DOE F 1325.8
(12-84)

United States Government Department of Energy

memorandum

DATE:
REPLY TO
ATTN OF:

SUBJECT:

TO:

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DOE Oakland Operations Office (Office of the NIF)

FOIA Case **2000-0K-98**

Roseann Pelzner, OAK GLD

In response to FOIA Case 2000-0K-98, my staff conducted a review of National Ignition Facility (NIF) Project files for the requested information. We believe the following documents to be both responsive and releasable:

1)

2) 3) 4) 5) 6) 7) 8)

NIF Functional Requirements and Primary Criteria of March 1997 (Attachment A)
Levell BCP 96-002 (Attachment B)
Levell BCPs 96-004, 96-005, and 96-006 (Attachment C)
Levels 1 and 2 BCPs 97-001 and 97-002 (Attachment D)
Levell BCP 97-004 (Attachment E)
Levell BCP 97-008 (Attachment F)
Levell BCP 98-012 (Attachment G)
Level 0 BCP 00-015 (Attachment H)

Please note that there have been no revisions/updates to BCP 00-015 or its attachments.

This completes our response to FOIA Case 2000-0K-98. If you have any questions, please contact Helen Gladden at (925) 422-2600.

Sincerely

Scott L. Samuelson
NIF Field Manager

Attachments

Cc:

Jim Anderson, DP-7 Tom Finn, DP-7

A

National Ignition Facility Project

Mail Stop:

2-6211

FROM:

SUBJECT:

L-488

May 5,1997 NIF-OOO2135 WBS 1.1.1

Distribution

Jeffrey A. paisn~
NIF Functional Requirements and Primary Criteria

The attached letter provides the DOE transmittal of: 1) the approved NIF Functional Requirements and Primary Criteria (FR/PC, Rev. 1.6), 2) the approved Work Smart Standards (WSS) Process document, and 3) the Directive to include the NIF FR/PC in Contract-48 (DE-ACO3-76SFOOO48). Incorporation of thes~ criteria into the contract is proceeding.

The NIP construction start in March 1997 necessitated an early resolution of the ES&H requirements for the NIF design and construction. To ensure protection of the institution, James Jackson, Deputy Department Head of the Hazards Control Department and a member of the LLNL WSS committee, was directly involved in the selection of the regulatory requirements (e.g., DOE Orders, Code of Federal Regulations, etc.). We also included members of the DOE Field NIF Project Office, Ken Zahora and Chuck Taylor, in the preparation of the Work Smart Standards Process document.

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A ttachmen ts

Distribution:
WSS Convened Grout2
M. Grissom, WSS Leader, L-871
R. Beach, L-353
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University Of California
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Others
G. Campbell, 1-382 M. Campbell, 1-466 1. Cleland, 1-668
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G. Deis, 1-465
W. Hatcher, L-580 J. Kilkenny, L-488 R. Kuckuck,1-005 B. Tarter, 1-001
J. Yatabe, L-493

I. Common Requirements for Weapons-Physics Experiments

1. Shot rate

The weapons program anticipates approxi- mately 1800 shots in the first three to four years of NIP operation. This implies that NIP will have a sustained shot rate of six per day. Because not all the proposed shots will require the full energy of NIP, much useful work can be done while it is being brought up to full potential. For example, some experiments involving the development of new diagnostic techniques can start as soon as light is delivered to the target chamber. Thus, the weapons programs needs -SCOla of the available shots from the beginning of operations.

2. **Spot size**

All beams must be capable of focusing
50% of the laser energy into a spot with a 100- micron d~ter and focusing 95% of the laser energy into a spot with a 200-micron dia~ter for an average of 6 shots per day. In addition, it must be possible to switch in less than eight hours from the large smooth spots currently planned for ICF applications to the small spot sizes needed for weapon applications. Last, it must be possible to align each beam so that 400/0 of the energy hits a l00-micron fiber attached to a target inside the target chamber.

3. **Power**

To create the weapons conditions required for many experiments, the weapons program
needs I megajoule (MJ) of 3CI> energy delivered
in a I-nanosecond (ns) pulse. Weapons program

ignition-capsule experiments will require the standard 1.8 MJ of energy, but the pulse will need to last for 5 ns. A comprehensive laser design effort is necessary if both requirements are to be met.

4. Target chambers

The weapons program needs a second target chamber that is initially fed by 10 to *200/0* of the NIP beams. An additional design requirement will be the capability for upgrading this second chamber to provide it with all the capabilities of the first. This upgrade will permit sustaining a high shot-frequency rate by switching to the alternate d\amber as the other cools.

5. **Laser wavelength**

The laser will deliver both 2(1) and 3(1) light to
the center of each target chamber.

6. **Target positioners**

Three separate target positioners are needed; however, only one requires cryogenics.

7. **Pulse forming**

Pulse lengths will be variable from 100 picoseconds (ps) to 21 ns. Gaussian, square, rising,.iaIling, and picht-fence-shaped pulses must be available. Eam beam must be capable of independatt timing (in groups of 4) and have up to 200-ns relative delays.

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8. **Line focus**

At least 200/0 of the beams must provide
a 6-an x lOOim' line focus with > lQlS w / an2 at both the *2m* and 3CI> energy levels.

9. Stayout zone

The ability to accommodate pinholes that
are wi d'Iin 5 cm of the target is necessary.

13. Materials capabilities

The facility must be capable of handling small amounts of uranium and other radioactivl materials. The am:>unts required are small ~ugh for NIF to maintain its designation as a non-nuclear facility.

10. Unconverted light

When operating at 3(1), there must be a region extending perpendicularly away from
the center of the hohlraum that is free from unconverted lighl It must have at least a cylindrical shape that is 2 mm in ~er and 5 cm long. For other geometries, the ability to shield experimental packages external to the hohlraum from stray light must be maintained.

11. Diagnostic stations

There will be at lmst twelve, 12-in. manipu- lator tubes (11M) with bodt complementary orthogonal views and views separated by about 200 of latitude. These are required to increase the amount of data returned from each shot. The TIMs must be capable of supporting instruments weighing up to 500 pounds each. This will allow for x- and gamma-ray shielding of instruments.

12. **Target alignment**

All target positioners must allow for
target alignment with 5 degrees of freedom
(2 rotations and 3 translations) within .1:.10 ~ and.1:. 0.10 of accuracy.

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II. Requirements for Opacity Experiments

lntrod uction

The advent of a > (XX)..terrawatt (IW) NIP will lead to the creation of laboratory conditions that nearly replicate some physical processes found in nuclear weapons. Based on simple scaling of the conditions measured at Nova with the NIP design calculations, it is clear that NIP will access qualitatively new physics and advance studies begun at Nova into regil1'e more directly relevant to secondary design. For example, radiative properties will be studied in opacity experiments using uranium ionized to the same electronic configurations found in a weapon, although at lower densities. For the first time in aboveground laboratories, hydrodynamic-mix experiments williast long enough to track instabilities from perturbative growth through turbulence at high compression. Also, for the first time, we can take equation-of- state (EOS) measurements at pressures above a gigabar (Gbar), which will provide data in high- energy-density regimes. And finally, some integral experiments designed to simulate stockpile dynamics will use actual stockpile materials rather than lighter surrogates. If the NIF is equipped with a laser power that is less than 600 1W, it will significantly limit our ability to directly simulate conditions created by stockpile materials. Of course, scaled experiments using lower-density and lower-Z materials will still have of some benefits.

Role of opacity studies

Opacities control fue transport of radiative energy in nuclear weapons. As such, they affect many important aspects of weapons performance. Opacity m>dels are complex, requiring knowledge of atomic structure, level populations, spectral-line shapes, and plasma interactions. Current m>dels often rely on

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simplified assumptions and use approximations because of the enormous amount of atomic data required and the intractable nature of many- body problems. Opacity experiments are crucial for e'lSuring that our simplified models are reliable. Increased confidence in calculating opacities is essa\tial to the goal of moving from an empirical to a predictive understanding of weapons performance.

Nova opacity experiments

To date, Nova experinetts have provided highly resolved, frequency-dependent opacities for several mid-Z elements in L TE at temperatures from 10 -&> eV and densities around 1% of nonna1. In Nova experiments, an exceptional amount of effort went into simultaneously measuring the opacity, temperature, and density of plasmas. These experiments provided highly constraining benchmark data that significantly and unambiguously d\a1lenged the capabilities of
our standard opacity codes. In response, new opacity models were developed for heavy elements. As a consequence, Nova experinetts are driving new theoretical developments. The subsequent success of the new opacity rrodels in explaining previous nuclear underground-test data represents a major demonstration of the role of laser experiments in improving the predictive capability of nuclear-design codes.

Because of the limited capabilities of Nova, opacity-modeling techniques have been benchmarked only in a fairly narrow temperature and density regime for a range of -low~Z'elements not directly applicable to weapons. In addition, significant uncertainties persist in the treatment of solid and higher densities, and of course, nothing can entirely take the place of measurements using actual stockpile materials, such as uranium. We have determined through straightforward extrapolation of techniques proven on Nova that

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NIF will be capable of extending our understanding of radiative opacities into these crucial regimes.

NIF opacity experiments

The advent of the NIP will significantly enhance the study of radiative opacities. Its ability to produce higher mergy densities will permit accessing significantly higher tempera- tures and usher opacity research into qualita- tively new regimes where radiation Dlore nearly dominates the energy balance in a target. This provides opportunities to study relevant ions of high-Z elements, including uranium, and plasma conditions approaching solid density. It also allows us to directly connect opacity data from laboratory experima1ts to opacity data from underground nuclear tests.

Laser conditions

Many areas of weapons-physics research,
in addition to opacity studies, need high- temperature hohlraums to access mallerial conditions relevant to weapons. MarlY also require higher powers, shorter pul~i, and better focusing than those needed for ignition experiments. *A study must be undertaJten* to *identify a* cost *effr:dive laser design that* J:S *consistent with achieuing both ignition and high peak-Jocused power.* Models indicate that for the high- temperature radiative environments produced by NIF, radiative losses through laser-entrance and diagnostic holes in hohlraums will begin to dominate hohlraum energetics. These losses can be minimized by making the targets ,md laser entrance holes small (provided this i~i consistent with maintaining laser-target coupling, obtaining suitable plasma conditions, and performing diagnosable experiments).

Opacity experiments on the NIF will be driven to equilibrium using radiative processes that mandate a hohlraum environment that minimizes radiative losses and produces a

Planckian radiation spectrum. In a model of a proposed NIF opacity experiment that used stockpile materials, we assumed the following: a laser power of ~ 1W; a l-ns square pulse; and a 200i1m spot size. Losses from laser back reflectioo, due to stimulated Brillouin scattering, were neglected. Our low-density uranium sample was stripped into an open-M-shell c<Xtfiguration and provided a target lifetime sufficient to establish both a steady state (i.e., nearly in LTE) and allow taking measurements. We found that even though laser-target coupling losses were not included and there were no provisions for backlighting, laser powers above ~ 1W are probably necessary.

Hohlraum conditions

Approximately 50 NIP shots will be needed to develop, optimize, and characterize high- temperature hohlraum conditions. An addi- tional15 shots will be required to develop and optimize the high-intensity x-ray backlighters that produce an absorption spectra with high- temperature samples. Approximately 125 shots will be required for collecting actual opacity data. Most of the emphasis of these shots will focus on the emission spectra in the thermal region of the highest-temperature samples and include spectroscopic diagnostics of sample conditions and equilibrium. Some absorption experiments will explore the high-energy L-shell spectra of open-M-shell high-Z plasmas, where plasma emission does not complicate measurements. Opacity experiments in the thermal region will require simultaneously measuring both the emission and absorption spectra of moderate-temperature samples and then comparing these measurements to each other to ensure that L TE conditions are obtained. Finally, integral opacity measurements from foil bumthrough experiments will test energy balance and albedo questions related to the role of wall loss in radiation flow. Foil burnthrough measurements will also access conditions up to near solid density. .

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Proposed opacity experiments*

1. Creating and characterizing high- temperature hohlraums
1.1. Energy coupling and plasma instabilities .Laser requirements:
Energy = 500 kJ. '
Pulse = 1 ns, square shaped (or equivalent) with fewer beams.
.Number of shots: 10.
.Special diagnostics:
Optical and x-ray spectro~ters, x-ray imaging, and calorimetry.
.Goals:
Confirm models and perform scaled experiments on laser-matter energy coupling at the high-intensity short scale length needed to create high-temperature radiation e\vironrnents. Measure intensity of laser back reflection from stimulated Brillouin scattering (SBS), stimulated Raman scattering (SRS), and test models for laser coupling and conversion efficiency to x rays.
.Deliverables:
O\aracterize and test D1(xjels for laser-matter coupling to guide the design of high-temperature hohlraums and provide understanding of hohlraum energetics.
1.2. Hohlraum filling and lifetime
.Laser requirements:
Energy = 500 kJ.
Pulse = 1 ns, square shaped.
.Number of shots: 20.
.Goals:
Test designs (vacuum or gas/foam fill) for limiting hohlraum closure, providing optimal laser coupling, and optimizing target lifetime.
.Deliverable:
Provide a proven hohlraum design with a lifetime that allows for target heating, equilibration, and taking measurements.

Approximately 210 shots for the first three years.

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1.3. Hohlraum conditions
.Laser requirements:
Energy = 500 kJ.
Pulse = 1 ns, square shaped. .Number of shots: 20.
.Goals:
Measure the x-ray-drive spectrum, time-d epend en t eq ui v alent tempera tur e , shock. breakout, and average ionization in high-Z foam targets. Optimize the high-temperature hohlraum design models used to produce a nearly Planckian spectrum and L TE conditions.
.Deliverable:
Provide the highest temperature hohlraum to date with a characterized Planckian spectrum that allows for the smallest corrections to any non- equilibrium process.

2. **Backlighter techniques development"**

.Laser requirements:

Energy = 200 kJ.

Pulse = 500 *PS,* square shaped. .Number of shots: 10.

.Goals:

Develop methods for providing broad- band high-brightness backlighters needed for absorption measurenetts both in the multi-kilovolt range and in the thermal spectral regions of high- radiation-temperature plasmas.

.~liverables:

High-energy backlighters for measuring absorption in the multi kilovolt regime where target emission is small. High- radiation-temperature backlighters for spectroscopically measuring the Rosseland mean opacity for the highest possible temperatures.

..Shots are for technique validation and may take place during the NIF phase-in period.

3. High-temperature emission experiments using optimized hohlraums

.Laser req uiremen ts :

Energy = 700 kJ.

Pulse = 1 N.

Risetime = 10 -9()O!o in < 100 ps.

Spot size = 200 J1m.

.Number of shots: SO.

.Goal:

Measure the themIal emission spectra of well-characterized, high-temperature high-Z targets. The plasma t:onditioN and equilibrium will be determined by using spectroscopic diagnostics arKi tracer elements. Sample con,ditions and materials will vary.

.Deliverables:

High-resolution measurements of the LTE emission spectra and high-Z- sample conditions. Data should allow reasonable estimates of the Rosseland mean opacities (which are needed for calculating radiative heat flow) and provide highly detailed spectroscopic measurements of opacity. These are also necessary for testing the accuracy of approximations used in opacity models. This should allow for nmrly' direct comparisons with existing underground nuclear-test data.

4. **High-temperature inner-shell absorption experiments**

.Laser requirements:

Energy = 700 kJ.

Pulse = 1 ns.

Risetime = 10 -900/0 in < 100 ps. .Number of shots: 25.

.Goals:

Measure the L-shell (inner-shell) absorption spectra of well characterized, open-M-shell high-Z samples using high-energy x-raybacklighters in a spectral region where the sample emission is low. Test the iru\er-shell absorption spectra as a possible diagnostic of plasma conditions.

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[)eliverables:
Inner-shell absorption spectra data that can be used for testing aspects of line- broadeting models used for outer shells that strongly influence radiative heat transfer. Develop plasma diagnostic tedtniques for other measurements.

S. High-temperature spectroscopic
emission and absorption opacity measurements in the thermal region
.Laser requirements:
Energy = 700 kJ.
Pulse = 1 ns.
Risetirne = 10 -9<Y'/o in < 100 ps.
Spot size = 200 ~.
.Number of shots: SO.
.Goal:

Measure the them'\al emission and absorption spectra of well characterized, moderate-temperature high-Z targets. Higta-radiation-temperature thermal backlighters will be required to measure the absorption of the highest- temperature samples. Proximity to L TE conditions will be verified by applying Kirchhoff's law *I* which relates the emission and absorption spectra.

Plasma conditions (including radiation and electron temperatures, electron density *I* and the population distribution of atomic energy levels) will be determined using spectroscopic diagnostics and tracer elemmts. Sample conditions and materials will vary. The x-ray backlighting requirements in the thermal,region will restrict measure- ments to lower temperature samples and necessitate scaling results to materials and conditions relevant
to weapons.

.Deliverables:
High-resolution measurements of LTE emission and absorption spectra and conditions for high-Z samples. Data should allow for accurate determinations of Rosseland mean opacities, whim are necessary for calculating radiative heat flow. Data should also provide highly detailed

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spectroscopic measurem8\ts of opacity, which are necessary for testing the accuracy of approximations used in opacity models. Using both emission and absorption spectra to characterize conditions will improve the accuracy of the data, ensure that the data ~ quality standards, ~ provide the data needed to determine if these are
appropriate for L TE opacities.

6. High-Z bumthrough wedge foils
.Laser requirements:
Energy = 700 kJ.
Pulse = 1 ns.
Risetime = 10 -90 % in < 100 ps. Spot size = 200 J1In.
.Number of shots: 25.
.Goal:

Measure the rate of radiation-energy penetration and the propagation ot: a Marshak wave in a high-Z foil by

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comparing spectral brightness versus time as a functim of sample thickness using a high-Z wedge target. With careful drive characterization, this will be an integral measurenett of the Rosseland mean opacity at high densities. This can also be used to identify energy-loss mechanisms, a n!quirement for understanding radiation flow.
~verable:

Enhanced understanding of radiation penetration versus albedo in high-Z materials, which is needed for testing energy-loss mechanisms and radiation-flow models in weapons.

For further information, contact

William H. Goldstein (510) 422-2515, or Paul T. Springer (510) 423-9112.

III. Requirements for Radiation-Flow Experiments

Introduction

Radiation-flow experllJetts on NIF will study the transport of energy by x rays through one-, two-, and three-dimensional (l-D, 2..D, and 3-D) geometries. Energetic x-ray drives ~rill be needed to create regi~ where the relati'~e contributions of radiation and material er11ergy densities can be varied as much as possibJle. Considerable flexibility in laser irradiatiOI\ conditions and diagnostic positioning will also be required to investigate complicated 2- cmd 3- D radiation-flow geometries.

Special system and diagnostic requirements

1. SOP (ultraviolet) and adjacent FXI/SXI (x-ray) diagnostic ports capable of supporting simultaneous, almost colinear, views of shock breakouts. from the rear surfaces of foils.
2. A short,l-ns, pulse delivering 1 MJ of laser energy at 3CD to drive energetic hohlraums.
3. A gas-fill system that delivers 1 -10 atmospheres of gases such as krypton, xenon, or radon. The gas-fill reservoirs and delivery tubes must be thermostatically controllable at temperatures up to -700 C and caJ!,able of containing chemically corrosive gases such as UF6'
4. Shielding for. experimental packagle5 external to the hOhlraum to prated: them from stray laser light
5. Complementary diagnostic views.
6. A Dante-like instruD'8\t with channels sensitive to higher phOton energi~i.
7. A 200-J1m spot size for smaller, hotter hohlraums and brighter x-ray backlighters.
8. The capability for placing diagnostic pinholes within a 5-cm radius of the target.

Proposed radiation-flow experiments.

1. Hohlraum characterization

.Number of shots: ~.

.Goal:

Detailed dlaracterization of the x-ray drive from a variety of hohlraum sources. This is of prime importance for design and diagnosis of NIP radiation- flow experiments. Problems related to shot-to-shot reproducibility should be carefully examined.

.Deliverables:

Measurement of the time-, frequency-, and angular-dependence of the x-ray spectra produced by different NIF hohlraum drivers. Both cylindrical and spherical hohlraums will be used as well as possible alternative hohlraum designs. The production of hot, Planckian spectra will be optimized.

2. One-dimensional bum through foils

.Number of shots: SO.

.Goal:

Simultaneously measure the shock breakout and x-ray radiative bumdtroUgh from high-Z foils. This data can be used to constrain dteoretical high-Z opacity models.

.Estimates by topic (total number of shots, -350) for the first three years.

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~verable:
Measurements of the time-, frequ~-, and 1-0 spatial depe"dence of radiation and shock-front propagation dtrough foils with different atomic numbers. This data will be used in conjunction with opacity code calculations and radiation hydrodynamic simulations of shock- and Marshak-wave propagation.

3. Two-dimensional radiation flow in high-Z tubes
.Number of shots: 80.
.Goal:
O\aracterize radiation flow through cylindrical tubes.
.Deliverables:
Measurements of the radiatiorl flow down tubes as a function of: opacity of wall materials, tube length, and x-ray- drive strength. A variety of materials of interest will be experimentally' quantified for use in conjunction with code simulations.

4. Radiation flow in more complicated geometries
.Number of shots: SO.
.Goal:
Characterize radiation flow through 2- and 3-D geometries.
.Deliverable:
Measurement of the time- and spatial- dependence of radiation and material temperatures at various locations in

complicated geometries.

S. Mass **ablation** rates of x-ray-driven foils

.Number of shots: SO.

.Goal:

Study a suite of materials with different atomic numbers and sample densities to quantify the I-D process describing the x-ray hmting and subsequent radiation hydrodynamics caused by x-ray ablation by materials. This study will also il¥:lude interaction at boundaries of layered materials.

.Deliverable:

Measurement of the time- and spatial- dependence of the density and temp- erature of x-ray-ablated materials (both doped and undoped) using a variety of initial material densities, compositions, and x-ray drive conditions.

6. Advanced diagnostic development

.Number of shots: 30.

.Goal:

Develop advanced diagnostic techniques for a variety of radiation- flow experiments.

.Deliverable:

New capabilities and experimental methods.

For further information, contact

Ted Peny (510) 423-2065, or Richard Ward (510) 423-2679.

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IV. Requirements for Equation-of-State Experiments

Introd uction

Program guidelines

An equation of state (EOS) is a mathe- matical expression of the fundamental relationship between pressure, density" and temperature of a material. An accurate EOS describes how materials react and interact and is crucial to any hydrodynamic description of a system.

All weapons performance and effects simulations and laser experiments supporting the stockpile stewardship program require accurate equation-of-state information in regimes where experimental data are very sparse or non-existenl For most materials, some fundanM!ntal (interpretation-independent) data may be available at pressures less than 5 Mbar. However, at higher pressures there are only sparse interpretation-dependent data available for a few materials. (Most of these are based on impedance-matching data.) Virtually all EOS data required for stockpile-stewardship applications are in high-pressure regimes that are far above 5 Mbar. Because calculation.., require EOS inforn'lation over a large parameter space encompassing pressure, density, and temperature, EOS models providing interpolation and extrapolation must be used. We use experiments to gather baseline data that is used to validate models. Our experimental data, to date, show inconsistencies and errors in our EOS database.

High-energy-density EOS are needed for stockpile stewardship and laser applications in these particular areas:

.Implosion dynamics.

.Single- and multiple-shock timing. .Radiation-matter interactions. .Ionization and thermal-wave propagation.

.Hydrodynamics.

.Effects on diagnostics in high-energy- density environments.

Equation-of-state experiments on the NIF will concentrate on the region of maximum uncertainty, which is typically in the 3- to 1(xx)" Mbar range. Below 3 Mbar, accurate data is available from gas-gun experiments. At high pressures, the ThomarFermi theory is accurate, although l<XX>-Mbar is probably still too low for Thomas-Fermi analysis of high-Z metals. Presently, fundama\tal data is only available under 5 Mbar. However, by the time NIF is on line, this regime may have been extended through the use of other exotic schemes or by Nova experiments. In any case, some data will have to be obtained in NIF low-pressure regimes to normalize it to known data and thus begin a bootstrap method of collecting EOS data for higher-energy-density regimes.

We will begin by obtaining fundamental data for standard materials (i.e., materials used in impedance-matching experi1Ie\ts). Experi1Ie\tal data for standard materials must be as code- or model-independent as possible with regard to interpretation.

Measuring temperatures in EOS experiments has a high priority because temperature and density are explicit variables in both EOS and opacity models. We have learned that:

.Temperature is a n¥>re sensitive test of EOS ~els.
.There is higher uncertainty surrounding temperature than pressure or density.
.Temperature is a n¥>re sensitive .measure of shock stability than velocity.

Determining the temperature of shocked and compressed matter is a problem yet to be solved, and it is expected to remain difficult However, experiments in this area can provide an 8'ormous arrVJunt of EOS information.

We expect that to conduct EOS measurements at 1 Ghar, we will N!ed shocks stronger than 10 Gbar. With the planned NIF capabilities, this can only be done using small- scale hohlraums, beams at nearly hill e1ergy levels, and a laser spot size smaller than 200 fUn.

Further metrology for Eas targets will require routine meas~ts of 0.1% flab\ess over wedges and step plates that are tens-of- microns thick.

Proposed EOS experiments.

The anticipated program has been divided into seven areas. Additiooal notation regarding required instrumentation is included at the end of this section.

1. Method characterization
.Number of shots: 20.
.Goal:

Evaluate med\ods of steady shock production and shock unifonnity in direct, indirect, and hohlraum drives and measure the x-ray preheat of targets. (If a temperature diagnostic is developed on Nova, before NIF is operational, it will be evaluated on NIF during these shots.)

.Special requirements:

X-ray laser (XRL) interfero~er or a Nova-demonstrated reflectometry setup, which is as yet untested.

.~liverables:

1. Quantified demonstration of uniform single-shock brE'.akout using three different drives eac:h with timing benchmarked to code predictions. These experimental results will lead to the selection of a preferred method for driving different types of experiments.
2. Measurement of preheat due to ambient x rays from heating source in targets.
3. Measurement of pnal'\eat ahead of a shock created by radiatjon emitted from the shock front.

Approximately 405 shots over 5 y'ears.

2. **Temperature diagnostic development**

.Number of shots: 20.

.Goal:

Evaluate emission and absorption spectroscopy used to infer electron temperatures between 10 and 100 eV in compressed (> solid density) matter.

.Special requirements:

A sub-picosecond ~resolved streak camera operating in the ultraviolet spectrum with a hard x-ray *(i.e.,* 4 -7 keY} continuum backlighter.

.Deliverables:

1. A spectroscopic method for evaluating temperatures of shocked matter.
2. Idmtification of a preferred method for driving EOS experi~ts.

3. Hugoniot measurements of fundamental materials

.Number of shots: 100.

.Goal:

Obtain interpretation-independent Hugoniot curves for standard materials.

.Special requirements:

A temperature diagnostic and sub- picosecond time-resolved streak. camera

.Deliverables:

Principal Hugoniot data in the 1-Mbar to 1-Gbar range for aluminum, molybdenum. and gold.

4. Hugoniot measurements of secondary materials

.Number of shots: 30 shots per material (200 shots minimum).

.Goal:

Obtain interpretation-independent (impedance-matched) Hugoniot curves for additional materials.

.-Special.requirements:

A temperature diagnostic and a sub- picosecond time-resolved streak. camera

.Deliverables:

Principal Hugoniot data in the I-Mbar to I-Gbar range for plastic (0-1), solid deuterium-tritium, uranium, and plutonium.

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Release experiments

.Number of shots: 40.

.Goal:

Investigate off-Hugoniot data of released isentropes.

.Special requirements:

XRL int2rferometer setup am also temperature diagnostics.

.Deliverables:

Released isentrope data for deuterium- tritium and gold.

Isochoric heating experiments

.Number of shots: 15

(5 -10 require ignition).

.Goal:

Investigate off-Hugoniot data of non- ablative isochoric heating by neutrons and Ka line photons.

.Special requirements:

Ignition hohlraums, extremely high- intensity laser source, XRL interferometer, and temperature and neutron diagnostics.

.Deliverable:

Evaluation of short-burst Ka heating, neutron heating of thin samples and comparisons of EOS models.

Exotic experiments

.Number of shots: 10.

.Goal:

Generate extre~ly high pressures using plasma jets or colliding flyer plates to approach the regime where tI'\e Thomas-Fem\i theory is valid.

.Special requirements:

Extremely high intensity backlighter, XRL interferometer setup, and temperature diagnostic.

.Deliverable:

Comparison to Thomas-Fem\i theory of inferred pressures in the > 10 Gbar regime.

Required instrumentation

.Goal:

~elop a high-speed high-dynarnic- range streaked camera,

.Equipment specifications:

T~ resolution = 200 fs for very high velocity shocks. For many experiments, 100 fs resolution is preferred,

Dynamic range = > SO.

This camera needs to operate in both the UV and XUV spectrum, (i.e., 4 -1SO eV), but not simultaneously.

.Special requirements:

A pulsed optical-laser interferometry / reflectometry station on the equator that is either movable or fixed at 90', The optical laser must be capable of producing at least 100 mW with pulse lengths greater than 10 ns.

Additional considerations

It will be necessary to have an instrumentation diagnostic dteckout facility so that full-system shots are not wasted on this required, but mundane, task. It seems that there are three options:

1. Periorm d1eckouts only as ride-alongs to other experiments.

   This is the least favorable option, but the ability to perform instrument debugs as ride-alongs must be available.

2. Perform meckouts at another, but comparable facility.

   This may mean using the Omega facility in Rochester, NY, whim would be approximately adequate for our needs, or using the second target chamber at the megajoule laser facility in France.

3. Build a second target chamber at LLNL similar to the French design.

The third option is the most flexible, but presumably the most expensive. However, a second wgetchamber at LLNL would provide the opportunity for conducting lower-intensity (Nova energy level) experiments in parallel with higher-energy shots.

__For the EOS program. a second target chamber would be used for ted\nique development aId diagn~tic d\eCks. However, it is anticipated that D¥:>st EOS shots involving
data collection will be dme with high drive energies. The NIF drive energy is at least an order of magnitude smaller than required to reach the ~ma&-Fenni regime in high-Z
materials. This means that the approach to Thoma&-Fenni (high-energy-density) measurements needs to be done with the highest drive energy available. Accuracies in measurements at lower~rgy density will be limited by experimental configuration conditions. Improving the accuracy of measuren'e\ts requires large' targets (spatially larger shocks over longer times), therefore, eva1 for these measurements, the high drive energy will be used.

Note that, most of the ted\nique and diagnostic developlna\t experima1ts listed can take place during the NIF phase-in period.

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For further information, contact

Robert Cauble (510) 422-4724.

Introduction

density physics that cannot be accessed in the absence of underground nuclear testing. following is a proposed three-year experimental plan for non-LTE x-ray laser experiments on NIF, totaling 200 shots. needed to maintain our core competency in non-LTE design and to develop short-wavelength x-ray lasers for dual-benefit applications. To perform x-ray laser research on NIF, we must have narrow (~ 100 µm at FWHM) line-focused beams available.

Our plan includes developing a testbed for non-LTE physics, exploring new regimes and schemes in x-ray laser research, and using x-ray lasers for plasma-imaging diagnostics. These lasers are used for plasma imaging because they provide absolute plasma-density measurements. validate codes and benchmark data for both the ICF and weapon-physics communities. report we describe the goals, plans, and facility requirements for each type of experiment over a three-year period.

Proposed experiments

V. Requirements for Non-LTE and X-Ray Laser Experiments

The NIF will allow us to study high-ei'\ergy-

The

These are

target from the backlighter beams
and debris.
Alignment for x-ray laser imaging:
Use an in-situ technique.
Facility ~uirements:
Singie-sided line-focused illumination that is 6 cm x 100 ~ and >1015 W / cm2 at 2C1> (until we demonstrate x-ray laser operation at 3CJ».
Goals:
With its short wavelength (35 -400 A), controllable short-pulse duration, high- peak brightness, and spatial and temporal coherence, the x-ray laser is ideally suited as a plasma diagnostic for imaging rapidly evolving « 1 ns) laser- driven plasmas with high electron densities (1021 cm-3 < ne < 1024 cm-3). We have recently applied technological advances in multilayer mirrors and beam splitters to the soft x-ray regime and used the unique properties of x-ray lasers to develop a soft-x-ray laser interferometer that operates at 155 A on Nova. The continued development and application of short-wavelength x-ray lasers to probe rapidly evolving high-
density laser plasmas on NIF is of great interest to both the ICF and weapon- physics communities. The shots in this series of experiments are needed to test x-ray laser configurations for interferometry applications using differ~t types of targets in a variety of experimental setups.
Deliverable:
The ultimate objective is to develop a reliable diagnostic instrument for the ICF and weapon-physics communities. A short-wavelength x-ray laser interferometer will permit measuring 2-D electron-density profiles. This

This information is needed to

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plasma imaging

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Pulse requirements:
Shaped and delivered on target at least 200 ns before :the:main beams arrive. Number of shots: SO.
Special diagnostics: X-ray laser
Stay-out zone for x-ray laser target Depends on ability to shield the primary

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information is important for
benchmark.ing and validating code physics in numerical simulations.

Proposed ionization balance experimen ts

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Number of shots: SO.
We propose using 20 shots to characterize the x-ray spectrum of the source and the backlighter. The remaining 30 shots study the temporal evolution of uniform plasmas, such as argon and krypton gas cells.
Facility requirements:.
These point-projectioo backlighter experiments use a rohlraum as the radiation source and include a
backlighter beam. TtM! backlighter beam
needs to be focused to a spot of the order of 100 J1m in diameter with intensities 00 the order of 1016 W / an2. Goal:
Develop a radiatively driven gas or
foam cell, which will be used to develop a testbed for photoionization and recombination kinetics and radiation transfer in non-LlE plasmas. Using either a hohlraum or other x-ray converters, such as a high-Z slab, we can irradiate and photoionize spatially uniform plasmas. We can then measure ionization states of these plasmas using inner-shell point-projection absorption spectroscopy. Potentially, this testbed could be used to measure radiation- transfer properties of optically thick plasmas and line-profile variations of optically thick lines using a cavity design. By carefully controlling experimental configurations, we can use this testbed to calibrate our codes. Deliverable:
Develop~t of a testbed for non-L lE physics and the initial study of non-L lE physics issues relevant to high-energy- density regimes.

Similar to the requirements for radiation-flow
experiments in Section m.

