some areas of weapons research. However, it doesn't examine these areas because 'such experiments [using fissile material] could not be performed at the NIF as it is presently designed, and there is no intention on the part of the Department to pursue such experiments' (p.14). The draft should not be so quick to discount the possibility that this intention could change and that simple modifications to the facility would adapt it for these experiments." (Larkin, WC2, p. 10)

**Appendix II of the study, which outlines the new DOE ICF classification guidance, states that research on capsules containing fissile material would remain classified. However, the draft report has been amended to state that a physical upgrade to NIF as well as further National Environmental Policy Act (NEPA) approval would be required in order to use fissile material at NIF. There currently is no intention on the part of the Department to pursue classified or unclassified research at NIF involving fissile material. It should be mentioned in this context that the use of depleted uranium is likely not to require further NEPA process, and could be conducted at NIF as it is presently designed. These latter experiments would be subject to the type of transparency measures or outside scientific program review regarding classified experiments that are proposed in the study.**

**COMMENTS ABOUT NIF'S PURPOSE:**

**(17) NIF's real purpose is to preserve the capability to design and develop new nuclear weapons.**

"From the beginning, NIF has been conceived as a research facility for nuclear weapons design... The study outlines various areas of weapons research that clearly demonstrate NIF's potential for major advances in 'weapons science.' These advances will yield new weapons concepts, and consequently new weapons designs. .." (Larkin, PM5, p. 106, WC1, p. 3, WC2, p. 2)

"We can only view the NIF as one key component of U.S. plans to maintain substantial nuclear weapons research, developments and production capabilities well into the 21st century." (Gould, PM3, p. 154-155)

"This proposed facility is obviously designed to allow continued testing of nuclear weapons and, by extension, new designs and concepts for nuclear weapons." (Igel, PM4, p. 23; also Patton, WC1, p. 1)

"... despite its claims for dual use, the facility is intended largely to continue experimentation and development of nuclear weapon capabilities." (Pilisuk, WC1, p. 2, WC2, p. 2)

"U.S. PIRG believes that the NIF will contribute little if anything to the development of a clean, affordable energy source, and thus this justification is merely a smokescreen for continuing weapons-related research." (Anna Aurilio, WC2, p. 1)

It is contradictory that approximately only 20 percent of the experiments at NIF will be classified while the facility is fully funded out of the defense budget. (Eldredge, PM5, p. 80-81)

"If there is a valid peace-time purpose for the NIF, let the UN and non-aligned nations supervise its development." (Lovuolo-Bhusan, WC1, p. 1)

"I am particularly upset with the lies that the DOE is giving to the press regarding this project. This morning's San Francisco Chronicle quotes a DOE Draft Report as saying,...'None of the experiments planned for the huge complex - not even the secret ones - could help weapons scientists design new nuclear weapons or enable other nations to develop their own.' This is contrast to the LLNL's Institutional Plan 1994-1999..." (Scott, WC2, p. 1)

"One of the major contentions, in this report and elsewhere, is that the NIF along with other advanced scientific facilities are absolutely necessary to maintain the planned stockpile in a 'safe and reliable' manner, while at the same time making the claim that they of course couldn't and wouldn't be used to design new nuclear weapons. This defies BASIC LOGIC." (Nesbitt, WC2, p. 1)

"The Policy Conclusions in the Department of Energy's Draft Study of August 23 state that the Administration is not planning to develop new types of nuclear weapons. However, according to a Livermore planning document, one of NIF's principal missions is "to provide an aboveground simulation capacity for nuclear weapon effects on strategic, tactical, and space assets..." (Nurmela, WC2, p. 1)

"Our country doesn't need the weapons programs now like it did through the early eighties. The political situation does not warrant it. The NIF is really a DOE project primarily for weapons." (Barlow, WC2, p.1)

"NIF is being "sold" as all things to all people. The local community is told it will create jobs. "Doves" in Congress and astrophysicists are told it will be a great tool for scientific research. The Defense Department and the "hawks" are told it will be used to maintain existing weapons, to help develop new weapons, and to keep a cadre of weapons designers competent should the world situation becoming more threatening to the U.S. I see the NIF as a dangerous example of pork barrel politics and am very concerned about the possibility of increasing proliferation risks." (Dean-Freemire, WC2, p.1)

**As stated in the study, the U.S. Congress and the President have directed the Secretary of Energy to ensure that the stewardship program preserves the core intellectual and technical competencies of the United States in nuclear weapons without nuclear testing and without new weapons development and production. The Department has determined that NIF contributes to the mission of stockpile stewardship through supporting the examination of some of the basic physics processes involved in nuclear weapons operation and by retaining and attracting talented scientists and engineers. Although NIF could provide some input data into some new weapon type designs, its primary weapons application is for studying physics issues that relate only to maintaining the U.S. arsenal. Furthermore, nuclear testing would be needed to develop and place into the stockpile new warhead designs which we are confident are reliable. To assure the public and the international community that the NIF is not being used to develop new types of nuclear weapons, the study recommends several measures to enhance openness surrounding U.S. weapons work at NIF.**

## NIF AND VERTICAL PROLIFERATION:

- (18) **Since NIF cannot proof-test a nuclear weapon, the study ignores what NIF can do for weapons development in a more limited role.**

"Repeatedly [stated] throughout the document is that since NIF cannot proof-test a nuclear weapon or nuclear device, it is somehow not a proliferation risk, and we proffer that that rationale is not sufficient.... And we ask that more weight be given to the NIF's ability to improve weapons design, and 'tweak' or modify current designs, especially in the context of other aspects of the SBSS program." (Eldredge, PMS, p. 78-79, WC2, p. 1)

"NIF...would isolate the fusion reaction and take it out of the noisy environment of a bomb blast.... The advantages are obvious. The draft study ignores these advantages.. and [concludes] NIF may not be all that useful for weapons development... It is misleading, therefore, to present NIF as a poor substitute for underground tests. It should be judged for what it is and the role it will play in the future, not for how well it substitutes for the role played by test explosions in the past." (Larkin, WC2, p. 9-10)

"A term like 'new nuclear warhead design' can have a wide ranges of meanings. At one extreme the design could be so different from existing designs as to be very difficult to develop, even with full-scale test explosions.... At the other extreme, designers should have no difficulty at all developing certain designs that are not identical to currently proof-tested designs.... Intermediate between these extremes, it appears to me that there probably is a range of warhead designs that could be developed with a NIF, but not without it. Therefore, statements that NIF cannot proof-test a design do not allow the conclusion that the NIF cannot replace proof-testing in all potentially significant situations." (Anderson, WC2, p. 8)

"Unfortunately, the report falls short in its analysis and does not resolve key questions, inconsistencies, and contradictions produced by the various arguments DOE has made. For example, how important is the weapons information that the NIF would provide?" (Horner, WC2, p. 1)

"The response of the government to concerns about future weapons design activity has been that new designs cannot be deployed without full-scale nuclear testing. This however, should not be the end of the inquiry in a proliferation impact review. The review should also consider how much progress can be made towards developing weapons with new or improved military capabilities using the proposed array of simulation facilities." (Western States Legal Foundation, WC2, p. 6-7)

