ICF Program Status

Presented to:
Fusion Power Associates
Annual Meeting

By:
Dr. Christopher J. Keane
Assistant Deputy Administrator for
Inertial Confinement Fusion and the NIF Project
National Nuclear Security Administration

September 28, 2006

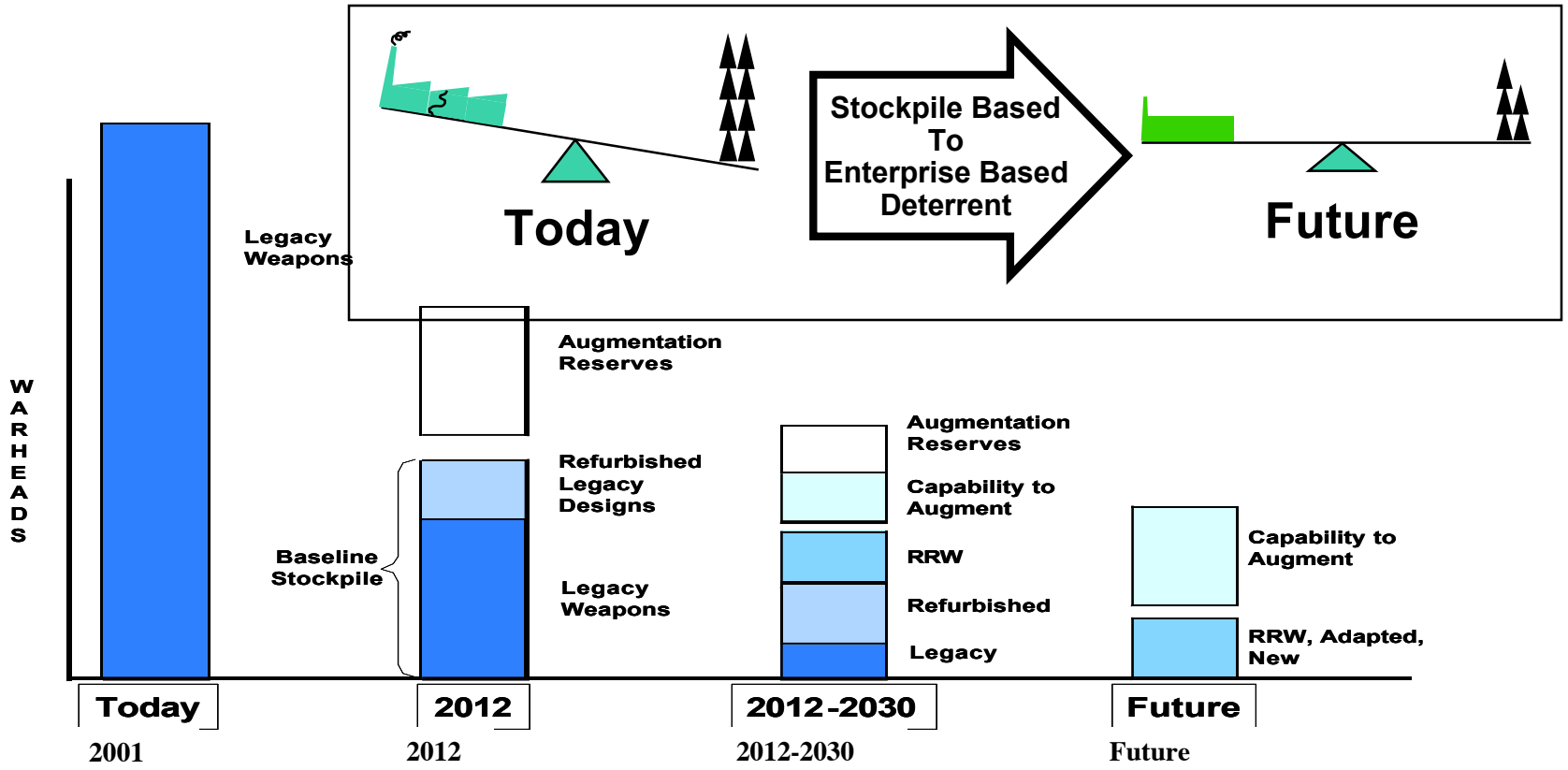
Key points

- **A new vision (Complex 2030) for the nuclear weapon complex and stockpile is being implemented**
  - **High energy density physics- essential piece of Defense Programs long term science and technology base**
  - **Logic: increase margin/uncertainty**