New regimes and schemes for x-ray lasers

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Pulse requirements:
Picket-ferw:e shape, including the pre- pulse, with traveling-wave capability. Number of shots: 100.
Facility requirements:
~uble-sided line-focused illumination that is 6 cm x 100 ~ and > 1016 W / cm2 on each side at 2co (until we demonstrate x-ray laser operation at 3CI». A set of the backlighter beams capable of pointing
~ 15 cm away from the primary target
to test long x-ray laser architectures. These long lasers deliver double-sided line-focused illumination that is 6 an
x 100 ~ and > 1015 W / 01\2 on each
side at 2(1). Delays should be of the order of 1 ns.

Goal:
Gain understanding of the physics of short wavelength x-ray lasers and x-ray- laser architectures required to produce more efficient and brighter x-ray sourc~. The large mergy available on NIP will allow us to extend existing x-fay-laser sd\~ into new regi~ and to test new sch~ for producing short-wavelength x-ray lasers. The addition of flexible pointing, in the x-y direction, will allow us to study extreme saturation effects and to test X-fay-laser architectures, such as the oscillator- amplifier configurations.
Deliverable:
Developnett of an efficient, bright,
and coherent x-ray source is important in the study of non-LTE plasmas.
These shots are needed to test new schemes and to explore new x-ray-
lasers regimes. Ultimately, the information gathered will be used to study various laser architectures and
test architectural components.

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Other facility requirements

Second target chamber
An additi<X\al target chamber, with up to 25% of all the ~ able to be directed at the target d\amber, would allow us to test diagnostics with greater flexibility and faster shot turn arouro.

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Contributing authors

Alan S. Wan, Peter Celliers, Robert Cauble, Luiz B. Da Silva, Jeffrey A. Kod1, Stephe\ B. Libby, Rid\ard A. l.m1don,. Juan C. More-.o, Joseph Nilsen, and Rosemary S. Wailing.

For further information, contact

Stephm B. Ubby (510) 422-9785, Joseph NilS8\ (510) 422-4766, or Alan S. Wan (510) 423-3342.

VI. Requirements for Hydrodynamic Experiments

Introduction

Experiments for the NIF hydrodynamic program will look at instability behaviors in two and three dimensions. They will also be used to study instabilities, develop advanced experimental tedmiques, and examine other topics of hydrodynamic interest. Require-- ments for hydrodynamics experiments include the following:

1. A long drive pulse, lasting more than 25ns.
2. Flexibly timed, independently pointable beams that can be used to make x-ray backlighting sources. The pointable beams must contain up to 500 kJ of laser energy and must be capable of being delayed up to 40 ns.
3. Pinholes that can be placed within a 5- on radius of the target, as needed.
4. Shielding from stray light, as needed, for experimental packages located external to the hohlraum.
5. Diagnostic stations that provide complementary orthogonal views of the target are very desirable. These will

increase the amount of data returned by each shot.

6. Target alignment with 5 degrees of freedom (2 rotations and 3 translations) within.i: 10 I.Lm and :t 0.10 of accuracy.
7. A smaller laser-focus spot (i.e., 200ilm diameter). As many as 25% of the experiments could benefit from the.capabilityto produce a smaller fOCUsed spot.
8. A second target chamber, with energy levels on the order of 200 kJ. This could be used to test diagnostics and new

configurations and to conduct related experiments that do not require the full power of the NIP. This last request, while expensive, is necessary if we are to properly utilize the NIP for these
types of experiments.

Proposed hydrodynamic experimen ts .

1. Rough-surface Richtmyer-Meshkov instability
   .Number of shots: roo
   .Goal:
   Investigate Richtmyer-Meshkov instability, at internal interfaces, in a regime that has small, rough initial perturbations driven through large amp lifica tion.
   .Deliverable:
   Measurement of the development of the mixing region as a function of time for varying Atwood numbers, shock strengths, and surface roughnesses.

2. Rough-surface Rayleigh-Taylor instability
   .Number of shots: 40.
   .Goal:
   Investigate Rayleigh-Taylor instability, at internal interfaces, in a regi~ that has small, rough initial perturbations driven through large amplification.
   .--Deliverable:
   Measurement of the development of the mixing region as a function of time for varying Atwood numbers, acceleration speeds, and surface roughnesses.

* A total of ~ 490 shots over three years.

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3. Convergent 2-D instabilities
   .Number *of* shots: 40.
   .Goal:
   Study imtabilities and mixing in 2-D convergent geo~es.
   .Deliverable:

Measurement *of* instability growth in a 2-D convergent geometry for different
drive conditions, initial perturbations, and cylindrical geometries.

4. Three-dimensional (3-D) instabilities
.Numberofshots: 50--.
.Goal:
Study instabilities and mixing in 3-D
geometries.
.Deliverable:
Measurement of instability growth in a 3-D geometry for different drive conditions, initial perturbations, and geometric configurations.

S. **Atomic-scale turbulent mixing**
.Number of shots: sc:r.
.Goal:
Study small-scale mixing in both turbulent and non-turbulent regimes.
.Deliverable:
Measurement of the fine-scale (atomic) mixing and analysis of its dependence on a variety of parameters including: surface roughnesses, Atwood numbers, and acceleration/shock conditions.

6. Large-scale flows
.Number of shots: 75.
.Goal:
Investigate large-scale sb'uctures, such as jets and shear layers, found in a variety of flows in an environment characterized by high temperature, high density, andhigh Mach number.
.Deliverable:
ExperiDettal quantification of a variety of flows of interest for use in conjunction with code simulations.

.Some will use ignition.

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7. **Advanced topics**
.Number of soots: 75..
.Goal:
Develop advanced diagnostic techniques for use on a variety of hydrodynamics issues, such as radiochemistry, deuterium-tritiurn reactions, and direct drive.
.Deliverable:
New capabilities that can address other hydrodynamics issues, such as the measurement of atomic mixing.

8. Developmental work

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.Number *of* shots: 100 .
.Goals:
Develop new diagnostics, methods, and configurations for NIP exper~ts, as well as some sub-NIF experiments (with the addition *of* a second chamber).
.Deliverables:
New diagnostic capabilities and experimental methods that have beat tested under realistic cmditions and demonstration *of* proof-of-principle for high-risk ideas. Additionally, a second chamber would provide a matched facility for pursuing parameter variations over a mudllarger range than is logical for NIP. For example, quantities sudl as low-end shock strength could be explored in a range that doesn't require the full energy *of* NIP, but would, at the same time,
benefit from the NIF diagnostics, laser characteristics, and facility peculiarities, etc. Not everything will have been done in the earlier Nova regime leaving a portion *of* pararrW!ter space between NIP and Nova for experinettation.

For further information, contact

Guy Dimonte (510) 423-ffi96, Paul Miller (510) 423-6455, or Tom Peyser (510) 423-6454.

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VII.

Requirements

Overview

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The facility design requirements for weapons-physics capsule experiments are similar to those for ICF capsules (see the NIF Conceptual Design Report). The description, justification, and deliverables for these experiments are necessarily contained elsewhere; consequently, this section just summarizes the experimental shot plans.

- Ignition capsules containing uranium, 40 shots.
- X-ray output from ignition capsules, 40 shots.
- Sub-ignition capsules containing uranium, 40 shots.
- Special effects, 140 shots.

Note that because 160 of these are full-yield shots, they will only be possible after ignition and gain are demonstrated. They therefore will need to be scheduled three to four years after the first ignition experiments. Additional diagnostics required for these experiments will also include neutron spectrometers with spectral coverage from 100 keV to 20 MeV, electromagnetic-pulse detectors, and radiochemistry procedures for recovering most of the initial mass in the capsule for analysis.

For further information,

Ted Perry (510) 423-2065 or
Dana Rowley (510) 422-9675.

Approximately 260 shots.

contact

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Capsule-Implosion

Experiments

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DEPARTMENT OF ENERGY
BASELINE CHANGE PROPOSAL
LEVEL 1 DISPOSITION

PROJECT TITLE: National Ignition Facility

30) BCP Number :	31) BCP Title:
96-002	Update of NIF Primary Criteria/Functional Requirements

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DEPARTMENT OF ENERGY
BASELINE CHANGE PROPOSAL
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PROJECT TITLE: National Ignition Facility

30) BCP NUMBER:	31) BCP TITLE:
96-004	Directed Changes in DOE Orders and Federal Regulations

32) MEMBERS (Required)		RECOMMENDATION
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Robert L. McCrory NAME (Print/Type) [signature] SIGNATURE - Dir. Laboratory for Laser Energetics, Univ of Roch.	UR/LLE ORG 1 Apr 96 DATE	[X] APPROVE [ ] ENDORSE [ ] DEFER [ ] REJECT
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33) Remarks (If BCP is Approved with Conditions, Deferred, or Rejected)		

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PROJECT TITLE: National Ignition Facility

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National Ignition Facility
Baseline Change Proposal
Request Fonn and Record of Decision

1. BCP number 2. BCP title 3. Submitted by *G.Deis/J.* Yatabe BCP 96-005 Functionality Changes to the NIF Phone: *27657/26115*
Baseline: 1. Qptics assembly Fax: *36506/37651*
capability, 2. Addition *of* beam
smoothing, 3. Addition *of* flashlamp
cooling, 4. Addition *of* 4x2
amplifiers, 5. Not to preclude direct
anve, 6. Not to preclude radiation
***effects* testinl!, 7. Laser spot size.**

t. Uate received: I
~vel3 3/1/96 Level 2 Levell I Level 0
-ange Priority eve 7. Directed ange
0 Routine Level 0 0 Yes
.Priority .Levell .No
0 Level 2 .B.asis: Add increased 0LI3functionality to meet user
eve reQuirements

8. Change description: .Scope 0 Schedule (TBD) .Cost
This change incorporates the functionality changes to the NIF Baseline that have been identified as high priority needs to meet the Stockpile Stewardship mission. If approved the changes incorporated into the NIF Functional Requirements and Primary Criteria and lower tier criteria will add these functionality changes into the Title I
design.

9. Justification and impact of change (see wor eet)
The proposed changes represent either required features to meet the current Primary Criteria such as optics assembly capability, addition of be~m smoothin& the improved 4~ laser amplifier archite.cture, associated flashlamp cooling needed for baseline turnaround, and laser spot sIZe. It also adds the design features to not preclude future direct drive capability addition (note: see BCP 96-006 for full direct drive implementation as an option) and to not preclude future addition of radiation effects testing.

10. Impact of not approving BCP I
I
If the proposed. func~ionality i~ not approve.d' the improvements in t,echnology that have o<;,~urred sinc,e .the 1994 conceptual design will not be incorporated mto the NIF, and the basis for future test capability for addition of direct drive and-radiation effects testing will not be added to the NIF capability.

Record of BCCB decision

! .Record of BCCB decision 1'J. Passed to Higher Level BCCB 13. Date of BCCB decision
___.Approved (see II) .Yes
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4. Date received:
Level 3 3/1/96 Level 2 3/6/96 Level 1 Level 0

5. Change Priority	6. BCP Level	7. Directed Change
☐ Routine ■ Priority	☐ Level 0 ■ Level 1 ☐ Level 2 ☐ Level 3	☐ Yes ■ No Basis: Add increased functionality to meet user requirements

8. Change description: ■ Scope ☐ Schedule (TBD) ■ Cost

This change incorporates the functionality changes to the NIF Baseline that have been identified as high priority needs to meet the Stockpile Stewardship mission. If approved the changes incorporated into the NIF Functional Requirements and Primary Criteria and lower tier criteria will add these functionality changes into the Title I design.

9. Justification and impact of change (see worksheet)

The proposed changes represent either required features to meet the current Primary Criteria such as optics assembly capability, addition of beam smoothing, the improved 4x2 laser amplifier architecture, associated flashlamp cooling needed for baseline turnaround, and laser spot size. It also adds the design features to not preclude future direct drive capability addition (note: see BCP 96-006 for full direct drive implementation as an option) and to not preclude future addition of radiation effects testing.

10. Impact of not approving BCP

If the proposed functionality is not approved, the improvements in technology that have occurred since the 1994 conceptual design will not be incorporated into the NIF, and the basis for future test capability for addition of direct drive and radiation effects testing will not be added to the NIF capability.

Record of BCCB decision

11. Record of BCCB decision	12. Passed to Higher Level BCCB	13. Date of BCCB decision
■ Approved (see II) ☐ Disapproved ☐ Returned for specific data	■ Yes ☐ BCCB	3/1/96

Approval signature
.1~~~<::t"£:b1 Date ...;>// /] C
I itations:

Pen + ink changes based on input from Leann Morrow, DOE OAK, on 3/28/96

National Ignition Facility
Baseline Change Proposal Worksheet

1. BCP nwr(ber

BCP96-GO5

I 2. BCP title

IFunctionality Changes to th1 NIF Baseline !

4. Technical baseline change inputs

3. Submitted by

Gary Deis/Jon Yatabe

Phone #: 27657/26115 Fax #: 36506/37651

Other technical baseline documents: P..2AR

.Primary Criteria .System ,Design ReqUirement !.Functional Requirements. Interface Control Document

i-S[~put ./I 84~. ~YY\ Budget analysis
I Inputs: TEC ..fI~ -"$'FBB I Contingency $1.2M for new
, Title I work activi~ raising Title I to
I $34.7M Change to funding profile included

oPC
Other

nIlQ.
nIlQ.

Original budgeted amount Project to date actual cost Current lien balance --

DYes (attached)
.No

$33.5M
~
~
$;.4..2M

I 6. Schedule input
0 Level 0 milestone 0 Levell milestone 0 Level 2 milestone 0 Level 3 milestone

7. ES&H impacts
Yes
.PSAR/FSAR
0 PElS
0 QA Program
0 Other documents

Milestone title/months L\. TBD after coffi};2letion of Title I

1ifft I ~fu/)t -laiq{ Ll:j)1/\p/?tt- 11/;'Q/'!

Titles

8. Other impacts (e.g., security, stakeholders)

These changes will enhance user community support for NIF

Baseline Change Prol2osal 96-005

Impact Assessment and Change Description

Rev A

Requirements changes

Functional- Requirements! Primary Criteria (based on Rev 1.3, March 1994) [New text in bold. Deleted text in stfilEet.,k.:'.=.. Editor's notes in *italics.]*

(Optics Assembly Capability)

1.4 Site-Specific Requirements

These requirements have been written for a generic site, such that NIF could be located at many different sites with only minor modifications. When a site selection is made, these requirements will be revised as necessary to include site-specific natural phenomena, environmental characteristics, and potential use of existing infrastructure, facilities, and services. The buildings functionality required at all candidate sites are: Laser and Target Area and the Optics Assembly Capability. If new facilities are necessary, the requirements are as described in these criteria.

6.1 Design Life Requirements

The NIP faciities shall be designed for at least 30 years design life for permanent structures.

Systems or portions of systems for which that is impractical shall bedesigned for ease of replacement. Ease of replacement means that replacement is feasible at reasonable cost and can be accomplished in a timely manner, consistent with plant availability requirements. "Replacement" here also includes removal, refurbishment, and reinstallation of original equipment

The performance category for Target Area and Laser Structural sytems shall be category 2 with a graded approach for other systems.

Where alternative designs and modes of construction are possible at essentially equivalent cost, the design and construction method which most readily allows for future reconfiguration and modification should be selected.

6.2 Vibration Requirements

Certain facilities or areas within facilities will house vibration-sensitive special equipment The structural design of these areas shall provide means to effectively isolate this equipment to control vibration within specified displacement and rotation requirements. ~Le lasef Bal" e~Ef'ef~7.e:".tal afea .;iBfaee:". li=.its =.\:lstalle\': Specific constraints are specified in the System Design Requirements for NIF Facilities.

6.3 Cleanliness Requirements

The laser bays, experimental areas, and optical assembly rooms must be dust free to prevent laser damage to the optics. Specific constraints are specified in the System Design Requirements for NIF Facilities.

(Addition of 1D SSD)

2.1.11 Beam Smoothness

The NIF shall have spatial and temporal beam conditioning to control intensity fluc~ati~ns in the target plane. -hay.'e tle*ible bea=:-. 5=:-.eet~.:"-.g eapabilitj' f~f the
eapabilitj' shall ~-LeIHele:
eliametef eifele a:-.eI ~-.tegfateEi eY.'ef a f 7.e *ei* 19 ps.
baj:'Ld~v'idtJ:-, tJ:-lat is a-y-ailable at 3 tI);

(Addition of Flashlamp Cooling)

After BCP approval, future SDR and ICD revisions will be made.

(Addition of 4x2 Amplifiers)

After BCP approval, future SDR and ICD revisions will be made.

(Not* to *preclude Direct Drive)

2.1.12 Direct-Drive Requirements*
Future upgrade to meet the following requirements, specific to direct-drive experiments, shall not be precluded in the baseline NIF design.

2.1.12.1 Direct-Drive Irradiation Symmetry
Direct-drive ICF targets shall be irradiated by three pairs of concentric cones, with midplane symmetry. The cone half-angles and number of beams on each cone shall be:

Direct- Drive Cone	Inner	Outer	Waist
Cone Half-Angle (a~~roximate)	Same as indirect drive	Same as indirect drive	75 degrees
Fraction of Total Beams	1/6	1/3	1/2

(Not to Preclude Radiation Testing)

2.1.3 Laser Pulse Wavelength""
The wavelength of the laser pulse delivered to the target shall be 0.35 microns (I.Lm). The design should not preclude delivering 0.53 I.Lm and 1.053 I.Lm wavelength light to the target with reasonable modifications.

2.1.13 Beam Focusing and Pointing
The NIF should have flexibility in beam focusing and pointing to address the needs of radiation effects testing and other users.

2.2 Experimental Area
The National Ignition Facility shall be operated in a manner consistent with its role as a national resource. Whenever possible, the design shall accommodate the requirements of i'e~Letelj"leeatee users with diverse needs. The baseline facility design shall not preclude future t:1pgi'aee addition of target chambers for additional weapons physics e*pei'~~Le~Lts, eii'eet eri~"e, and/ or radiation effects testing T.'."eape~L eif(:ets tai'get ~hLa~Lbei's. The baseline design and operation should be capable of performing radiation effects testing of important national assets, up to system level components, to maintain and certify their reliability. The following requirements are intended to satisfy the most basic of these needs.

2.2.12 Distributed Laser Plasma Radiation Source Compatibility *
The NIF should provide the basic capability to allow laser irradiation of distributed target arrays with future upgrade. The target chamber should allow flexibility in beam dump placement.

(Laser Spot Size)

2.1.10 Laser Pulse Spot Size
'rJ.""]"""",..-,,,~~~~ ~1..~111..~ I:nn..- ..~ 1..~ ...3~J::_~...3 ~~ *t~11~T.'*~. 'rJ."" "'~T""1~_,,, ~*t* ..1..", 1~~",-
~'"..'- '"~""-'" "'t""'" """'-'- """..~'"'"."... vvvt"'~~'I""""'" ~...~~..' ~'" ,"...,,",",...,""'. ~~ ...~ ~...,t""""" ..~ '"~""-..
eliametei'. Each beam shall deliver its design energy and power encircled in a 600 J.Lm diameter spot at the target plane or its equivalent. In the appropriate configuration, each beam should deliver 50% of its design energy and power encircled in a 100J.Lm diameter spot at the target plane or its equivalent.

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National Ignition Facility
Baseline Change Proposal

Request Fonn and Record of Decision

1. BCP number: 96-002 2. BCP title: Update of NIF Primary 3. Submitted by: G ry Deis/J Criteria/Functional Requirements Yatabe/John Hunt
Phone: 2-7657/2-6115/2-5467
Fax: 3-6506

.Date received: 1
Level 3: 2/12/96 Level 2 Levell i Level 0 ;;- th~ni~ Prlo-rtty 6. BCP Level ~.~. ~ I 7. Directed ~~~;e
.Routine 0 Level 0 .Yes 0 Priority I' .Levell: Primary Criteria 0 No.
.Level 2: Functional BasIs:
Requirements I
.LI3All'fII (See attachment) eve: ocation 0 I
Contingency

Record of BCCB decision

.'. Recor 0 BCCB ecision 1') Passed to Higher Leve BCCB 13. Date of BCCB decision ~ Approved (see II) f:8 Yes
1"1. / ***1$"/16*** **~ 3**
0 Disapproved 'b BCCB
0 Returned for specific data

11

..~ 7~~:ct~..l..1-" **Date** ***~51b***
1 ons:

~

8. Change description: .!.§ -Scope ~ -Schedule X.§ -Cost
The NIF Primary Criteria/Functional Requirements are updated for Laboratory Project, DOE Field Office, and DOE ONIF a~proval to p'rovide .the guil;ia~ce for !itle I desi~. The update~ include: 1. dire.cted changes in scope for: user requIrements, direct drive, radIation testing, 2. addition of the Optics Assembly Building common to all sites, and 3. regulatory updates in DOE Orders, National Consensus Codes and standards.
9. Justification and impact of change (see works eet)
The NIF CDR completed in 1994 was based on the current approved Primary Criteria/Functional Requirements I (Attachment A for information). Since 1994, guidance has been received from: 1. Users directing that the ! capability for increased shot rate capability and increased yield capability were required (Attachment B, Reference .). 2. DOE directed evaluation of not precluding or adding full dIrect drive capability (Attachment B, Reference 2), and 3. DOE directed evaluation of not precluding the addition of full radiation testing capability in the future (Attachment B, Reference 3), 4. Site evaluation confirming that the OAB is required at each construction site, and 5. changes in DOE Orders and National Consensus Codes and Standards. The revised Primary Criteria/Functional , Requirements is included as Attachment C. As a result of this BCP, the Title I design will be in accordance with the revISed Primary Criteria and Functional Requirements. At the end of Title I design a revised total Project cost and schedule will be provided.
10. Impact of not approving BCP I
If this BCP is not approved and these issues were not resolved during the early phases of Title I design, the subsequent fixes would require significant design rework with attendant cost increases and schedule delays.

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National Ignition Facility
Baseline Change Proposal Worksheet

1. BCP .96-002 2. BC~ title: Update of N!F Primary 3. Submitted by: Gary Deis/Jon \..:ntena/Functional Requirements I Yatabe/John Hunt

! Phone: 2-7657/2-6115/2-5467 Fax: 3-6506

4. Technical baseline change inputs
.Update top level design criteria impacts lower tier criteria: SDRs and ICDs.

Other technical baseline documents:

Impacts
.Primary Criteria .System Design Requirements .f~~tional Requirements. Interface Control Document

::>. Cost input
Inputs: TEC: ~$ Contingency for new Title I design scope raising FY96 Title I total to 35.2M$.
arc: $ None at this time Other $

Budget analysis: Original budgeted amount 33.4 M $ mC for Title I design)
___________Project to date actual cost .2 M $ (TEC) Current lien balance 4.2 M $ mC)

Change to funding profile included: .Yes (See revised FY97 Project Data Sheet 0 No attached to BCP96-QO3)

6. Schedule input
0 Level 0 milestone
0 Levell milestone
0 Level 2 milestone
0 Level 3 milestone
.Determination required by March I, 1996 or WUllInpact Title I design schedule
7. ES&H impacts
___- Yes
.PSARjFSAR
0 PElS
0 QA Program
.Other documents Titles: Securi~ Plan-
.New DOE Order ES&H requirements and new CFRs impacting safety and environment to be incorporated.

Milestone title/months ~

[redacted]

8. Other impacts (e.g., security, stakeholders)

Proposed changes reflect incorporation of Weapons Physics, radiation effects testing and indirect/ drive Users needs.

number:

1

NATIONAL IGNITION FACILITY PROJECT LEVEL 2 -BASELINE CHANGE PROPOSAL
RECORD OF DECISION

BCP NUMBER: BCP TITLE: Functionality Changes to the NIF Baseline:
1. Optics assembly capability, 2. Addition of beam smoothing, 3. Addition of flashlamp cooling, 4. Addition of 4x2 amplifiers, 5. Not to preclude direct drive, 6. Not to preclude radiation effects testing, 7. Laser spot size.
i MEMBERS (ReQuired) RECOMMENDATION

~~:=~~~=~~ ~J 0/16'

__-Title: NIF Project Engineer Date

=7:=:=:?~~ ~

__-Title: OAK ICF Program Manager Da~

iY l£Ll'lbN
Title: Direcoor, EFM

Jlt/1L
Date

Title:

Date

~ *f'1* Po *V* c;T"

APj1R.~Je-

ADVISORS (As Required)

'lltle: ICFD ES&H Manager

Date

Title:

Date

Title:

Date

'!itle:

Date

'lltJe:

Date

~

_*iL~L~~*
Date

1~EcOMMENDATION

DISPOSITION () Approved
(~ndorsed
( ) Rejected
( ) Directed Change

96-005

C

DOE F 1325.8
(08-93)
United States Government

Department of Energy

memorandum

DATE:
REPLY TO ATTN OF:
SUBJECT:

TO:

April 2, 1996 DP-32:J.Beitz:3-3181

REVIEW OF BASELINE CHANGE PROPOSAL (BCP) FOR THE NATIONAL IGNITION FACILITY (96-0-111) I

L. Morrow, DOE Oakland Baseline Change Control Board Secretariat

Baseline Change Proposals 96-004, 96-005, and 96-006 for the National Ignition Facility were submitted to this office for processing.

The Board members provided their recommendations and the Chairman approved the BCPs. Attached are the original BCPs and a summary of the Board's actions.

Should there be questions concerning the BCP I
I Please contact me at (301)
903-3181 or Tom Finn at (202) 586-4797.

~ *OtIJ'MZA.* Ja ,i M. Beitz,

[)P aselineChange

Secretariat
Control

Board

Attachment
cc:
A. Tavares, FM-20
T. Finn, DP-18
K. Foley, DP-42
M. Sluyter, DP-11

W. Simmons
R. McCrory, UR LLE, Rochester S. Samuelson, DOE OAK
J. Paisner, LLNL NIF
M. Gray, LANL ICF
S. Bodner, NRL ICF
M. Campbell, LLNL
J. Quintenz, SNL ICF

Tom Finn, DP-18

Completion Of Recent National Ignition Facility (NIF) IChange Control Board Actions

NIF Levell Change Board Members and ICF Program Directors

Pumose -This memo summarizes the disposition by the $ Baseline Change Control Board (BCCB) of proposed Levell changes 96-002 to 96-006 iqclusive.

Background -The first meeting of the DOE Headquartersilevel (level 1) NIP Baseline Change Control Board took place on February 27, 1996 in room

t -419 of the DOE Germantown

Facility. The Board consists of the following members:

-David Crandall, NIF Office, DP-I0 (Chairman)
-Marshall Sluyter, Office of Research and Inertial Fusion, DP-ll -Kathleen Foley, Office of Research and Development Programs, DP-42 -Robert McCrory, University ofRocheste
1 -William Simmons, private consultant

~~r~~%~e~t~mbers were in attendance. In addition repre,e:~~tives from DP-32 and FM-20

Initial ProQosed Changes -The Board was presented with itwo change proposals approved by the level 2 Board, 96-002 and 96-003. The purpose of th

i proposed changes is to incorporate

into Title I activities that appropriately respond to recent hysics advances in the program and requests by user groups.

1. 96-002 -This proposal recommended the fOllOwing
l three ~hanges to the NIF
Criteria/Functional Requirements:

a. Change the scope to include the capability:

-to increase the shot rate from 8 hours between shots to 4 hours
-to carry out direct drive experiments, -to carry out radiation effects testing.

b. Add the requirement for an Optics Assembly Building common to all sites.

c. Update the requirements to incorporate changes
l in DOE Orders, and National
Consensus Codes and Standards.

2. 96-003 -This proposed change recommended addi~g to the Project Data Sheet the Optics Assembly Building, including optics assembly equipm4nt.

Initial Board Action -The Board disapproved the propostjd baseline changes because of their impact on cost, and directed the lower level

boards to re-~ubmit the proposed changes to incorporate the functionality into the scope of the project Within the framework of no cost growth. This was done so that the design activities could ~e carried *out* in Title I but a decision on actual implementation of the proposed activities could be made at the end of Title I. In addition, the project was directed to conduct studies to identify cap~bilities which could be reduced in
order to lower costs. It was also decided that an addition~ meeting of the level! Board was not
necessary. I

Revised ProQosed Changes -As a result of these directioQs the level 2 Board submitted by mail to each of the Board members the following proposed chang~s (summary sheets are enclosed):

10 96-004 -This proposed change incorporates basic r~quirements which allow the project to update changes in DOE Orders, and Federal Regulati9nso

2. 2~ -This proposal incorporates the following ~nctionality changes into the NIF
baseline: I

-Optics assembly capability,
-Addition of beam smoothing,
-Addition offlashlamp cooling,
-Change to of 4X2 amplifier architecture, -Not to preclude direct drive,
-Not to preclude radiation effects testing, -Reduce the spot size of each laser beam.

3. 96-006 -This proposed change is to conduct two et1gineering design studies. The first is to increase the shot rate from 8 hours between shots to ~ hours. The second is to implement fully direct drive on the NIP. I

Final Board Action -All the Board members recornrnende~ approval of proposed changes 96-004, -005, and -006; and approval of the changes was signed ~y David H. Crandall on April 1, 1996.

2

National Ignition Facility
Baseline Change Pr~posal
Request Form and Record pf Decision

1. BCP number i 2. BCP title 3. Submitted by G.Deis/J. Yatabe BCP 96-004 IIDirected Changes in DOE Orde s Phone: 27657/26115
~nd Federal Re~ulations Fax: 36506/37651

.LJate received:
.evel3 3/1/96 Level 2 Levell Level 0
ange Priority : 6. 7. Directe ange
0 Routine 0 Level 0 .Yes
.Priority .Le~ell 0 No
0 Level 2 Basis: Changes in DOE 0 Level3 Orders and Federal Regulations

I

8. Change description: .Scope 0 Sched

~ e .Cost

This change incorporates basic requirements which will allow NIF to eet the new DOE Orders and Federal Regulations issued since the 1994 Conceptual Design Report and gener I text updates.

Y. justitication and impact of change (see worksheet)
Th~s change will result in a complete update of the DOE Orders and Fe~eral Regulations (e.g., Code of Federal Regulations) that have occurred since the 1994 NIF Conceptual Design f{eport was published. The update includes the applicable national consensus codes and standards that have been revised or reissued during that period. Once approved by the Levell Baseline Change Control Board, the Orders, Federal Regulations, Codes and Standards will be frozen and the Project will be designed and constructed to these specifications.

10. Impact 0 not approving BCP
The NIF would be designed to DOE Orders, Federal Regulations, Code and Standards existant in 1994. Many of these Orders have been canceled and replaced by new requirements e.g., DOE Order 6430.1A replaced by DOE Orders 420.1 and 430.1). '

Record of BCCB decision

11. Record of BCCB decision 12. Passed to Higher Level BC B 113. Date of BCCB decision .Approved (see II) .Yes *3/1/96*
0 Disapproved 0 BCCB
0 Returned for specific data

14. Approval signature

I!l~

Limitations-:

Date

d/t/;'t

Ken r ink changes

based on input

ann Morrow, DOE OAK, on 3/28/96

National Ignition Fa~ility
Baseline Change Proposal Worksheet

1. BCPnumber

BCP96-O04

2. BCP title

Directed Changes in DOE drders and Federal Regulations .I

3. Submitted by

Gary Deis/Jon Yatabe

Phone #: 27657/26115
f~#:36506/37651

4. Technical baseline change inputs

Other technical baseline documents:
~

.Primary Criteria 0 System Design Requirements i. Functional Requirements 0 Interface Control Document

5. Cost input ~ *I.J'J. IYI* Budget analysis: Or ginal budgeted amount $33.4M Inputs: TEC .::1fi- ~m &A- prc>ject to date actual cost &2M

Contingency $O.lM for new CJrrent lien balance ~ Title I work to $33.5M
______IOPC mD. Change to funding p ofile included: 0 Yes (attached) Other mD. .No

6. Schedule input
0 Level 0 milestone 0 Levell milestone 0 Level 2 milestone 0 Level 3 milestone

17. ES&H impacts
i Yes
.PSAR/FSAR
0 PElS
0 QA Program
0 Other documents

Milestone title/months ~ tlQ

Titles

8. Other impacts (e.g., security, stakeholders)

Baseline Change Prol2osal 96-004
Impact Assessment and Change Description
RevB I

Requirements changes
i* Functional Requirements! Primary Criteria (based 0 Rev 1.3, March 1994) [New text in bold. Deleted text in stl'iketl--Lr~. Editor's notes in *it lics.]

1.2 Application I
The Functional Requirements and Primary Criteria se~es as a technical baseline for the project. Any modifications must be processed througli the change control mechanism specified in the NIP Ge~Lee~t'.:.al gesig:-L See~e aRe Pl~~ Project Execution Plan and formally approved. Each individual requirement or cr~teria has been placed in one of two hierarchy levels for control purposes. Those item~ which are Levell, Primary Criteria, are marked with either a single or a double a,terisk and are controlled by DOE Headquarters. Nonasterisked items are classified as L~veI2, Functional requirements, and are controlled by the Gal~la~Le G~efatie~Ls GfHee ItIIF DOE Field Qffiee Manager. The control of double ~sterisk ~equirements may be d
.1~eg~ted to Gal~';};FLe Gpefatie~..':; Gffiee the NIF DOE FIeld Qffiee Manager at some p mt m the future as part of the
ongoing decentralization process.

1.3 Terms I
The terms "should" and "shall," have important impli~ations beyond what might be implied by common usage. "Shall" denotes a require~ent which is mandatory and must be met. "Should" denotes a feElHife~.e;:".t ';;~.ie~. is ;:".et .t.: date~F, BHt ~.;~.ie~. is a nonmandatory recommendation or goal. I

2.1.5 Beamlet l2e~~Lf""~Lg Positioning Accuracy*
The rms deviation in pe~~ti1"'Lg the position of the cen roids of all beams from their specified aiming points shall not exceed 50 micromet rs (~) at the target plane or its equivalent. *Lrrnf* mfQf1 *Sf'OI!Dd*

2.2.4 Classification Level of Experiments* -I
The facility shall be designed to allow both classified ~at the SRD level) and unclassified experiments. Its design should permit Ch
tnging classification levels with minimal impact on operations and cost.