"The Study should give the same level of attention to the potential technical advantages of new, more sophisticated weapons test simulation techniques as it gives to the disadvantages when comparing them to full-scale nuclear testing." (Western States Legal Foundation, WC2, p. iv)

**The study describes NIF's capability, in the absence of nuclear testing, to allow for meaningful, albeit small laboratory-scale, study of some of the basic physics processes involved in weapons operation, namely the fusion processes. Thus, the study does examines the type of input data that NIF could provide on some of the basic physics of advanced nuclear weapon concepts. However, while the same fusion processes would occur during NIF target ignition as in a nuclear explosion, they occur in a nuclear weapon on a much larger scale and simultaneously with other competing processes. As stated in the report, the United States, using computer codes based on decades of nuclear weapon test data, can do the necessary extrapolation to nuclear weapon size and calculate the effect of many competing processes for existing weapons in the stockpile. However, for new nuclear weapon design concepts, there would likely be no nuclear test data to compare with NIF results, and therefore, it would be extremely difficult for U.S. weapons scientists to successfully develop a new type of nuclear weapon using the NIF, even in conjunction with other stockpile stewardship facilities.**

**(19) The description of vertical proliferation is inconsistent in the report.**

"Nowhere does the Report establish that NIF has the technical capabilities to lead to vertical proliferation, yet the Report offers detailed solutions to "managing" this non-existent problem. This is a serious deficiency...It is a grand leap from the conclusion that NIF will improve understanding of weapons physics to one that NIF raises vertical proliferation concerns. How will NIF increase numbers, yield or 'development of a next generation of weapons.... The report seems to implicitly adopt the position taken by many anti-nuclear activists regarding what constitutes 'vertical proliferation'." (Chandler, WC2, p. 1)

**The term 'vertical proliferation' in this study refers to increases in the numbers of nuclear weapons or warheads or the development of new types of nuclear weapons (advanced weapon concepts). The United States is now in an era of no new nuclear weapon development and of rapid dismantlement of nuclear weapons and warheads. The purposes of stockpile stewardship - to maintain the safety and reliability of remaining U.S. nuclear weapons without nuclear testing - is not considered vertical proliferation.**

**(20) The description of "new" nuclear weapons is not clear in the report. It appears the United States is still developing new nuclear weapons.**

"We are also very concerned about the definition of new weapon or new weapon type...I think it could be clarified and would help in our questions on proliferation risk." (Eldredge, PM5, p. 79)

"What role could ICF play in a weapons program which plans to, or may, introduce a new warhead into its

arsenal, where the new warhead is 'of the same family' as an existing fully tested and stockpiled weapon?" (Cochran, WC2, p. 2)

"A point emphasized in the Draft Study is that the NIF must be viewed in the broader context of the U.S. arms control efforts.... This position is paradoxical in light of the Draft Study's narrowing of scope to exclude other U.S. efforts to improve nuclear weapons research, development, and testing capabilities. The messages sent by the United States concerning the trajectory of its nuclear weapons policy, moreover, have been decidedly mixed." (Western States Legal Foundation, WC2, p. 8-9)

"[The report] says no new designed nuclear warhead production.... Frankly, I don't believe that... First of all, the definition of a new weapon is kind of a slippery slope. Just last week we found out that the B-53, 9 megaton doomsday bomb is being replaced with a more modern... safer B-61 modification that apparently is an earth penetrator... It sure looks like a new weapon to us... [It is] infinitely more useable than the old doomsday, 9 megaton B-53 bomb... This year,... a high powered radio frequency warhead, which, I believe, implicates some of the same technologies that the NIF would employ, reached an engineering decision...that weapon was in fact in the pipeline."(Cabasso, PM7, p. 127-9)

"This study asserts ...that...the administration is not intending to develop new weapons, and I have two questions related to that. First is, how can this study deal with the ongoing nuclear weapons development, ongoing R&D that is happening today, everything from the B53 -- proposed replacement of the B53 in the arsenal with an advanced earth-penetrator warhead to other studies that are just concluding or still ongoing for weapons like the high-powered radio frequency warhead, and so one -- one can go through the budget and simply pick out all of this weapons-development work. So that's number one, the assertions...are incorrect at this time." (Kelley, PM6, p.21)

**The study has been amended to clarify the term, "new nuclear weapon" (page 14). A new nuclear weapon would involve a substantially new warhead design concept or advanced weapon concept (a new type of nuclear weapon). Repackaging an existing design to add additional safety features or to remedy an aging defect should not be considered to be development of a "new nuclear weapon" since it is not a new warhead design concept nor an advanced weapon concept. For example, the B-61 replacement for the earth penetrating capability of the to-be-retired B-53 is not a new warhead design concept and is a replacement of an existing military capability with modern, safer, more reliable technology. On the other hand, a high powered radio frequency weapon would be a "new nuclear weapon" and falls into the category of a "new weapon type" or "advanced weapon concept." Although the Departments of Energy and Defense recently concluded a phase 2 feasibility study for a high power radio frequency type weapon, no development of an actual weapon is planned. The United States is now in an era of no new nuclear weapon development and of rapid dismantlement of nuclear weapons and warheads.**

**(21) NIF can be used to develop pure fusion weapons.**

"[The] question is why are two obvious categories in new weapons left out of your list? Number one is what led to NIF in the first place, and that is the decisions at Livermore... to go all-out to try to find ways to make

pure-fusion explosives. That led to inertial confinement fusion." (Taylor, PM7, p. 45)

"Meeting the stated NIF goal of producing fusion explosions, of any size, that release more energy than used to cause them would clearly be an important step in the direction of developing pure fusion weapons. I see no guarantees that the kinds of new knowledge that would be derived from inertial confinement fusion experimental programs would not help stimulate new ideas regarding ways to concentrate the needed energy in much smaller packages. Successful pursuit of such ideas in the U.S. or elsewhere, could have extreme global consequences." (Taylor, WC2, p. 2)

"If it achieves the NIF goal of releasing more energy in a fusion explosion than needed to produce it, such a device could qualify as a pure fusion weapon, even though it would be much bigger and heavier than any practically deliverable warhead or bomb." (Taylor, WC2, p. 2)

**The conditions needed for fusion ignition in an ICF capsule - i.e. the temperatures and energy densities - are generally already widely known. Research at NIF might provide some useful information on whether these conditions can be achieved with a laser driver. However, for two reasons, NIF would not be sufficient to develop a pure fusion weapon: (1) NIF targets are much too small to be a weapon; and (2) the driving mechanisms and conditions that would be required for a deliverable pure fusion weapon are entirely different than those required for ICF. The fundamental problems in developing the most complicated part of a pure fusion weapon, namely, the driver, have to do with high explosive-driven hydrodynamics, hydrodynamic instabilities and magnetohydrodynamics on a much larger scale.**