- **The next 10 years will offer extraordinary new opportunities for inertial fusion and high energy density physics**
  - **OMEGA EP; Z/ZR; NIF and ignition; petawatt capabilities;…**
  - **Ignition and applications planned for NIF; integrated program of "non-ignition" experiments to be conducted at OMEGA/ZR/NIF**

- **Federal government vision for high energy density physics under development- response to NAS reports and Senate mark (HEDP Office)**
  - External use program at "intermediate scale" facilities

The nuclear weapon stockpile and complex will be transformed



Increased confidence in warhead designs and demonstration of a responsive infrastructure will enable a reduction in total stockpile size

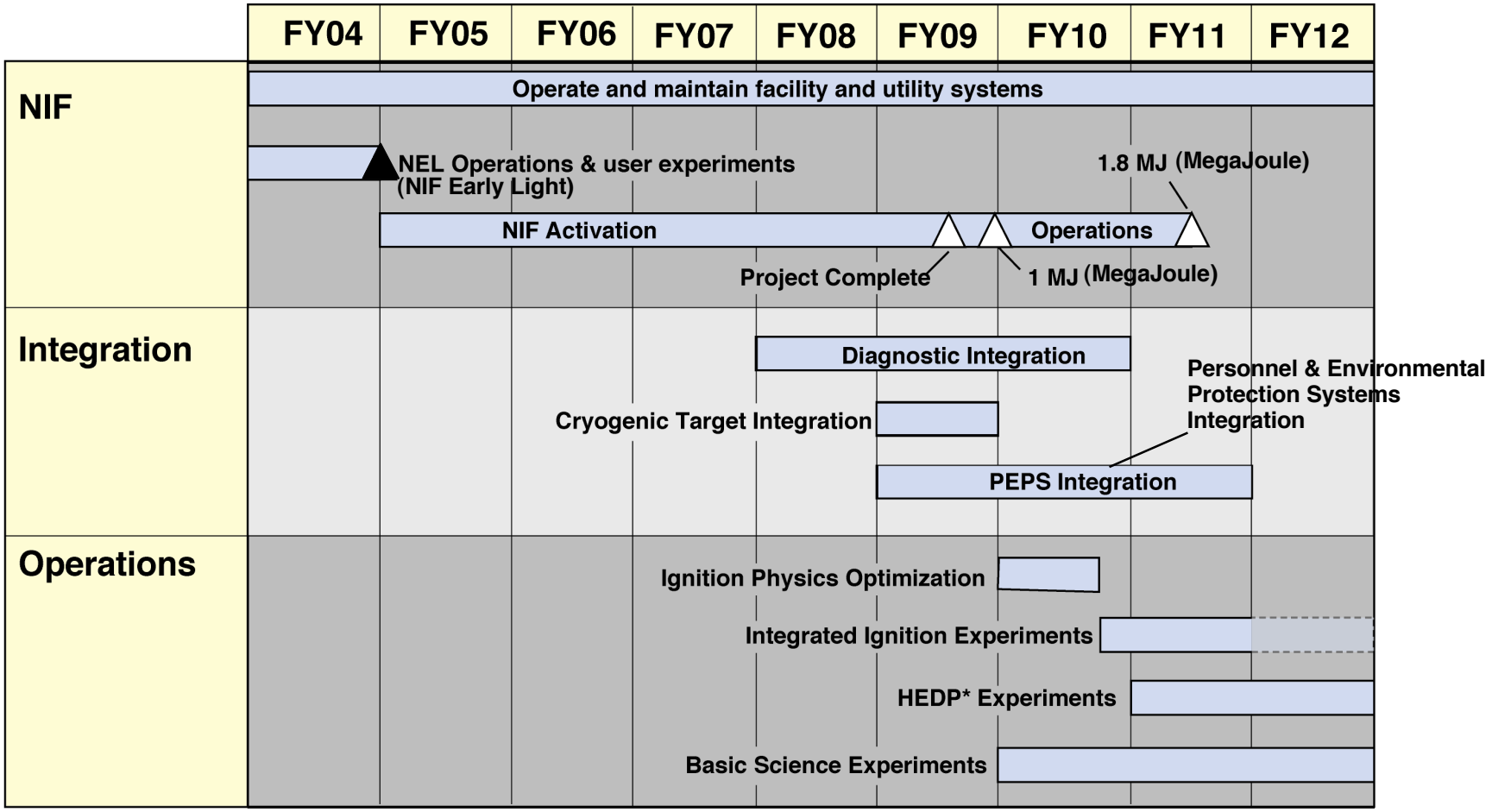
"Getting the Job Done"
Building Confidence in the Transformation Process