2.2.11 Personnel Access Inside the Target Chamber* I
Personnel access to the inside of the target chamber sljtall be consistent with requirements for periodic cleaning necessary to main~ain radiological, low-hazard, non- nucl~ar operations and for inspection and maintenan
je consistent with operational requIrements

3.0 Safety Requirements**

The NIP shall be designed, constructed, and oper ted as a low-hazard, nonnuclear facility. Compliance with this classification shall b verified through a Preliminary Hazard Analysis assessment of bounding acciden s involving those radionuclides and/ or chemicals presenting the most significant azards (see QGE-Gr-der-s-§48~,

~t1:leleaF Sa:~t:," 6A_-.al:,"sis RepeFts aRa §481.1B 10C~R 830.110 Nuclear Safety Management, Safety Analysis Report, and DOE Order 5481.1B, Safety Analysis Review System). Administrative controls shall be ~stablished prior to K9-4 CD3 to ensure that inventory limits for a radiologicallow~hazard, non-nuclear facility are not exceeded. I

3.1 Radiation Protection'"

I Collective and individual ionizing radiation doses to the public from all exposure pathways fromthe NIP shall meet the requiremen~ of DOE Order 5400.5, Radiation Protection of the Public and the Enviornment, andl40 CFR 61, National Emission Standards for Emissions of Radionuclides Other ~an Radon from Department of Energy Facilities. These requirements state that e~posure of members of the public from emissions of radionuclides in the ambient airl from normal NIP operations shall remain below 10 mrem/y. The facility shall also ~eet the requirements of DOE Order 5400.5 [ICRP 60 540 (1990 Recommendatin dof the International Commission on Radiological Protection), 10 CFR 20.1301.a.1 (C~de of Federal Regulations- Standards for Protection Against Radiation)] to fetLaL~L eele~'.' not cause the public dose li~Lit ef 199 ~Lfe~LtJ. from all exposure mode$ and all sources of radiation at the site boundary to exeed 100 mrem/y.

The NIP personnel radiation protection program s~all follow DOE Order 9489.11 N441.1, Radiation Protection for Occupational Wotkers and 10 CFR 835 Occupational Radiation Protection. The ALARA (~s low as reasonably achievable) principle shall be utilized in both design and operation of the facility to eliminate unnecessary radiation dose to workers in the Laser and Target Area Building, co-located employees, and visitors from both rou

t e and

off-normal operations. Radiation protection shall' clude: shielding; control of workplace ventilation; monitoring of personnel fo external and internal radiation dose; establishment of a routine contamination m nitoring program including air monitoring, and the proper containment of radiati n and radioactive materials. The radiation shielding design shall be more conserva .ve than required by DOE Order 64..,9.1~A~ ~eeee~L 1..,99 6.~ 420.1, Facility Safety, in at maximum doses to an individual worker shall be limited to one tenth (s 'elding design goal) of the occupational external dose limits specified in QGE Gfeef 9489.11 10 CFR 835. Concrete shielding shall comply with ACI m 3011which provides adequate strength for DBE loads.

1 The requirements for the confinement of tritium f r Fusion Test Facilities in DOE Order 64..,9.1~A~ ~eetieR 1..,~8 420.1, Facility Safety, hould be evaluated by the designers and incorporated when they are determ ed to be cost effective, even though the projected inventory of tritium in NIP (.-0.05g or 500 Ci) is well below the threshold for a nuclear facility. e target chamber and tritium processing systems shall form the primary confin ment barrier. Leakage past these barriers shall be ALARA. The experimental area v~ntilation system shall be designed to operate at negative pressures during ~nd immediately after shots of greater than one megajoule and provide secondary tritium confinement. [...]

3.2 Life Safety** I

The NIP shall fully comply with the requirements for life safety contained in DOE Order §4SQ.7 £A.. 420.1, Facility Safety. Particular focus shall be directed towards features related to ~itmg means of egress, such as protection of vertical openings, travel distances, capacities, and emergency lighting.

3.3 Laser Safety* I

The laser safety shall comply with ANSI 2136.1 ~ ~ G~~AA feElwfeme;:-.ts. Exposure to hazardous levels of laser light shall be prevente4 by the use of physical barriers, personnel training, interlocks, and personnel entryi controls. Protective equipment, such as laser goggles, shall be used when necessary for operational purposes. Interlock systems shall be dedicated and designed ~o fail safe and shall activate laser shutters or shut off power to laser systems if acces 1doors are opened and hazardous exposures are possible.

3.4 Industrial Hygiene and Occupational Safety* I

Industrial hygiene and occupational safety shall co ply with 29 CFR 1910 and DOE Order . et..h.eF applieable eeeHpaee::,.al saf~~. sta::,.eaFes) 440.1, Worker Prot~ction Management for DOE Federal and Construction Employees. QGB GFeeF;e489.19, Ge::'.tFaeteF l:-.eHstFial

Construction safety shall comply with the require ents of 29 CFR 1926, OSHA and DOE Order e489.9, Ge::'.:;=-~eee::'. ~af~~. ';};F.e Healt..J... PFegFa~. 440.1, Worker Protection Management for DOE Federal and Co~tractor Employees.

Facility subsystems (e.g., capacitor banks, vacuum ~ystems, tritium recovery, nitrogen supply, and personnel safety interlock SY I'tems) shall be designed to default to a safe state upon loss of power.

3.5 Fire Protection*

The NIP shall meet the design and fire protection r quirements of DOE Orders 6439.I..A~ a::,.e 6489.7 ..A~, FiFe PFeteetie~. 420.1, FacilitY Safety, and the Uniform Building Code (UBC). The structural members of ~he Experimental Building (including exterior walls, interior bearing walls, co umns, floors, roofs, and supporting elements) shall, as a minimum, meet C fire resistive standards. Appropriate fire barriers shall be

provided to limit property damage, fire propagati n, and loss of life by separating adjoining structures, isolating hazardous areas, an protecting egress paths. The NIP shall meet the requirements for an "improved risk" I level of fire protection sufficient to attain DOE objectives. To achieve this level of p~otection, automatic fire sprinklers shall be installed throughout the complex. The spr~nklers shall be coupled with adequate fire protection water supplies and autom~tic and manual means for detecting and reporting incipient fires. Fire hazarq analyses will be completed as required by DOE Order 420.1 I

3.6 Robotic System Safety I

Robotic systems shall comply with the requirem~nts of ANSI/RIA R15.06-1992, Industrial Robots and Robot System -Safety Requirements.

4.1 Waste Management""" I

The NIP shall minimize the generation of wastes at the source per: DOE Gfeefs Policy 94QQ.1 P450.1, Environmental Safety and ~ealth Policy for the DOE Complex, General Environmental Protection Progtamj 94QQ..1, H~afeeHS ~ 4 Raeieaetiy:e ~.fuEee \A!aste l2fegFa~.j and DOE Ord~r5820.2A, Radioactive Waste Management; and the Resource Conservation and IRecovery Act (USC 6901 e~ to 6992) and the Toxic Substance Control Act (15 U

~c 2601-2692). The NIP waste handling areas shall comply with the standards of confinement and ventilation requirements specified by DOE Order 5820.2A, Ra ioactive Waste Management. The NIP will generate hazardous waste, low-level adioactive waste (LLW), and mixed (LLW and hazardous) waste. These wastes $hall be collected in approved containers, labeled, packaged, sorted, ffeatee, and Ishipped to an EP AI DOE-approved treatment or disposal site accord in to the Resource Conservation and Recovery Act and the following regulations: azardous waste per 40 CPR 260, 261, and 262; .; low-level waste per DOE Order 5820.2A; and mixed (LLW and ha2{ardous) waste per DOE Orders 94QQ..1 a1'".el5820.2A, and 40 CPR 260. The LLW pac~ages shall meet the radioactive solid waste acceptance criteria of the final approv~ disposal site.

4.2 Effluents* I

Liquid effluent discharges from NIP discharge po~ts shall be monitored and

controlled in compliance with: 10 CFR 835; DOE Qrder 5400.5, Radiation Protection of the Public and the Environment; the Clean WatEtr Act (33 U.S.C.1251 et. seq.; and by conditions on 40 CFR 125 criteria and standar4s for National Pollutant

Discharge Elimination System.

Gasee~s effl~e~Lt eise~Lafges Air emissions shall ~eet the requirements of Section 3.1 (radiation shielding and confinement) for radionu~lides and the requirements of the Clean Air Act, (42 U.S.C 7401) including National I Emission Standards for Hazardous Air Pollutants (NESHAPs), and state ard local air quality management district requirements. I

5.0 Safeguards And Security I**

The NIP safeguards and security features shall m~t the requirements of DOE Order

Security Interests, and DOE Order 470.1, Safeguards and Security Program. The requirements include Tl--.is feElHife~.e~.t ~~.elHEles physical protection of classified

data and equipment.. mattef and items in use and in storage. For the fac lity security areas and access control, requirements shall be

established based on nature of the experiments (i. ., classified or unclassified) being performed. The limited areas shall be the target ar a, target receiving and inspection, final target alignment, classified data acquisition a d office areas where classified computing is performed. Automated Data Process.ng (ADP) systems handling

classified information shall meet the requirementsl of DOE Orders 5637.1, Classified Computer Security Program, and 5300.4(;: D, Teleqommunications: Protected Distribution Systems. Elements of DOE Orders 470.1 Safeguards and Security Program and 472.1 Personnel Security Activities will also be incorporated into the security plan.

I The NIP complex shall also meet the requirements for physical protection of DOE property and unclassified facilities, protection program operations, and personnel security, including issuance, control, and use of b~dges, passes, and credentials. Because the continuous operation of the NIP is no~ required to prevent adverse impacts on national security or the health and saf, ty of the public, it is not classified as a vital facility, per DOE Order ...

~.4atefial a:"".e '!ital EElHip~Le;:Lt 5632.1C.

6.4 Temperature Control

J Temperatures in the laser bays and experimental ,reas must be controlled te :;Eg.3°(;: in order to maintain a stable laser alignment. Spe~ific constraints are specified in the System Design Requirements. I

6.5 Electrical Power

*** Electric power shall be installed in accordance wi NFP A 70, which includes details from the National Electrical Code, IEEE 49 ,**

Recommended Practices for Design of Reliable Industrial and Commercial po
jer Systems and ANSI C2, the National Electrical Safety Code. c

6.5.2 Standby Power

iStandby power shall be available for health, life, p operty, and safeguards and security loads, including emergency egress lightin , fire alarms and sensors, security systems, and radiation monitors. Power for safety nd security functions shall be installed and operated according to NFPA 101, th~ Life Safety Code; IBBB 466 (~t...e Gfa~.ge Beel~~ *ANSI/NFPA* 110-1993, the Standar~ for Emergency and Standby Power Systems; NFP A 72, the .,. ,
Pfeteeti~:e 6ig-:.alir.g 6yste~.s National Fire Alarm Code; and other applicable NFP A and OSHA standards.

7.2 Recovery Time* I

Because of its importance to the DOE, the NIP sha~l be designed to survive any abnormal event, including accidents and natural p~enomena, expected to occur more frequently than once in §GOO 2000 years. The I time required to recover from such events is allowed to vary in accordance with ~e probability of occurrence. Maximum recovery times are specified below. „""1 c

Probability of Occurrence Per Year. P
__P=l
1 > P ~ 10-2
10-2 > P ~ 5 x 10-4

Maximum Recove~ Time
_24 hol,lrs
1 weef
3 mo
~ths for laser, target, and assoc'ated building structures 6 roo ths for support systems

The probabilities of occurrence listed in YGRb :1:e91:1:Q DOE-STD-1O20-94 shall be utilized for natural phenomena. A supplemental risk assessment shall be performed in accordance with Appendix I of NFP A 78 to determine the risk of loss due to lightning.
Standby power shall be available to preserve proc~ss continuity in cases designated by the NIP Project and specified in the System Des~gn Requirements. Neither uninterruptible power systems nor standby powerl is required for the computer systems.

8.0 Decontamination And Decommissioning I

The NIP design shall meet the requirements of DO~ Order 6439.1.A~, Seetie:-. 1399.11 420.1 and site-specific requirements. The NIP shailibe designed for periodic cleaning of the interior of the test chamber to maintain triti~ levels on interior surfaces eele\'.'19 Gi as low as reasonably achievable. Th

j NIP design shall include

considerations which will allow for cost effective ture decommissioning of the structures and equipment.

A plan for NIP Decontamination and Decommissi ning (D&D) shall be developed in accordance with DOE Order 5820.2A, Radioactive Waste Management, and DOE Order 6439.l..A~ 420.1. A D&D assessment shall be n1ade during conceptual design to ensure that features and measures are incorporated in NIP to simplify D&D. The
NIP D&D plan will be prepared before the end of the Title I design.

10.1 DOE Orders*

~The NIF shall be designed and constructed in full ompliance with DOE Orders and Federal Regulations. Exceptions shall be limited to those cases where the project has formally requested and been granted either an ex

II ption or a finding of equivalency by Headquarters.

It is recognized that updates and additions to DO Orders-aOO; federal regulations, and consensus industry standards are outside of t}le control of the project team and are a frequent source of cost and schedule growth. !':!:1".e i~.¥aet e~ all ~¥elates a:".e
_______..".
...'.'..' .~ .~ ..,.
These requirements are all frozen as of March 1, 1996.

10.2 Codes and Standards I

Nationally recognized codes, standards, and guid~s should be utilized whenever available. A partial listing of these documents is in luded as £A~ppe:"'.Eli* £A~ in the following sections. Additional references may be dentified and formally added during the Conceptual and Title
I design phases, with the list baselined at the end f Title I design. Updates and additions to the baselined list codes and standards after the

completion of Title I design shall be approved through the Project Cha ge Control Process.

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Be suB~.itteei w..:i~h. ~h.at eiee'd...~.eAt.

W:4 10.3 Applicable Orders, Codes, and Standards

This section lists DOE Orders, codes, and standards considered applicable on GeteeeF I, I99a March 1, 1996. The listing begins with DOE and other federal regulations (e.g., Resource Conservation and Recovery Act) followed by national consensus standards and finally other documents which establish facility requirements. The applicable portions of these documents will apply.

1Q.4.110.3.1 DOE Orders

-4919.1~A~ '!alHe H:-.t~~.eeFL~.g
.4399.18 Site ge~.relepme:-.t J21af\:-.b.g
-43a9. 4~A~ ~T4aL~.te:-.a:-.ee ~T4~ age:-:,.e:-.t
a-A'7nn 1 D_~;~~4- ~A~~~~~~~~4- C'T~4-~~
A., vV.A. A. ~'"'J"'~' ~T~~~.~-;';"L'-1.'~""Y~=L
.5300.4GD -Telecommunications: Protected Distribution System
.5400.1 General Environmental Protection Program
.§499.3 Ha~aFaeHS a:-.a R:aaieaee~:e ~T4e~ea \A!aste J2FegFa:-:'.
.5400.5 -Radiation Protection of the Public and the Environment
.§i49.1H ~mJ2 ~A~ Ge:-:,.pliF.ee J2FegFam
gpeFatie:-.s
~T1ateFials, Ha~aFaeH5 SH~stF.ees, :iF.a H~aFaeHS1.A!astes
-""Anr\ A T""\r\r ~-_.: 4-_1 D_~4-~~~~~ C~&~k._-~.J TJ~_I4-1.. D_~4-~~4-;~~ C4-~~~~-~,..
.B'tO\:l.':t t:;t~e eit-;tit1tttitt:ttttt~ A. ~'"""'~'~'"'~""""~~""J' -.-A.4'-~"'-1.L A. ~'""',-'-"~,",1.' '-'...~ ~~ , -§489.7 ~A~ IiiFe J2Feteetie:-.
.§489.9 Ge:-..:t:-..:.eee:-. SaEe~r a:-.a Healt£-. J2FegFam
.§489.19 Ge:-.tFaeteF Ir.aHstFial Hjrgie:-.e J2FegFam
.§489.11 Raaiatie:-. J2Feteeee:-. EeF GeeHpaee:-.al \~! eFkeFS
.§489.~8 ~JatHFal J2~.e:-.e-::.e:-.a-Ha~aFEis ~T4itigaeeb.
.5481.1B -Safety Analysis and Review System (for non-nuclear facilities and hazards only)
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.e6a~.e P~.j'sieal PfeteeeeR et Glassifiee ~.4at~~f
.e6a~.6 P~.j'sieal Pfeteeee:-. et 9GB Pfel3e~'
.5637.1 -Classified Computer Security Program
.5700.6C- Quality Assurance
.5820.2A -Radioactive Waste Management
.643G.14AA Ge:-.efal gesig;:-. Gfitefia
.151.1 -Comprehensive Energy Management Pr gram
.420.1 -Facility Safety
.430.1 -Life Cycle Asset Management
.440.1- Worker Protection Management for DO Federal and Contractor Employees
.N441.1 -Protection for DOE Radiological Acti~ties
.P450.1 -Environment, Safety and Health Poli for the Department of Energy Complex
.451.1- National Environmental Policy Act Co rogram
.460.1 -Packaging and Transportation Safety
.470.1 -Safeguards and Security Program
.471.1 -Information Security Program
.472.1 -Personnel Security Activities

19A.2 10.3.2 Other Government St~.elafels Regulatioqs

.10 CFR 830.110 -Nuclear Safety Management, ~afety Analysis Report

.10 CFR 835- Occupational Radiation Protection i
.10 CFR 20 -Standards for Protection Against Ra4iation
.29 CFR 1910 -Occupational Safety and Health Aft (OSHA)-operation
.29 CFR 1926 -Occupational Safety and Health A

~ t (OSHA)-construction

.40 CFR 125 -Criteria and Standards for NPDES National Pollutant Discharge Elimination System) i
.40 CFR 260, 261, 262 -Hazardous Waste ManageFent System
.40 CPR 61 Subpart H -National Emission Standard for Emissions of Radionuclides other than Radon from Department of Energy Facilities
.FED-Sill-209E -Airborne Particulate Cleanlines Classes in Cleanrooms and Clean Zones
.33 USC ~ 1251 et seq., Clean Water Act
.42 USC 7401, Clean Air Act
.42 USC 4321 et seq.. NEP A (National Environm tal Policy Act)
.40 USC 6901 et-seEt: to 6992, Resource Conservat on and Recovery Act (RCRA)
.15 USC 2601-2692, Toxic Substance Control Act

1(;).4.3 10.3.3 National Consensus Standards
The order standards and codes listed as mandatory' DOE Orders are not referenced in this list.
.Air Movement and Control Association (AMC): Certified Program-Air Performance, 211-1994
.American Concrete Institute (ACI):
-Specifications for Structural Concrete for uildings, ACI 301 -1996 .American National Standards Institute (ANSI):
-ANSI B40.1 -1991, Gauges-Pressure, Indi ating Dial Type Elastic Element -ANSI MC96.1 -1982, Temperature Measur~ment Thermocouples
-ANSI/ IEEE Sill 241 -1991, IEEE Reco ended Practice for Electric Power Systems in Commercial Buildings
-ANSI ZI36.1-1993 Laser Safety
-ANSI C2 -1993, National Electric Code
-ANSI C84.1-1989, Electrical Power Syst ms and Equipment -Voltage Rating (60 Hz) I
-ANSI/NFPA 110-1993, Standard for Emer~ency and Standby Power Systems
-ANSI/RIA R15.06-1992, Industrial Robo~ and Robot Systems -Safety Requirements
.American Society for Testing and Materials (AstM)
-ASTM Cl50 -1995, Standard Specification Ifor Portland Cement
-ASTM C33 -1993, Standard Specification for Concrete Aggregates
-ASTM C94 -1994, Standard Specification for Ready-Mixed Concrete
-ASTM C260 -1994, Standard Specificati°ti for Air-Entraining Admixtures -ASTM C494 -1992, Standard speCificatio

~or Chemical Admixtures for Concrete

-ASTM C618 -1994, Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Ad .ture in Portland Cement Concrete
-ASTM A615 -1995, Standard specificati0

1for Deformed and Plain Billet- Steel Bars for Concrete Reinforcement

-ASTM A416 -1994, Standard Specificatio for Steel Strand. Uncoated Seven Wire Stress Relieved for Prestressed Concr~te
-ASTM A36 -1994, Standard Specification I for Structural Steel
-ASTM A307 -1994, Standard Specificatio for Carbon Steel Bolts and Studs, 60000 psi Tensile Strength
-ASTM A325 -1994, Standard Specificatio for High Strength Bolts for Structural Steel Joints
-ASTM A449 -1993, Standard Specificatio for Quenched and Tempered Steel Bolts and Studs
ASTM A490 -1993, Standard Specification or Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
.International Commission on Radiological Prot~ction:
-Publication 30 (methodology only) -Limi

t S *of* Intakes *of* Radionuclides by

Workers
-Publication 60 -1990 Recommendations 0 the International Commission on Radiological Protection "c

-Publication 61 -Annual Limits on intake O

JRadionuclides by Workers Based on the1990 Recommendations

.Instrument Society of America (ISA):
-ISA S5.1 -1992, Instrument Symbols and I entification
-ISA-S50.1 -1992, Compatibility of Analog ~ignals for Electronic Industrial Process Instruments I
.YGRb 1.9919 Qesi',;:"'. ~ El ~~..alHatieR bHiEleli:'.es If~f QG~ Faeilities
.UCRL 53526 Rev. 1 -~*tfe~.e t.A!i:'.Elt+e~.aEle l=Ia~afEl ~.4eElels Natural Phenomena Hazards Modeling Project for Department pf Energy Sites (1985)

.UCRL 53582 Rev. 1 -~eis~.ie l=Ia~afEls ~.1eElel Nafral Phenomena Hazards Modeling Project for Department of Energy Sites (1984)
.DOE-STD-1020-94, Natural Phenomena Hazard$ Design and Evaluation Criteria for DOE Facilities
I .DOE-STD-1021-93, Natural Phenomena Hazard Performance Categorization Guidelines for Structures, Systems, and C

j mponents

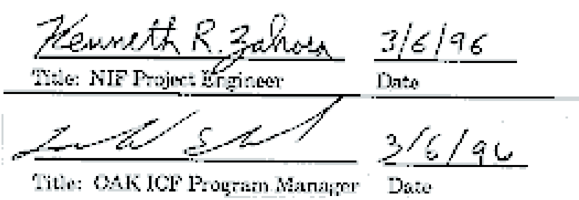
.NFPA 70 -1996, National Electric Code
.NFPA 72 -1993, National Fire Alarm Code
.NFP A 101 -1994, Code for Safety to Life from F re in Buildings and Structures

NATIONAL IGNITION

~ILITY PROJECT LEVEL 2 -BASELINE C GE PROPOSAL

RECORD OF CISION

BCP NUMBER: I BCP TITLE: I



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Chairperson, NIF DOE Field Manager

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Date

Approve

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APPROVE

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DOE F 1325.8
(08-93)
United States Government **Department of Energy**

memorandum

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DATE:
REPLY TO
ATTN OF: SUBJECT:

TO:

January 15, 1997 DP-40:J. Beitz:3-3181

BASELINE CHANGE PROPOSALS (BCP) FOR'THE NATIONAL IGNITION FACILITY

L. Morrow, DOE Oakland Baseline Change Control Board Secretariat

BCPs 97-001 (Rev 8) and 97-002 (Rev 8) for the National Ignition Facility were submitted to this office for processing. On December 18, 1996 a Baseline Change Control Board (BCCB) meeting was held to discuss the proposed changes. The meeting minutes are attached.

Based on the recommendations of the board members, the Chairman dispositioned the BCPs as follows.

BCP 97-001 (Rev 8). Approval is conditional on external review of orders and standards applicable to construction prior to Construction Approval (CD-3) and full revalidation of applicable orders and standards through the revised "Work Smart" process to be established at LLNL within one year.

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BCP 97-002 (Rev 9). The BCP was revised and endorsed by the Chairman and submitted to the Level 0 BCCB for action on December 24, 1996.

Should you have any questions regarding this BCP I you can reach me at (301) 903-3181 or Tom Finn at (202) 586-4797.

Jamie M. Beltz, Secretariat
DP Baseline Change Control Board

Attachments

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f"

'"

cc:
A. Tavares, FM-20
D. Crandall, DP-18
K. Foley, DP-41
R. McCrory, LLE, UR
W. Simmons, System Solutions D. Giovanelli, Sumner Associates J. Wolfe, DP-41
T. Finn, DP-18
A. Epstein, DP-40
T. Gipe, FM-20
S. Samualson, DOE OAK
J. Paisner, LLNL

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Page 2

Level 1 National Ignition Facility
Baseline Change Control Board Meeting Minutes
December 18, 1996

Pre-Session

Steve Kumpan gave a background briefing to representatives of the Level 0 Baseline Change Control Board (BCCB) functional organizations and the NIF Level 1 BCCB. He went through each NIF system, summarizing the key design features. The purpose of the briefing was to prqvide the technical basis for the Level I BCCB meeting. I

Level 1 Baseline Change Control Board Meeting

The Level I BCCB meeting convened at 10:30 a.m. December 18, 1996 at DOE Headquarters. Members present included: Da'Jid Crandall, Chairperson, Director of the Office of Inertial Confinement Fusion and the National Ignition Facility; Kate Foley, DP Financial

Management Representative; Robert McCrory from University of Rochester, Laboratory for Laser Energetics; William Simmons from Systems Solutions (formerly LLNL); and Damon Giovanelli from Sumner Associates (formerly LANL). Attachment 1.2 lists the representatives that attended the meeting. A I.

Jamie Beitz-Heard, the Secretary of the BCCB, stated that the Level I Baseline Change Proposal (BCP) along with the BCCB recommendation will be submitted to the DOE Level a BCCB since it exceeds established Level 1 thresholds. Representatives from the Office of Field Manag~ment recommended an action decision memorandum be transmitted to the Level a BCCB. The Level a BCCB will have 15 working days to provide their recommendation to the Secretary.

Dave Crandall stated that today's actions could be viewed as the culmination of the project design phase and preparation for construction. He summarized the Mission Need Statement approved in 1993 and reaffirmed during KD1 and KD1 Prime (Nonproliferation Study). We are examinilng the functionality and flexibility of the NIF to meet the Mission Need. A primary boundary condition is the cost. He explained that the ICE cost estimate agrees to within -1 % of the Project Office estimate and that higher level DOE and OMB authorities have been informed of potential cost growth of about 10%. TEC increases by $203.1 M from $842.6M to $1045.7M. OPC decreases by$77.8M from $231.0M to $153.2M. TPC increases by $125.3M from $1073.6M to $1198.9M.

Scott Samuelson, Chairperson of the Level 2 BCCB, presented Baseline Change Proposals 97-001 and 97-002 (Attachments 1.3 land 1.4). He discussed the Project data sheet and the two engineering studies requested by the Level 1 BCCB in BCP 96-006. He first described 97-001 to update the Primary Criteria

and Functional Requirements to be used as a basis for Title II design. Note: This BCP also updates the Section on applicable Orcfiers, Codes and Standards. In response to deferring the shield doors to the ICF program, the board inquired when the shield doors would be installed. The nesponse was -3-5 years into operation; the installation should not interfere with operation since all mounting hardware will be in place. Charlie Tiplitz, FM leader of the ICE team, agreed the cost could be relegated to the Program and removed from the TPC.

Scott Samuelson described 97-002 which updates the Project Data Sheet. This reflects the cost and schedule estimates from Title I Design. Dave Crandall emphasized that the DOE guidance of $229.1 M ,obligational authority in FY98 is a probable request limit, to be decided within th~ Administration. He requested further discussion of the funding option strategy 'at the end of the meeting.

Kate Foley clarified the definitions of both Budget Authority (BA) and Budget Outlay (BO). Although the implementation of the new OMB policy is still to be worked out, the project will have a specific obligational profile that will be lower than the total Congressionally approved BA. Scott went on to describe possible FY98 funding options and their impact on Total Project Cost and schedules. Scott completed his discussion on the integrated nature of Title I design that incorporates all of the functionality additions requested by the Board in BCP 96-005. Dave Crandall emphasized that the Project cost is based on the preferred site which will be verified by the Record of DeCi

,ion on the PElS for Stockpile Stewardship and Management.

Jeff Paisner (Attachment 1.5) presented details *Of* the functionality changes approved by the Board in its April 1, 1996 decisipns on design scope. He went through each functionality change (e.g., flash lamp cooling, 2x4 amplifiers, etc.). There were technical questions on 1 D-SSD (be~m smoothing), optics assembly capability, and flash lamp cooling from the Boardl members. Producing adequate crystals for doubling and tripling wavelengths involved a lengthy discussion, as did design features to not preclude direct drive. ,Bob McCrory addressed the issue of cost for 2D-SSD including an additional ithird crystal. Jeff Paisner replied that the Project has put into place a procurement plan to provide crystals produced using existing technology if the rapid growth crystals are not successful. The cost exposure for this option IS estimated at $20M. The question on the extent of Defense Special Weapons Agency (DSWA) funding support for their experiments was raised by the Board. The cost for DSWA features for radiation testing was discussed. Th~ Board members (Giovanelli and McCrory) questioned the inclusion of $6~9Mifor DSWA work when DSWA had not committed to its development of experimental capability to use the NIF. Dave Crandall stated that DSWA had funded some modeling and design efforts and that their actual implementation of experiments was under discussion.

Jeff Paisner described the cost of each functionality change requested by the Levell Board. Kate Foley stated that the cost for the optics assembly capability

was not included in the original Project Data Sheet.

Jeff Paisner discussed the net savings if functiohality additions were disapproved (e.g., DSWA future test capability cost $6.9M, but removal would save only $1.7M to account for lost design and redesign costs). He went on to discuss other Project costs. Kate Foley asked Charlie Tiplitz about ICE reconciliation. The open issues are operating spares and associ~ted maintenance protocol. Charlie Tiplitz stated that the overall agreement

of the ICE and higher Project estimates is within $7M (-1 %, with ICE higher) which is in the "noise" (good agreement), but that the ICE had not looked at t

re cost of the schedule stretch out.

Lunch break

Jeff Paisner presented the beneficial impact of selecting the preferred site. With the infrastructure available, the first laser bundle would be activated for Stockpile Stewardship experiments as early in FY2001 as: possible. Nova shutdown timing was discussed. Kate Foley asked when Nova shuts down under the 12/10/96 DOE funding guidance case. The answer was, "about two years before first NIF laser bundle operation". Alternatively, Charlie lliplitz asked when NOVA would be shut down if there were no Project acceleration. Jeff Paisner responded that
it would be around two years before NIF became operational in order to provide necessary training. The DOE guidance was discussed by Kate Foley. A discussion on safety analysis reviews and reports was held by Bob McCrory and Charlie Tiplitz. I

Jeff Paisner completed his presentation with the two engineering studies 1) increased shot rate and 2) fully implementing dir:ect drive, requested by the Board in BCP 96-006. Jeff Paisner showed repC!>rts documenting each engineering study. There was discussion of full costs for actual implementation of direct drive with a conclusion that at least $19M (FY97 dollars) should be included in the Inertial Confinement Fusion Program planning around 2006 for direct drive implementation.

Scott Samuelson concluded by reiterating that BCP 97-002 shows the cost and schedule impacts of proceeding with the integrated NIF Title 1 design, incorporating DOE's 12/10/96 guidance of $229.1M in FY98 (i.e., a year slip and a $51 M cost increase). He then presented the impacts of four funding options evaluated by the Laboratory Project Office, and recommended an option which is constrained to $325M in FY98 BA and saves $36M and 9 months in schedule over the 12/10/96 guidance. Scott Samuelson concluded by stating that the Level 3 and Level 2 BCCB's recommended the i;.evel1 BCCB approve/endorse the BCPs, but strongly preferred Option 2 (FY98 limited to $325M) over Option 3 (FY98 funding limited to $229M). He emphasized that the confidence in the cost estimate is high based on the ICE review (i.e., overall agreement within 1 %). Charlie Tiplitz supported this conclusion for the baseline case.

Following questions by Arnold Epstein, DP-40, regarding changes to the Project list of codes, orders, and standards, Kate Foley recommended a review of BCP 97 -001 with regards to the updates and change$ to the section on applicable orders, codes and standards by the DP staff. Also, Headquarters DP budget needs to review the Project Data Sheet which is part of BCP 97-002. She pointed out that the correct funding scenario must be selected and agreement reached with DP-1 and the Level 0 BCCB. It was agreed that the schedule to get early first bundle testing for Stockpile Stewardship is part of every option. The incremental cost of this is comparable to continued Nova operation. Dave Crandall went over the funding options and contluded that the BCCB incorporate cases 2 and 3. The funding options decision will be made by Vic Reis, DP-1, for recommendation to the Level 0 BCCB. Jeff Paisner suggested full FY98 appropriations should be requested. Kate Foley stated full BA funding in FY 1998 is an OMB policy, but that does not mean unconstrained obligations in FY 1998. „]

The BCPs will be conditionally accepted pending these internal reviews. The action decision memorandum will go up to the Level 0 BCCB.

MEETING ATTENDANCE L,IST

PROJECT:

SUBJECT:

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National Ignition F

~ Cility Baseline Change P oposal

Request Form and Recor of Decision

1. BCP number: 97-001 (Rev 8))f 2. BCP title: Title I Update
1£ 3. Submitted by Functional Requirements/P .mary ~ary Deis
(NIF Project ECR 80) Criteria Phone #: 2-7657

F~,-4-5195

"" Uate received:
Level 3: Level 2 L Level 0 ange Priority 6. BCP Leve 7. Directe ange
.Routine 0 LevelO 0 Yes
0 Priority .Levell .No
0 Leve12 Basis:
0 Leve13

8. Change description: 1:§ -Scope ~ -Schedule ~ -Cost Proposed changes to Functional Reguirements and Primary Criteria) Revision 1.4, are detailed in Attachment 1. ~ese ch~ng~~ fall into four c~tegones: 1. Req~irements c~anges to ~llo:w deferral of acquisition of high-yield and hIgh-avaIlabIlIty suppo~ eq~lpmen!, not reg~red for the. fi~st ti;ree ~o five.yea.rs of operation; 2. Addition of several DOE orders oInltted m prevIous revISIons, and elImInation df duplIcative orders; 3. Update of national consensus standards, to move detailed standards on material and wprkmanship to proper level in requirements hierarchy; 4. Miscellaneous minor changes. I

***Cost ..10M, and is in~luded in BCP97-002.**
,'. JtlSti
Adoption 0 t IS C ange wi up ate t e F Functional Reguiremeqts and Primary Criteria (FR/PC) to Revision 1.5, Eased on the results of Title I design, and of the Title I design re1jriew. The cost impact of these changes is included in BCP97-002.

The changes corresponding to category 1 in Section 8, above, result ~n a cost avoidance of approximately $9M, by deferring the acquisition of items which are not required until three 'to five years after the start of operation, and which might be significantly rescoped, redesigned, optimized, or otherwise modified as result of early operational data. These items, and the justification for their deferral, are as follo~s: ~

, .Target Bay shield doors -these are not required until wel~ into the experimental program, when significant yiela is attained. Prior to that time, they will adversely affect system operability and increase operating cost. If acquired now, these doors will probably be significantly ovEjr-designed because o(the inherent conservatism required in shield design. Deferral of ilie doors will a~low dosimet!Y to be used to refine the requirements ana analysis, resulting in less-conservative, and hencei less-costly doors. This deferral will result in adaitional operating cost to add the doors later, but this cost is expej:ted to be less than the deferred cost, $4M. Hardware which must be built into the facility to allow later addition of the doors remains in the l?roject scope.