**(22) NIF can be used to develop mini-nuclear weapons.**

"...the Pandora's box that's being opened [by ICF research at NIF] is moving toward new kinds of weapons ... which capitalize on the nature of modern military and civilian technology to use very little energy to do an enormous amount of damage with small explosions." (Taylor, PM7, p. 117)

**Most concepts for mini-nukes are single-stage, fission-only devices. As the report explains, NIF lacks basic relevance for these weapons. Even for mini-nuke concepts that involve both fission and fusion, the same reasoning which applies to NIF's limited relevance to weapons development for nuclear weapons relates to NIF's relevance to fission-fusion mini-nukes - i.e., the fission trigger would still be much larger than an ICF capsule, the driving conditions are different than in a mini-nuke and the energy densities are still less than a thermonuclear weapon. (See the study section entitled "Approach of Technical Analysis".) Research and development on mini-nuclear weapons is currently banned by legislation.**

**(23) The NIF has applicability to developing EMP and microwave weapons.**

"...there's nothing in there [the report] about what seems to be the most -- to many people, who attend conferences, the most exciting category of nuclear weapons and non-nuclear weapons today, and that is those that produce electromagnetic pulses that can be directed with antennas, that can play all kinds of new roles in high altitude or space warfare." (Taylor, PM7, p. 46)

"The study contains no discussion of the role that the NIF project and possible extensions of it might play in the development of new types of nuclear or non-nuclear weapons: In particular, no attention is given to possible directed energy weapons that use NIF-like technology to energize extremely high power, narrow beams of microwaves." (Taylor, WC2, p. 2)

"...the NIF facility as a whole represents a possible, very effective, long-range-effect nuclear weapon, the whole facility. It's a pulse power source... [that could] drive a microwave weapon that is sitting right next to it... upward at space targets." (Taylor, PM7, p. 48)

**Electromagnetic pulse (EMP) and microwave weapons are types of directed energy weapons. The study addresses the relevance of NIF to these types of weapon concepts on pages 19-20. under the heading, "X-ray Laser Research", in the section entitled, "What weapons science do U.S. weapons scientists believe is technically possible on NIF?" This section concludes that "experiments on directed energy weapon concepts are considered highly speculative and NIF would only be able to play a very limited role in addressing some of the physics aspects of such weapons, and then, only on a small laboratory scale" (p. 20). As with other advanced weapon concepts, full-scale nuclear testing would be needed to develop directed energy weapons, including EMP and microwave weapons, and place them into the stockpile with a tolerable level of confidence.**

**On the specific weapon concept that proposes using the output energy from ignited NIF capsules to drive microwave converters, NIF capsules would not produce enough energy to be effective for such an application and there are much more efficient and practical means to produce microwave energy, for example, by using high explosive drivers or charging up capacitor banks with the local electric company.**

**(24) NIF will cause a continuation of the arms race among the nuclear weapon states.**

"... other NWSs [nuclear weapon states] like Russia are more likely to experience our SBSS [Science-Based Stockpile Stewardship] program as pressure to duplicate a high level of investment in nuclear weapons design and development programs, tailoring the nature of their investments to suit their particular situation." (Mello, WC1, p. 4; also Mr. and Mrs. Leonard, WC1, p.1)

"... the NIF will serve to increase the power of those military hard-liners in Russia who also wish to continue nuclear weapons research." (Pilisuk, WC1, p. 2, WC2, p.2)

"Competition among nuclear weapon states for advanced above-ground experimental facilities would clearly demonstrate to the world the continued importance of nuclear weapons in the strategic policies of the five nuclear weapons states." (Zerriffi, PM5, p. 74)

"This raises the possibility of a new kind of 'virtual arms race' in the area of simulated test technologies, and also is relevant to the incentives both nuclear weapon states and potential proliferants may have to 'break out' of a test ban regime." (Western States Legal Foundation, WC2, p. v)

**The United States and a large number of other NPT parties took the position at the recent Nuclear Nonproliferation Treaty Extension Conference that the nuclear arms race is over. This is evidenced by the unprecedented reductions in nuclear weaponry by the U.S. and Russia, as well as nuclear weapon states' commitment to conclude a Comprehensive Test Ban Treaty by 1996 and to commence negotiations on a multilateral convention prohibiting fissile material production for nuclear weapons purposes. Under a zero-yield Comprehensive Test Ban Treaty, the challenge to the United States will be maintenance of its weapons. To accomplish this mission, the United States has chosen to embark on a science-based program which does not involve any level of nuclear testing and includes a dual-use and predominantly open, basic science facility, the NIF.**

### **NIF AND HORIZONTAL PROLIFERATION:**

- (25) **There seems to be a contradiction between keeping the NIF out of the hands of proliferant nations, and using NIF to encourage other nuclear weapon states such as Russia or France to join a Comprehensive Test Ban Treaty.**

"There seems to be some conflict with the idea of keeping the NIF out of some hands and satisfying the Russians... and what that would take to bring them on board [a zero-yield CTBT]." (Weisman, PM6, p. 17)

**The Department is currently developing screening procedures to prevent scientists from proliferant countries from gaining access to NIF. Also, U.S. classification regulations will prevent NIF data from being published which could directly contribute to another nation's nuclear weapons program. At the present time, collaborations with the French and Russians on ICF are unclassified.**

**(26) We should consider abolishing ICF since it is a dangerous nuclear -weapon related technology.**

"We could lead by example... Ted Taylor has suggested abolishing inertial confinement fusion technology, which, in the context of this discussion, seems almost absurd on its face, but it could be done." (Cabasso, PM7, p. 194)

"... when this [ICF] technology spreads around the world, especially if it turns out to achieve ignition, will that be the same sort of foundation for the creation of thermonuclear weapons that nuclear reactors amount to, or a foundation for the creation of fission weapons?" (Burroughs, PM7, p. 147)

"My assessment of inertial confinement fusion technology, over many years, has led me to conclude that its successful development will increase the risks to humankind of nuclear violence much more than can be balanced by any conceivable benefits. I therefore strongly advocate a prompt, global, internationally safeguarded ban on further development of this technology." (Taylor, WC2, p. 3)

"The use of NIF (whose main purpose is clearly military) for civilian purposes would represent a significant weakening of the barriers between civilian and military nuclear technology, especially in a symbolic way." (Anderson, WC2, p. 4)

"The horizontal proliferation analysis does not fully consider the ways NIF technology might be used by potential proliferators, and fails to consider the long range consequences of ICF research and deployment." (Western States Legal Foundation, WC2, P. 13)

"Fusion, including ICF, is a technology whose widespread use for power generation would be inextricably intertwined with the knowledge and technology needed to manufacture weapons of mass destruction, and the materials of which they are made." (Western States Legal Foundation, WC2, p. iv)

**Inertial Confinement Fusion (ICF) is a well-established technology in the international community, and is being pursued by a number of advanced industrialized nations for peaceful purposes, i.e. scientific, technological and energy applications. Successful research on ICF may lay the foundation for utilization of fusion as a nuclear energy source in lieu of fission. This would enhance nonproliferation efforts, since nuclear fusion would not produce plutonium and would not involve enrichment, reprocessing, or other technologies with greater proliferation potential.**