National Nuclear Security Administration

NNSA short term commitments:

- Continue to deliver products to DoD.
- Eliminate backlog of surveillance units in FY 2007.
- Accelerate dismantlement of retired weapons by 49% from FY 2006 to FY 2007.
- Deliver B61-ALT357 First Production Unit (FPU) in FY 2006.
- Deliver W76 FPU in FY 2007.
- Certify the W88 with a new pit and manufacture 10 pits in FY 2007.
- Extract Tritium in FY2007.
- Support the science base by completing: pit lifetime estimates (2006), ASC Purple machine (2006), MESA (2008), DARHT (2008), and NIF (2010).
- Support an RRW decision by the Nuclear Weapons Council in Nov 2006.
- Implement starting actions to achieve Complex 2030 infrastructure vision.

The plan for use of NIF calls for first ignition experiments in FY2010



* Weapons physics experiments in support of Stockpile Stewardship

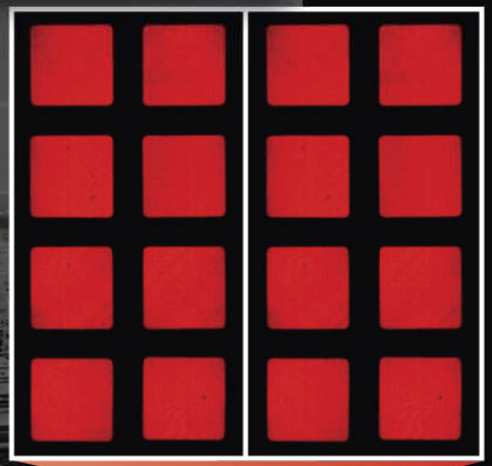
Both Bundles Meet All Performance Requirements