.Decontamination equipment -This equipment is modular in nature, and sufficient equIpment for the first 3 to 5 years of operation is included in the project scope. Addittonal units may be required for high-yield operation, and this cost will be borne by the operating program wh~n the equipment is determined by the program to be needed. However, early operational experience, combined with technology development (e.g. in first wa11 materials) may reduce or eliminate the need the this equipment. A $ignificant fraction of the $4.5M deferred may be permanently avoided.

.Mamtenance equipment -Projections of the quantity of $aintenance devices that are required for continuous high-ayailability operation are extremely uncertain at t~s time. Actual needs will depend strongly on Ithe manner in which the facility is operated, the kind of experiment~ that are performed, and the failure rate of individual components. Deferring the acquisition of extra maintenance devices will allow an optimized selection I to be made, which will best address the actual needs and priorities <l>f the operating program. All maintenance equipment will be designed, and one unit of each will be provided within the project scope. Acquisition of additional units, if and when it is determined to be necessary, will be an operating cost. The cost deferred in this manner is approximately $1.5M.

The changes in the list of OOE orders and national ~onsensus stand rds (items 2, 3, and 4 listed in Section 8) have no cost or schedule impact.

1100 Impact 0 not approving BCP

If not aPl?roved, the FR/PC version used to govern Title I design wtll also be used for the remainder of the engineenng desi~ phase, instead of the updates incorporating cha~ges derived from Title I engineering. Approximately $lOM would have to be added to the project funding.

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Record of BCCB decision

11. Record of BCCB decision 1"1 Passed to Higher Level BCCB 13. Date of BCCB decision
___0 Approved (see II) 0 Yes
0 Disapproved 0 BCCB
I 0 _Returned for specific data

..4. Approval signature r'
Date
itations:

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National Ignition Facility
Baseline Change Proposal Worksheet

1. BCP number: 97-001

4. Technical baseline change inputs

Other technical baseline documents:

.Primary Criteria 0 System Design Requiremerlts .Functional Requirements 0 Interface Control Docume~~

.::>. Cost input
Inputs: TEC: n/ a -see BCP97-O02 OPC: n/a -see BCP97-002 Annual Operation: n/ a -see BCP97 -002

Budget analysis:
Original budgeted amount: ___
Project to date actual cost: ___
Current lien balance:

n/ a -see BCP97-O02 n/a -see BCP97-O02 n/a -see BCP97-O02

Note: Change in DOE orders has no cost impact

Change to funding profile included:

DYes
.No

6. Schedule input: ***N/A*** **-see BCP97-002 Milestone title/modths t1 0 Level 0 milestone .~ ".c."j",c"""_.", 0 Levell milestone**
0 Level 2 milestone
0 Level 3 milestone

7. ES&H impacts

None
0 PSAR/FSAR
0 PElS
0 QA Program
0 Other documents

Titles

18. Other impacts (e.g., security, stakeholders)

An operational requirement for Tritium accountability has be~n added via incorporation of DOE a 5633.2B. The quantity of tritium which requires accountability will occur in NIF after FY2005.

2. BCP title: Ii 3. Su by
! Functional Requirements/Pri ary Gary Deis
, Criteria Phone #: 2-7657 Fax #: 4-5195

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NATIONAL IGNITION FACILITY PROJECT LEVEL 2 -BASELINE CHANGE PROPOSAL RECORD OF DECISION

BCP NUMBER: 97-001

Kenneth R. Zahn

Title: NIF Project Engineer

BCP TITLE: Title I UPdat

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Criteria c

13-Dec-1t:

Date

Approve

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Title: Director EFM Date

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Title: Director, WRD Date

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RECOMMENDATION

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( ) Directed Change

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I ADVISORS (As Reauired)

I REC~MMENDATION

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DP-40.1 FAX:

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DEPARTMENT OF ENERGY
BASELINE CHANGE PROPOSAL
LEVEL 1 DISPOSITION

PROJECT TITLE: National Ignition Facility	
30) BCP NUMBER: 97-001	31) BCP TITLE:

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I prior to CODS1f1:lction Approval (CD-3) and fun revalid,ation ofapplicabl~ ~rders and I~andards br-.{f(.- I
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DATE

12/23/96

DEPARTMENT OF ENERGY
BASELINE CHANGE PROPOSAL
LEVEL 1 DISPOSITION

PROJECT TITLE: National Ignition Facility

30) BCP NUMBER: 97-001

31) BCP TITLE:

32 MEMBERS RECOMMENDATION

Kate Fole

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NAME (PnntIType)

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William Simmons
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33) Remarks (If BCP is Approved with Conditions, Deferred, or Rejectedl '.~ *tJ*
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BCP 97-001 Attachment 1

Attachment #1 to BCP97 -001

Title I Update of Functional Requirements and Primary Criteria

Detailed description of changes
~The proposed changes in the Functional Requirem nts and Primary Criteria are shown below. Strikeouts denote text to be eliminated and underline denotes new text. Italics denote comments which will not be incorporated' the revised document.

2.2.2 Annual Number of Shots with Fusion Yield

t Or Chamber Design*

The NIF shall be capable of performing yield sh ts with total DT fusion yield of 1200 MJ / year. The NIP shall be capable of performing u to 50 shots per year with a routine DT fusion yield of 20 MJ. The NIP design shalll2fovide for life-c~cle-cost-effective and decontamination equil;:!ment.

7.1 Reliability, Availability and Maintainability (~M)*

The components, systems, and processes that lixPit overall facility availability shall be identified during the design process through anc)lyses of turnaround times, mean times between failures, mean times to repair, prevet1tive maintenance requirements, etc. Techniques such as in-site backups, on-hand spares, modular components, on-call maintenance forces, and more robust designs shall e used to increase availability if the following goals cannot otherwise be achieved:

.The facility shall be available for three s ft operations at least 253 days per year (73% availability).

.The facility shall be available for at least 16 no-yield target shots per year. To address the possible future needs of dire~t-drive and other users, the design should not preclude an increase in the availability to approximately 1200 total shots per year. The I2roJect shalll2rovide the initial set of maintenance equil2ment. consisting of at least one unit of each l2iece of equil2ment that is required to maintain and °l2erate NIP. Future addition of more units of NIF °l2eration. as defined above. ma~ require future additional units of maintenance equil2ment

.The lasers shall perform within specific a 'on (e.g., laser energy, beam balance, pointing accuracy) on at least 80 *Yo* of all shots.

The project should also use this RAM process t determine how to achieve availability in the most cost-effective manner, to de ermine what spares in what quantities should be kept in inventory, to optimize turnaround procedures, to plan preventive maintenance and inspection programs, nd to respond to unscheduled outages.

BCP 97-001 Attachment 1

***Note: the following section* is *proposed* to *be added* to *the Functional Requirements and Primary Criteria* I**

11.0 Revision Record

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96-006

97-001
97-002

Directed changes in DOE Orders and Federal Regulations. Miscellaneous changes throughout document
Functionali~ Changes to the NIF Baseline.
Changes include the addition of: oJ2tic assembl~ caJ2abili~. beam smoothing. flashlamJ2 cooling. 4x2 I amJ2lifiers. not-to-J2reclude direct drive. not-to- I J2reclude radiation effects testing. and laser sJ2ot
~

I En ineerin tion Studies: increased shot ra~ I and full imJ,2lementation of direct drive.
Title I U date of Functional Re uirements Prima Criteria. Changes to incorJ,2orate results of Title I design and design review, uJ,2date of DOE Orders and ~tandards. and miscell~neous chan~es

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BCP 97-001 Attachment 1

***Note: All of the following changes result directly from changes in Section* 10 *-Orders, Codes, and Standards.* I**

3.0 Safety Requirements**

The NIF shall be designed, constructed, and operated as a radiological low-hazard, non-nuclear facility. Compliance with this classification shall be verified through a Preliminary Hazard Analysis assessment of bounding accidents involving those radionuclides and/or chemicals presenting the most significant hazards (see lQ GI'R 8~Q.IIQ ~~Heleaf ~aie~" ~Ar.ageme:-.t, ~aie~" £A :.alj"sis Re¥eft, :""".e DOE Order 5481.1B, Safety Analysis Review System). Administrative controls shall be established prior to CD3 to ensure that inventory limits for a radiological low-hazard, non-nuclear facility are not exceeded.

3.1 Radiation Protection*

Collective and individual ionizing radiation doses to the public from all exposure pathways from the NIF shall meet the requirements of DOE Order 5400.5, Radiation Protection of the Public and the Environment, and 40 CFR 61, National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities. These requirements state that exposure of members of the public from emissions of radionuclides in the ambient air from normal NIP operations shall remain below 10 mrem/y. The facility shall also meet the requirements of DOE Order 5400.5 [ICRP 60 540 (1990 Recommendations of the International Commission on Radiological Protection), 10 CFR 20.1301.a.1 (Code of Federal Regulations-Standards for Protection Against Radiation)] to not cause the public dose from all exposure modes and all sources of radiation at the site boundary to exceed 100 mrem/y.
The NIP personnel radiation protection program shall follow DOE Order *N441.-t-i.* Radiation Protection for Occupational Workers and 10 CFR 835, Occupational Radiation Protection. The ALARA (as low as reasonably achievable) principle shall be utilized in both design and operation of the facility to eliminate unnecessary radiation dose to workers in the Laser and Target Area Building, col19cated employees, and visitors from both routine and off-normal operations. Radiation protection shall include: shielding; control of workplace ventilation; monitoring of personnel for external and internal radiation dose; establishment of a routine contamin~tion monitoring program including air monitoring; and the proper containment of radi~tion and radioactive materials.
The radiation shielding design sl-.all be ::-.el'e ee-:~se:-':aeY:e t..1...a-:. l'eElHil'eEi bj' gG~ GI'Eiel' 4~Q.l, ~aeili~' ~a{e~', ~"'. tl-.at limit the maxim~m doses to an individual worker sl-.all be li::-.itee to one- tenth (shielding design

goal) of the occupational external dose limits specified in 10 CFR 835. Concrete shielding sijall comply with ACI 301, which provides adequate strength for DBE loads.

BCP 97-001 Attachment 1

The requirements for radiological safety in gQ~ Qfelef 42:Q.~, ~aeilitj. ~afctj., 10 CFR 835. Occupational Radiation Protection. should be evaluated by the designers and incorporated when they are determined to be cost effective, even though the projected inventory of tritium in NIP (-0.05 g or 500 Ci) is well below the threshold for a nuclear facility. The target chamber and tritium processing systems shall form the primary confinement barrier. Leakage past these barriers shall be ALARA. The experimental- area ventilation system shall be designed to operate at negative pressures during and immediately after shots of greater than one megajo¥le and provide secondary tritium confinement.
The final exhaust release point from this system I should be elevated for dispersion. Exhaust air shall be continuously monitored for radioactivity. The target area shall also be monitor~d to ensure that radiological conditions are safe for personnel entry.

3.2 Life Safety**
The NIP shall fully comply with the requirements for life safety contained i.~L gG~ Gl'ael' 4~9.1, ¥aeilitjT ~afetjT all National Fire Protection Association (NFP A) Codes. Particular focus shall be directed towards features related to the means of egress, such as protection of vertical openings, travel distances, capacities, and emergency lighting.

3.4 Industrial Hygiene and Occupational Safety*

Industrial hygiene and occupational safety shall comply with 29 CFR 1910~
ccu ati nal afe and Health Act 0 HA -erati n a~Ld DGB Grder 44Q.I, \A!erlEer Pret~~tie~. ~Aa~.age::-.e-:.t fer DGB Federal a-:.d Ge-:.eaeter B::-.~!::;jT~~.
__Construction safety shall comply with the requirements of 29 CFR 1926, OSHA: a~Ld Ge~Ltraeter B::-'13lejTees.
__Facility subsystems (e.g., capacitor banks, vacuum systems, tritium recovery, nitrogen supply, and personnel safety interlock systems) shall be designed to default to a safe state upon loss of power.

3.5 Fire Protection*

The NIP shall meet the design and fire protection requirements *ei* QG~ G~ee~ 4~Q.l, ~aeili~' ~aiet~T, all NFPA Codes and the Uniform Building Code (UBC). The structural members of the Experimental Building (including exterior walls, interior bearing walls, columns, floors, roofs, and supporting elements) shall, as a minimum, meet UBC fire- resistive standards. Appropriate fire barriers shall be provided to limit property damage, fire propagation, and loss of life by separating adjoining structures, isolating hazardous areas, and protecting egress paths. The NIP shall meet the requirements for an "improved risk" level of fire protection sufficient to attain DOE objectives. To achieve this level of protection, automatic fire sprinklers shall be installed throughout the complex. The sprinklers shall be coupled with adequate fire protection water supplies and automatic and manual means for detecting and reporting incipient fires.

BCP 97-001 Attachment 1

Fire hazard analyses will be completed as requiredlby QGB Gfaef 4~g.1 all NFP A Codes. i

.8.0 Decontamination and I:j)ecommissioning

The NIP design shall meet the feEfHife~.e:-.ts *ei* IPGB Gfeef 4~9.1 a~Le site-specific requirements. The NIP shall be designed for period~c cleaning of the interior of the test chamber to maintain tritium levels on interior surf~ces as low as reasonably achievable. The NIP design shall include considerations that w1ll allow for cost-effective future decommissioning of the structures and equipment. i
A plan for NIP Decontamination and DecommiJsioning (D&D) shall developed in accordance with DOE Order 5820.2A, Radioactive Waste Management, a:-.e QGH Gfeef ~. A D&D assessment shall be made during co~ceptual desigIl: to ensure that features and measures are incorporated in NIP to s~plify D&D. The NIP D&D plan will be prepared before the end of the Title I desi~.

10.0 Orders, Codes, aqd Standards

10.1 DOE Orders*

The NIP shall be designed and constructed in full compliance with DOE Orders and federal regulations. Exceptions shall be limited to those cases where the project has formally requested and been granted either an exeIf\ption or a finding of equivalency by Headquarters.
It is recognized that updates and additions to DOE Orders, federal regulations, and consensus industry standards are outside of the control of the project team and are a frequent source of cost and schedule growth. Thesei requirements are all frozen as of March 1,1996. i

10.2 Codes and Standards

Technical ~Jatie~.ally feeeg:-.~ed codes, standar~s, and guides l2romulgated b~ nationall~ recognized organizations should be utilized b~ the NIP Project whenever available and l2ractical. l2er DOE Order 1300.2A. A partial listing of tl'.ese deeH~.e~.ts a~.d tl'.e applieable fe~.'isie~~ nationall~ recognized organizations is included in the following sections. Additional references ~.ay be identified a~.d fef~.allj' added during the Ge~.eept'.:al a~.d :;I:itle I desig:-. develol2mental phases shall be formall~ cited and

BCP 97-001 Attachment 1

af3f3Fe~:eEi through the Project Change Control Process.

10.3 Applicable Orders, Codes, and Standards

This'section lists DOE Orders, codes, and standards in effect ee~LsieleFeel ai3i31ieaele on March 1, 1996, that are considered to be at1t1licable to the NIP Project. The listing begins with DOE and other federal regulations (e.g., Resource Conservation and Recovery Act), and is followed by a t1artiallisting of national consensus standards
The
applicable portions of these documents will apply.

10.3.1 DOE Orders
.1300.2A -Technical Standards Program
.5300AD -Telecommunications: Protected Distribution System .5400.1- General Environmental Protection Program
.5400.5 -Radiation Protection of the Public and the Environment .5480.19 -Conduct of O~erations
.5481.1B -Safety Analysis and Review System (for non-nuclear facilities and hazards only) I
.*5632.1C* -Protection of Safeguards and Security Interests
.5633.3B -Control and Accountabili~ of Nuclear Material
.5637.1- Classified Computer Security Program
.5700.6C -Quality Assurance
.5820.2A -Radioactive Waste Management
.151.1 -Comprehensive *Bl"'.efbJ* Emergenc~ Management System -4~Q.l Faeili~' ~ate~'
.430.1- Life Cycle Asset Management
B='l31eyees
.N441.-1-2 -Radiological Protection for DOE RaElielegieal Activities .P450.1 -Environment, Safety and Health Policy for the Department of
Energy Complex
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.470.1- Safeguards and Security Program
.471.!-2 -Information Security Program
.472.1 -Personnel Security Activities

10.3.2 Other Government Regulations
.10 CFR 835 -Occupational Radiation Protection
.10 CFR 20 -Standards for Protection Against Radiation
.29 CFR 1910 -Occupational Safety and Health Act (OSHA) -Operation .29 CFR 1926 -Occupational Safety and Health Act (OSHA) - Construction

BCP 97-001 Attachment 1

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40 CFR 125 -Criteria and Standards for NPQES (National Pollutant Discharge Elimination System) i
40 CFR 260,261,262 -Hazardous Waste Marlagement System
40 CFR 61 Subpart H -National Emission Standard for Emissions of Radionuclides other than Radon from Department of Energy Facilities
FED-Sill-209E -Airborne Particulate Cleanl~ess Classes in Cleanrooms arid Clean Zones i

j 33 USC 1251 et seq. -Clean Water Act
42 USC 7401 -Clean Air Act
42 USC 4321 et seq. -NEP A (National Envir nmental Policy Act)
40 USC 6901-6992 -Resource Conservation ~d Recovery Act (RCRA)
15 USC 2601-2692 -Toxic Substance Control [Act

10.3.3 National Consensus Standards
The NIP ProJect shall comI2l~ with the following national consensus standards. as noted elsewhere in this document:
______-ACI 301 -1996 ecifi ations f r tru ncrete for Buildin s
-ANSI C2 -1993. National Electric Code
______-ANSI 4.1 -1989 Electrical P wer terns and E ui ment-Volta . (60HZ)
______-ANSI Z136.1 -1993. Laser Safet,Y
______-ANSI/RIA R15.06 -1992. Industrial Robots and Robot S~stem-Safet,Y Requirements
______-DOE-STD-1020-94 Natural Phenom na Hazards Desi and Evaluation Criteria for DOE Facilities
______-D E-STD-1021-93 Natural Phenomena Hazards Performance Cate orization uidelines for Structures S stems & om onents.
-IEEE 4931990. IEEE Recommended Practice for the Design of Industrial and Commercial Power S~stems
______-All NFP A Codes
______-NFPA 701996. National Electric Code
______-NFP A 72 1993. National Fire Alarm Code
______-NFP A 1011994. Code for safet,Y to Life from Fire in Buildings and Structures -ANSI/NFPA 110-1993. Standard for Emergenc~ and Standb~ Power S~stems -Uniform Building Code (UBC) 1994
__Orders, standards, and codes listed as mandatow in DOE Orders are not necessaril~ referenced in this list. i

a}2}2licable and a}2}2ro}2riate national consensus codes and standards in the design. s~stems. and com}2onents.}2er DOE Order 1300.2A. Codes. standards. and guides of shall be a}2}2lied as a}2}2ro}2riate to NIF materials and workmanshi}2:

AA Aluminum Association

BCP 97-001 Attachment 1

AA HTO Am rican Ass iati n f tat Hi hwa fficials
ABMA American Boiler Manufacturers Association
ACI American Concrete Institute
A IH American Council of vernm nt Industrial H ienists
AISC American Institute of Steel Construction
AISI American Iron and Steel Institute
AMCA Air Movement and Control Association
ANSI American National Standards Institute
AP A American PI~ood Association
ARI Air onditionin and Refri eration Institute
ARMA AsI2halt Roofing Manufacturers Association
ASCE American Socie~ of Civil Engineers
ASHRAE Ame~can Societ~ of Heating. Refrigerating & Air Conditioning Engineers
ASME American Socie~ of Mechanical Engineers
ASTM American Socie~ for Testing and Materials
A WS American W elding Socie~
A WW A American Water Works Association
BHMA Builders Hardware Manufacturers Association
CI CA Ceilin and Interior stems ntractors Association

CGA Coml2ressed Gas Association
CMAA Crane Manufacturers Association of America
CRSI Concrete Reinforcing Steel Institute
EPRI Electric Power Research Institute
FM Facto~ Mutual Engineering and Research
GA G~sum Association
ICB International Coun il of Buildin fficials Uniform Buildin
ICEA Insulated Cable Engineers Association
IEEE Institute of Electrical and Electronics Engineers
IES Illuminating Engineering Socie~ of North America
ISA Instrument Socie~ of America
NAPHCC National Association of Plumbing. Heating. & Cooling Contractors NCMA National Concrete Mason~ Association
NEC National Electric Code (NFP A)
NEMA National Electrical Manufacturers Association
NIOSH National Institute for Occul2ational Safe~ and Health
NIST National Institute of Standards and Technolo~
NFP A National Fire Protection Standards
RFCI Resilient Floor Covering Institute
SDI Steel Deck Institute
SDI Steel Door Institute
SMACNA Sheet Metal & Air Conditioning Contractors National Association SSPC Steel Structures Painting Council
STI Steel Tank Institute
SWI Steel Window Institute
TCA Tile Council of America
TIMA Thermal Insulation Manufa tur r Association

BCP 97-001 Attachment 1

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BCP 97-001 Attachment 1

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National Ignition Facility
Baseline Change Proposal
Request Form and Record of Decision

4. Date received Level 3:

5. Change Priority
V Routine 0 Priority

Level 2

2. BCP title: Project Data Sheet Update

Level 1

6. BCP Level
V Level 0 0 Leve/1 0 Level 2 0 Level 3

3. Submitted by
Dave Rardin Phone #: 3-1186 Fax #: 4-5195

Level 0

-- 7. Directed Change
V Yes
0 No
Basis: BCP 96-005

8. Change description: ~ -Scope ~ -Schedule ~ -Cost

This Baseline Change Proposal modifies the Project Data Sheet to reflect the currently-estimated project cost and schedule, based on the completed Title I design. This change permanently implements design changes resulting from changes in Functional Requirements directed in BCP 96-005: optics assembiy capability, addition of beam smoothing, addition of flash lamp cooling, addition of 4x2 amplifiers, "not to preclude" direct drive, "not to preclude" radiation effects testing, and laser spot size. This change also includes the impact of the requirements updates included in BCP97 -001, and incorporates all of the design impacts developed during Title I that ~ultfrom all Title I requ~ments changes.

9. Justification and impact of change (see worksheet)
Title I design has been completed, using the requirements as presently listed in Functional Requirements and Primary Criteria Rev 1.4 This set of requirements included additional requirements added by BCP96-005, approved 1 April, 1996. When BCP96-005 was approved, the cost and schedule impact of those requirement changes was assessed only for the Title I design effort, and not for the remainder of the project (post Title I). This BCP incorporates the full project impact of the BCP96-005 changes. The requirement changes increase the overall functionality of the NIF for all future users. This BCP also includes the cost impact of the changes proposed by BCP97-OO1, incorporating the results of the Title I design and Title I design review.

This proposal assumes that obligations in FY 1998 are limited to the amount contained in the FY 1997 Congressional data sheet (which is the same as the one submitted with the FY 1998 OMB Budget), and that the annual obligations in subsequent years are constrained to amounts that can be accommodated within DOE outyear planning levels. The revised Total Project Cost (TPC) after incorporating the functionality changes and constraining annual obligations is $1,198.9 million. The schedule for start of construction is not affected but there is a 12 month delay in project completion. Other funding scenarios were

considered including one that would allow the project to meet its original completion date. However, even though total project cost for this approach would be about $50 million less, the significant increase needed in the FY 1998 obligation level (almost $300 million) could not be accommodated within the OMB Passback amount for Defense Programs.

Attachment 1 is ~sed Project Data $~,_correspondinQ to this BgP. Attach!!!ent 2 details the impact to NIF e!Qi~ctmjlestones

10. Impact of not approving BCP
A modification of the Project Data Sheet is required to reflect the current project design and its associated cost and schedule estimates. as well as to provide accurate input in support of the FY98 Budget Submission. Failure to update the data sheet at this time could result in a funding request that does not accurately reftect the project's total funding needs.

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11. Record of BCCB decision
0 Approved (see II)
0 Disapproved
9 Retu~~d for specific dat~

12. Passed to Higher Level BCCB 0 Yes
0 BCCB

-
14. Approval signature
Previously endorsed by Jeff Paisner on 12/16/96

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13. Date *of* BGGB decision

Date

1. BCP number: 97-002 (Rev 9)*

(NIF Project ECR 81)

Record of BCCB decision

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15. Conditions! Limitations:

.Rev 9 reflects changes from the Levels 2 and 1 BCCB.

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National Ignition Facility
Baseline Change Proposal Worksheet

1. BCP number: 97-002 (Rev 9)

I 2. BCP title: Project Data Sheet
! Update

4. Technical baseline change inputs

0 0

Primary Criteria 0 System Design Requirements Functional Requirements 0 Interface Control Document I

i 3. Submitted by Dave Rardin Phone#: 3-1186 Fax #: 4-5195

Other technical baseline documents:

5. Cost input
Inputs: TEC: $1.045.7 M
_____OPC: $153.2 M
_____Annual Cost: $121.9 M

(these numbers corresDond to fundina "case 3")

6. Schedule input

Budget analysis: Original budgeted amount: = $842.6 M TEC
-$231 M OPC
___________Project to date actual cost: $I1 M
Current lien balance: $~

Change to funding profile included:

YVes
0 No

Milestone title/months ~

In general, overall schedule is delayed by 12
1onths. See Attachment 2 for specific milestone changes.

v Level 0 milestone see Attachment 2 I v Level 1 milestone see Attachment 2 I v Level 2 milestone see Attachment 2
v Level 3 milestone see Attachment 2

7. ES&H impacts
v None
0 PSAR/FSAR
0 PElS
0 QA Program
0 Other documents

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8. Other impacts (e.g., security, stakeholders)

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NATIONAL IGNITION FACILITY PROJECT LEVEL 2 -BASELINE CHANGE PROPOSAL RECORD OF DECISION

BCP NUMBER: 97-002

BCP TITLE: Project Data Sheet Update

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i Title: Director. WRD LJate

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F DOE Field Manager Date I ( ) Directed Change

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PROJECT TITLE: National Ignition Facility

30) BCP NUMBER: 97-002 Rev 9

31) BCP TITLE:

32 MEMBERS RECOMMENDATION

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DEPARTMENTOFENERGY
BASELINE CHANGE PROPOSAL
LEVEL 1 DISPOSITION

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DEPARTMENT OF ENERGY
BASELINE CHANGE PROPOSAL
LEVEL 1 DISPOSITION

PROJECT TITLE: National Ignition Facility

30) BCP NUMBER: 96-005

31) BCP TITLE: Functionality Chgs to the NIF B/L : 1. Optics assy capability, 2. Addition of beam smoothing, 3. Addition of flashlamp cooling, 4. Addition of 4x2 amplifiers, 5. Not to preclude direct drive, 6. Not to preclude radiation affects testing, 7. Laser spot size

32) MEMBERS (Required) — RECOMMENDATION

MEMBER	ORG / DATE	RECOMMENDATION
NAME (Print/Type) SIGNATURE - Dir., Office of Inertial Confinement Fusion	ORG DATE	[ ] APPROVE [ ] ENDORSE [ ] DEFER [ ] REJECT
NAME (Print/Type) SIGNATURE - Dir. Office of R&D Programs Financial Management	ORG DATE	[ ] APPROVE [ ] ENDORSE [ ] DEFER [ ] REJECT
Robert L. McCrory NAME (Print/Type) [signature] SIGNATURE - Dir. Laboratory for Laser Energetics, Univ of Roch	UR/LLE ORG 1 April 96 DATE	[X] APPROVE [ ] ENDORSE [ ] DEFER [ ] REJECT
NAME (Print/Type) SIGNATURE - Project Consultant	ORG DATE	[ ] APPROVE [ ] ENDORSE [ ] DEFER [ ] REJECT

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DEPARTMENT OF ENERGY BASELINE CHANGE PROPOSAL LEVEL 1 DISPOSITION	
PROJECT TITLE: National Ignition Facility	
30) BCP NUMBER: 98-005	31) BCP TITLE: Functionality Chgs to the NIF B/L : 1. Optics assay capability, 2. Addition of beam smoothing, 3. Addition of flashlamp cooling, 4. Addition of 4x2 amplifiers, 5. Not to preclude direct drive, 6. Not to preclude radiation effects testing, 7. Laser spot size

32 MEMBERS RECOMMENDATION

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SIGNATURE -David H. Crandall, NIF Chairperson' DATE

SIGNATURE -Robin Staffin DAS for R&D If Level 0 Action R DATE

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DEPARTMENT OF ENERGY **BASELINE CHANGE PROPOSAL** **LEVEL 1 DISPOSITION**	
PROJECT TITLE: National Ignition Facility	
30) BCP NUMBER: **96-005**	**31) BCP TITLE: Functionality Chgs to the NIF B/L : 1. Optics assy capability, 2. Addition of beam smoothing, 3. Addition of flashlamp cooling, 4. Addition of 4x2 amplifiers, 5. Not to preclude direct drive, 6. Not to preclude radiation effects testing, 7. Laser spot size**

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DEPARTMENT OF ENERGY BASELINE CHANGE PROPOSAL LEVEL 1 DISPOSITION	
PROJECT TITLE: National Ignition Facility	
30) BCP NUMBER: 96-005	31) BCP TITLE: Functionality Chgs to the NIF B/L : 1. Optics assy capability, 2. Addition of beam smoothing, 3. Addition of flashlamp cooling, 4. Addition of 4x2 amplifiers, 5. Not to preclude direct drive, 6. Not to preclude radiation effects testing, 7. Laser spot size

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DEPARTMENT OF ENERGY BASELINE CHANGE PROPOSAL LEVEL 1 DISPOSITION	
PROJECT TITLE: National Ignition Facility	
30) BCP NUMBER: 96-005	31) BCP TITLE: Functionality Chgs to the NIF B/L : 1. Optics assy capability, 2. Addition of beam smoothing, 3. Addition of flashlamp cooling, 4. Addition of 4x2 amplifiers, 5. Not to preclude direct drive, 6. Not to preclude radiation effects testing, 7. Laser spot size

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SIGNATURE -Dir. Office of Inertial Confinement Fusion

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SIGNATURE - David H. Crandall, NIF Chairperson

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SIGNATURE - Robin Staffin, DAS for R&D (If Level 0 Action Req'd) DATE

SIGN~TURE -Dr. V. Reis, ASDP (If Level 0 Action Required)

DATE

33) Remarks (If BCP is Approved with Conditions, Deferred, or Rejected)

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DISPOSITION

DECISION

National Ignition F

~ ility Baseline Change Pr posal

Request Form and Recor of Decision

1. BCP number 2. BCP title 3. Submitted by G.Deis/J. Yatabe
BCP 96-006 Conduct en~eering option s dies. Phone:27657/26115
1. Increased shot rate, 2. Full Fax: 36506/37651
I im lementation of direct driv .
4. Date received: I Level3 3/1/96 Level 2 Level 0
5. ange Priority 6. 7. Directe ange
0 Routine 0 Level 0 0 Yes
.Priority .Levell '
[.No 0 Level2 .B.asis: To provide increased 0 I3.i functionality to support user
Leve , reQuirements

8. Change description: .Scope 0 ~~(TBD1 .Cost
(~ee impact of not approving.)
This change will result in two Title I design studies, on: 1. increased hot rate; and 2. full implementation of direct drive. The changes in the Functional Requirements and Primary Crit ria to incorporate increased shot rate capabilities are shown in Attachment A; these modified requirements will be used as the basis of Title I design, and the increased shot rate is highly desirable if it can be provided within the Project funding constraints. The fUll implementation of increased snot rate will be determined after Title I ompletion.

! 9. justification and impact of change (see worksheet)
I The proposed changes will initiate Title I design of two additional NI capabilities. Increased shot rate is an extremely important capabilit:Y, and has been requested by all user groups, includin't; Weapons Physics, Radiation Effects Testing, and ICF. Full implementation of direct drive is a major decision, which can be implemented by DOE at any time in the future, because the basis for not precluding its inclusion is incorporated in BCP96-005.

10. Impact 0 not approving BCP
If the proposed designs are not performed, then: 1. the present shot te (8 hours between shots, 616 total shots per year) wilrbe the maximum achievable in NIF; and 2. the design and c st impact of full direct drive implementation will not be known at the end of Title I design.

Record of BCCB decision

11. Record of BCCB decision 1') Passed to Higher Level BCCB 13. Date of BCCB decision
__.Approved (see II) .Yes 3/ /
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14. Approval slgn-aIUre
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Limitations:

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Pen + ink changes based on input from Jean Morrow, DOE OAK

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National Ignition Facility
Baseline Change Proposal Worksheet

1. BCP number
BCP96-QO6

2. BCP title

Conduct Engineering Option Studies: Increased Shot Rat t and Full Implementation of Direct Drive

I 4. Technical baseline change inputs
I

3. Submitted by

Gary Deis/Jon Yatabe

Phone #: 27657/26115 Fax #: 36506/37651

Other technical baseline documents:
~

.Primary Criteria .System Design Requirement
.Functional Requirements D Interface Control Document
5. Cost input .J# *4O:J.lco* r't'\ Budget analysis: a ginal budgeted amount $34.7M: Inputs: TEC *'If* ~e pr
r.ect to date actual cost ~ Contingency $O.5M for new Cu ent lien balance K;?M
Title I work to $35.2M
______apc $I:e.:Q. Change to funding p ofile included: DYes (attached)
I Other $I:e.:Q. .No

6. Schedule input
0 Level 0 milestone 0 Levell milestone 0 Level 2 milestone 0 Level 3 milestone

7. ES&H impacts
Yes
.PSAR/FSAR
0 PElS
0 QA Program
0 Other documents

Milestone title/mon+ *L* TBD after completion of Title I

Engineering Options Study | Start - 12/95 complete - 9/96

Titles

8. O~er impacts (e.g., security, stakeholders)

Baseline Change Proposal 96-006
Impact Assessment and Change Description
Rev A I

Requirements changes I

Functional Requirements/ Primary Criteria (based oft Rev 1.3, March 1994) [New text in bold. Deleted text in stfiket1-L~~' Editor's notes in *italics.]*

2.2.2 Annual Number of Shots with Fusion Yield for hamber Design*
The NIF facility shall be capable of ...

, ,
}Feaf *v:it..\...* yield iF. tl--.e far.ge ef e te 2:9 ~.1J. performing yield shots with total DT fusion yield of 1200 *MJ/year.* The NIF should be capable O

r performing up to 50 shots per year with a routine DT fusion yield of 20 MJ. "

2.2.6 Time Between Shots with No Fusion Yield
***l* To address the needs of indirect-drive, direct-drive nd other users, the laser and experiment area shall be capable of conducting no fusion yield experiments with a time between shots of 8 hours f~f! s!:-.ets \':i*. :".e f.lGie:". j'ield with a goal of 4 hours.**

7.1 Reliability, Availability and Maintainability (RAM)'"

The components, systems, and processes that limit overall facility availability shall be identified during the design process through analyses of turnaround times, mean-timesbetween-failures, mean-times-to-repait, preventative maintenance requirements, etc. Techniques such as in-site backups, on-hand spares, modular components, on-call maintenance forces, and more robust designs shall be used to increase availability if the following goals cannot (i)therwise be achieved:

.The facility shall be available for three shift O

~erations at least 253 days per year (72% availability).