**(27) By the nature of technological development, advances will proliferate regardless of control efforts -- the experiments at NIF will be no exception to this rule.** (Brechtin, PM3, p. 166-167, WC1, p. 1; Erickson, PM3, p. 161; Frisch, PM3, p. 208; Fulk, PM3, p. 103; M. Kelley, PM1, p. 21; Nesbitt, PM3, p. 101)

"Nothing in your report talks about how knowledge spreads.... I think people look... and say, 'Why did he do that open experiment? Well, he must know something along these lines; right?' And you can infer what's classified, and the knowledge starts to spread, as you advance weapons science... Openness exacerbates this concern." (Larken, PM7, p. 89 also PM3, p. 88-90, PM7, p.33, WC1, p. 4-5, WC2, p. 14-17)

"... the section on horizontal proliferation downplays the value of experience and training at NIF for

proliferating countries. It is unreasonable to assume that scientists could only benefit from experiments that are directly relevant to weapons." (Zerriffi, PM5, p. 72)

"... is it possible... to learn information that would be useful for weapons design from unclassified work?" (Eldredge, PM5, p. 30)

"The conclusion... [that] 'proliferation concerns can be successfully managed' is a farce and an insult to anyone seriously concerned about proliferation. Knowledge can NOT be managed!" (Hagen, WC2, p. 2).

The Report fails to adequately address the horizontal proliferation risk caused by sharing ICF research and/or technology with non-nuclear weapons states that may desire to develop a core competency in weapons development, while overstating its ability to manage the concern. (Cochran, WC2, p. 2-3)

"... history shows that classification is not a substantial barrier to the proliferation of technical information.... The study itself is ambivalent about the value of classification. For example, the last two paragraphs... [on page 29] contradict each other... The first says that classification 'can serve only as a temporary stop-gap to the flow of high energy density data to other countries'. The second says that it 'places severe limits on the weapons-related utility of NIF for non-U.S. scientists'." (Larkin, WC2, p. 16)

"Against the limited value of stewardship must be opposed its costs. The construction and operation of NIF and related facilities would not be cheap. More important are the consequences for the present and future danger of proliferation. NIF will bring together the weapons and unclassified communities. People will rub elbows, share facilities, collaborate on unclassified experiments and communicate their interests and concerns to each other. Information and understanding will diffuse from the classified to the unclassified world, without any technical violation of security." (Katz, WC2, p. 2)

**Certainly the advancement and spread of technology internationally is inevitable, and many technologies have military as well as civilian applications. The use of technology for benign or hostile purposes hinges upon the intent of the user. At NIF, the Department will screen users and experiments to identify those with weapons potential. In this way and through classification, we believe that proliferation through use of NIF experiments can be successfully managed.**

**The study did consider the mechanisms and risks of the flow of information. The study notes that research at ICF facilities is being published in open literature around the world, and that some of the computer codes that are used to predict behavior of an ICF pellet have much in common with codes used to design boosted primaries and secondaries. Classification will continue to be used by the United States to slow dissemination of specific information useful for weapons. When DOE classification guidelines were reviewed in 1991, the value of information proposed for declassification in assisting proliferant nations with their weapons programs was taken into account. Therefore, it is unlikely that an experiment conducted openly would be able to contribute directly to another country's nuclear weapons program.**

**(28) The value of nuclear testing for a proliferant nation is overstated.**

"... it's U.S. policy that before a weapon can be placed in the stockpile, that it has to meet certain reliability standards... And for that reason, it's been necessary to proof-test weapons with an underground explosion before they can be placed in the stockpile... In the draft study, it seems to apply that same criteria to other states... Take another country that, in fact ... used ICF research to improve boost, but doesn't care if it's reliable or not, but develops the weapon anyway... we'd be scared of it, just as if they had proof-tested." (Larkin, PM7, p. 187-190)

"Fission weapons have already been designed without proof-testing, and a country with that experience may be able to use the knowledge from NIF to develop a secondary." (Zerriffi, PM5, p. 73)

"... states that develop weapons for purposes of deterrence may have weaker standards.... deterrence doesn't depend on a high degree of reliability." (Larkin, WC2, p. 12)

"The study.... pretends that a 'proliferator' would have to take data from ICF experiments, relate it to other information (past test data), and contemplate what it all means for nuclear weapons... So the horizontal proliferation question is not just 'What good would ICF data be to someone who didn't have past test data?', but 'What good are the new models, the new understanding of how weapons work, and the new technologies and devices that result?'" (Larkin, WC2, p. 14)

"Much of the horizontal proliferation concern surrounding the NIF involves states that have developed fission weapons and are seeking thermonuclear weapons ('Category Three'). DOE minimizes this concern by arguing that 'extrapolating to a functioning warhead from scaled ICF data would be extremely tentative without past nuclear test data' (p.26). But development of codes would be a significant advance toward a thermonuclear capability." (Horner and Lyman, WC2, p. 2)

**The study states, under the heading "Value of ICF to Category Three proliferators" in the section "Proliferation by other states", that "one cannot rule out that a technologically advanced country would be able to field a very conservatively designed thermonuclear weapon that would present a credible threat without nuclear testing" (p. 27). The study also states, under the heading "Value of ICF to Category Two Proliferators" in the same section, that "ICF data including those from NIF would not be necessary for a Category Two proliferator to develop a boosted primary" (p. 27).**

**(29) Disagreement with the Draft Study's Discussion on the Categories of Proliferators:**

"It [the study] presumes, that anyone who wants to obtain nuclear weapons must follow a path that roughly recapitulates the history of nuclear weapons development in this country.... Although it's careful to call them 'categories', not 'stages', it assumes that 'proliferators' in each category will be in a position to move only to the next category up." (Larkin, WC2, p. 15)

"The draft NIF report fails to address at all the value to a non-weapon state of pursuing an aggressive ICF program for the undeclared purpose of having a contingent capability to more rapidly develop thermonuclear weapons.... The NIF report should describe in some detail how maintaining a thermonuclear design breakout capability could benefit a country such as Japan, and relate this to the report's discussion of the value to the U.S. of retaining a capability to develop quickly new nuclear weapons." (Cochran, WC2, p. 2)

"... the study leaves out many important issues related to vertical and horizontal active and latent proliferation of nuclear weapons... Latent proliferation, whether vertical or horizontal, means accomplishment of major steps in the direction of acquiring nuclear weapons without actually making them or necessarily deciding to make them. (The build-up of large stockpiles of plutonium in or extracted from spent nuclear power fuel, or the assembly of computational capacity for nuclear weapons design calculations, for examples.)" (Taylor, WC2, p. 1)

"The Study should also analyze the role ICF could play in the maintenance of a nuclear weapons contingency program by a technologically sophisticated, industrialized state which has ICF programs, extensive nuclear power systems, and large supplies of fissile material. Such countries might develop the capability to develop thermonuclear weapons relatively quickly, to the point where they would have to 'break out' of a CTB regime only for final proof-testing of designs which were fairly well understood." (Western States Legal Foundation, WC2, p. iv)