.The facility shall be available for at least 616 0 yield ~+ -Q.aaEi) target shots per year. To address the possible future needs of direct-drive and other users, the design should not preclude an increase in the availability to approximately 1200 shots per year.

~ .The lasers shall perform within specification (e.g., laser energy, beam balance, pointing accuracy) on at least 80% of all sh ts.

The proje~t should also use this RAM process to d termine how to achieve availability in the most cost effective manner, to determine what spares in what quantities should be kept in inventory, to optimize turnaround procedures, to plan ~~~:;~:~ve maintenance and inspection programs..jand to respond to unscheduled

NATIONAL IGNITION FACILITY PROJECT LEVEL 2 -BASELINE CHANGE PROPOSAL
RECORD OF DECISION

" BCP N~~ER: BCP TITLE: I

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Title: NIF Project Engineer

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Date

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_Title: OAK ICF Pro~am Man~er

3/6/96

Date

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Title: Direcoor. EFM

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_-Title: Dir~r!~- Date

Title: ICFD ES&H Manager

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RECOMMENDATION

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Conduct engineering option studies. 1. Increased shot rate, 2. Full implementation of direct drive.
MEMBERS (ReQuired) MMENDATION

96-006

'fide: Date
I ADVISORS (As ReQuired)

DEPARTMENT OF ENERGY BASELINE CHANGE PROPOSAL LEVEL 1 DISPOSITION	
PROJECT TITLE: National Ignition Facility	
30) BCP NUMBER: 96-004	31) BCP TITLE: Directed Changes in DOE Orders and Federal Regulations

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4/1/96

SIGNATURE - Robin Staffin, DAS for R&D (If Level 0 Action Req'd) DATE

SIGNATURE -Or. V. Reis, ASDP (If level 0 Action Required)

DATE

33) Remarks (If BCP is Approved with Conditions, Deferred, or Rejected)

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DEPARTMENT OF ENERGY
BASELINE CHANGE PROPOSAL
LEVEL 1 DISPOSITION

PROJECT TITLE: National Ignition Facility	
30) BCP NUMBER: 96-008	31) BCP TITLE: Conduct engineering option studies. 1. Increased shot rate, 2. Full implementation of direct drive.

32) MEMBERS (Required)		RECOMMENDATION
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SIGNATURE - Dir. Laboratory for Laser Energetics, Univ of Roch	1 Aug 1996 DATE	[ ] DEFER [ ] REJECT
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33) Remarks (If BCP is Approved with Conditions, Deferred, or Rejected)

DEPARTMENT OF ENERGY BASELINE CHANGE PROPOSAL LEVEL 1 DISPOSITION	
PROJECT TITLE: National Ignition Facility	
30) BCP NUMBER: 96-006	31) BCP TITLE: Conduct engineering option studies. 1. Increased shot rate, 2. Full implementation of direct drive.

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30) BCP NUMBER: 98-006	31) BCP TITLE: Conduct engineering option studies. 1. Increased shot rate, 2. Full implementation of direct drive.

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DEPARTMENT OF ENERGY BASELINE CHANGE PROPOSAL LEVEL 1 DISPOSITION	
PROJECT TITLE: National Ignition Facility	
30) BCP NUMBER: 96-006	31) BCP TITLE: Conduct engineering option studies. 1. Increased shot rate, 2. Full implementation of direct drive.

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DISPOSITION

DEPARTMENT OF ENERGY
BASELINE CHANGE PROPOSAL
LEVEL 1 DISPOSITION

PROJECT TITLE: National Ignition Facility

30) BCP NUMBER: 96-006	31) BCP TITLE: Conduct engineering option studies. 1. Increased shot rate, 2. Full implementation of direct drive.

,32) MEMBERS (Required) RECOMMENDATION -,
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SIGNATURE - Robin Staffin, DAS for R&D (If Level 0 Action Req'd) DATE

SIGNATURE -Dr. V. Reis. ASDP (If Level 0 Action Required)

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33) Remarks (If BCP is Approved with Conditions, Deferred, or Rejected)

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DISPOSITION

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United States Government Department of Energy

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DATE: March 20, 1997
~~~6~ DP-40.:J.Beitz:3-3181
SUBJECT: REVIEW OF BASELINE CHANGE PROPOSAL (BCP) FOR THE NIF PROJECT

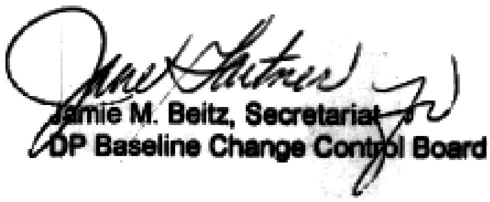
TO:

Leann Morrow, DOE Oakland (NIF) Baseline Change Control Board Secretariat

A Baseline Change Proposal BCP 97-004 for the NIF project was submitted to this office for processing. BCP 97-004 incorporated minor word changes to the "NIF Functional Requirements and Primary Criteria" which officially closes out BCP 97- 001 as directed by the Level 1 Baseline Change Control Board.

On this date, the Chairman approved the BCP

Should there be questions concerning the BCP I please contact me at (301) 903-3181 or D. Crandall at (202) 586-7349.



Attachment
cc:
A. Tavares, FM-20
D. Crandall, DP-10, ***wID*** **att T. Finn, DP-18,** ***wID*** **att**

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NATIONAL IGNITION FACILITY PROJECT LEVEL 2 -BASELINE CHANGE PROPOSAL RECORD OF DECISION

~ --
BCP NUMBER: 97-004

BCP TITLE: NIF Functional Requirements and Primary Criteria-Minor Wording Changes

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I Title: OAK ICF Program Manager Date

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DISPOSITION () Approved
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ENGINEERING CHANGE REQUEST WORKSHEET		
ECR No: 96	Date: 3/10/97	Title: Functional Requirements & Primary Criteria Minor Wording Changes

Submitted by:

Gary Deis, 2-7657

Technical baselines affected:
.Primary Criteria .Functional Requirements 0 Specificiations
0 Sub-system Design Requirements

NIF Project: NIF Project Office WBS Number: 1.1.5

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System Design Requirements
mterface Control DoCument
Dra~gs (see below)
Other

LRU effected: n/a WBS Number: n/ a

Detailed Description of Change:
i Miscellaneous changes received from DOE reviewers. Some typographical changes.
! Some changes to reflect completion of PElS ROD, and LLNL site selection. No project impact.

: Changes detailed in attached marked-up copy of FR/PC.

This ECR/BCP closes out the documention of the process for the development of the NIF Primary Criteria and Functional Requirements, see NIF-OOOO1566. Approval of this ECR/BCP will also approve Revision 1.6 of the NIF Primary Criteria and Functional Requirements.

Reason for change: Requested by DOE
! Cost Impact Summary: no cost impact Schedu e Impact Summary: no
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United States Government Department of Energy

memorandum

DATE:
REPLY TO
ATTN OF:

SUBJECT:

TO:

MAR 1 3 1997

Oakland Operations Office (ICFD)

Submittal of Baseline Change Proposals 97-004 for Levell Baseline Change Control Board Action I

David H. Crandall, DP-18

The NIF Baseline Change Proposal (BCP) 97-004 incorporates minor word changes to the "NIF Functional Requirements and Primary Criteria" whicr officially closes out BCP 97-001 as directed by the Levell Baseline Change Control Board (BCCB). The Level 3 and Level 2 BCCBs have unanimously endorsed the minor word changes in the BCP 97-004 and recommend that you approve and sign the enclosed document (NIF Functional Requirement and Primary Criteria, Revision 1.6).

Attached is a copy of the complete change proposal package, meeting minutes, and subsequent record of decision from the Level 3 BCCB. The Level 2 BCCB review notes and Record of Decision is also being forwarded you at this time.

If you have questions regarding the minor words changes in BCP 97-004, please contact me at (510) 423-0593.

ICFD

Samuelson

03/13/97

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Attachments

cc: Jane Gartner, DP-40 Arnold Epstein, DP-40 Joanne Wolfe, DP-41 Tom Finn, DP-18
Allen Levy, LLNL
Tim Gipe, FM-20 JeffPaisner, LLNL Jon Yatabe, LLNL

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Scott L. Samuelson Chairperson, Level 2, BCCB

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'Ur~ted States Government Department of Energy

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memorandum

DATE: REPLY TO
ATTN OF:

SUBJECT:

TO:

MAR 1 3 1991
Oakland Operations Office (ICFD)

Submittal of Baseline Change Proposals 97 -
j04 for Levell Baseline Change Control Board Action"

David H. Crandall, DP-18

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Attached is a copy of the complete change proposal package, meeting minutes, and subsequent record of decision from the Level 3 BCCB. The Level 2 BCCB review notes and Record of Decision is also being forwarded to you at this time.

If you have questions regarding the minor words changes in BCP 97-004, please contact me at (510) 423-0593.

Scott L. Samuelson

Chairperson, Level 2, BCCB

~

Attachments

cc: Jane Gartner, DP-40 Arnold Epstein, DP-40 Joanne Wolfe, DP-41 Tom Finn, DP-18
Allen Levy, LLNL
Tim Gipe, FM-20 JeffPaisner, LLNL
Jon Yatabe, LLNL

To:

From:

Subject:

Distribution

Leann Morrow, Level 2 BCCB Secretary

March 12, 1997, DOE/OAK NIF LeV1el 2 Baseline Change Control Board (BCCB) Review of the Baseline Change Proposal 97 -004 I

NIF Level 2 Board Member Participants

Scott Samuelson, Chairperson NIF DOE Field Manager

Walter Von Flue, Member
Director, Weapons Research Division

Kenneth Zahora, Member OAK NIF Project Engineer

John Gonzales, Member
Director, Engineering & Facilities Management

Jim Shakiba, Member
OAK ICF Program Manager

Leann Morrow, BCCB Secretary NIF Project Coordinator

Advisor Present
Charles Taylor ICFD/ES&H Manager

The DOE/OAK National Ignition Facility (NIF) Level :2 Baseline Change Control Board (BCCB) Chairperson elected to circulate and poll the members on their acceptance and endorsement of the minOl' word changes included in the Baseline Change Proposal (BCP) 97-004. Each Le'"el 2 BCCB Member and Advisor was given a copy of the minor word changes made to the "NIF Functional Requirements and Primary Crit ria' (Re,- 1.6). These minor word changes were recommended by the Levell CCB as part of the official action to close out BCP 97 -001 (December 118. 19 6). ~Iember5 were also provided a copy of the Level 3 BCCB documentati n and Record of Decision. After reviewing the proposed minor word changes all Level 2 BCCB Members and Advisor elected to endorse the BCP 9i -00-1 a d for',-ard to the Levell BCCB for acceptance and approval.

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Distribution:

Scott Samuelson, ICFD Chuck Taylor, ICFD Jim Shakiba, ICFD
Ken Zahora, ICFD
John Gonzales, EFM Walt Von Flue. WRD

",,-

NATIONAL IGNITION FACILITY PROJECT LEVEL 2 -BASELINE CHANGE PROPOSAL RECORD OF DECISION

BCP NUMBER: 97-004

BCP TITLE: NIF Functional Requirements and Primary Criteria-Minor Wording Changes

Kenneth R. Zahora 12-Mar-97

Title: NIF Project Engineer **Date**

3/13/97

Title: OAK ICF Program Manager **Date**

Title: Director. EFM

Date

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Title: Director. WRD Date

Title:

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Date

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( ) Directed Change

'--- MAR. 12. 1997

2:19PM

NO. 243

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NATIONAL IGNITION FACILITY PROJECT LEVEL 2 -BASELINE CHANGE PROPOSAL
RECORD OF DECISION

P.16

BCP ~1BER: 97-004 BCP TITLE: NIF Functional Requirements and PriDlary Critetia-Minor Wording Changes

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Title; Date

Title: Date

Title: Date

Chair~rson, 1-JIF DOE Field M~~

Date

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~ RECOMMEl'I1DATION

DISPOSITION

( )Approved ( ) Endorsgd ( ) Rejected
( ) DirectGd Change

I MEMBERS (Required) I l'RiCO:MMEN:QATION__-

I Title: OAK ICF Pro~!!!:.-- Mana,;er Date i

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Title: Director. EFM Date --

Title: Director, WRD Date

Title; ICFD ES&H Manager Date

Title:

D~~

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Lawrence Livermore National Laboratory

March 10, 1997
NIF-OOOI686
WBS 1.1.1

Mr. Scott L. Samuelson
U.S. Department of Energy
Oakland Operations office
Lawrence Livermore National Laboratory P.O. Box 808, L-293
Livermore, CA 94550

Dear Mr. Samuelson:

Subject:

BCP 97-004, NIF Functional Requirements and Primary Criteria-Minor Wording Changes

The Level 3 Baseline Change Control Board has approved BCP 97-004 which incorporates minor wording changes to the NIP Functional Requirements and Primary Criteria. This completes the action from the December 18, 1997 Levell BCCB to update the project criteria (97-001).

Rev. 1.6 of the NIF Functional Requirements and Primary Criteria is included for your approval.

The minutes of the Board review are attached.

Sincerely.

\'-::*#~~ () ;:2~~

Wfr~; A. Paisner
Project Manager
National Ignition Facilit)'

JAP:JMY:jlh
Attachments

cc:

D. Crandall, Chairman of Levell BCCB J. Gartner, Secretary of Levell BCCB
L. Morrow, Secretary of Level 2 BCCB

pr o/lnivpr.;//vnfC.1iifomia ° **PO** *Box 808 Livermore.* **CA** *94551.9900 ° Te'E':",one (5101422-1100 ° "'...x* **;:-:)-386-8339** *UCLLL LV~,11*

National Ignition Facility
Baseline Change Proposal
Request Form and Record of Decision

1. BCP number: 97-004 2. BCP title: Functional 3. Submitted by Requirements & Primary Criteria Gary Deis
(NIF Project ECR 96) Minor Wording Changes Phone #: 2-7657 Fax #: 4-5195

8. Change description: --~ -Scope ~ -Schedule M!! -Cost
Proposed changes to Functional Requirements and Primary Criteria, Revision 1.5, are detailed in Attachment 1. These are minor changes, primarily to reflect the selection of LLNL as the official NIF site, as a result of release of the ROD for the PElS.
This action also closes out the "conditional" status of the approval of BCP97-O01, by inco~orating final changes to the necessary and sufficient set of standards. Approval of this BCP results in approval of Revision 1.6 of the NIF Functional Requirements and Primary Criteria.

~.Jus-tilication and impact ot change (see worksheet)
There is no cost or schedule impact from the proposed changes. (No worksheet is required.)
10. Impact of not approving BCP
Presently, BCP97-OO1 has been "conditionally" approved, but the resulting revision, Rev 1.5, of the Functional Requirements and Primary Criteria has not been si~ed. If this BCP is not approved, the proposed changes would notoe made, and the new revision (Rev 1.6) would also not be approyed. This would require the approval of the previous revision, Rev 1.5, by DOE.

Record of BCCB decision

.Recor 0 B CB ecision ,., Pass BCCB decision ';;Ef Approved (see II) ~
0 Disapproved 0 BCCB
0 Returned for sDecific data

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3/10/97

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Date *a)0/77*

Level 2 Levell Level 0
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0 Routine 10 .Yes
.Priority .Levell 0 No
0 Level 2 Basis: fax comments from
DOE/OAK, and "conditional"
0 Level3 approvaL of BCP97-OOI

ENGINEERING CHANGE REQUEST WORKSHEET		
ECR No: 96	Date: 3/10/97	Title: Functional Requirements & Primary Criteria Minor Wording Changes

Submitted by:

Gary Deis, 2-7657

Technical baselines affected:
.Primary Criteria .Functional Requirements 0 Specificiations
0 Sub-system Design Requirements

INIF Project: NIF Project Office WBS Number: 1.1.5

0 0 0 0

System Design Requirements Interface Control Document
Drawings (see below)
Other

LRU effected: n/ a WBS Number: n/a

Detailed DescrIptIOn of Change: I
Miscellaneous changes received from DOE reviewers. Some typographical changes. Some changes to reflect completion of PElS ROD, and LLNL site selection. No project impact.

Changes detailed in attached marked-up copy of FR/PC

This ECR/BCP closes out the documention of the process for the development of the NIP Primary Criteria and Functional Requirements, see NIF-GOOO1566. Approval of this ECR/BCP will also approve Revision 1.6 of the NIF Primary Criteria and Functional Requirements.

Reason for c~~nK~~~ested by DOE I

Cost Impact Summary: no cost impact

Schedu~e ImpactSummary: no schedul~ imDact

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National Ignition Facility Project

***Mail Stop:* L-493**

***Ext:* 2-6115**

March 10, 1997
NIP-DOO1688
WBS 1.1.2

TO: Distribution I
FROM: JonYata~'J~--.l
SUBJECT: Minutes o~the March 10, 1997 NIP Level 3 Baseline Change Control Board (BCCB) Meeting

The Secretary of the Level 3 BCCB polled all of the voting members individually on March 10, 1997. Minor corrections to the NIP Functional Requirements were received from Allen Levy, Dave Rardin, and Mike Sorem. These were incorporated, and BCP 97-004 was approved unanimously.

JMY~lli/cy

Distribution:

Level 3 BCCB Members J. Boyes, SNL
J. Hunt, L-465
S. Kumpan, L-465
A. Levy, L-488
H. Lowdermilk, L-490 J. Paisner, L-488
D. Rardin, L-465
M. Sorem, LANL
J. Soures, UR/LLE

Copy to:
G. Deis, L-465

University Of California

III. Lawrence Livermore
~ National Laboratory

NIF-OOOIOO6-0C

National Ignition Facility Functional Requirentents and Prim.ary Criteria

Revision 1.6

March 1997

NIF

The National Ignition Facility

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Functional Requirments and Primary Criteria Revision 1.6

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NIF-OOOIOO6-0C

NIF Functional Requirements a;nd Primary Criteria
Rev. 1.6
Approval Sheet

NIP Project Manager

NIP DOE Field Manager

Director, Office of the National Ignition Facility

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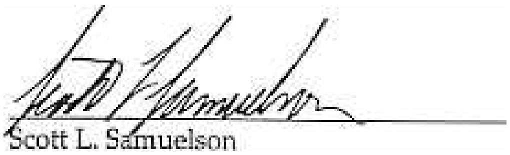
***a~f* Aaa~ner**

Lawrence Livermore National Laboratory



Oakland Operations Office

David H. Crandall Defense Programs

Functional Requirments and Primary Criteria Revision 1.6

NIF-OOOIOO6-0C

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Functional Requirments and Primary Criteria Revision 1.6

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Functional Requirments and Primary Criteria Revision 1.6

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1.0 Introduction

1.1 Objectives

This document establishes the scientific and engineering requirements that must be achieved by the National Ignition Facility (NIP). The process useq for developing these requirements is described in "Process for the Devel<l>pment of the NIP Primary Criteria and Functional Requirements," NIF-OOO1566, March 1997. Mission goals, as defined in the Justification of Mission Need, are translated into laser power, laser beam characteristics, and other performance specifications. Top-level operability, safety, and environmental requirements are defined and discussed. Finally, key requirements that must be met to satisfy Department of Energy (DOE) Orders, state, and federal regulations, national consensus standards and preferred procedures are highlighte~ to help ensure that they are incorporated by the design teams. I

1.2 Application

The Functional Requirements and Primary Criteria serves as a technical baseline for the project. Any modifications must be processed through the change control mechanism specified in the NIP Project Execution Plan and implementing procedures and formally approved. Each individual requirement or criterion has been placed in one of two hierarchy levels for control purposes. Those items which are Levell, Primary Criteria, are marked with either a single or double asterisk and are controlled by DOE Headquarters. Nonasterisked items are classified as Level 2, Functional Requirements, and are controlled by the NIF DOE Field Manager. The control of double-asterisk requiI;ements may be delegated to the NIP DOE Field Manager at some point in the future as part of the ongoing decentralization process.

1.3 Terms

The terms "should" and "shall" have important implications beyond what might be implied by common usage. "Shall" denotes a requirrment that is mandatory and must be met. "Should" denotes a nonmandatory recommendation or goal.

1.4 Site-Specific Requirements

These requirements are applicable to the LLNL s~te, selected by the DOE in the Record of Decision for the Programmatic Environmental Impatt Statement for Stockpile Stewardship and Management. i

I March 1997

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Functional Requirments and Primary Criteria Revision 1.6

NIF-OOOIOO6-0C

2.0 Mission-Related Requirements

The laser system shall be designed to meet the following requirements simultaneously, although all performance requirements need not be demonstrated simultaneously on a single event.

2.1 Laser

2.1.1 Laser Pulse Energy*
The laser shall be capable of routinely producing a temporally-shaped pulse of energy at least 1.8 million joules (MJ) incident on the entrance hole of the target hohlraum.

2.1.2 Laser Pulse Peak Power'"
The laser shall be capable of producing a pulse with peak power of at least 500 trillion watts (TW).

2.1.3 Laser Pulse Wavelength*
The wavelength of the laser pulse delivered to the target shall be 0.35 microns (J.Lm). The design should not preclude delivering 0.53 J.Lm and 1.05 J.Lm wavelength light to the target with reasonable modifications.

2.1.4 Beamlet Power Balance*
The rms deviation in the power delivered by the laser beams from the specified power shall be less than 8% of the specified power averaged over any 2 nanosecond (ns) time interval.

2.1.5 Beamlet Positioning Accuracy*
The rms deviation in the position of the cen.troids of all beams from their specified aiming points shall not exceed 50 micrometers (~m) at the target plane or its equivalent.

2.1.6 Laser Pulse Duration
The laser shall be capable of producing a pulse with overall duration of up to 20 ns.

2.1.7 Laser Pulse Dynamic Range
The laser shall be capable of delivering pulses to the fusion target with a dynamic range of at least 50:1, where the dynamic range is defined as the ratio of intensity at the peak of the pulse to the intensity in the initial"foot" portion of the pulse.

2.1.8 Capsule Irradiation Symmetry
Variations in the x-ray energy deposited on the fusion capsule, located in the target hohlraum, should be :52% rms. Current target design and performance calculations indicate that this level of irradiation uniformity can be achieved by two-sided laser illumination of the hohlraum. Multiple laser 1:leams on each side enter the hohlraum along two concentric cones with cone half-an~~les of approximately 27 degrees and 53 degrees, and with two-thirds of the beams on the outer cone and the remaining one- third on the inner cone. Each cone shall consist of 8 or more beams. The capability shall be provided for the pulse shape delivered by beams on the inner cone to be different from the shape delivered by those on the outer cone.

2.1.9 Prepulse Power
The laser intensity delivered to the target during the 20-ns interval prior to arrival of the main laser pulse shall not exceed 108 W / cm.2.

2.1.10 Laser Pulse Spot Size
Each beam shall deliver its design energy ,md power encircled in a 600 ~ diameter spot at the target plane or its equivalent. In thle appropriate configuration, each beam should deliver 50% of its design energy and power encircled in a 100 J.Lm diameter spot at the target plane or its equivalent.

2.1.11 Beam Smoothness

The NIP shall have spatial and temporal beam conditioning to control intensity fluctuations in the target plane.

2.1.12 Direct-Drive Requirements*

Future upgrade to meet the following requirements, specific to direct-drive experiments, shall not be precluded in the baseline NIP design.

2.1.12.1 Direct-Drive Irradiation Symmetry. Direct-drive ICF targets shall be irradiated by three pairs of concentric cones, ~vith midplane symmetry. The cone half- angles and number of beams on each cone shall be:

Direct-drive cone	Cone half-angle (approximate)	Fraction of total beams
Inner	same as indirect drive	1/6
Outer	same as indirect drive	1/3
Waist	75 degrees	1/2

2.1.13 Beam Focusing and Pointing

The NIP should have flexibility in beam focusing and pointing to address the needs of radiation effects testing and other users.

2.2 Experimental Area

The National Ignition Facility shall be opE!rated in a manner consistent with its role as a national resource. Whenever possible, th,e design shall accommodate the requirements of users with diverse needs. The baseline facility design shall not preclude future addition of target chambers for additic)nal weapons physics and/or radiation effects testing. The baseline design and operation should be capable of performing radiation effects testing of important national assets, up to system level components, to maintain and certify their reliability. The following requirements .are intended to satisfy the most basic of these needs.

2.2.1 ICF Target Compatibility*

The target chamber and target area support systems shall be capable of target operations with both cryogenic and noncryog;enic targets containing fusion fuel. Provisions shall be made to accommodate and support experimenter-supplied cryostats for cryogenic targets.

2.2.2 Annual Number of Shots with Fusion Yield for Chamber Design*

The NIF shall be capable of performing yi~~ld shots with total DT fusion yield of 1200 MJ / year. The NIF shall be capable of perfomling up to SO shots per year with a routine DT fusion yield of 20 MJ. The NIF design shall provide for life-cycle-cost-effective future addition of components that are needed only for high yield operations and are therefore not needed in the first three to five),ears of operations, such as shield doors and decontamination equipment.

2.2.3 Maximum Credible DT Fusion Yield*

The target chamber shall be designed based on routine DT fusion yield of 20 MJ *f* with the capability to withstand a DT fusion yield produced by a single shot of up to 45 MJ (a 45 MJ yield corresponds to 1.6 x 1019 neutrons).

2.2.4 Classification level of Experiments*

The facility shall be designed to allow botl.1 classified (at the SRD level) and unclassified experiments. Its design should permit changing classification levels with minimal impact on operations and cost.

2.2.5 Target Positioner

The target positioner shall be capable of placing and holding targets within 3 cm of target chamber center, with accuracy, repeatability, and stability consistent with the relative laser/target alignment specified in Section 2.1.5 and operations specified in Section 2.2.1.

2.2.6 Time Between Shots with No Fusion 'Y'ield

To address the needs of indirect-drive, direct-drive, and other users, the laser and experimental area shall be capable of conducting no fusion yield experiments with a

time between shots of 8 hours, with a goal of 4 hours.

2.2.7 Target Chamber Vacuum Capability

The target chamber shall be capable of achieving a vacuum level of <1 x 10-5 Torr.

2.2.8 Diagnostic Instrument Capabilities to Verify Laser Performance

The facility shall have the following measurement capabilities that are required to verify the Primary Criteria and Functional RE~quirements:

- .Laser pulse energy and power.
- .Laser pulse duration and dynamic range.
- .Laser beam power balance.
- .Simultaneity of arrival of pulses from :individual beamlines at target chamber center with 10 ps accuracy.
- .Laser beam pointing accuracy with 10--20 micron spatial resolution.
- .Laser prepulse intensity.
- .Laser pulse spot size.
- .Laser pulse smoothness.
- .Laser beam thermal recovery time.

2.2.9 Diagnostic Instrument Capabilities foJ[Ignition and Applications Experiments The target chamber and area shall be capable of accommodating diagnostic

instruments for the following measurements necessary for fusion ignition and applications experiments:

- .Symmetry of x-ray emission from imploded cores with 5- to 10-micron spatial resolution.
- .Motion of the x-ray emitting volumes in hohlraums with 20 micron spatial resolution.
- .Laser light backscattered into the focu~;ing lens.
- .Radiation flux out of hohlraums withiI.1 the photon energy range 0.15-2.5 keY with 100-ps time resolution and 20% accuracy.
- .Strength of radiation driven shocks with 5- to 10-micron resolution and time resolution of 10 ps.
- .Fusion yield over a range from 1011 to 1019 neutrons.
- .Symmetry of neutron emission from imploded cores with 20-micron spatial resolution.
- .Temperature of the compressed fusion fuel with 20% accuracy for ion temperatures of 2 keY or greater.
- .Number and energy distribution of fast electrons in hohlraums in the band from 5 ke V to 300 ke V .
- .Radiation flux out of hohlraums withi11 th2 photon energy range 2.5-100 keY with 20% accuracy.

2.2.10 Removal and Replacement of Diagno,stic Instruments*

Rapid removal and replacement of diagnostic instruments consistent with the shot frequency specified in Section 2.2.6 shall be accomplished by diagnostic inserters and manipulators for close-in target diagnostics.

2.2.11 Personnel Access Inside the Target Chamber*

Personnel access to the inside of the target chamber shall be consistent with requirements for periodic cleaning necessary to maintain

radiological, low-hazard, non- nuclear operations and for inspection and maintenance consistent with operational requirements.

2.2.12 Distributed Laser Plasma Radiation Source Compatibility*

The NIP should provide the basic capability to allow laser irradiation of distributed target arrays with future upgrade. The target chamber should allow flexibility in beam dump placement.

3.0 Safety Requirements**

The NIF shall be designed, constructed, and operated as a radiological low-hazard facility. Compliance with this classification shall be verified through a Preliminary Hazard Analysis assessment of bounding accidents involving those radionuclides and/ or chemicals presenting the most significant hazards (see DOE Order 5481.1B, Safety Analysis Review System). Administrative controls shall be established prior to the first use of tritium-bearing targets to *ensure* that inventory limits for a low-hazard radiological facility are not exceeded.

3.1 Radiation Protection*

Collective and individual ionizing radiation doses to the public from all exposure pathways from the NIF shall meet the requirements of DOE Order 5400.5, Radiation Protection of the Public and the Environment, and 40 CFR 61, National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities. These requirements state th,lt exposure of members of the public from emissions of radionuclides in the ambient air J:rom normal NIF operations shall remain below 10 mrem/y. The facility shall also meet the requirements of DOE Order 5400.5 to not cause the public dose from all exposure modes and all sources of radiation at the site boundary to exceed 100 mrem/y.

The NIF personnel radiation protection program shall follow DOE Order N441.2 Radiation Protection for Occupational Workers and 10 CFR 835, Occupational Radiation Protection. The ALARA (as low as reasonably achievable) principle shall be utilized in both design and operation of the facility to eliminate unnecessary radiation dose to workers in the Laser and Target Area Building, collocated employees, and visitors from both routine and off-normal operations. Radiation protection shall include: shielding; control of workplace ventilation; monitoring of personnel for external and internal radiation dose; establishment of a routine contamination monitoring program including air monitoring; and the proper containment of radiation and radioactive materials.

The radiation shielding design limit the maximum doses to an individual worker to one- tenth (shielding design goal) of the occupational external dose limits specified in 10 CFR 835. Concrete shielding shall comply with ACI 301, which provides adequate strength for DBE loads.

The requirements for radiological safety in 10 CFR 835, Occupational Radiation Protection,_should be evaluated by the designers and incorporated when they are determined to be cost effective, even though the projected in\'entory of tritium in NIF (-0.05 g or 500 Ci) is well below the threshold for a nuclear facility. The target chamber and tritium processing systems shall form the primary confinem~nt barrier. Leakage past these barriers shall be ALARA. The experimental-area ventilation system shall be designed to operate at negative pressures during and immediately after shots of greater than one megajoule and provide secondary tritium confinement.

The final exhaust release point from this system should be elevated for dispersion. Exhaust air shall be continuously monitored for radioactivity. The target area shall also be monitored to ensure that radiological conditions are safe for personnel entry.

3.2 Life Safety**

The NIF shall fully comply with the requirements for life safety contained all National Fire Protection Association (NFP A) Codes. Particular focus shall be directed towards features related to the means of egress, such as protection of vertical openings, travel distances, capacities, and emergency lighting.

3.3 Laser Safety*

The laser safety shall comply with ANSI 2136.1. Exposure to hazardous levels of laser light shall be prevented by the use of physical barriers, personnel training, interlocks, and personnel entry controls. Protective equipment, such as laser goggles, shall be used when necessary for operational purposes. Interlock systems shall be dedicated and designed to be fail-safe and shall activate laser shutters or shut off power to laser systems if access doors are opened and hazardous exposures are possible.

Industrial Hygiene and Occupational Safety*

Industrial hygiene and occupational safety shall comply with 29 CFR 1910 Occupational Safety and Health Act (OSHA) -Operation. Construction safety shall comply with the requirements of 29 CFR 1926, OSHA- Construction.

Facility subsystems (e.g., capacitor banks, vacuum systems, tritium recovery, nitrogen supply, and personnel safety interlock systems) shall be designed to default to a safe state upon loss of power.

Fire Protection*

The NIP shall meet the design and fire protection requirements, all NFP A Codes and the Uniform Building Code (UBC). The structural members of the Experimental Building (including exterior walls, interior bearing walls, columns, floors, roofs, and supporting elements) shall, as a minimum, meet UBC fire-resistive standards. Appropriate fire barriers shall be provided to limit property damage, fire p~opagation, and loss of life by separating adjoining structures, isolating hazardous areas, and protecting egress paths. The NIF shall meet the requirements for an " improved risk" level of fire protection sufficient to attain DOE objectives. To achieve this level of protection, automatic fire sprinklers shall be installed throughout the complex. The sprinklers shall be coupled with adequate fire protection water supplies and automatic and manual means for detecting and reporting incipient fires. Fire hazard analyses will be completed as required by all NFP A Codes.

3.6 Robotic Systems Safety

Robotic systems shall comply with the requirements of ANSI/RIA R15.06-1992; Industrial Robots and Robot System-Safety Requirements.

4.0 Environmental Protection

4.1 Waste Management**

The NIF shall minimize the generation of wastes at the source per: DOE Policy P450.1, Environmental Safety and Health Policy for the Department of Energy Complex, General Environmental Protection Program, and DOE Order 5820.2A, Radioactive Waste Management; and the Resource ConseI.'Vation and Recovery Act (USC 6901 to 6992); and the Toxic Substances Control Act (lJSC 2601-2692). The NIP waste handling areas shall comply with the standards of confinement and ventilation requirements specified by DOE Order 5820.2A, Radioactive Waste Management.

The NIF will generate hazardous waste, low-level radioactive waste (LLW), and mixed (LL Wand hazardous) waste. These wastes shall be collected in approved containers, labeled, packaged, sorted, and shipped to an EP A/DOE-approved treatment or disposal site according to the Resource Conservation Recovery Act and the following regulations: hazardous waste per 40 CFR 260, 261 and 262; low-level waste per DOE Order 5820.2A; and mixed (LLW and hazardous) waste per DOE Order 5820.2A, and 40 CFR 260. The LL W packages shall meet the radioactive solid waste acceptance criteria of the final approved disposal site. Pollution prE~vention will be considered in the NIP design as required by DOE Order 430.1.

4.2 Effluents*

Liquid effluent discharges from NIP discharge points shall be monitored and controlled in compliance with 10 CFR 835, DOE Order 5400.5, Radiation Protection of the Public and the Environment; the Clean Water Act (33 U.S,C. 1251 et seq.); and by conditions on 40 CFR 125 Criteria and Standards for National Pollutant Discharge Elimination System.

Air emissions shall meet the requirements of Section 3.1 (radiation shielding and confinement) for radionuclides and the requirements of the Clean Air Act, (42 U.S.C. 7401) including National Emission Standards for Hazardous Air Pollutants (NESHAP), and state and local air quality management district requirements.

5.0 Safeguards and Security**

The NIP safeguards and security features shall meet the requirements of DOE Order 5632.1C, Protection of Safeguards and Security Interests, and DOE Order 470.1, Safeguards and Security Program. These requirements include physical protection of classified data and equipment and items in use and in storage. For the facility security areas and access control, requirements shall be established based on the nature of experiments (i.e., classified or unclassified) being performed. The limited areas shall be the target area, target receiving and inspection, final target alignment, classified data acquisition, and office areas where classified computing.is performed. Automated Data Processing (ADP) systems handling classified information shall meet the requirements of DOE Orders 5637.1, Classified Computer Security Program, and 5300AD, Telecommunications: Protected Distribution Systems. Elements of DOE Orders 470.1, Safequards and Security Program, and 472.1, Personnel Security Activities, will also be incorporated into the security plan.

The NIP complex shall also meet the requirements for physical protection of DOE property and unclassified facilities, protection program operations, and personnel security, including issuance, control, and use of badges, passes, and credentials.

Because the continuous operation of the NIP is not required to prevent adverse impacts on national security or the health and safety of the public, it is not classified as a vital facility, per DOE Order 5632.1C.

6.0 Building Systems

6.1 Design Life Requirements

The LTAB and the Optics Assembly Building (GAB) represent the only newly constructed facilities at LLNL. The NIP facilities shall be designed for at least 30 years design life for permanent structures. Systems or portions of systems for which that is impractical shall be designed for ease of replacement. Ease of replacement means that replacement is feasible at reasonable cost and can be accomplished in a timely manner consistent with plant availability requirements. "Replacement" here also includes removal, refurbishment, and reinstallation of ~Jriginal equipment.

The performance category for target area and laser structural systems shall be category 2 with a graded approach for other systems.

Where alternative designs and modes of construction are possible at essentially equivalent cost, the design and construction method that most readily allows for future reconfiguration and modification should be selected.

6.2 Vibration Requirements

Certain facilities or areas within facilities will house vibration-sensitive special equipment. The structural design of these areas shall pro\ide means to effectively isolate this equipment to control vibration within specified displacement and rotation requirements. Specific constraints are specified in the System Design Requirements for NIP Facilities.

6.3 Cleanliness Requirements

The laser bays, experimental areas, and optical assembly rooms must be dust free to prevent laser damage to the optics. Specific constraints are specified in the System Design Requirements *for* NIP Facilities.

6.4 Temperature Control

Temperatures in the laser bays experimental areas must be controlled in order to maintain a stable laser alignment. Specific constraints are specified in the System Design Requirements.

6.5 Electrical Power

Electric power shall be installed in accordance with NFP A 70, which includes details from the National Electrical Code; IEEE 493, Recommended Practices for Design of Reliable Industrial and Commercial Power Systems; and ANSI C2, the National Electrical Safety Code.

6.5.1 Voltage Quality

Voltage shall be maintained in compliance with ANSI C84.1, Electrical Power Systems and Equipment-Voltage Rating (60 HZ). Electrical supply systems shall operate within the limits specified for Range A of this specification. Voltage occurrences outside these limits should not exceed the Range B limits. These variances should be limited in extent, frequency, and duration. Computers shall be protected with low voltage dropouts requiring manual restart.

6.5.2 Standby Power

Standby power shall be available for healttl, life, property, and safeguards and security loads, including emergency egress lighting, fire alarms and sensors, security systems, and radiation monitors. Power for safety and security functions shall be installed and operated according to NFP A 101, the Life Safety Code; ANSI/NFP A 110- 1993, the Standard for Emergency and Standby Power Systems; NFP A 72, National Fire Alarm Code; and other applicable NFP A and OSHA standards.

6.5.3 Uninterruptible Power
Uninterruptible power systems (UPS), are not required for the NIP facilities or special equipment.

7.0 Operational Availability

User demands for shot time are expected to be high, therefore, the facility shall be designed for maximum reasonable availability and rapid recovery from unplanned shutdowns.

7.1 Reliability, Availability and Maintainability (RAM)*

The components, systems, and processes that limit overall facility availability shall be identified during the design process through analyses of turnaround times, mean times between failures, mean times to repair, preventive maintenance requirements, etc. Techniques such as in-site backups, on-hand spares, modular components, on-call maintenance forces, and more robust designs shall be used to increase availability if the following goals cannot otherwise be achieved:

- **.The facility shall be available for three shift operations at least 253 days per year (73% availability).**
- **.The facility shall be available for at least 616 no-yield target shots per year. To address, the possible future needs of direct-drive and other users, the design should not preclude an increase in the availability to approximately 1200 total shots per year. The project shall provide the initial set of maintenance equipment, consisting of at least one unit of each piece of equipment that is required to maintain and operate NIP. Future addition of more units of maintenance equipment shall not be precluded. Continuous high-availability NIP operation, as defined above, may require future additional units of maintenance equipment.**
- **.The lasers shall perform within specification (e.g., laser energy, beam balance, pointing accuracy) on at least 80% of all shots.**

The project should also use this RAM process to determine how to achieve availability in the most cost-effective manner, to determine what spares in what quantities should be kept in inventory, to optimize turnaround procedures, to plan preventive maintenance and inspection programs, and to respond to unscheduled outages.

7.2 Recovery Time*

Because of its importance to the DOE, the NIP shall be designed to survive any abnormal event, including accidents and natural phenomena, expected to occur more frequently than once in 2000 years. The time required to recover from such events is allowed to vary in accordance with the probability of occurrence. Maximum recovery times are specified below.

Probability of Occurrence Per Year, P	Maximum Recovery Time
P = 1	24 hours
$1 > P \geq 10^{-2}$	1 week
$10^{-2} > P \;\; 5 \times 10^{-4}$	3 months for laser, target, and associated building structures 6 months for support systems

The probabilities of occurrence listed in DOE-Sill-1O20-94 and DOE-Sill-1O21-93 shall be utilized for natural phenomena.

Standby power shall be available to preserve process continuity in cases designated by the NIF Project and specified in the System Design Requirements. Neither uninterruptible power systems nor standby power is required for the computer systems. .

8.0 Decontamination and Decommissioning

The NIP design shall meet the site-specific requirements. The NIF shall be designed for periodic cleaning of the interior of the test chamber to maintain tritium levels on interior surfaces as low as reasonably achievable. The NIF design shall include considerations that will allow for cost-effective future decommissioning of the structures and equipment.

A plan for NIP Decontamination and Decommissioning (D&D) shall be developed in accordance with DOE Order 5820.2A, Radioactive Waste Management. A D&D assessment shall be made during conceptual design to ensure that features and measures are incorporated in NIP to simplify D&D. The NIP D&D plan will be prepared before the end of the Title n design.

9.0 Quality Assurance**

The NIP Quality Assurance Program shall meet the requirements of DOE Order 5700.6C, Quality Assurance. As specified in this DOE Order, a graded approach using quality levels based on risk assessment shall be spelled out in the NIP Quality Assurance Program Plan and utilized throughout the project. The QA Program Plan shall cover all aspects of the NIP Project in a phased implementation, beginning with conceptual design.

10.0 Orders, Codes, and Standards

10.1 DOE Orders*

The NIP shall be designed and constructed in full compliance with DOE Orders and federal regulations. Exceptions shall be limited to those cases where the project has formally requested and been granted either an exemption or a finding of equivalency by Headquarters.
It is recognized that updates and additions to DOE Orders, federal regulations, and consensus industry standards are outside of the control of the project team and are a frequent source of cost and schedule growth. These requirements are all frozen as of March 1, 1996.

10.2 Codes and Standards

Technical codes, standards, and guides promulgated by nationally recognized organizations should be utilized by the NIF Project whenever available and practical, per DOE Order 1300.2A. A partial listing of nationally recognized organizations is included in the following sections. Additional references identified during the developmental phases shall be formally cited and controlled in system and subsystem design requirements documents and specifications through the Project Change Control Process.

10.3 Applicable Orders, Codes, and Standards

This section lists DOE Orders, codes, and standards in effect on March 1, 1996, that are considered to be applicable to the NIF Project. The listing begins with DOE and other federal regulations (e.g., Resource Conservation and Recovery Act), and is followed by a partial listing of_national consensus standards organizations. The applicable portions of these documents will apply.

10.3.1 DOE Orders

.1300.2A -Technical Standards Program
.5300.4D -Telecommunications: Protected Distribution System
.5400.1- General Environmental Protection Program
.5400.5 -Radiation Protection of the Public and the Environment
.5480.19 -Conduct of Operations
.5481.1B -Safety Analysis and Review System (for non-nuclear facilities and hazards only)
.5632.1C -Protection of Safeguards and Security Interests
.5633.3B -Control and Accountability of Nuclear Material

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5637.1- Classified Computer Security Progr m
5700.6C -Quality Assurance
5820.2A -Radioactive Waste Management
151.1 -Comprehensive Emergency Manage ent System
430.1 -Life Cycle Asset Management
N441.2 -Radiological Protection for DOE Ac vities
P450.1- Environment, Safety and Health Po cy for the Department of Energy Complex
470.1- Safeguards and Security Program
471.2 -Information Security Program
472.1- Personnel Security Activities

10.3.2 Other Government RegUlationS

~ JC; .10 CFR 835 -Occupational Radiation Protecti n
.10 CFR 20 -Standards for Protection Against Radiation
.29 CFR 1910 -Occupational Safety and Heal Act (OSHA) -Operation .29 CFR 1926 -Occupational Safety and Heal Act (OSHA) -Construction .40 CFR 125 -Criteria and Standards for NPD S (National Pollutant Discharge Elimination System)
.40 CFR 260,261,262 -Hazardous Waste Man gement System
.40 CFR 61 Subpart H -National Emission St dard for Emissions of Radionuclides other than Radon from Depa ent of Energy Facilities
.FED-Sill-209E -Airborne Particulate Clean!. ess Classes in Cleanrooms and Clean Zones
.33 USC 1251 et seq. -Clean Water Act
.42USC 7401- Clean Air Act
.42 USC 4321 et seq. -NEPA (National Enviro ental Policy Act)
.40 USC 6901-6992 -Resource Conservation a d Recovery Act (RCRA) .15 USC 2601-2692 -Toxic Substance Control ct

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~ 10.3.3 National Consensus Standards :!'

The NIP Project shall comply with the following ational consensus standards, as noted elsewhere in this document: !
-ACI 301 -1996, Specifications for Stru ral Concrete for Buildings
-ANSI C2 -1993, National Electric Code
-ANSI C84.1-1989, Electrical Power Syst ms and Equipment-Voltage Rating (60 HZ)
-ANSI Z136.1 -1993, Laser Safety
-ANSI/RIA R15.06 -1992, Industrial Rob ts and Robot System-Safety Requirements
-DOE-STD-1020-94, Natural Phenomena azards Design and Evaluation Criteria for DOE Facilities
-DOE-STD-1021-93, Natural Phenomena azards Performance Categorization Guidelines for Structures, Systems, & C mponents.

-IEEE 493 ~990, IEEE Recommended Pr,ctice for the Design of Industrial and CommercIal Power Systems
I -All *NFP* A Codes
.-NFPA 701996, National Electric Code I.
-NFPA 721993, National Fire Alarm Cotie
-NFPA 1011994, Code for safety to Life from Fire in Buildings and Structures -ANSI/NFP A 110-1993, Standard for E~ergency and Standby Power Systems -Uniform Building Code (UBC) 1994 I
Orders, standards, and codes listed as mandatorY in DOE Orders are not necessarily referenced in this list. I

In addition to complying with these specific starldards, the NIP Project shall utilize applicable and appropriate national consensus cod~s and standards in the design, procurement, fabrication, installation, construction; inspection, and testing of structures, systems, and components, per DOE Order 1300.2A.i Codes, standards, and guides of recognized technical and professional organizations, such as those in the following list, shall be applied as appropriate to NIP materials and workmanship:

AA
AASHTO ABMA
ACI ACGIH
AISC
AISI ' AMCA
ANSI
APA
ARI ARMA ASCE ASHRAE

ASME
ASTM
AWS AWWA BHMA CISCA CGA CMAA CRSI EPRI FM

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Aluminum Association
American Association of State Highway Officials
American Boiler Manufacturers ~sociation
American Concrete Institute
American Council of Government Industrial Hygienists
American Institute of Steel Construction
American Iron and Steel Institute
Air Movement and Control Association
American National Standards Institute
American Plywood Association I
Air Conditioning and Refrigeratipn Institute
Asphalt Roofing Manufacturers Association
American Society of Civil Engine,ers
America~ Society of Heating, ~efrigerating & Air Conditioning Engmeers
American Society of Mechanical :f:ngineers
American Society for Testing and Materials
American Welding Society I
American Water Works Associat,on
Builders Hardware Manufacturers Association
Ceiling and Interior Systems Cor~tractors Association
Compressed Gas Association
Crane Manufacturers AssociatioJ of America
Concrete Reinforcing Steel Insti~te
Electric Power Research Institute
Factory Mutual Engineering and IResearch20 20

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GA Gypsum Association !
ICBO International Council of Building Officials (Uniform Building Code) ICEA Insulated Cable Engineers Association
IEEE Institute of Electrical and Electronics Engineers
IES Illuminating Engineering Societ}f of North America

ISA Instrument Society of America
NAPHCC National Association of Plumbing, Heating, & Cooling Contractors NCMA National Concrete Masonry Association
NEC National Electric Code (NFP A)

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NEMA National Electrical Manufacturers Association.
NIOSH National Institute for Occupatiorlal Safety and Health
NIST National Institute of Standards and Technology
NFPA National Fire Protection Standar~s
RFCI Resilient Floor Covering Institut
i SDI Steel Deck Institute
SDI Steel Door Institute
SMACNA Sheet Metal & Air Conditioning ~ontractors National Association SSPC Steel Structures Painting Council
sn Steel Tank Institute I
SWI Steel Window Institute >1
TCA Tile Council of America
nMA Thermal Insulation Manufacturets Association
UL Underwriters Laboratories

11.0 Revision Record

~ ~ BCP# Descri~tion of/Reason for Change
1.3 r 3/94 n/a CDR release
***A/l/96* 96-004 Directed changes in DOE Orders and Federal Regulations. Miscellaneous changes throughout document**
I F~~ti~~;lity Cfianges to the NIP Baseline. Changes include the addition *qf:* optic assembly capability, beam smoothing, flashlamp cooling, 4x2 amplifiers, not-tb-preclude direct drive, not-to- preclude radiati?n effects testing, and laser spot

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! Engineering Option Studies:-mcreasedShot rate and full implementation of direct drive.
Title I Upd~te of Functional Requirements/Primary
Criteria. Chang~s to incorporate results of Title I design and design review, update of DOE Orders
: and standards, and miscellaneous changes
I Typographical changes and minor wording changes to refledt completion of ROD and final incorporation oflNecessary and Sufficient Standards,

96-005

96-006

97-001 I 97-002

97-004

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National Ignition Facility Functional Requirements and Primary Criteria

Revision 1.~~6~~5

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Functional Requirments and Primary Criteria Revision 1.2;5

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NIF Functional Requirements a~d Primary Criteria
Rev. 1.25
Approval Sheet

NIP Project Manager

NIP DOE Field Manager

Director, Office of the National Ignition Facility

Jeffrey A. Paisner
Lawtence Livermore National Laboratory

Scott L. Samuelson Oakland Operations Office

David H. Crandall Defense Programs

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6.0 Building Systems ! 6.1 Design Life Requirements I 6.2 Vibration RequIrements r 6:3 <;:leanliness Requirements f 6.4 Temperature Control r 6.5 Electrical Power f 6.5.1 Voltage Quality 1 6.5.2 Standby Power] 6.5.3 Uninterruptible Power 7.0 Operational Availability =:.j':..; "'." '.'
7.1 Reliability, Availability and Maintainability (KAM)* 7.2 Recovery Time* ' 1' ,.",..,..,... 8.0 Decontamination and Decommissioning '1" '...
9.0 Quality Assurance** 10.0 Orders, Codes, an*d Standards '...' "1"" 10.1 DOE Orders 10.2 Codes and Standards 1 10.3 Applicable Orders, Codes, and Standards
10.3.1 DOE Orders 10.3.2 Other Government Regulations 10.3.3 National Consensus Standards

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Functional Requirments and Primary Criteria Revision ***1.[i5-***

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1.0 Introduct1on

1.1 Objectives

This document establishes the scientific and en .eering requirements that must be achieved by the National Ignition Facility (NIP). Th rocess used for de,'"elo in the re uirements is described in "Process for the Oevel ment of the NIP Prima Criteria and Functional Re uirements" NIF-OOO1566 March 19 7. Mission goals, as defined in the Justification of Mission Need, are translated into las r power, laser beam characteristics, and other performance specifications. Top-level operabi ity, safety, and environmental requirements are defined and discussed. Finally, ke requirements that must be met to satisfy Department of Energy (DOE) Orders, state, and fed ral regulations, national consensus standards and preferred procedures are highlighte to help ensure that they are incorporated by the design teams.

1.2 Application

The Functional Requirements and Primary (rite ia serves as a technical baseline for the project. Any modifications must be processed throu h the change control mechanism specified in the NIP Project Execution Plan and imp ementing procedures and formally approved. Each individual requirement or criterion as been placed in one of two hierarchy levels for control purposes. Those items which are evell, Primary Criteria, are marked with either a single or double asterisk and are controlled y DOE Headquarters. Nonasterisked items are classified as Level 2, Functional Requirem nts, and are controlled by the NIF DOE Field Manager. The control of double-asterisk requi

ements may be delegated to the NIP DOE Field Manager at some point in the future as part of the ongoing decentralization process.

1.3 Terms

The terms "should" and "shall" have important

fmPliCatiOnS beyond „"hat might be implied by common usage. "Shall" denotes a requir ment that is mandatory and must be me
"Should" denotes a nonmandatory recommendatio or goal.

1.4 Site-Specifi{ Requirements

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1.0 Introduction

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that is mandatory and must be met. *IIShouldll* denotes a nonmandatory recommendatio or goal.

1.4 Site-Specific Requirements

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2.2 Experimental Area

The National Ignition Facility shall be operated iin a manner consistent with its role as a national resource. Whenever possible, the design shall accommodate the requirements of users with diverse needs. The baseline facility design shall not preclude future addition of target chambers for additional weapons physics and/ or radiation effects testing. The baseline design and operation should be capable of performing radiation effects testing of important national assets, up to system level components, to maintain and certify their reliability. The followinglrequirements,are intended to satisfy the most basic of these needs. ,

2.2.1 ICF Target Compatibility*
The target chamber and target area support systems shall be capable of target operations with both cryogenic and noncryogenic targets containing fusion fuel. Provisions shall be made to accommodate and suPRort experimenter-supplied cryostats

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for cryogenic targets. I

2.2.2 Annual Number of Shots with Fusion Yield for Chamber Design*
The NIP shall be capable of performing yield shots with total DT fusion yield of 1200 MJ / year. The NIP shall be capable of performing up to 50 shots per year with a routine DT fusion yield of 20 MJ. The NIP design shall provide for life-cycle-cost-effective future addition of components that are needed only for high yield operations and are therefore not needed in the first three to five years *of* operations, such as shield doors and decontamination equipment. ;

2.2.3 Maximum Credible DT Fusion Yield* ii
The target chamber shall be designed based on rbutine DT fusion yield of 20 MJ, with the capability to withstand a DT fusion yield produced by a single shot of up to 45 MJ (a 45 MJ yield corresponds to 1.6 x 1019 neutrOns).

2.2.4 Classification level of Experiments* !
The facility shall be designed to allow both classified (at the SRD level) and unclassified experiments. Its design should permit changing classification levels with minimal impact on operations and cost. I

2.2.5 Target Positioner
The target positioner shall be capable of placing find holding targets within 3 cm of target chamber center, with accuracy, repeatability, and stability consistent with the relative laser/target alignment specified in Section 1.1.5 and operations specified in Section 2.2.1. I

**2.2.6 Time Between Shots with No Fusion Yield **
To address the needs of indirect-drive, direct-dri~e, and other users, the laser and experimental area shall be capable of conducting nol fusion yield experiments with a time between shots of 8 hours, with a goal of 4 hours.

j '" 2.2.7 Target Chamber Vacuum Capability :;.'1

The target chamber shall be capable of achiev. g a vacuum level of <1 x 10-5 Torr.

2.2.8 Diagnostic Instrument Capabilities to Veri' Laser Performance

The facility shall have the following measurem t capabilities that are required to verify the Primary Criteria and Functional Require ents:

.Laser pulse energy and power.
.Laser pulse duration and dynamic range.
.Laser beam power balance.
.Simultaneity of arrival of pulses from indivi ual beamlines at target chamber center with 10 ps accuracy.
.Laser beam pointing accuracy with 10-20 spatial resolution.
.Laser prepulse intensity.
.Laser pulse spot size.
.Laser pulse smoothness.
.Laser beam thermal recovery time.

2.2.9 Diagnostic Instrument Capabilities for Igni 'on and Applications Experiments

The target chamber and area shall be capable of accommodating diagnostic instruments for the following measurements neces ary for fusion ignition and applications experiments:

.Symmetry of x-ray emission from imploded ores with 5- to 10-micron spatial resolution. I
.Motion of the x-ray emitting volumes in ho~raums with 20 micron spatial resolution. I
.Laser light backscattered into the focusing Ie s.
.Radiation flux out of hohlraums within the hoton energy range 0.15-2.5 keY with 100-ps time resolution an 20% accuracy.
.Strength of radiation driven shocks with 5- t 10-micron resolution and time resolution of 10 ps.
.Fusion yield over a range from 1011 to 1019 eutrons.
.Symmetry of neutron emission from implod d cores with 20-micron spatial resolution.
.Temperature of the compressed fusion fuel ith 20% accuracy for ion temperatures of 2 keY or greater.
.Number and energy distribution of fast elec ons in hohlraums in the band from 5 ke V to 300 ke V .
.Radiation flux out of hohlraums within the hoton energy range 2.5-100 keY with 20% accuracy.

2.2.10 Removal and Replacement of Diagnostic I struments*

Rapid removal and replacement of diagnostic' struments consistent with the shot frequency specified in Section 2.2.6 shall be accomplished by diagnostic inserters and manipulators for close-in target diagnostics.

2.2.11 Personnel Access Inside the Target Chamber*

Personnel access to the inside of the target chafi1ber shall be consistent with require~ents for periodic cleaning necessary to maintain radiological, low-hazard, non- nuclear operations and for inspection and mainten4nce consistent with operational requirements.

2.2.12 Distributed Laser Plasma Radiation Source: Compatibility*

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The NIF should provide the basic capability to allow laser irradiation of distributed target arrays with future upgrade. The target chamber should allow flexibility in beam

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dump placement. I

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3.0 Safety Requirements**

The NIP shall be designed, constructed, and op rated as a radiological low-hazard, :"'.9R:"'.ueleaf _facility. Compliance with this classific tion shall be verified through a Preliminary Hazard Analysis assessment of bound. g accidents involving those radionuclides and/or chemicals presenting the mos significant hazards (see DOE Order 5481.1B, Safety Analysis Review System). Ad inistrative controls shall be established prior to the first use f tritium-bearin t r ets GOO to ensure that inventory limits for a faei919gieallow-hazard, :"'.9:"'. ~.ueleaf radiological facility are not exceeded.

3.1 Radiation Protection *

Collective and individual ionizing radiation dos s to the public from all exposure pathways from the NIP shall meet the requirements of DOE Order 5400.5, Radiation Protection of the Public and the Environment, and 4 CFR 61, National Emission Standards for Emissions of Radionuclides Other Th Radon from Department of Energy Facilities. These requirements state that exp sure of members of the public from emissions of radionuclides in the ambient air from ormal NIF operations shall remain below 10 mrem/y. The facility shall also meet the re uirements of DOE Order 5400.5
.A~gai:,.st RaetiatieR)1 to not cause the public dose fro all exposure modes and all sources of radiation at the site boundary to exceed 1 0 mrem/y.

The NIP personnel radiation protection program shall follow DOE Order N441.;f-l- Radiation Protection for Occupational Workers and 0 CFR 835, Occupational Radiation Protection. The ALARA (as low as reasonably achie able) principle shall be utilized in both design and operation of the facility to eliminat unnecessary radiation dose to workers in the Laser and Target Area Building, coIl cated employees, and visitors from both routine and off-normal operations. Radiation p otection shall include: shielding; control of workplace ventilation; monitoring of pers nnel for external and internal radiation dose; establishment of a routine contamin tion monitoring program including air monitoring; and the proper containment of radia ion and radioactive materials.

The radiation shielding design limit the maxim doses to an individual worker to one- tenth (shielding design goal) of the occupation 1 external dose limits specified in 10 CFR 835. Concrete shielding shall comply with ACI 01. which provides adequate strength for DBE loads.

The requirements for radiological safety in 10 C R 835, Occupational Radiation Protection,_should be evaluated by the designers an incorporated when they are determined to be cost effective, even though the pro ected inventory of tritium in NIF (-0.05 g or 500 Ci) is well below the threshold for a uclear facility. The target chamber and tritium processing systems shall form the prim ry confinement barrier. Leakage past these barriers shall be ALARA. The experiment I-area ventilation system shall be

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designed to operate at negative pressures during a d immediately after shots of greater than one megajoule and provide secondary tritium onfinement.

The final exhaust release point from this system hould be elevated for dispersion. Exhaust air shall be continuously monitored for rad oactivity. The target area shall also be monitored to ensure that radiological conditions Te safe for persox:mel entry.

3.2 Life Safety**

The NIF shall fully comply with the reqUiremen tfor life safety contained all National Fire Protection Association (NFP A) Codes. Particular focus shall be directed towards features related to the means of egress, suc as protection of vertical openings, travel distances, capacities, and emergency lighting.

3.3 Laser Safety*

The laser safety shall comply with ANSI 2136.1. xposure to hazardous levels of laser light shall be prevented by the use of physical arriers, personnel training, interlocks, and personnel entry controls. Protective quipment, such as laser goggles, shall be used when necessary for operational purpo es. Interlock systems shall be dedicated and designed to be fail-safe and shall acti ate laser shutters or shut off power to laser systems if access doors are opened and hazardous exposures are possible.

3.4 Industrial Hygiene and Occupational Safety*

Industrial hygiene and occupational safety shall omply with 29 CFR 1910 Occupational Safety and Health Act (OSHA) -aper tion. Construction safety shall comply with the requirements of 29 CFR 1926, OS -Construction.

Facility subsystems (e.g., capacitor banks, vacuu systems, tritium recovery, nitrogen supply, and personnel safety interlock syst ms) shall be designed to default to a safe state upon loss of power.

3.5 Fire Protection*

The NIP shall meet the design and fire protectio requirements, all NFP A Codes and the Uniform Building Code (UBC). The structural m mbers of the Experimental Building (including exterior walls, interior bearing aIls, columns, floors, roofs, and supporting elements) shall, as a minimum, meet UB fire-resistive standards. Appropriate fire barriers shall be provided to limit roperty damage, fire propagation, and loss of life by separating adjoining structures, is lating hazardous areas, and protecting egress paths. The NIP shall meet the requ rements for an "improved risk" level of fire protection sufficient to attain DOE objec ives. To achieve this level of protection, automatic fire sprinklers shall be installe throughout the complex. The sprinklers shall be coupled with adequate fire prote tion water supplies and automatic

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and manual means for detecting and reporting incipient fires. Fire hazard analyses will be completed as required by all NFP A Codes. I

3.6 Robotic Systems Safety

Robotic systems shall comply with the requirements of ANSI/RIA R15.06-1992; Industrial Robots and Robot System-Safety Requirements.

4.0 Environmental Erotection

4.1 Waste Management**

The NIP shall minimize the generation of waste~ at the source per: DOE Policy P450.1, Environmental Safety and Health Policy for Ithe Department of Energy Complex, General Environmental Protection Program, and D<DE Order 5820.2A, Radioactive Waste Management; and the Resource ConservatioI} and Recovery Act (USC 6901 to 6992); and the Toxic Substances Control Act (USC ~601-2692). The NIP waste handling areas shall comply with the standards of confinement and ventilation requirements specified by DOE Order 5820.2A, Radioactive Wast~ Management.

The NIF will generate hazardous waste, low-Iev~1 radioactive waste (LLW), and mixed (LLW and hazardous) waste. These wastes shall be collected in approved containers, labeled, packaged, sorted, and shipped fp an EP A/DOE-approved treatment or disposal site according to the Resource conserva ~on Recovery Act and the following regulations: hazardous waste per 40 CFR 260, 261 d 262; low-level waste per DOE Order 5820.2A; and mixed (LLW and hazardous) w ste per DOE Order 5820.2A, and 40 CFR 260. The LLW packages shall meet the radioac .ve solid waste acceptance criteria of the final approved disposal site. Pollution 12revention will be considered in the NIP design as required b~ DOE Order 430.1.

4.2 Effluents*

Liquid effluent discharges from NIP discharge pints shall be monitored and controlled in compliance with 10 CFR 835, DOE Or er 5400.5, Radiation Protection of the Public and the Environment; the Clean Water A t (33 U.S.C. 1251 et seq.); and by conditions on 40 CFR 125 Criteria and Standards fo National Pollutant Discharge Elimination System.

Air emissions shall meet the requirements of Se tion 3.1 (radiation shielding and confinement) for radionuclides and the requiremen is of the Clean Air Act, (42 U.S.C. 7401) including National Emission Standards for H zardous Air Pollutants (NESHAP), and state and local air quality management district equirements.

5.0 Safeguards and Security**

The NIP safeguards and security features shall meet the requirements of DOE Order 5632.1C, Protection of Safeguards and Security Interests, and DOE Order 470.1, Safeguards and Security Program. These requiremelrlts include physical protection of classified data and equipment and items in use and in storage. For the facility security areas and access control, requirements shall be established based on the nature of experiments (i.e., classified or unclassified) being performed. The limited areas shall be the target area, target receiving and inspection, final target alignment, classified data acquisition, and office areas where classified computing is performed. Automated Data Processing (ADP) systems handling classified info~ation shall meet the requirements of DOE Orders 5637.1, Classified Computer Security Program, and 5300AD, Telecommunications: Protected Distribution Systems. Elements of DOE Orders 470.1, Safequards and Security Program, and 472.1, PersoI)nel Security Activities, will also be incorporated into the security plan.

The NIP complex shall also meet the requirements for physical protection of DOE property and unclassified facilities, protection program operations, and personnel security, including issuance, control, and use of bad~es, passes, and credentials.

Because the continuous operation of the NIF is Il,Ot required to prevent adverse impacts on national security or the health and safety of the public, it is not classified as a vital facility, per DOE Order 5632.1C. i

6.0 Building Systems

6.1 Design Life Requirements

The LTAB and the Optics Assembly Building (0 B) represent the only newly constructed facilities at LLNL .'. The NIF facilities shall be designed for at least 30 years desi life for permanent structures. Systems or portions of systems for which that is im ractical shall be designed for ease of replacement. Ease of replacement means that rep acement is feasible at reasonable cost and can be accomplished in a timely manner c nsistent with plant availability requirements. "Replacement" here also includes re ovaL refurbishment and reinstallation of original equipment.

The performance category for target area and la er structural systems shall be category 2 with a graded approach for other system.

Where alternative designs and modes of construFtion are possible at essentially equivalent cost the design and construction methoq that most readily allows for future reconfiguration and modification should be selecteq.

6.2 Vibration Requirements

Certain facilities or areas within facilities will ho~se vibration-sensitive special equipment. The structural design of these areas shal ~ provide means to effectively isolate this equipment to control vibration within sp cified displacement and rotation requirements. Specific constraints are specified in th System Design Requirements for NIP Facilities.

6.3 Cleanliness Requirements

The laser bays, experimental areas, and optical

t SemblY rooms must be dust free to

prevent laser damage to the optics. Specific constra' ts are specified in the System Design Requirements for NIF Facilities.

6.4 Temperature Control

Temperatures in the laser bays experimental are

f s must be controlled in order to

maintain a stable laser alignment. Specific constrain s are specified in th~ System Design Requirements.

6.5 Electrical Power

Electric power shall be installed in accordance ~th NFP A 70~ which includes details from the-National Electrical Code; IEEE 493, Reconiffiended Practices for Design of Reliable Industrial and Commercial Power Syste ; and ANSI C2, the National Electrical Safety Code.

6.5.1 Voltage Quality

Voltage shall be maintained in compliance with ANSI C84.1, Electrical Power Systems and Equipment-Voltage Rating (60 HZ). t;lectrical supply systems shall operate within the limits specified for Range A of t1{is specification. Voltage occurrences outside these limits should not exceed the Range B tiInits. These variances should be limited in extent, frequency, and duration. Comput~rs shall be protected with low voltage dropouts requiring manual restart.

6.5.2 Standby Power

Standby power shall be available for health, life'lproperty, and safeguards and security loads, including emergency egress lightin

1fire alarms and sensors, security systems, and radiation monitors. Power for safety d security functions shall be

installed and operated according to NFP A 101, the ife Safety Code; ANSI/NFP A 110- 1993, the Standard for Emergency and Standby Po~er Systems; NFP A 72, National Fire Alarm Code; and other applicable NFP A and osH4 standards.

6.5.~:::;~::b;:::~s;stems (UPS), are n:~:1 uired for the NIP facilities or special equipment. r

7.0 Operational Availability

User demands for shot time are expected to be

~gh' therefore, the facility shall be designed for maximum reasonable availability and apid recovery from unplanned shutdowns.

7.1 Reliability, Availability and Maintainability (RAM)*

The components, systems, and processes that l

$'t overall facility availability shall be identified during the design process through an lyses of turnaround times, mean
times between failures, mean times to repair, preve tive maintenance requirements, etc. Techniques such as in-site backups, on-hand spares~ modular components, on-call maintenance forces, and more robust designs shall e used to increase availability if the following goals cannot otherwise be achieved:

.The facility shall be available for three shift 0 erations at least 253 days per year (73% availability).

.The facility shall be available for at least 616 o-yield target shots per year. To address, the possible future needs of dire -drive and other users, the design should not preclude an increase in th availability to approximately 1200 total shots per year. The project shall provide the initial set of maintenance equipment, consist' g of at least one unit of each piece of equipment that is required to mainta n and operate NIP. Future addition of more units of maintenance equip ent shall not be precluded. Continuous high-availability NIP operation, s defined above, may require future additional units of maintenanc equipment.

.The lasers shall perform within specification e.g., laser energy, beam balance, pointing accuracy) on at least 80% 0 all shots.

The project should also use this RAM process to etermine how to achieve availability in the most cost-effective manner, to det rmine what spares in what quantities should be kept in inventory, to optimize maround procedures, to plan preventive maintenance and inspection programs, d to respond to unscheduled outages.

7.2 Recovery Time*

Because of its importance to the DOE, the NIP sh 11 be designed to survive any abnormal event, including accidents and natural ph nomena, expected to occur more frequently than once in 2000 years. The time require to recover from such events is allowed to vary in accordance with the probability f occurrence. Maximum recovery times are specified below.

Probability of Occurrence Per Year, P	Maximum Recovery Time
$P = 1$	24 hours
$1 > P \geq 10^{-2}$	1 week
$10^{-2} > P \quad 5 \times 10^{-4}$	3 months for laser, target, and associated building structures 6 months for support systems

The probabilities of occurrence listed in DOE-STD-IO20-94 and DOE-STD-IO21-93 shall be utilized for natural phenomena. I

Standby power shall be available to preserve process continuity in cases designated by the NIP Project and specified in the System Design Requirements. Neither uninterruptible power systems nor standby power is required for the computer systems.

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8.0 Decontamination and Decommissioning

The NIP design shall meet the site-specific requirements. The NIP shall be designed for periodic cleaning of the interior of the test chamber to maintain tritium levels on interior surfaces as low as reasonably achievable. The NIP design shall include considerations that will allow for cost-effective future decommissioning of the structures and equipment.

A plan for NIP Decontamination and Decommis~ioning (D&D) shall Q.g..developed in accordance with DOE Order 5820.2A, Radioactive Waste Management. A D&D assessment shall be made during conceptual designl to ensure that features and measures are incorporated in NIP to simplify D&D.IThe NIP D&D plan will be prepared before the end of the Title II design. I

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9.0 Quality Assurance**

The NIP Quality Assurance Program shall meetithe requirements of DOE Order 5700.6C, Quality Assurance. As specified in this DC1>E Order, a graded approach using quality levels based on risk assessment shall be speJled out in the NIP Quality Assurance Program Plan and utilized throughout ~e project. The QA Program Plan shall cover all aspects of the NIP Project in a phaseq implementation, beginning with conceptual design.).

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10.0 Orders, Codes, an~ Standards

10.1 DOE Orders*

The NIF shall be designed and constructed in fuJI compliance with DOE Orders and federal regulations. Exceptions shall be limited to those cases where the project has formally requested and been granted either an ex

Jption or a finding of equivalency by Headquarters.

It is recognized that updates and additions to E Orders, federal regulations, and consensus industry standards are outside of the CO

~!trol of the project team and are a frequent source of cost and schedule growth. These requirements are all frozen as of March 1, 1996.

10.2 Codes and Standards

Technical codes, standards, and guides promulg,ated by nationally recognized organizations should be utilized by the NIP Project whenever available and practical, per DOE Order 1300.2A. A partial listing of nationa~ly recognized organizations is included in the following sections. Additional refer~nces identified during the developmental phases shall be formally cited and c~ntrolled in system and subsystem design requirements documents and specifications ~rough the Project Change Control Process. .I

10.3 Applicable Orders, Codes, and Stand~rds

This section lists DOE Orders, codes, and standa~ds in effect on March I, 1996, that are considered to be applicable to the NIP Project. TPe listing begins with DOE and other federal regulations (e.g., Resource Conservati~n and Recovery Act), and is followed by a partial listing of_national consensus s andards organizations. The applicable portions of these documents will apply.

10.3.1 DOE Orders

.1300.2A -Technical Standards Program
.5300AD -Telecommunications: Protected Di tribution System
.5400.1 -General Environmental Protection P ogram
.5400.5 -Radiation Protection of the Public an the Environment
.5480.19 -Conduct of Operations
.5481.1B -Safety Analysis and Review S)'ste (for non-nuclear facilities and hazards only)
.5632.1C -Protection of Safeguards and Secur ty Interests

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5633.3B -Control and Accountability of Nuqear Material
5637.1- Classified Computer Security Progr m
5700.6C -Quality Assurance
5820.2A -Radioactive Waste Management

151.1 -Comprehensive Emergency Manage ent System
430.1- Life Cycle Asset Management
N441.2 -Radiological Protection for DOE Ac 'vities
P450.1- Environment, Safety and Health Pol cy for the Department of Energy Complex
470.1- Safeguards and Security Program
471.2 -Information Security Program
472.1 -Personnel Security Activities

10.3.2 Other Government Regulations I
.10 CFR 835 -Occupational Radiation Protecti~n
.10 CFR 20 -Standards for Protection Agains
~ Radiation .29 CFR 1910 -Occupational Safety and Heal Act (OSHA) -Operation .29 CFR 1926 -Occupational Safety and Heal Act (OSHA) -Construction .40 CFR 125 -Criteria and Standards for NPD S (National Pollutant Discharge Elimination System) .
.40 CFR 260,261,262 -Hazardous Waste Management System
.40 CFR 61 Subpart H -National Emission Standard for Emissions of Radionuclides other than Radon from Department of Energy Facilities
.FED-Sill-209E -Airborne Particulate Cle .ess Classes in Cleanrooms and Clean Zones
.33 USC 1251 et seq. -Clean Water Act
.42 USC 7401 -Clean Air Act
.42 USC 4321 et seq. -NEP A (National Enviro ental Policy Act)'
.40 USC 6901-6992 -Resource Conservation a d Recovery Act (RCRA) .15 USC 2601-2692 -Toxic Substance Control :Act

10.3.3 National Consensus Standards
The NIP Project shall comply with the following national consensus standards, as noted elsewhere in this document:
-ACI 301 -1996, Specifications for Struc ral Concrete for Buildings
-ANSI C2 -1993, National Electric Code
-ANSI C84.1-1989, Electrical Power Sys ems and Equipment-Voltage Rating (60 HZ)
-ANSI Z136.1-1993, Laser Safety
-ANSI/RIA R15.06 -1992, Industrial Ro ots and Robot System-Safety Requirements
-DOE-Sill-1020-94, Natural Phenomena Hazards Design and Evaluation Criteria for DOE Facilities
-DOE-Sill-1021-93, Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, & C mponents.

-IEEE 493 1990, IEEE Recommended Pra tice for the Design of Industrial and Commercial Power Systems
-All NFP A Codes
:. NFP A 70 1996, National Electric Code
-NFP A 72 1993, National Fire Alarm Co e
-NFPA 1011994, Code for safety to Life trom Fire in Buildings and Structures -ANSI/NFPA 110-1993, Standard for E 1' rgency and Standby Power Systems -Uniform Building Code (UBC) 1994

Orders, standards, and codes listed as mandato in DOE Orqers are not necessarily referenced in this list.

In addition to complying with these specific standards, the NIP Project shall utilize applicable and appropriate national consensus code$ and standards in the design, procurement, fabrication, installation, construction, fnspection, and testing of structures, systems, and components, per DOE Order 1300.2A. Codes, standards, and guides of recognized technical and professional organizations tsuch as those in the following list, shall be applied as appropriate to NIP materials and workmanship:

AA AASHTO ABMA
ACI
ACGIH AISC
AISI AMCA ANSI APA
ARI ARMA ASCE ASHRAE

ASME
ASTM
AWS AWWA BRMA CISCA CGA CMAA CRSI EPRI FM

Aluminum Association I
American Association of State Highway Officials
American Boiler Manufacturers sociation
American Concrete Institute
American Council of Governmen Industrial Hygienists
American Institute of Steel Const uction
American Iron and Steel Institute
Air Movement and Control Asso iation
American National Standards Ins

! "tute American Plywood Association

Air Conditioning and Refrigerati n Institute
.Asphalt Roofing Manufacturers Association
American Society of Civil Engine rs
American Society of Heating, efrigerating & Air Conditioning Engineers
American Society of Mechanical ngineers
American Society for Testing and Materials
American Welding Society
American Water Works Associati n
Builders Hardware Manufacturer Ass'ociation
Ceiling and Interior Systems Con ractors Association
Compressed Gas Association
Crane Manufacturers Association of America
Concrete Reinforcing Steel Institu e
Electric Power Research Institute
Factory Mutual Engineering and esearch20 20

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GA Gypsum Association
ICBO International Council of Building Officials (Uniform Building Code) ICEA Insulated Cable Engineers Association
IEEE Institute of Electrical and Electronics Engineers
IES illuminating Engineering Society of North America
ISA Instrument Society of America
NAPHCC National Association of Plumbing, Heating, & Cooling Contractors NCMA National Concrete Masonry Association
NEC National Electric Code (NFPA)
NEMA National Electrical Man ufacturets Association
NIOSH National Institute for Occupational Safety and Health
NIST National Institute of Standards and Technology
NFPA National Fire Protection Standards

RFCI Resilient Floor Covering Institut~
SDI Steel Deck Institute I
SDI Steel Door Institute
SMACNA Sheet Metal & Air Conditioning Contractors National Association SSPC Steel Structures Painting Council
sn Steel Tank Institute I
SWI Steel Window Institute \;
TCA Tile Council of America I
nMA Thermal Insulation Manufacturers Association
UL Underwriters Laboratories

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11.0 Revision Record

~ BCP# Descri~tion of/Reason for Change
.3/94 n/a CDR release
96-004 Directed changes in DOE Orders and Federal Regulations. Miscellaneous changes throughout , document
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FUnctionality Ci}anges to the NIP Baseline. Changes include the addition of: optic assembly capability, beam smoothing, flashlamp cooling, 4x2 amplifiers, not-to-preclude direct drive, not-to- preclude radiation effects testing, and laser spot size. '

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I Engineering Option Studies: increased shot rate and full i~plem~ntation of direct drive.

Title I Update of Functional Requirements/Primary Criteria. Changes to incorporate results of Title I design and design review, update of DOE Orders

! and standards, and miscellaneous changes

i T~ogra~hical changes and minor wording changes to reflect com~letion of ROD and final inco~oration of Necessar~ and Sufficient

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2.0 Mission-Related Requirements

The laser system shall be designed to meet the f<j>llowing requirements simultaneously, although all performance require~ents need not be demonstrated simultaneously on a single event. I

2.1 Laser

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The laser shall be capable of routinely producin a temporally-shaped pulse of energy at least 1.8 million joules (MJ) incident on th entrance hole of the target hohlraum.

2.1.2 Laser Pulse Peak Power* I
The laser shall be capable of producing a pulse ¥th peak power of at least 500 trillion watts (TW).

2.1.3 Laser Pulse Wavelength*
The wavelength of the laser pulse delivered to e target shall be 0.35 microns (J.lm). The design should not preclude delivering 0.53 J.lm d 1.05 ~m wavelength light to the target with reasonable modifications.

2.1.4 Beamlet Power Balance*
~The rms deviation in the power delivered by the laser beams from the specified power shall be less than 8% of the specified power veraged over any 2 nanosecond (ns) time interval.

2.1.5 Beamlet Positioning Accuracy'"
The rms deviation in the position of the centroid of all beams from their specified aiming points shall not exceed 50 micrometers (Jlm) at the target plane or its equivalent,
2.1.6 Laser Pulse Duration
The laser shall be capable of producing a pulse 'th overall duration of up to 20 ns.

2.1.7 Laser Pulse Dynamic Range
The laser shall be capable of delivering pulses to the fusion target with a dynamic range of at least 50:1, where the dynamic range is d fined as the ratio of intensity at the peak of the pulse to the intensity in the initial "foot' portion of the pulse.

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2.1.8 Capsule Irradiation Symmetry
Variations in the x-ray energy deposited on the fusion capsule, located in the target hohlrauin, should be S2% rInS. Current target design

and performance calculations indicate that this level of irradiation uniformity CaJ1 be achieved by two-sided laser illumination of the hohlraum. Multiple laser beams on each side enter the hohlraum along two concentric cones with cone half-angles of approximately 27 degrees and
S3 degrees, and with two-thirds of the beams on th~ outer cone and the remaining one- third on the inner cone. Each cone shall consist of Bor more beams. The capability shall be provided for the pulse shape delivered by beam~ on the inner cone to be different from the shape delivered by those on the outer cont.

C

~ c,:c 2.1.9 Prepulse Power ,,'.',,0'

The laser intensity delivered to the target durin the 20-ns interval prior to arrival of the main laser pulse shall not exceed 108 W / cm2.

1 2.1.10 Laser Pulse Spot Size "

Each beam shall deliver its design energy and P wer encircled in a 600 Jim diameter spot at the target plane or its equivalent. In the aPP

r OPriate configuration, each beam

should deliver 50% of its design energy and power ncircled in a 100 J.lm diameter spot at the target plane or its equivalent.

2.1.11 Beam Smoothness

The NIF shall have spatial and temporal beam c nditioning to control intensity fluctuations in the target plane.

2.1.12 Direct-Drive Requirements*

Future upgrade to meet the following requirem ts, specific to direct-drive experiments, shall not be precluded in the baseline design.

2.1.12.1 Direct-Drive Irradiation Symmetry. D~rect-drive ICF targets shall be irradiated by three pairs of concentric cones, with midplane symmetry. The cone half- angles and number of beams on each cone shall be: I

Direct-drive cone Cone half-a ate) Fraction of total beams
Inner same as m lrec rIve 1/6 Outer same as indirect drive 1/3 Waist 75 de ees 1/2

•

dP ..;.

1 .; 2.1.13 Beam Focusmg an oIntIng .';.;c.;

The NIP should have flexibility in beam focusin and pointing to address the needs of radiation effects testing and other users.

Marchjaftttaf'j" 1997

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.DofF 1325& & ...y-
, (08-93)

United States Government De artment of Ener

memorandum

DATE: September 18, 1997
~~~~~ DP-40:J.Beitz:3-3181
SUBJECT: REVIEW OF NIF BASELINE CHANGE PROPOSAL (BCP) 97-008 FOR LEVEL 1 BASELINE CHANGE CONTROL BOARD ACTION