"The Study should evaluate how both non-nuclear and nuclear states can use all available technical means in combination to design and improve nuclear weapons." (Western States Legal Foundation, WC2, p. iv)

**The study acknowledges that ICF research does provide a means by which other countries can build or maintain a cadre of scientists who are knowledgeable about the fundamental physics of nuclear weapons. This would be true whether NIF was built or not since other countries are already openly publishing ICF results. The report has been amended to account for the fact that advanced industrialized nations could probably move fairly quickly to developing advanced fission or thermonuclear weapons without first actually building fission weapons. Please note the revised introduction to the section entitled "Proliferation by Other States and the Role of ICF data."**

**(30) What policy does the Department of Energy recommend with regard to collaboration by U.S. researchers on a) ICF research projects in general, and b) NIF experiments in particular, with researchers from the following countries: 1) Japan, 2) Israel, and 3) India and Pakistan? (Cochran, WC2, p. 3)**

**The Department of Energy guidance on inertial confinement fusion (ICF) cooperative research is that collaboration should occur through government to government agreements which have appropriate review and controls. The United States has no such bilateral agreements with Israel, India, or Pakistan. With regard to Japan, the United States and Japan have had a "cooperative agreement" on fusion energy since 1975. This agreement has concentrated primarily on magnetic fusion activities, since Japan has chosen not to cooperate on any work funded by the Department's Office of Defense Programs. In the event that a country with which the United States does not have a bilateral agreement proposes any sort of ICF collaboration, the proposal is handled on a case by case basis, and must undergo rigorous scientific and policy level scrutiny. With regard to ICF collaboration at NIF in particular, the study outlines some additional possible screening procedures which would prevent non-NPT parties and NPT parties not in good standing from participating in NIF research.**

**(31) What are the negative implications in the international community of denying access to certain countries?**

"How do you decide which countries get access, and what is that going to do to the nonproliferation regime in general if some countries are getting access and others aren't, and what kind of strains will that cause?" (Zerriffi, PM5, p. 40)

"Pages 25-27 refer to the value of NIF in helping other nations maintain a cadre of knowledgeable people under the guise of legitimate scientific activity. Pages 29-30 assure us that we can limit scientists and experiments to those from friendly, trustworthy nations. But who can tell when our allies will become our enemies? Shifting alliances are a fact in world politics. Scientists from friendly nations could use the information learned on NIF to develop nuclear weapons to be used against us tomorrow." (Dean-Freemire, WC2, p. 1)

"The screening procedures that are proposed to prevent horizontal proliferation may not work and may be discriminatory. For NPT signatories, their rights under Article IV promoting civilian uses could be denied if the U.S. refuses them access to the facility." (Zerriffi, PM5, p. 73)

**Denial of access may be based on a variety of criteria. Limitations on access, for example, may be mandated by U.S. nonproliferation policies, laws and regulations, and international treaty commitments, such as the Nonproliferation Treaty (NPT). At a minimum, a state's nonproliferation credentials, including membership in the NPT, need to be considered in determining whether or not a state should be permitted to participate in NIF experiments. Other criteria, such as a state's sponsorship of terrorism, will also need to be weighed. The United States remains committed to sharing the benefits of nuclear technology for peaceful purposes with states that faithfully observe internationally accepted nonproliferation norms. However, at the recent NPT Extension Conference, the NPT membership as a whole fully understood and was prepared to accept the reality that an NPT party which was not abiding by its obligations not to acquire nuclear weapons would be denied peaceful nuclear cooperation.**

- (32) The study does not focus on proliferation more broadly - for example, on the value of obtaining fissile material, nor on the difference between fusion and fission pathways to proliferation.**

"The study's section on the technical requirements for proliferation states that a country would require both fissile material and access to test data in order for NIF to have any use. The question of access to fissile material is irrelevant to the discussion of NIF's proliferation implications.... If the Department of Energy is going to consider the role of fissile material in this context, it should consider this aspect fully..." (Zeriffi, PM5, p. 72)

"... there needs to be a chapter that discusses the nature of the nonproliferation issue itself, not just in the context of the National Ignition Facility. This chapter should discuss the present nonproliferation principles, describe the control and safeguard policies, and describe the relative likelihood of proliferation through the fission versus fusion pathways. Only by including such a discussion can it become clear how far one has to stretch one's imagination in order to conclude that the National Ignition Facility would constitute a significant proliferation threat." (Dean, PM3, p. 74-75)

**Under the Horizontal Proliferation heading, in the last sentence of the section entitled, under "Technical Factors that Mitigate utility of NIF for proliferation," (p. 25), the study outlines the most important technical means of preventing nuclear proliferation are - namely, controlling production of fissile material, preventing the spread of classified information about nuclear weapons design and nuclear weapon test data, prohibiting nuclear weapons testing, and preventing espionage. Limiting access to fissile material is a key nuclear nonproliferation goal, but the larger issues related to limiting access to fissile material do not fall within the more limited scope of this study. The primary purpose of this report is to analyze the specific impacts of U.S. construction and operation of the National Ignition Facility on U.S. arms control and nonproliferation efforts.**

**Please note that the report has been amended to include our view that utilization of fusion as a nuclear energy source would present fewer proliferation concerns than utilization of fission (see page 11 under heading, "NIF for Commercial Energy and Basic Science").**

### **COMMENTS ON THE NIF AND NONPROLIFERATION PROCESS:**

#### **(33) Comments in praise of the NIF and Nonproliferation Public Process:**

"I first wish to commend you on the thoroughness of the draft study and your willingness to address all issues related to possible contributions of NIF to weapons proliferation. Your painstaking efforts to incorporate the concerns and views of all segments of society were clearly evident." (Luhmann, WC2, p. 1)

"The study represents an important, perhaps unprecedented, effort by the Department of Energy (DOE) to address basic concerns about a major project in the early stages. DOE is to be commended for undertaking the process of which this report, these comments, and the public meetings are a part. The report does not ignore or dismiss the potential proliferation problems that the NIF raises... We welcome DOE's frank acknowledgment of these and other problems..." (Homer, WC2, p. 1)

#### **(34) The Department should declassify the reviewers comments on the classified draft study. (Ted Taylor, PM7, p. 44)**

**Unfortunately, the Department cannot declassify the reviewers' comments that dealt with classified issues. Their comments have been incorporated in both the classified and unclassified versions of the report. Each of the reviewers has concluded that the reader is not at a disadvantage in judging the validity of the study by virtue of not having had access to the classified material and that the unclassified study adequately addresses all the issues relevant to the topic of NIF and the issue of nonproliferation. It is also important to note the reviewers represented a broad spectrum of views and expertise.**

- (35) **The Department should summarize the public comments on the outline as well as the public comments on the draft study.**

"And the second comment has to do with something that I was struck with when I read the draft study, and that is to the extent to which it ignored the comments that were made previously by the public... Will previously-given comments, written comments and oral comments made at previous hearings be included with that [later comments]?" (Larkin, PM7, p. 27-29)