TO:

K. Baynes, DOE Oakland (NIF) Baseline Change Control Board Secretariat

A NIF Baseline Change Proposal 97-008 providing an Updated NIF Project Data Sheet for FY 1999 was submitted to this office for processing.

The board members and advisors provided their recommendations. On this date, the Chairman approved the BCP.

Should there be questions concerning the BCP I please contact me at (301)
903-3181. .

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" mle M.;Beitz, secretariat-:::;t'-u
P Baseline Change Contr9fBoard
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Attachment
cc:
A. Tavares, FM-20 D. Crandall, DP-18 T. Finn, DP-18
J. Wolfe, DP-41
A. Epstein, DP-40

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7.-

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
(Changes from FY 1998/FY 1999 Congressional Budget Request are denoted with a vertical line in left margin.)

WEAPONS ACTIVITIES
(Tabular dollars in thousands. Narrative material in, whole dollars.)

Weapons Stockpile Stewardship
Inertial Confinement Fusion

Title and Location of Project: National Ignition Facility (NIF)
Lawrence Livermore National Laboratory (LLNL), Livermore, CA

2a. Project No. 96-0-111 2b. Construction Funded

Preliminary Estimate

Title I Baseline

Current Baseline Estimate

3a.

3b.
4a.

4b. 5.
6.

Date A-E Work Initiated,
(Title I Design Start Scheduled): A-E Work (Titles I & II) Duration: Date physical Construction Starts: Date Construction Ends:
Total Estimated Cost (TEC)
Total Project Cost (TCP)

1st Qtr. FY 1996 24 months
3rd Qtr. FY 1997 3rd Qtr. FY 2002 842, 600 1,073,600

1st Qtr. FY 1996 27 months
3rd Qtr. FY 1997 3rd Qtr FY 2003 1,045,700 1,198,900

1st Qtr. FY 1996
27 months
3rd Qtr. FY 1997 3rd Qtr. FY 2003 1,045,700 1,198,900

Financial Schedule (Federal Funds);

Fiscal Year

Appropriation

Adjustments

Obligations

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Previous
1996 1997 1998 1999
2000 20m
2002 2003

$ 0
37,400 131,900 197,800 284,200 248,100 74,100 65,000 7,200

$

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0 0 0
0
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$ 0
37,400 131,900 197,800
284,200
248,100 74,100 65,000 7,200

$ 0
33,990 103,010 180,600 208,300 199,900 179,700 122,000 18,200

Note:

ull funding of $678,609,000 is requested in FY 1999.

PROJECT TITLE: National Ignition Facility	
30) BCP NUMBER: BCP 97-008	31) BCP TITLE: Updates to Project Data Sheet

DEPARTMENTOFENERGY
BASELINE CHANGE PROPOSAL
LEVEL 1 DISPOSITION

.32) MEMBERS (Required) RECOMMENDATION .,

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_SIGNATURE -Dr. V. Reis ASDP If Level 0 Action R ulred DATE I] DEFER (J REJECT
\'33) Remarks (If BCP is Approved with Con.ditions, Deferred, or Rejected) / !
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JAPPROVE] DEFER

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Title and Location of project:

National Ignition Facility
Lawrence Livermore National Laboratory (LLNL).Livermore. CA

2a. Project No. 96-D-lll 2b. Construction Funded

8.

I:>ro~ect Description. Justification and Scope :> .

The Project provides for the design, procurement, construction, assembly, installation, and acceptance testing of the National Ignition Facility (NIF), an experimental inertial confinement fusion facility intended to achieve controlled thermonuclear fusion in the laboratory by imploding a small capsule containing a mixture of the hydrogen isotopes, deuterium and tritium. The NIF will be constructed at the Lawrence Livermore National Laboratory (LLNL), Livermore, California as determined by the Record of Decision made on December 19, 1996, as a part of the Stockpile Stewardship and Management Programmatic Environmental Impact Statement (SSM PElS).

The mission of the National Inertial Confinement Fusion (ICF) program is to achieve controlled thennonuclear fusion in the laboratory. This program supports the DOE mandate of maintaining nuclear weapons science expertise required for stewardship of the stockpile, testing of nuclear weapons effects, and the development of fusion power by providing a database for inertial fusion ignition. As a key element of the Stockpile Stewardship Program, the NIF is designed to achieve propagating fusion bum and modest (1-10) energy gain within 2-3 years of full operation and to conduct high energy density experiments, both through fusion ignitions and through direct application of the high laser power. This mission was identified in the NIF Justification of Mission Need, which was endorsed by the Secretary of Energy. Identification of target ignition as the next important step in ICF development for both defense and non-defense applications is consistent with the earlier (1990) recommendation of OOE's Fusion Policy Advisory Committee, and the National Academy of Sciences Inertial Fusion Review Group. In 1995, the DOE's Inertial Confinement Fusion Advisory Committee affinned the program's readiness for an ignition experiment. A review by the JASdNs in 1996 affirmed the value of the NIF for stockpile stewardship.

The NIF project supports the DOE mandate to maintain nuclear weapons science expertise required for stewardship of the stockpile. After the United States announcement of a moratorium on underground nuclear tests in 1992, the Department established the Stockpile Stewardship program to ensure the preservation of the core intellectual and technical competencies in nuclear weapons. In addition, as a means of reducing the danger posed by nuclear weapons proliferation, the President announced that the United States would seek a zero yield Comprehensive Test Ban Treaty (CTBT). The treaty was signed on September 24,1996. One of the six safeguards that defines the-- terms of the CTBT is the conduct of the Stockpile Stewardship program to ensure the safety and reliability of the stockpile. The NIF is one of the most vital facilities in that program. The NIF will provide the capability to conduct laboratory experiments to address the high energy density and fusion aspects that are so important to both primaries and secondaries in stockpile weapons.

At present, the Nation's computational capabilities and scientific knowledge are inadequate to ascertain all of the perfonnance and safety impacts from changes in the nuclear warhead physics packages due to aging, remanufacturing, or engineering and design alterations. Such changes are inevitable if the warheads in the stockpile are retained well into the next century, as expected. In the past, the impacts of such changes were evaluated through nuclear weapon tests. Without underground tests, we will require better, more accurate computational capabilities to assure the reliability and safety of the nuclear weapons stockpile for the indefinite future.

To achieve the required level of confidence in our predictive capability, it is esseQtial that we have access to near-weapons conditions in laboratory experiments. The importal'lce of nuclear weapons to our national security requires such confidence. For detonation of weapon primaries, that access is provided in part by hydrodynamic testing. For secondaries and for some aspects of primary performance, the NIF will be a prin,ipallabora,tory experimental physics facility.

The most sigI1ificallt pote'ltial commercial application of ICF in the long tenD is the generation of electric power. Consistent with the recommendat~ol1s of the 1;II,;i()11 Policy Advisory Cofnn1ittee, the NIF will provide a unique capability to address critical elements of the

1

Title and Location of Project:

National Ignition Facility
Lawrence Livermore National Laboratory (LLNL).Livermore. CA

2a. Project No. 96-0-111 2b. Construction Funded

inertial fusion energy program by exploring moderate gain (1 to 10) target designs, establishing requirements for driver energy and target illumination for high gain targets, and developing materials and technologies useful for civilian inertial fusion power reactors.

The ignition of an inertial fusion capsule in the laboratory will produce extremely high temperatures and densities in matter. Thus, the NIF will also become a unique and valuable laboratory for experiments relevant to a number of areas of basic science and technology.

The NIF is an experimental fusion facility consisting of a laser and target area, and associated assembly and refurbishment capability. The laser will be capable of providing an output pulse with an energy of 1.8 megajoules (MJ) and an output pulse power of 500 terawatts (TW) at a wavelength of 0.35 micrometers (~) and with specified symmetry, beam balance and pulse shape. The NIF design calls for an experimental facility to house a multibeam line, neodymium (Nd) glass laser capable of generating and delivering the pulses to a target chamber. In the target chamber, a positioner would center a target containing fusion fuel, a deuterium-tritium mixture, for each experiment. Diagnostics provided by this project would provide the test data to demonstrate subsystem performance and initial operations.

The NIF experimental facility, titled the Laser and Targ~t Area Building, would provide an optically stable and clean environment. This laser building would be shielded for radiation confinement around the target chamber and will be designed as a radiological, low -hazard facility capable of withstanding the natural phenomena

specified for the LLNL site. The baseline facility is for one target chamber, but the design shall not preclude future upgrade for additional target chambers.

The NIF project consists of conventional and special facilities.

Site and Conventional Facilities include the land improvements (e.g., grading, roads) and utilities (electricity, heating gas, water), as well as the laser building, which has an approximately 20,300 square meters footprint and 38,000 square meters in total area. It is a reinforced concrete and structural steel building that provides the vibration-free, shielded, and clean space for the installation of the laser, target area, and integrated control system. The laser building consists of two laser bays, each 31 meters (m) by 135 m long, and a central target area--a heavily shielded (1.8 m thick concrete) cylinder 32 m in diameter and 32 m high. The laser building includes security systems, radioactive confinement and shielding, control rooms, supporting utilities, fire protection, monitoring, and decontamination and waste handling areas. Optics assembly and refurbishment capability is provided for at LLNL by incorporation of an optics assembly area attached to the laser building and minor modifications of other existing site facilities.

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1. Title and Location of project:

National Ignition Facility
Lawrence Livermore National Laboratory (LLNL).Livermore. CA

2a. Project No. 96~D-lll 2b. Construction Funded

9.

~~IS of Cost Estima1e- Item Cost Total Cost

a. Design and Management Costs " $ 220,100
1. Engineering, design and inspection at approximately 21.9 percent of construction costs (Item c) $ 152,000 2. Construction management at approximately 3.1 percent of construction costs (Item c) 21,500 3. Project management at approximately 6.7 percent of construction costs (Item c) 46,600
b. Land and land rights ".' '... 0 c. Construction costs , ; 693,800
1. Improvements to land , 1,800 2. Buildings modification : 175,800 3. Site-specific infrastructure , 0 4. Other Structures 0 5. Utilities SOO
6. Special Facilities d. Standard equipment : 0 e. Major computer items : ,...0 f. Removal cost less 0 g. Design and project liaison, testing, checkout and acceptance , , ,..,
,." *JJ*. h. Subtotal (a through $ 913,900 i. Contingencies of approximately 15.1 percent of remaining costs at completion of Title I Design 131.800
j. Total line item cost [Section 11.a.1.(a») =.-.~::; =~:::;-.-;-;;-;;.-;:;-.-;~:-;-;;-;;~~~;;;;~; ; $1,045,7001/
k. LESS: Non-Federal contribution " *D*. I. Net Federal total estimated cost (TEC) , $1,045,700

The cost estimate assumes a project organization and cost distribution consistent with the management requirements appropriate for a DOE Strategic System as outlined in the DOE Order 430.1, Life Cycle Asset Management and the NIP Project Execution Plan. Actual cost distribution will be in conformance with accounting guidelines in place at the time of project execution.

II Based on 100 percent Title I design completion

1

Title and Location of Project:

National Ignition Facility
Lawrence Livermore National Laboratory (LLNL).Livermore. CA

2a. Project No. 96-D-lll 2b. Construction Funded

10.

Methnd nf Performance

The NIF Laboratory Project Office (consisting of LLNL, LAN!., SNL, and UR/LLE and supported by competitively-selected contracts with Architect Engineering firms, a Construction Manager, equipment and material vendors, and construction finnS) will prepare the design, procure equipment and materials, and perform conventional construction, safety, system analysis, and acceptance tests. DOE will maintain oversight and coordination through the Headquarters Office of Inertial Fusion and the National Ignition Facility Project and the field office. DOE conducted the site selection and the NEP A determination. LLNL was selected as the construction site in the Record of Decision made on December 19, 1996. The procurement and installation/test of special equipment will be performed by the NIF Laboratory Project Office. Inspection and Title III engineering contracts for the conventional systems will be competitively awarded. NIF start-up will be conducted by the NIF laboratory operations staff.

1,

Title and Location of Project:

National Ignition Facility
Lawrence Livermore National Laboratory (LLNL) ,Livermore, CA

2a. Project No. 96-0-111
2b. construction Funded

11.

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FY 1997

FY 1998

FY 1999

Out~ears

I.o1al

a. Total project costs
1. Total facility costs
(a) Line item (Section 9.j.) (b) Plant, Engineering and Design (PE&D) (c) Operating expenses funded equipment (d) Inventories
Total facility costs (Federal and Non-Federal) , 2. Other project costs
(a) R&D necessary to complete construction (b) Conceptual design costs (c) Decontamination and Decommissioning (0&0) (d) NEP A documentation costs (e) Other project related costs (f) Total other project costs (g) Total project cost , ; (h) LESS: Non-Federal contribution , -
(i) Net Federal total project (TPC) L-
Note: Budget Authority (BA) requirements
TEC 3 / 37,400 131,900 197,800 678,600 1045700
4 ' ,
OPC / 4L.8.Q.Q 52..2QQ :ll...1Q.Q .6...800 1:4..lOO 153.200
Total. 79,200 191,100 229,100 685,900 14,100 1,198,900 b. Related annual costs (estimated life of project-30 years)
I: Facility operating costs. , ~~ ~ $ 20,600 2. Facility maintenance and repair costs , """."""""""."""..'..."."""""'. 32,400
3. Programmatic operating expenses directly related to the facility 59,600 5/
4. Capital equipment not related to construction, but related to the programmatic effort in the facility 200
5. GPP or other construction related to programmatic effort in the facility , 200 6. Utility costs , , 8,800 7. Other costs , , , , 6.200
Total related annual funding (in FY 1999 dollars) ""."""""""."""""""""""""""""".' , ..$128,000

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/ Prior Years actuals are changed to reconcile with DOE Financial Information System (FIS) costs and corrections made to cost account WBS as~ignment.
! specific long-lead procurements and contracts (e.g.. building construction; 'major laser. optics, and target area special equipment) require BA in advance of costs. Full funding of $678,600,000 is requested in FY 1999.
specific long-lead procurements and contracts (e.g.. optics facilitization) require BA in advance of costs.
/ This primary experimental operating expense will be included in the base Inertial C:onfinement Fusion Program budget.

1

Title and Location of Project

National Ignition Facility
Lawrence Livermore National Laboratory (LLNL).Liverrnore. CA

2a. Project No. 96-0-111 2b. Construction Funded

12.

~

a. Total project costs
1. Total facility costs
(a) Line item --Narrative not required.
(b) PE&D --None.
(c) Operating expense funded equipment --None. (d) Inventories --None.

2. Other project costs

(a) R&D necessary to complete construction --Costs include optics vendor facilitization ($73,200,000) and optics quality assurance ($27,700,000).
(b) Conceptual design and engineering studies -Includes the original conceptual design report completed in FY 1994 ($12,000,000) and the conceptual design activities for the optical assembly and refurbishment capabiliry and site infrastructure ($300,000).
(c) Decontamination and decommissioning (D&D) --None.
(d) NEP A documentation --Preparation includes the NIP portion of the Stockpile Stewardship and Management Programmatic Envirorunental Impact Statement ($2,600,000) and envirorunental monitoring and permits ($2,000,000).
(e) Other project related costs -Engineering studies (including advanced conceptual design) of project options ($5,800,000); assurances, safety analysis, and integration ($9,300,000); start-up planning, management, training, and staffing ($8,600,000); procedure preparation ($1,500,000); operating spares ($600,000); start-up ($7,700,000); and ORR ($1,900,000).

D.- Related annual costs
1. Facility operating costs --Includes operator labor, engineering support and materials for upgrades and modificationS, and consumables for operation of special equipment.
2. Facility maintenance and repair costs --Includes cost of labor, engineering support, and consumables for special equipment maintenance and refurbishment, including optics. Also includes maintenance for the laser building and support buildings.
3. The current NOVA experimental program, including LLNL, LANL, SNL, and General Atomics, is approximately $40,100,000 annually. Based on use of complex cryogenic targets, increased diagnostics support, and higher levels of three dimensional physics modeling, the annual direct NIF experimental program costs are estimated at $59,600,000. Additional program costs will be associated with use of the facility.
4. Fabrication accounts, procurements, such as small lasers and some laser parts, Computer-Aided Design systems, etc. to support upgrades.
5. Minor additions and modifications to the facility related to programmatic effort.
6. Electricity only. Gas, sewer, water, etc. are paid out of the General and Administrative budget.
7. Nitrogen and argon for laser and transport bean) tubes, stock inventory, and procurement support.

1

Title and Locati9n of project:

National Ignition Facility
Lawrence Livermore National Laboratory (LLNLI,Livermore, CA

2a. Project No. 96-D-lll 2b. Construction Funded

DON'T INCLUDE THIS PAGE FOR CONGRESSIONAL

13.

<u>Design and Con."truction of Federal Facilities</u>

All DOE facilities are designed and constructed in accordance with applicable Public Laws, Executive Orders, OMB Circulars, Federal Property Management Regulations, and DOE Orders. The total estimated cost of the project includes the cost of measures necessary to assure compliance with Executive Order 12088, "Federal Compliance with Pollution Control Standards"i section 19 of the Occupational Safety and l:iealth Act of 1970, the pr:ovisions of Executive Order 12196, and the related Safety and Health provisions for Federal Employees (CFR Title 29, Chapter XVII, Part *1960)i* and the Architectural Barriers Act, Public Law 90-480, and implementing instructions in 41 CPR 101-19.6. The project will be located in an area not subject to flooding determined in accordance with Executive Order 11988. DOE has reviewed the GSA inventory of Federal Scientific laboratories and found insufficient spa~e available, as reported by the GSA inventory.

National Ignition Facility
Baseline Change Proposal
Request Fonn and Record of Decision

1. BCP number 2. BCP title 3. Submitted by

D. Rardin
Phone: 510-423-1186
Fax:: 510-422-4667

4. Date receive:
I Level 3 Level 2 Levell elO
5. ange Priority /~ ange
.Routine 0 Level 0 Yes (FY99 Budget Submittal)
0 Priority .Levell 0 No
0 Level 2 Basis:
0 Level3

8. Change description: ❑ Scope ❑ Schedule ■ Cost

The Baseline Change Proposal provides the updated NIF Project Data Sheet for FY1999. The outyear funding profile has been revised as has the annual operations cost.

i 9. Justification and impact 0 change see wor eet)
:
Annual update of the Project Data Sheet for the FY1999 budget submittal. There are no changes in TEC, TPC, or I schedule. There are minor changes in the budget and cost profiles. There are changes in the annual operating costs i to reflect escalation (FY1998 to FY1999 basis) and a 4% change to reflect higher utirity costs.

10. Impact of not approving BCP

The updated Project Data Sheet will be submitted with the President's FY1999 budget request provided that full funding is not appropriated in FY1998.

Record of BCCB decision

11. Recor 0 B B ecision 12. Passe B 13. Date 0 B B ecision .Approved (see II) .Yes
0 Disapproved 0 BCCB Level 2
0 Returned for s ecific data

I 14. Approval signature

l~~~~~<:'~ ..,;L, A"",CJ,i~ 61/0/ tJ 7

Date

97-008

Updates to Project Data Sheet

1

National Ignition Facility
Baseline Change Proposal Worksheet

1. BCP number

97-008

2. BCP title

Updates to Project Data Sheet

4. Technical baseline change inputs

None

3. Submitted by

D. Rardin

Phone #: 510-423-1186 Fax #: 510-422-4667

Other technical baseIme documents:

0 Primary Criteria 0 System Design Requirements 0 Functional Requirements 0 Interface Control Documentl

5. Cost input
Inputs: TEC$ 1045.7M $ apc 153.2M $ Annual Op (FY99) 68.4M $

6. Schedule input
0 Level 0 milestone 0 Levell milestone 0 Level 2 milestone 0 Level 3 milestone

7. ES&H impacts
Yes
0 PSAR/FSAR
0 PElS
0 QA Program
0 Other documents

Budget analysis: Original budgeted amount 1198.9M $ Project to date actual cost 125.8M $ Current lien balance ~l.4M $

Change to funding profile included:

.Yes (attached Proj. 0 No___pata Sheet)

Milestone title/months 8

~

None

Titles

8. Other impacts (e.g., security, stakeholders)

None

o e c D a a S e e U P d a e A tta chm en t 1 to B CP h -008 - 1

Pro p o e d P

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
(Changes from FY 1998/FY 1999 Congressional Budget Request are denoted with a vertical line in left margin.)

1.

WEAPONS ACTIVrnES
(Tabular dollars in thousands. Narrative material in whole dollars.)

Weapons Stockpile Stewardship
Inertial Confinement Fusion

Title and Location of Project: National Ignition Facility (NIF)
Lawrence Uvermore National Laboratory (LLNL), Livermore, CA

2a. Project No. 96-0-111
2b. Construction Funded

3a. Date A-E Work Initiated, (Title I Design Start Scheduled): 1st Qtr. FY 1996

3b. A-E Work (Titles I & ll) Duration: 27 months

4a. Date Physical Construction Starts: 3rd Qtr. FY 1997

4b. Date Construction Ends: 3rd Qtr. FY 2003

7.

Financial Schedule (Federal Funds):

Fiscal Year

Appropriation

Ad~ustrnents

Previous
1996 1997 1998 1999
2000 2001 2002 2003

$ 0
37,400
131,900 876,400
0 0 0 0 0

$

0 0 0 0 0 0 0 0 0

5.

Previous Cost Estimate:
Total Estimated Cost (TEC) -$1,045,700 Total Project Cost (TPC) -$1,198,900

6. Current Cost Estimate:

TEC-- $1,045,700 TPC-$],,198,900

Obligations

~

$ 0
37,400 131,900 197,800
284,200
248,100 74,100 65,000 7,200

$ 0 33,990
103,010
180,600
208,300
199,900
179,700
122,000 18,200

~

1

8.

Title and Location of Project:

National Ignition Facility
Lawrence Livermore National Laboratory (LLNL) ,Livermore, CA

Project DescriI2tion. Justification and Sc°I2e

2a. Project No. 96-D-lll 2b. Construction Funded

The Project provides for the design, procurement, construction, assembly, installation, and acceptance testing of the National Ignition Facility (NIP), an experimental inertial confinement fusion facility intended to achieve controlled thermonuclear fusion in the laboratory by imploding a small capsule containing a mixture of the hydrogen isotopes, deuterium and tritium. The NIF will be constructed at the Lawrence Livermore National Laboratory (LLNL), Livermore, California as determined by the Record of Decision made on December 19, 1996, as a part of the Stockpile Stewardship and Management Programmatic Environmental Impact Statement (SSM PElS).

The mission of the National Inertial Confinement Fusion (ICF) program is to achieve controlled thermonuclear fusion in the laboratory. This program supports the DOE mandate of maintaining nuclear weapons science expertise required for stewardship of the stockpile, testing of nuclear weapons effects, and the development of fusion power by providing a database for inertial fusion ignition. As a key element of the Stockpile Stewardship Program, the NIP is designed to achieve propagating fusion bum and modest (1-10) energy gain within 2-3 years of initial operation and to conduct high energy density experiments, both through fusion ignitions and through direct application of the high laser power. This mission was identified in the NIP Justification of Mission Need, which was endorsed by the Secretary of Energy. Identification of target ignition as the next important step in ICF development for both defense and non-defense applications is consistent with the earlier (1990) recommendation of DOE's Fusion Policy Advisory Committee, and the National Academy of Sciences Inertial Fusion Review Group. In 1995, the DOE's Inertial Confinement Fusion Advisory Committee affirmed the program's readiness for an ignition experiment. A review by the JASONs in 1996 affirmed the value of the NIF for stockpile stewardship.

The NIF project supports the DOE mandate to maintain nuclear weapons science expertise required for stewardship of the stockpile. After the United States announcement of a moratorium on underground nuclear tests in 1992, the Department established the Stockpile Stewardship program to ensure the preservation of the core intellectual and technical competencies in nuclear weapons. In addition, as a means of reducing the danger posed by nuclear weapons proliferation, the President announced that 'the United States would seek a zero yield Comprehensive Test Ban Treaty (CTBT). The treaty was signed on September 24, 1996. One of the six safeguards that defines the terms of the CTBT is the conduct of the Stockpile Stewardship program to ensure the safety and reliability of the stockpile. The NIF is one of the most vital facilities in that program. The NIP will provide the capability to conduct laboratory experiments to address the high energy density and fusion aspects that are so important to both primaries and secondaries in stockpile weapons.

At present, the Nation's computational capabilities and scientific knowledge are inadequate to ascertain all of the performance and safety impacts from changes in the nuclear warhead physics packages due to aging, remanufacturing, or engineering and design alterations. Such changes are inevitable if the warheads in the stockpile are retained well into the next century, as expected. In the past, the impacts of such changes were evaluated through nuclear weapon tests. Without underground tests, we will require better, more accurate computational capabilities to assure the reliability and safety of the nuclear weapons stockpile for the indefinite future.

To achieve the required level of confidence in our predictive capability, it is essential that we have access to near-weapons conditions in laboratory experiments. The importance of nuclear weapons to our national security requires such confidence. For detonation of weapon primaries, that access is provided in part by hydrodynamic testing. For secondaries and for some aspects of primary performance, the NIF will be a principal laboratory experimental physics facility.

1. Title and Location of Project:

National Ignition Facility
Lawrence Livermore National Laboratory (LLNL) ,Livermore, CA

2a. Project No. 96-D-lll 2b. Construction Funded

The most significant potential commercial application of ICF in the long term is the generation of electric power. Consistent with the recommendations of the Fusion Policy Advisory Committee, the NIF will provide a unique capability to address critical elements of the inertial fusion energy program by exploring moderate gain (1 to 10) target designs, establishing requirements for driver energy and target illumination for high gain targets, and developing materials and technologies useful for civilian inertial fusion power reactors.

The ignition of an inertial fusion capsule in the laboratory will produce extremely high temperatures and densities in matter. Thus, the NIF will also become a unique and valuable laboratory for experiments relevant to a number of areas of basic science and technology.

The NIP is an experimental fusion facility consisting of a laser and target area, and associated assembly and refurbishment capability. The laser will be capable of providing an output pulse with an energy of 1.8 megajoules (MJ) and an output pulse power of 500 terawatts (1W) at a wavelength of 0.35 micrometers (J.lm) and with specified symmetry, beam balance and pulse shape. The NIF design calls for an experimental facility to house a multibeam line, neodymium (Nd) glass laser capable of generating and delivering the pulses to a target chamber. In the target chamber, a positioner would center a target containing fusion fuel, a deuterium-tritium mixture, for each experiment. Diagnostics provided by this project would provide the test data to demonstrate subsystem performance and initial operations.

The NIP experimental facility, titled the Laser and Target Area Building, would provide an optically stable and clean environment. This laser building would be shielded for radiation confinement around the target chamber and will be designed as a radiological, low -hazard facility capable of withstanding the natural phenomena specified for the LLNL site. The baseline facility is for one target chamber, but the design shall not preclude future upgrade for additional target chambers.

The NIP project consists of conventional and special facilities.

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Site and Conventional Facilities include the land improvements (e.g., grading, roads) and utilities (electricity/heating gas, water), as well as the laser building, which has an approximately 20/300 square meters footprint and 38/000 square meters in total area. It is a reinforced concrete and structural steel building that provides the vibration-free, shielded, and clean space for the installation of the laser, target area, and integrated control system. The laser building consists of two laser bays, each 31 meters (m) by 135 m long, and a central target area-a heavily shielded (1.8 m thick concrete) cylinder 32 m in diameter and 32 m high. The laser building includes security systems, radioactive confinement and shielding, control rooms, supporting utilities, fire protection, monitoring, and decontamination and waste handling areas. Optics assembly and refurbishment capability is provided for at LLNL by incorporation of an optics assembly area attached to the laser building and minor modifications of other existing site facilities.

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8.

Title and Location of Project:

National Ignition Facility
Lawrence Livermore National Laboratory (LLNL),Livermore, CA

Project Descril;!tion. Justification and Scol;!e (continued)

2a. Project No. 96-D-lll 2b. Construction Funded

Special facilities include the Laser System, Target Area, Integrated Computer Control System, and Optics.

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The laser system is designed to generate and deliver high power optical pulses to the target chamber. The system consists of 192 laser beamlets configured to illuminate the target surface with a specified symmetry, uniformity, and temporal pulse shape. The laser pulse originates in the pulse generation system. This precisely formatted low energy pulse is amplified in the main amplifier. To minimize intensity fluctuation, each beam is passed through a pinhole in a spatial filter on each of the four passes through the amplifier and through a transport spatial filter. The beam transport directs each high power laser beam to an array of ports distributed around the target chamber where the frequency of the laser light is tripled to 0.35 ~, spatially modulated by phase plates and focused on the target. Systems are provided for automatic control of alignment and the measurement of the power and energy of the beam. Structural support and auxiliary systems provide the stable platform and utilities required.

The target area includes a 10 m diameter, low activation (i.e., activated from radiation) aluminum vacuum chamber located in the Target Area of the laser building. Within this chamber, the target will be precisely located. The chamber and building structure provide confinement of radioactivity (e.g., x-rays, neutrons, tritium/ and activation products). Diagnostics will be arranged around the chamber to demonstrate subsystem performance for project acceptance (TEC) and initial operations (TPC).
Structural/ utility and other support systems necessary for safe operation and maintenance will also be provided in the Target Area. The target chamber and staging areas will be capable of conducting experiments with cryogenic targets. The Experimental Plan indicates that cryogenic target experiments for ignition will be needed 2-3 years after completion of the project. Therefore, the targets and this cryogenic capability will be supplied by the experiments. The NIP project will make mechanical and electrical provisions necessary to position and align the cryogenic targets within the chamber. The baseline is for indirectly driven targets. An option for future modifications to permit directly driven targets is included in the design. -~

The integrated computer control system includes the computer systems (note: no individual computer will cost over $100,000) required to control the laser and target systems. The system will provide the hardware and software necessary to support NIF operations. Also included is an integrated timing system for experimental control of laser and diagnostic operations. Safety interlocks and access control will also be provided.

Thousands of optical components will be required for the 192 beamlet NIP. These components include laser glass, lenses, mirrors, polarizers, deuterated potassium dihydrogen phosphate crystals, pulse generation optics, debris shields and windows, and the required optics coatings. Optics includes quality control equipment to receive, inspect, characterize, and refurbish the optical elements.

1. Title and Location of Project:	National Ignition Facility Lawrence Livermore National Laboratory (LLNL),Livermore, CA	2a. Project No. 96-D-111 2b. Construction Funded

9.

Details of Cost Estimate Item Cost Total Cost

a. Design and Management Costs ,.,.." "...,",..., """.,...,",.,..."" : $ 220,100
1. Engineering, design and inspection at approximately 21.9 percent of construction costs (Item c) $ 152,000
2. Construction management at approximately 3.1 percent of construction costs (Item c) 21,500
3. Project management at approximately 6.7 percent of construction costs (Item c) 46,600
b. Land and land rights 0
c. Construction costs ,." ,..,., ,..,..."., 693,800
1. Improvements to land ' '...' '.' '. 1,800
2. Buildings modification. 175,800
3. Site-specific infrastructure 0
4. Other Structures 0
5. Utilities 500
6. Special Facilities 515,700
d. Standard equipment 0
e. Major computer items , "' ".''..'.' ' '...'.. 0
f. Removal cost less salvage " ".' ' '... 0
g. Design and project liaison, testing, checkout and acceptance ".'..'..' '..' ~--1). h. Subtotal (a through g) $ 913,900
i. Contingencies of approximately 15.1 percent of remaining costs at completion of Title I Design "..'.".' ' ".'.'. 131.800
j. Total line item cost [Section 11.a.1.(a)] ,..!! $1,045,7001/ k. LESS: Non.Federal contribution 1).

1. Net Federal total estimated cost (TEC) , ~$1,O45,700

The cost estimate assumes a project organization and cost distribution consistent with the management requirements appropriate for a DOE Strategic System as outlined in the DOE Order 430.1/ Life Cycle Asset Management and the NIP Project Execution Plan. Actual cost distribution will be in conformance with accounting guidelines in place at the time of project execution.

1/ Based on 100 percent Title I design completion

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1. Title and Location of Project:

10.

Method of Performance

National Ignition Facility
Lawrence Livermore National Laboratory (LLNL).Livermore. CA

2a. Project No. 96-D-lll 2b. Construction Funded

The NIP Laboratory Project Office (consisting of LLNL, LANL, SNL, and UR/LLE and supported by competitively-selected contracts with Architect Engineering firms, a Construction Manager, equipment and material vendors, and construction firms) will prepare the design, procure equipment and materials, and perform conventional construction, safety, system analysis, and acceptance tests. DOE will maintain oversight and coordination through the Headquarters Office of Inertial Fusion and the National Ignition Facility Project and the field office. DOE conducted the site selection and the NEP A determination. LLNL was selected as the construction site in the Record of Decision made on December 19, 1996. The procurement and installation/test of special equipment will be performed by the NIP Laboratory Project Office. Inspection and Title ill engineering contracts for the conventional systems will be competitively awarded. NIP start-up will be conducted by the NIP laboratory operations staff.

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1. Title and Location of Project:	National Ignition Facility Lawrence Livermore National Laboratory (LLNL),Livermore, CA	2a. Project No. 96-D-111 2b. Construction Funded

11. Schedule of Pro~ect Funding and Other Related Funding Requirements
Prior Years FY 1997

FY 1998

FY 1999

Ou~ears

IQtgJ

a. Total project costs
1. Total facility costs
(a) Line item (Section 9.j.) (b) Plant, Engineering and Design (PE&D) (c) Operating expenses funded equipment (d) Inventories
Total facility costs (Federal and Non-Federal) 2. Other project costs
(a) R&D necessary to complete construction (b) Conceptual design costs (c) Decontamination and Decommissioning (D&D) ,
(d) NEPA documentation costs , (e) Other project related costs (f) Total other project costs (g) Total project cost (h) LESS: Non-Federal contribution (i) Net Federal total project (TPC) Note: Budget Authority (BA) requirements

TEC 2 / apc 3 / ~.~~.:~.~~ Total.

33,990	103,010
0	0
0	0
0	0

180,600	208,300	519,800
0	0	0
0	0	0
0	0	0

-

1,045,700 0 0 0
1,045,700

7,500	32,400	53,400
12,300	0	0
0	0	0
2,600	650	550
14,218	2,632	2,450
36,618	35,682	56,400
70,608	138,692	237,000
0	0	0

37,400
~
79,200

131,900
.1:2..2QQ
191,100

876,400
31.,2.QQ
907,700

lL

6,200	1,400	100,900
0	0	12,300
0	0	0
400	400	4,600
3,400	12,700	35,400
10,000	14,500	153,200
218,300	534,300	1,198,900
0	0	0

~
6,800

1tl.illl
14,100

1,045,700 153.200
1,198,900

b.

Related annual costs (estimated life *of* project--30 years)
1. Facility operating costs $ 20,600 2. Facility maintenance and repair costs "...'...'.' '...' ' '..' "... 32,400
3. Programmatic operating expenses directly related to the facility ...,...,..,.,..,., ,..,., , ., 59,6004/
4. Capital equipment not related to construction, but related to the programmatic effort in the facility 200 5. GPP or other construction related to programmatic effort in the facility 200 6. Utility costs , 8,800 7. Other costs 6.200

Total related annual funding (in FY 1999 dollars) ~~~~~ .

2/ Specific long-lead procurements and contracts (e.g., building construction; major laser, optics, and target area special equipment) require BA in advance of costs.
3/ Specific long-lead procurements and contracts (e.g., optics facilitizati.on) require BA in advance of costs.
4/ This primary experimental operating expense will be included in the base Inertial Confinement Fusion Program budget.

1. Title and Location of Project:

National Ignition Facility
Lawrence Livermore National Laboratory (LLNL),Livermore, CA

12. lanation of To ther Related Fundin .

a. Total project costs
1. Total facility costs
(a) Line item -Narrative not required.
(b) PE&D-None.
(c) Operating expense funded equipment --None. (d) Inventories -None.

2. Other project costs

2a. Project No. 96-D-lll 2b. Construction Funded

(a) R&D necessary to complete construction -Costs include optics vendor facilitization ($73,200,000) and optics quality assurance ($27,700,000).
(b) Conceptual design and engineering studies -Includes the original conceptual design report completed in FY 1994 ($12,000,000) and the conceptual design activities for the optical assembly and refurbishment capability and site infrastructure ($300,000).
(c) Decontamination and decommissioning (D&D) -None.
(d) NEP A documentation -Preparation includes the NIF portion of the Stockpile Stewardship and Management Programmatic Environmental Impact Statement ($2,600,000) and environmental monitoring and permits ($2,000,000).
(e) Other project related costs -Engineering studies (including advanced conceptual design) of project options ($5,800,000); assurances, safety analysis, and integration ($9,300,000); start-up planning, management, training, and staffing ($8,600,000); procedure preparation ($1,500,000); operating spares ($600,000); start-up ($7,700,000); and ORR ($1,900,000).

b. Related annual costs 'I
1. Facility operating costs -Includes operator labor, engineering support and materials for upgrades and modifications, and consumables for operation of special equipment.
2. Facility maintenance and repair costs -Includes cost of labor, engineering support, and consumables for special equipment maintenance and refurbishment, including optics. Also includes maintenance for the laser building and support buildings.
3. The current NOVA experimental program, including LLNL, LANL, SNL, and General Atomics, is approximately $40,100,000 annually. Based on use of complex cryogenic targets, increased diagnostics support, and higher levels of three dimensional physics modeling, the annual direct NIP experimental program costs are estimated at $59,600,000. Additional program costs will be associated with use of the facility.
4. Fabrication accounts, procurements, such as small lasers and some laser parts, Computer-Aided Design systems, etc. to support upgrades.
5. Minor additions and modifications to the facility related to programmatic effort.
6. Electricity only. Gas, sewer, water, etc. are paid out of the General and Administrative budget.
7. Nitrogen and argon for laser and transport beam tubes, stock inventory, and procurement support.

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1. Title and Location of Project:

National Ignition Facility
Lawrence Livermore National Laboratory (LLNL) ,Livermore, CA

DON'T INCLUDE THIS PAGE FOR CONGRESSIONAL

13. Design and Construction of Federal Facilities

2a. Project No. 96-D-lll 2b. Construction Funded

All DOE facilities are designed and constructed in accordance with applicable Public Laws, Executive Orders, OMB Circulars, Federal Property Management Regulations, and DOE Orders. The total estimated cost of the project includes the cost of measures necessary to assure compliance with Executive Order 12088, "Federal Compliance with Pollution Control Standards"; section 19 of the Occupational Safety and Health Act of 1970, the provisions of Executive Order 12196, and the related Safety and Health provisions for Federal Employees (CFR Title 29, Chapter XVII, Part 1960); and the Architectural Barriers Act, Public Law 90-480, and implementing instructions in 41 CFR

101-19.6. The project will be located in an area not subject to flooding detennined in accordance with Executive Order 11988. DOE has reviewed the GSA inventory of Federal Scientific laboratories and found insufficient space available, as reported by the GSA inventory.

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NIF BASELINE CHANGE PROPOSAL LOG

BCP#	BCP Tile	Date Received	Date Resolved	Level 3 BCCB Disposition	Level 2 BCCB Disposition	Level 1 BCCB Disposition	Change Submitted by

96-001 96-002

96-003

Contingency Allocation
Update of NIF Primary
Criteria/Functional
Requirements
Addition of Optics
Assembly Building
to Project Data Sheet
Directed Changes in DOE
Orders and Federal
Regulations
Functionality Changes
to the NIF Baseline

96-004

96-005

96-006

1/9/96 2/12/96

96-007 96-008

Conduct Engineering
Option Studies

2/12/96

1/10/96 2/15/96

SDRs 1-4, Revision A
Title I SDR Update

2/29/96

2/15/96

2/29/96

Approved
Approved for sub-mittal to Level 2 Board
Approved for sub-mittal to Level 2 Board
Approved for sub-mittal to Level 2 Board
Approved for sub-mittal to Level 2 Board
Approved for sub-mittal to Level 2 Board
Approved
Approved

2/29/96

3/1/96

4/12/96 9/5/96

3/1/96

NA
Approved for sub-mittal to Level 1 Board
Approved for sub-mittal to Level 1 Board
Approved for sub-mittal to Level 1 Board 3/6/96
Approved for sub-mittal to Level 1 Board 3/6/96
Approved for sub-mittal to Level 1 Board 3/6/96
NA
NA

3/1/96

4/16/96 9/11/96

NA
Disapproved 2/28/96

Disapproved 2/28/96

J. Post
G. Deis/J. Yatabe/ J Hunt

Approved 4/1/96

Approved 4/1/96

J Yatabe

G. Deis/J. Yatabe

Approved
4/1/96

G. Deis/J. Yatabe

NA NA

G. Deis/J. Yatabe

G. Deis G.Deis

97-001

97-002

97-004

97-003

Title I Update of Functional Requirements/Primary Criteria
Project Data Sheet Update

Functional Requirements & Primary Criteria Minor Wording Changes
Thermal Hat for Target Bay

12/11/96

12/11/96

3/10/97

3/12/97

12/11/96

12/11/96

3/10/97

3/14/97

Approved for Sub- Approved for sub- Approved mittal to Level 2 mittal to Level 1 12/20/96
Board 12/13/96
Approved for Sub- Approved for sub- Approved for sub- mittal to Level 2 mittal to Level 1 mittal to Level 0
Board 12/13/96 Board 12/20/96 Aproved by Level 0 on March 7, 1997

Approved for Sub-
mittal to Level 2

Approved

NA

NA

Page 1

G. Deis

D. Rardin

G. Oeis

P. Kempel

6/10/97

97-005

97-006

97-007

97-008

Cooling the Amplifier with N2 Gas
Flowdown of Gov't Orders & Standards
Target Bay & Switch Yard Siding Exterior Finish

Updates to Project Data Sheet

4/23/97

4/15/97

4/15/97

6/10/97

4/23/97

4/23/97

6/10/97

6/10/97

Approved

Approved

Rejected

NA

Approved for Sub-

mittal to Level 2

Page 2

NA

B. Pedrotti

G. Oeis

P. Kempel

D. Rardin

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6/10/97

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NATIONAL IGNITION FACILITY PROJECT LEVEL 2 -BASELINE CHANGE PROPOSAL RECORD OF DECISION

Title: NIF Project Engineer Date

Title: OAK ICF Program Manager Date

Title: Director, EFM Date

Title: Director. WRD

Date

Title:

Date

Title: Date'

Title:

Title:

Date

DISPOSITION

Date

( ) ~pYroved
...N Endorsed
( ) Rejected
( ) Directed Change

BCP NUMBER:

97-008

I MEMBERS lReauired) RECOM:MENDATION

BCP TITLE: Updates to Project Data Sheet

I ADVISORS (As Required)

Title: ICFD ES&H Manalrer

Date

I RECOMMENDATION

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Lawrence Livermore National Laboratory

June 10, 1997
NIF-OOO2457 WBS 1.1.1

Mr. Scott L. Samuelson
U.S. Department of Energy
Oakland Operations Office
Lawrence Livermore National Laboratory Livermore, CA 94550

Re:

FY 1999 NIF Project Data Sheet

Dear Mr. Samuelson:

On June 10, 1997 the NIF Level 3 Baseline Change Control Board approved the FY 1999 NIF Project Data Sheet and is submitting it to the Level 2 Baseline Change Control Board. with a recommendation for approval.

Sincerely,

A. Paisner
Project Manager
National Ignition Facility

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Attachment: Minutes from the L~vel 3 BCCB Meeting

cc:
David H. Crandall, Chairman of the Levell BCCB Jane W. Gartner, Secretary of the Levell BCCB Leann Morrow, Secretary of the Level 2 BCCB

An Equal Opporlunity Employer. University of California. P.O. Box 808 Livermore, California 94551-9989. *Telephone (510) 422-1100 .Twx91G-386-8339 UCLLL L VMR*

National Ignition Facility Project

Mail Stop: L-493

Ext: 2-6115

June 10,1997 NIF-0002459
WBS 1.1.2

TO: FROM: SUBJECT:

Distribution ::
1 "':
JonYatabe'\,v""~- "',"
Minutes of the June 10, 1997 NIF Level 3 Baseline Change Control Board (BCCB) Meeting

The Level 3 BCCB met to resolve BCP 97-007, Target Bay and Switchyard Metal Siding Exterior Finish, and BCP 97-008, Updates to Project Data Sheet. Dave Coats presented the added information from the Fire Marshall accepting the use of Drivit insulation for the NIP. Paul Kempel stated that an expert from Tinney and Associates is convinced that the application is completely feasible. This expert will be retained to consult on the LTAB application. Bob Kauffman asked about maintenance costs and was told that replacement might be needed in 15 years. The vote was unanimous to reject BCP 97-007. The represents cost avoidance, and no contingency is allocated.

Dave Rardin presented the proposed updates to the FY 1999 Project Data Sheet contained in BCP 97-008. He explained that there were no changes in total estimated cost, total project cost, and schedule. The cost profile was changed, and the annual operating cost increased by 4%, primarily due to increased utility costs. Allen Levy asked if there were federal requirements in Section 13 that contradicted the current Primary Criteria and Functional Requirements. Section 13 requirements are based on the January 1997 DOE Budget Formulation Handbook II-4.19 to 4.20. Gary Deis and Jon Yatabe were asked to review this section with Chuck Taylor. Chuck Taylor agreed to resolve the wording of that section.

Neither BCP involved the allocation of contingency *I* and the contingency log does not require updating. The updated baseline change log is attached.

JMY/jlh
Attachments
Distribution: Copy to:
Level 3 BCCB Members D. Coats, L-445
J. Boyes, SNL G. Deis, L-465
J. Hunt, L-465 A. Donovan, L-495 R. Kauffman, L-482 P. Kempel, L-445 S. Kumpan, L-465

A. Levy, L-488
H. Lowdermilk, L-490
J. Paisner, L-488
D. Rardin, L-465
R. Sawicki, L-465
M. Sorem, LANL
J. Soures, UR/LLE

University 01 Ca/ilornip

III. Lawrence Livermore
~ National Laboratory

DATE: September 25, 1998 ':

1 ~~~6~ DP-40:-J.Gartner:3-8235 :;1

SUBJECT: REVIEW OF BASELINE CHANGE PROPOSAL (BCP) 98-012 FOR LEVEL 1 BASELINE CHANGE CONTROL BOARD ACTION FOR THE NATIONAL IGNITION FACILITY PROJECT AT LIVERMORE, CALIFORNIA

""",-- -

TO: 'H. Gladden~ DOE Oakland (ICF) Baseline Change Control Board Secretariat

-A.'- :~!"

A Baseline Change Proposal for the National Ignition Facility project was submitted to this office for processing.

The board members and advisors provided their recommendations. On this date, the Chairman approved the BCP.

Should there be questions concerning the BCP I please contact me at (301) 903-8235 or Dave Crandall at (202) 586-7349.

Jane W.
DP

Gartner,

Secretariat Baseline Change Control Board

~

Attachment

cc: J. Wolfe, DP-41
A. Tavares, FM-20

DEPARTMENT OF ENERGY BASELINE CHANGE PROPOSAL LEVEL 1 DISPOSITION	
PROJECT TITLE: National Ignition Facility (NIF)	
30) BCP NUMBER: 98-012	31) BCP TITLE: Revision to FY2000 NIF (96-D-111) Project Data Sheet

NAME (PrintIType)

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RECOMMENDATION

.ADVISORS (As Required) RECOMMENDATION ,

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SIGNATURE -Dr. V. Reis, ASDP If Level 0 Action Re uired DATE] DEFER [ ] REJECT 33) Remarks (If BCP is Approved with Conditions, Deferred, or Rejected)

DISPOSITION

DECISION

National Ignition Facility
Baseline Change Proposal

BCP No.
<18-012

Title: Revision to FY2000 NIF (96-0-111) Project Data Sheet

Submitted by: Dave Rardin Phone: 3-1186

Change Priority .Routirle
0 Priority Need decision by:
(date)

CCB level
0 level 0 .Levell

Change Description and Justification:

0 Level 2 0 Level 3

Directed Change? 0 Yes
Basis:

0 Scope
8fI.Inding

0 Schedule

0 Cost

I This BCP requests revisions to the FY2000 NIF (96-0-111) Project Data Sheet with a change to the Other Project Cost (OPC) funding requirement. The proposed changes are to reduce the FY2000 Budget Authorization (BA) requirement by $4.1M (from $10.0M to $S.9M) and to increase the FY2001 BA by $4.1M (from $1.8M to $S.9M). This proposed revision is reflected on Attachment 1, Item 11 of the current Project Data Sheet. This draft shows the changes since the ! data sheet was submitted in the FY2000 Field Budget Request (version shown in attachment 2).

This funding profile change is necessitated in order to meet the FY2000 Defense Programs site target for funding to LLNL and is in the interest of generating the $16M needed to start the Terascale Computing Facility in FY2000. The NIF will not be adversely impacted by delaying this level of contract placements from FY2000 into FY2001.

Record of CCB Decisions

level 4 CCB Decision
0 Approved
0 Disapproved
0 Returned for specific data 0 Endorsed and forwarded

level 3 CCB Decision
0 Approved
0 Disapproved
0 Returned for specific data ~ Endorsed and forwarded

Comments/limitations:
Level 4 CCB decision not required

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Approval/ endorsement signature

Comments/limitations:

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Approval/ endorsement signature
~ *fl. j7~* ?U-'L

Date

Date
8/14/98

Attachment 1 - NIF Project Data Sheet, Item 1)
Revised to reflect proposed changes since FY2000 Field Budget Request

DRAFT

Title and Location of Project

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National Ignition Facility
Lawrence Livermore National Laboratory (LLNLI.Livermore. CA

-
24. Project No. 96-0-111 2b. Construction Funded

••
Schedule of Project Funding and Other Related Funding Requirements
Prior Years FY 1998
.

a Total project costs 2/ 1 Total facility costs
(a) Design
(b) Construction

96,199
12.085

42,671 118.845

FY 1999

2,750
229.450

FY 2000

250

~~o

FY2001

171,000

Total facility costs (Federal and Non-Federal) 108,284
2 Other project costs
(a) R&D necessary to complete construction $ 34,552 (b) Conceptual design costs *12,300 (c)* Decontamination and Decommissioning (D&D) ...0 (d) NEPA documentation costs """""""""""""""""""" 3,166 *(e)* O~her project related costs ~ (f) Total other project costs $ ~ (g) Total project cost $ 174,687 (11) LESS: Non-Federal contribution S 0 (i) Net Federal total project (TPC) """""""""""""""""'" $174,687
_Note: Budget Authority (BA) requirements .
-TEC 3/ ~~ *$169,300* $197,800 $284,200
OPC 4/ $.!Q!m2 S ~ $ M.QQ
Total. , $ *270,300* $ 229,100 $ 291,000 I
Related aIU'lual costs (estimated life of proje~t-30 years) ,
1. Facility operating costs ,' : : 2. Facility maintenance and repair costs 3. Pfogrammatic operating expenses directly related to the facility 4. Capital equipment not related to construction, but related to the programmatic effort in the facility
5.. CPP or other construction related to programmatic effort in the .facility , 6 Utility costs ,... """"""""""""""""""""""""""""..., 7 Other costs """""""""""""""""""""""""""" """"""
Total related annual funding (in FY 2000 dollars} """""""""""""""'"

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$254,000

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$80,000

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2/ Prior Years actuals are changed to re:oncile with DO£ Financial Information System (FIS) through FY 1997 and cost profiles for fY 1998 and beyond are updated to reflect ProJect-to-date contractuals and contingency allocations as of March 31. 1998.
***31* Specific long-lead procurements and contracts (e.g.. building construction; major laser, optics, and target area special equipment! require BA in advance of costs**

4/ Specific long-lead procurements and contracts (e.g.. optics facilitizationl require BA in advance of costs.
5/ This primary experimental operating expense will be included in the base Inertial Confinement Fusion Program budget.
I

ttachment 2 — NIF Project Data Sheet, Item 11
FY2000 Field Budget Request

Tlcle and Location of Project

National Ignition Facility
Lawrence Livermore National Laboratory ILLNLI,Livermore. CA

2a. Project No. 96-D-111 2b. Construction Funded

11

Schedule of Project Funding and Other Related Funding Requirements ..Prior Years FY 1998

a Total project costs 2/ I T ota I facility costs
(a) Line item (Section 9.d.) (h) Plant", Engineering and Design (PE&D) (c) Operating expenses ~ded equipment ,..
(d) Inventories
Total facility costs (Federal and Non-Federal) $108,284
:! Other project costs
(a) R&D necessary to complete construction $ 34,552
(h) Conceptual design costs 12,300
(c) Decontamination and Decommissioning (D&D) ...0 (d) NE~A documentation costs ' """'..' " "..'..'" 3,166 *(e)* Other project related costs ~ (f) Total other project costs $ ~
(g) Total project cost $174,687
(h) LESS: Non-Federal contribution 0
(i) Net :Federal total project (TPC) $174,687 $ 198,173 $267,640 $ 240,800 $ ~ :.. Note Budget Authority (BA) requirements
TEC 3/ $169,300 $ 197,800 $ 284,200 $ 248,100 $ 74,100
.-' OPC4/ $101,000 $ ~ $ ~ $ ~ $ ~ .Tot~..1. , , = $270,300 $ 229,100 $ 291,000 ~ $ 258,100 $ 75,900 U
.k! Related annual costs (estimated life of project-30 years)
1 Facility operating costs. , , .,
Fili ..d .
t_.ac ty maIntenance an repair cos s "."""""""""".."".."""..'."'..".'.'..'.'."""."".'."."""."""""""'.""""" : : 3. Progranunatic operating expenses directly related to the facility , """""".""""""""".""""""""' 4. Capital equipment not related to construction, but related to the programmatic effort in the facility 5. GPP or other construction related to programmatic effort in the facility "".""""'."""""'."".""'.".'
6 Utility costs 7 Other costs ,.- '.'..""'.'.' '...""""'.'.""""." "'..'."'.""..."'."..""""""""".""'.'" : Total related annual funding {in FY 2000 dollars) , : "".""..."'.

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FY 1999

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FY2000

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