**In addition to comments on the draft study, this compendium of public comment also includes public comments made at public meetings held on the draft outline for the study as well as those submitted in writing on the outline for the study.**

### **COMMENTS SUPPORTING NIF CONSTRUCTION:**

- (36) "I've seen many of these facilities built for nuclear fusion experiments, magnetic fusion, laser fusion, and it seems to me that after many experiments on each of these, they provide the justification to build a larger facility..." (Laughlin, PM6, p. 99)

"Since some of the reaction was negative and I believe misleading, I want to record my strong support for the 'NIF' facility. The NIF would be the ideal means of preserving readiness expertise in a manner that is completely consistent with nonproliferation. The fact that the program would continue to move toward a civil energy source for the next century can only be viewed as an additional and perhaps vital advantage." (Christensen, WC2, p. 1)

"The National Ignition Facility is a timely and necessary experiment to establish the scientific principles of inertial confinement fusion. The use of high power lasers to create small, high density, high temperature conditions permits not only the study of some of the conditions that occur in nuclear explosions, but also the study of the conditions that occur in stars, and the study of the physics of fusion energy for civilian applications. As such, the NIF will be a unique and powerful scientific tool, allowing scientists to create new forefront knowledge in several areas. NIF also extends our technological capability in many areas, including precision optics, high-speed micro diagnostics, laser architecture, and computer simulation." (Dean, PM1, p. 71)

"After extensive study of the draft as well as listening to your remarks and answers, I am convinced that Congressman Dellums' concerns which led to Key Decision One Prime have been fully addressed. I therefore hope that Secretary O'Leary will proceed forward with this important facility." (Luhmann, WC2, p. 1)

### **CRITICISMS UNRELATED TO NONPROLIFERATION:**

- (37) **NIF and commercial energy:**

"NIF technology is not appropriate for commercial fusion energy. NIF-type lasers cannot be fired frequently enough to generate commercially-usable energy, and there remains serious questions as to whether NIF will be able to achieve ignition.... The NIF... will divert funds from clean renewable energy programs." (Aurilio, WC2, p. 2)

"The NIF may fail to ignite." (Cochran, WC2, p. 1; also Rep. Stark, PM3, p. 56)

"There has been no national debate on whether a program to develop fusion energy makes any sense, nor has fusion been weighed against solar, wind, and other alternatives." (Larkin, WC2, p. 2)

"... only a small percentage of the fusion science generated by a NIF type facility will be useful for the development of Magnetic Confinement Fusion (MCF) reactors which are presently viewed as the most likely route to fusion produced electricity." (Brechin, WC1, p. 1-2)

"NIF's value to energy research is uncertain and speculative at best." (M. Kelley, PM3, p. 59; also Larkin, WC1, p. 2, WC2, p. 2; Zimmer, PM2, p. 47)

There are many more efficient and less costly manners of producing electricity than fusion energy and they are available immediately. (Miller, PM1, p. 46; Pilisuk, PM1, p. 98; Rippy, PM1, p. 65-66; Sipp, PM1, p. 74-75; Johnson, PM2, p. 52; Zimmer, PM2, p. 47; Nesbitt, PM3, p. 95-98)

The lasers proposed for use in the NIF "are not usable... as drivers for fusion energy." (Dale Nesbitt, PM3, p. 98)

**The subject of this study is the implications of the National Ignition Facility on U.S. arms control and nonproliferation efforts. Thus, the study analyzes the proliferation implications of NIF if it achieves ignition and if it does not. However, the study does not attempt to analyze whether or not the National Ignition Facility will achieve ignition nor its value as a commercial energy source. This is beyond the scope of this study.**

**(38) Concerns about NIF's cost:**

"Since each department of the federal government is under severe budget constraints, funding for the NIF would very likely come at the expense of scientific research with realistic civilian applications and environmental clean-up programs." (Rep. Stark, PM3, p. 57; also Acevedo, WC2, p. 1; Barlow, WC1, p. 1; Burnett, PM1, p. 155-116; Cabasso, PM4, p. 7-8; Dr. and Mrs. Cox, WC1, p. 1; Dean-Freemire, PM3, p. 195; Ebersole, WC1, p. 2; Frisch, PM3, p. 210; Fulk, PM3, p. 102; Gould, PM3, p. 158; Igel, PM4, p. 25; Johnson, PM2, p. 52; Kelly, PM7, p. 113; King, PM4, p. 60; Larsen-Beville, PM3, p. 67; Mr. and Mrs. Leonard, WC1, p. 1; Nesbitt, PM3, p. 96-97; Olin, PM4, p. 20-21; Robbins, WC1, p. 2; Rogers, PM3, p. 223; Scott, PM4, p. 18; Weida, PM3, p. 78; Zimmer, PM2, p. 46)

"Why spend money to develop a surrogate nuclear weapons testing program when people in the cities are homeless and many suffer from poor nutrition and inadequate health care?" (Franks, WC1, p. 1)

"We do not need or want a National Ignition Facility which is expensive and of no value to us." (Acevedo, WC2, p. 1)

"Currently available technology should suffice for maintaining the national stockpile. Investing nearly \$2 billion in this facility will waste resources which are needed for critical storage and waste cleanup at DOE's weapons complexes." (Igel, PM4, p. 24-25)

"What is the justification of such a costly program? Since the collapse of the Soviet Union, it can't be any

pressing need to further our ability to fight nuclear war.... NIF is the worst in a long line of schemes by the weapons labs to preserve their power, prestige, and cash flow, at the great expense and real harm to the causes of national security, world peace, and well being of the people of this nation." (Caseber, WC2, p. 1)

**The total project costs for the NIF are estimated at \$1.1 billion. Basic operation of the facility, not including the scientific program, is estimated at \$60 M/year.**

**(39) NIF's usefulness is questioned:**

Regional economic benefits of the NIF are vastly overestimated. (Candell, PM1, p. 36; Erickson, PM3, p. 162-163; Dean-Freemire, PM3, p. 195-196; Frisch, PM3, p. 210-211; Johnson, PM2, p. 51-52; Weida, PM3, p. 76-78)

DOE has manufactured support among the scientific community regarding the potential value and usefulness of NIF. (M. Kelley, PM3, p. 61-63)

"There are no guarantees of benefit for global peace, no concrete evidence that the laser program will produce cheap energy and lastly, LLNL administration cannot operate such a program efficiently." (Barlow, WC1, p. 1)

**These questions and concerns are best brought to the public fora that is part of the Stockpile Stewardship and Management Programmatic Environmental Impact Statement (PEIS) process.**

**(40) NIF is an environmental danger:**

"... the National Ignition Facility poses an environmental risk. It will add incrementally to the tritium burden, which is already high around Livermore." (M. Kelley, PM3, p. 59-60; also Dyskant, PM1, p. 43-44; Johnson, PM2, p. 50; Laub and Nurmela, WC1, p. 1; Mr. and Mrs. Leonard, WC1, p. 1; Nurmela, PM6, p. 100; Robbins, WC1, p.3)

"The NIF moves toward more potential public health risks, rather than toward "cleanup". (Ebersole, WC1, p. 2)

"... the NIF would continue to produce radioactive wastes when the existing wastes already pose a serious, costly and unresolved problem." (Pilisuk, WC1, p. 3, WC2, p. 2)

"Due to the extreme risks to life involved, however, I do not believe this prospect [fusion energy], in the form of the establishment of the NIF at Lawrence Livermore Laboratory, should be pursued at this time." (Olney, WC2, p. 1)

"Why build the NIF on an active earthquake fault?" (Olney, WC2, p. 2)

**In a preliminary assessment, NIF has been determined to be a non-nuclear low-hazard facility. However, NIF is subject to a full construction and operation environmental analysis under the Stockpile Stewardship and Management Programmatic Environmental Impact Statement (PEIS).**

**APPENDIX IV:**  
**PUBLIC MEETINGS ON THE OUTLINE FOR THE STUDY:**  
**PARTICIPANTS AND AFFILIATIONS**

	January 24	January 30	March 9-10	Written Comments
Richard Akin/Ironworkers, Local 378			x	
Carl Anderson/Private Citizen	x		x	
Robert Aronno/Tinsley Laboratories			x	
Jerry Balmer/Ironworkers, Local 378			x	
O.M. Barlow/Private Citizen				x
John Billheimer/Private Citizen			x	
Clyde Bland/Mayor, Tracey, California				x
Stephen Bodner/Department of the Navy				x
Vernon Brechin/Private Citizen			x	x
Gene Broadman/Bay Area Economic Forum			x	
Betty Brown/East Bay Peace Action				x
David Brown/Berkeley Nucleonics Corp.			x	
Bob Burnett/American Friends Service Committee Regional Office	x			
John Burroughs/Western States Legal Foundation			x	x
Jackie Cabasso/Western States Legal Foundation		x	x	x
Marlene Candell/Livermore Conversion Project	x			
Harry Carlson/Plasterers, Local 66			x	
Keith Carson/Alameda County Economic Development Advisory Board				x
Dr. Davida Coady/Private Citizen	x			
John Collins/Electricians, Local 595			x	
Richard Corvello/Electricians, Local 595			x	
Dr. William Cox/Alice Cox/Private Citizens				x
Katherine DaSilva Jain/Jinendra Jain/Private Citizens				x
Pat Davis/Livermore Chamber of Commerce				x
Stephen Dean/President, Fusion Power Associates			x	
Joanne Dean-Freemire/Private Citizen			x	
Theodore Delmar/Private Citizen				x
Erlene DeMarcus/Field Rep.-Cong. Baker	x		x	

	January 24	January 30	March 9-10	Written Comments
Leroy Diaz/Sheet Metal Workers, Local 104			x	
Edward Dijeau/Electricians, Local 595			x	
Barbara Dyskant/Private Citizen	x			
Raymi Dyskant/Private Citizen				x
Lawrence Ebersole/Private Citizen				x
Maureen Eldredge/Military Production Network		x		
Stephanie Erickson/Private Citizen			x	
Dr. and Mrs. A.A. Fischer/Private Citizens				x
Michael Franks/Livermore Conversion Project	x			x
Stephanie Fraser/Physicians for Social Responsibility	x			
Joann Frisch/Private Citizen			x	
Marion Fulk/Private Citizen	x		x	
Robert Gould/Physicians for Social Responsibility			x	
Laurie Harris/Bricklayers, Local 3			x	
Dave Hedgepeth/Nashville Peace Action		x		
Peter Henley/Hayward Area Peace and Justice Fellowship	x			
Lara Hilder/Sierra Club			x	
Jack Igel/Sacramento - Yolo Peace Action			x	
Brent Ives/Councilman, City of Tracey, California			x	
Cynthia Johnson/Women's Strike for Peace		x		
Marylia Kelley/Tri-Valley CARES	x		x	
Steven Kelly/Most Holy Trinity Catholic Church of San José			x	
Donald King/Tri-Valley CARES	x		x	x
Jeffrey Koch/Private Citizen				x
Dan Koontz/Ironworkers, Local 378			x	
Don Larkin/Private Citizen			x	x
Sherry Larsen Beville/Private Citizen	x		x	
Edith Laub/Lillian Nurmela/Women for Peace-East Bay				x
Dan Lee/Private Citizen			x	
Dr. and Mrs. Alvin Leonard/Private Citizens				x
Andrew Lichterman/Western States Legal Foundation	x		x	x

	January 24	January 30	March 9-10	Written Comments
Wayne Livingston/Building Trades			x	
Judith Lovuolo-Bhushan/Private Citizen				x
Barry Lubovski/Building and Trades Council of Alameda County			x	
Mary Lou Lucas/Coalition of Labor and Business-Alameda, Contra Costa, Solano Counties			x	
Daniel Marlin/Circle of Concern	x			
Marty Martin/Millwrights, Local 102			x	
David Matney/Electricians, Local 595			x	
Larry McReynolds/Triad Systems Corp.			x	
Greg Mello/Tri-Valley CARES, Los Alamos Study Group	x			x
Sharrell Michelotti/for Mayor, Pleasanton, Calif.			x	
Dale Miles/Private Citizen	x			
Del Miles/Private Citizen			x	
Barry Miller/Private Citizen	x			
Jack Miller/Painters, Local 3			x	
David Mulqueeney/Livermore Chamber of Commerce			x	
Dale Nesbitt/Peace Action, 20/20 Visions	x	x	x	
Virginia Nichols/for Tracey District Chamber of Commerce			x	
Lillian Nurmela/Women for Peace, East Bay	x			
Father William O'Donnell/Private Citizen	x			
Tom O'Malley/Tri-Valley Business Council			x	
David Oakely/Private Citizen			x	
Phyllis Olin/Private Citizen			x	
Margaret Olney/Circle of Concern			x	
Nancy Ortenblad/Alameda County Mayors Conference				x
Christopher Paine/Natural Resources Defense Council				x
Garry Patton/Planning and Conservation League				x
Myron Pederson/Operating Engineers, Local 3			x	
Jim Perry/Livermore Planning Commission			x	
Cindy Pile/National Catholic Peace Movement	x			
Mark Pilisuk/Psychologists for Social Responsibility	x			x

	January 24	January 30	March 9-10	Written Comments
Tom Reitter/Councilman, City of Livermore			x	
Ed Rippy/Private Citizen	x			
Frederick Robbins, et.al./Private Citizens				x
Mora Rogers/Private Citizen			x	x
Ron Rosequist/Economic Devel. Advisory Bd. of Alameda County			x	
Maylie Scott/Buddhist Peace Fellowship			x	
Dave Senff/Electricians, Local 595			x	
John Shirley/Private Citizen			x	
Katie Sipp/California Peace Action	x			
Jay Smart/Councilman, City of Manteca			x	
Kathryn Smick/Private Citizen				x
Jim Stagg/Electricians, Local 595			x	
John Stein/Vice-Mayor, Livermore			x	
Thomas Sweeney/Electricians, Local 595			x	
John Toeppen/Private Citizen			x	
Vincent Tripi/Sheet Metal Workers, Local 104			x	
Ray Trujillo/State Building Trades			x	
Tom Vargas/Councilman, Livermore			x	
Leo Von Gottfried/Private Citizen			x	
Ted Wagner/Carpet and Linoleum Workers, Local 12			x	
Steven Wampler/Private Citizen			x	
Bill Weida/Colorado College			x	
Ken Whitham/Private Citizen			x	
Bruce Word/Sheet Metal Workers, Local 104			x	
Chris Zimmer/Greenpeace		x		
Abraham Zwickle/Free for Peace	x			
Totals	26	6	72	31

**PUBLIC MEETINGS ON  
THE DRAFT STUDY  
PARTICIPANTS AND AFFILIATIONS**

	September 21	September 28		Written Comments
		A.M.	P.M.	
Martha Acevedo/U.S. Peace Council				X
Dorothy Adle/Private Citizen				X
Carl Anderson/Private Citizen			X	X
Tim Andrews/Private Citizen			X	
Anna Auriliq/U.S. Public Interest Research Group				X
O. M. Barlow/Private Citizen				X
Elijah Boyd/21 <sup>st</sup> Century Sci & Tech	X			
Ann Brier/Western States Legal Foundation			X	
Cathie Brown/Mayor, City of Livermore		X		
John Burroughs/Western States Legal Foundation			X	X
Jackie Cabasso/Western States Legal Foundation			X	X
Marlene Candell/Livermore Conversion Project		X		X
Jami Caseber/COPE				X
Christine Chandler/Private Citizen				X
Richard Christensen/Private Citizen				X
Thomas Cochran/NRDC				X
Joanne Dean-Freemire/Private Citizen				X
John DeGroot/Private Citizen			X	
Nancy DeGroot/Private Citizen			X	
Maureen Eldredge/Military Production Network	X			X
Stephanie Ericson/Tri-Valley CAREs			X	
Bernice Fischer/Peninsula CTB Nonproliferation Coalition				X
Julian Frazer/Council Member, City of Martinez, CA			X	
Marion Fulk/Private Citizen		X	X	
Jeff Garberson/Private Citizen			X	
Renee Gaspari/Energetics Inc.	X			
Aaron Grzybicki/Field Rep., Cong. Baker		X		

	September 21	September 28		Written Comments
		A.M.	P.M.	
Wilhelm Hagen/Private Citizen			X	X
Jim Hannon/Private Citizen			X	
Bill Hollen/Private Citizen			X	
Daniel Horner/Nuclear Control Institute	X			X
H. T. Jones/Private Citizen			X	
Pat Jordan/City of Livermore	X			
Glen Kade/Private Citizen		X		
J. I. Katz/Private Citizen				X
Marylia Kelley/Tri-Valley CAREs		X		
Stephen Kelly/Tri-Valley CAREs			X	
Vincent Kiernan/New Scientist	X			
Daryl Kimball/Physicians for Social Responsibility	X			
Don King/Private Citizen		X		
Dave Kramer/Inside Energy	X			
Don Larkin/Western States Legal Foundation			X	X
Aaron Laughlin/Private Citizen		X		
Dan Lee/Private Citizen		X		
Allen Levy/Private Citizen			X	
Andrew Lichterman/Western States Legal Foundation		X		X
Sally Light/Private Citizen			X	
Barry Luboviski/Building and Construction Trades Council for Alameda County		X		
N.C. Luhmann, Jr./Private Citizen			X	X
Edwin S. Lyman/Nuclear Control Institute				X
Margaret Massman/Physicians for Social Resp.			X	
Bruce McClintic/Private Citizen				X
Dale Nesbitt/Peace Action, 20/20 Vision		X		X
Lillian Nurmela/Women for Peace-East Bay		X		X
Dave Ohst/Private Citizen			X	
Phyllis Olin/Western States Legal Foundation			X	
Margaret Olnev/Circle of Concern				X

	September 21	September 28		Written Comments
		A.M.	P.M.	
Kevin O'Neill/Institute for Science and International Security	X			
Jeff Paisner/Private Citizen			X	
Marc Pilisuk/Psychologists for Social Responsibility				X
Thomas Rauch/American Friends Service Committee				X
Bob Russell/People for a New Nuclear Policy			X	
Maylie Scott/Private Citizen				X
John Shirley/Private Citizen		X		
Cary Spencer/Private Citizen			X	
Charles Stevens/21 <sup>st</sup> Century Sci & Tech.	X			
Theodore Taylor/Private Citizen			X	X
James Turner/DOE Oakland			X	
Dorothy Vance/Private Citizen				X
Michael Veiluva/Western States Legal Foundation				X
Steven Wampler/Private Citizen		X		
Jonathan Weisman/Tri-Valley Herald		X		
Hisham Zerriffi/Institute for Energy & Environmental Research	X			
John Zucca/Private Citizen			X	
TOTALS	11	16*	29*	32

\* Totals for September 28 meeting may be incomplete.



## Department of Energy

Washington, DC 20585

JAN - 2 1996

Dear Interested Stakeholder,

Secretary Hazel O'Leary has decided that the National Ignition Facility (NIF) supports the nuclear nonproliferation objectives of the United States. This decision is based upon the enclosed final study written by the Department's Office of Arms Control and Nonproliferation, which has no programmatic responsibility for the NIF. The study examines both vertical and horizontal proliferation implications of building and operating the NIF. The Department is committed to operating the National Ignition Facility in the most open manner possible while supporting our objective of reducing the global nuclear danger.

A full public process was followed in developing the study. Public meetings were held on the outline for the study and on an August 23, 1995 study draft in Washington, DC and in California. This study was also coordinated with other appropriate U.S. government agencies, including the Arms Control and Disarmament Agency and the Departments of State and Defense.

I want to thank all of the participants in the public meetings and those who submitted written comments. Your comments were invaluable in developing a thorough and responsive study. Appendix III of the study contains a complete compilation of all public comment received on the outline and the draft study, as well as Department responses to many questions and issues raised during public fora. We appreciate your conscientious involvement.

Additional copies of the final report can be found on the Internet at the Office of Nonproliferation and National Security's Home Page: <http://WWW.NN.DOE.GOV/NN>. Copies are also available at the DOE Freedom of Information Reading Room, U.S. Department of Energy, 1000 Independence Avenue, SW, Room 1E-190, Washington, DC 20585, (202) 586-6020 as well as at the Lawrence Livermore National Laboratory Visitor Center at East Gate and Greenville Road in Livermore, CA.

Thank you for your participation and continued interest.

Sincerely,

A handwritten signature in black ink that reads "Lisa J. Evanson". The signature is fluid and cursive, with a long horizontal line extending to the right.

Lisa J. Evanson  
Headquarters Coordinator for the Study  
Office of Arms Control and Nonproliferation  
U.S. Department of Energy

Enclosure