- Over 2 MJ equivalent in the ultraviolet
- 2 Bundles produce 300kJ @ 1ω

NATIONAL IGNITION FACILITY

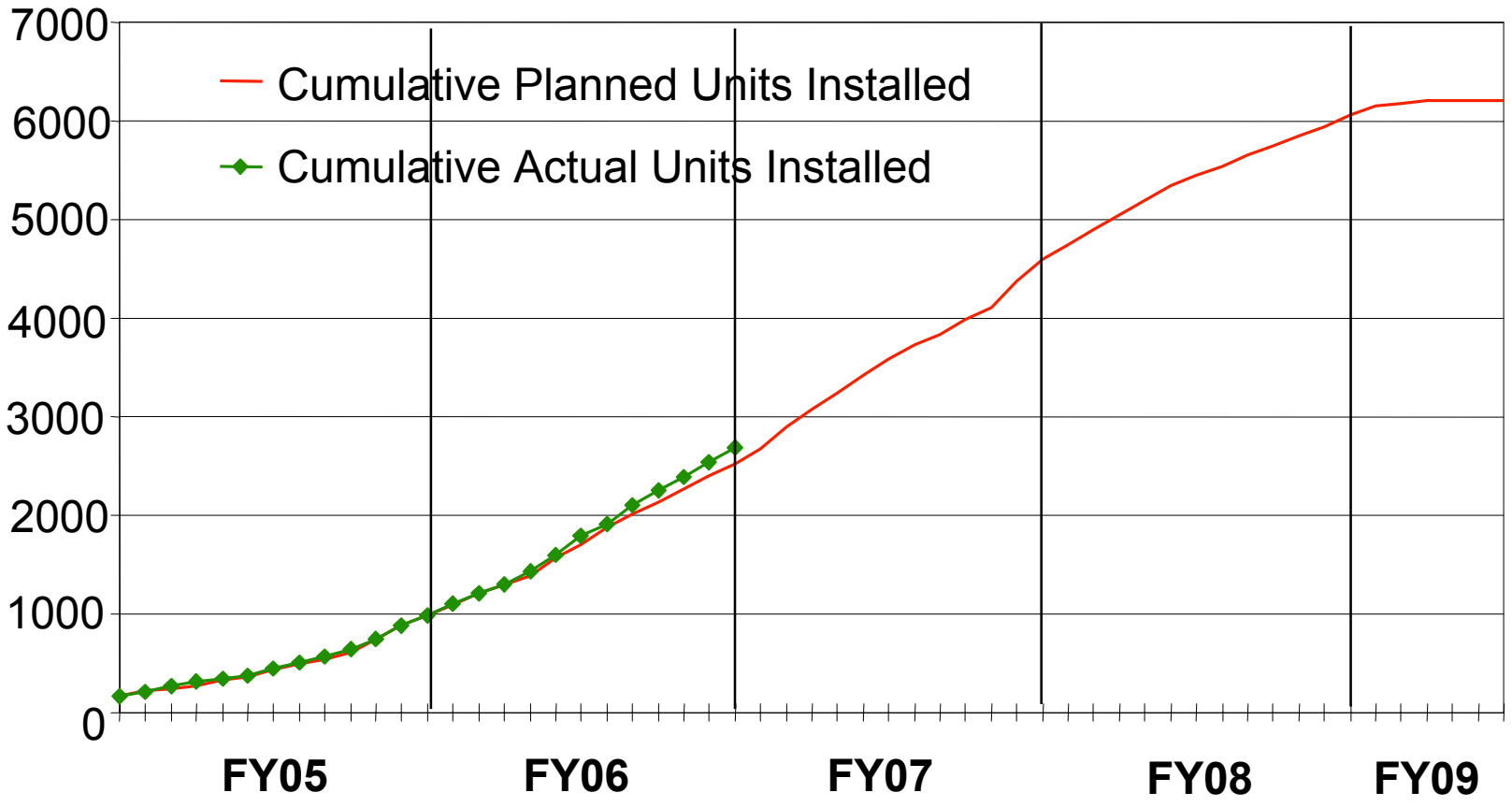
LRU Installation Count >2600

- Over 43% complete and ahead of schedule
- Learning curves at 80% or better



NIF is now nearly 88% complete and on schedule

NIF Line-Replaceable-Unit installation progress through Sept. 26, 2006



NIF and ignition is a major Departmental commitment

National Nuclear Security Administration

The Secretary of Energy
Washington, DC 20585

November 18, 2005

The Honorable Pete V. Domenici
United States Senate
Washington, D.C. 20510-6050

Dear Senator Domenici:

I want to follow up our recent phone conversation regarding the Department of Energy's (DOE) national security programs and the role that the National Ignition Facility (NIF) and the Dual-Axis Radiographic Hydrotest (DARHT) play in these programs. The DOE Stockpile Stewardship Program, including our scientific tools, is vital to the continued certification and assessment of the nuclear weapons stockpile without the need for underground nuclear testing. There are two projects in particular that I would like to highlight.

Proceeding with the National Ignition Facility is essential to the success of the Stockpile Stewardship Program. NIF is the only facility capable of creating the extreme conditions of temperature and pressure required for fusion ignition and other experiments that support stockpile stewardship. I visited the NIF site at Lawrence Livermore National Laboratory, and I have concluded that NIF ignition and the experimental campaigns planned for NIF will yield vital data necessary to maintain our nuclear deterrent. NIF remains a top priority for the Department.

The DARHT Facility at Los Alamos National Laboratory is another project that has my attention and support. I know DARHT is already producing results important to stockpile stewardship and that its capabilities will increase significantly when the two-axis hydrodynamic capability is established in Fiscal Year 2008. While there have been cost and schedule concerns at DARHT in the past, the Department is resolved to complete the project on the revised baseline.

Thank you for your continued support for these vital national security programs. I look forward to working with you to complete these important facilities. If you have any questions on these important DOE initiatives, please contact me or Ms. Jill Sigal, Assistant Secretary for Congressional and Intergovernmental Affairs, at (202) 586-5450.

Sincerely,

Samuel W. Bodman

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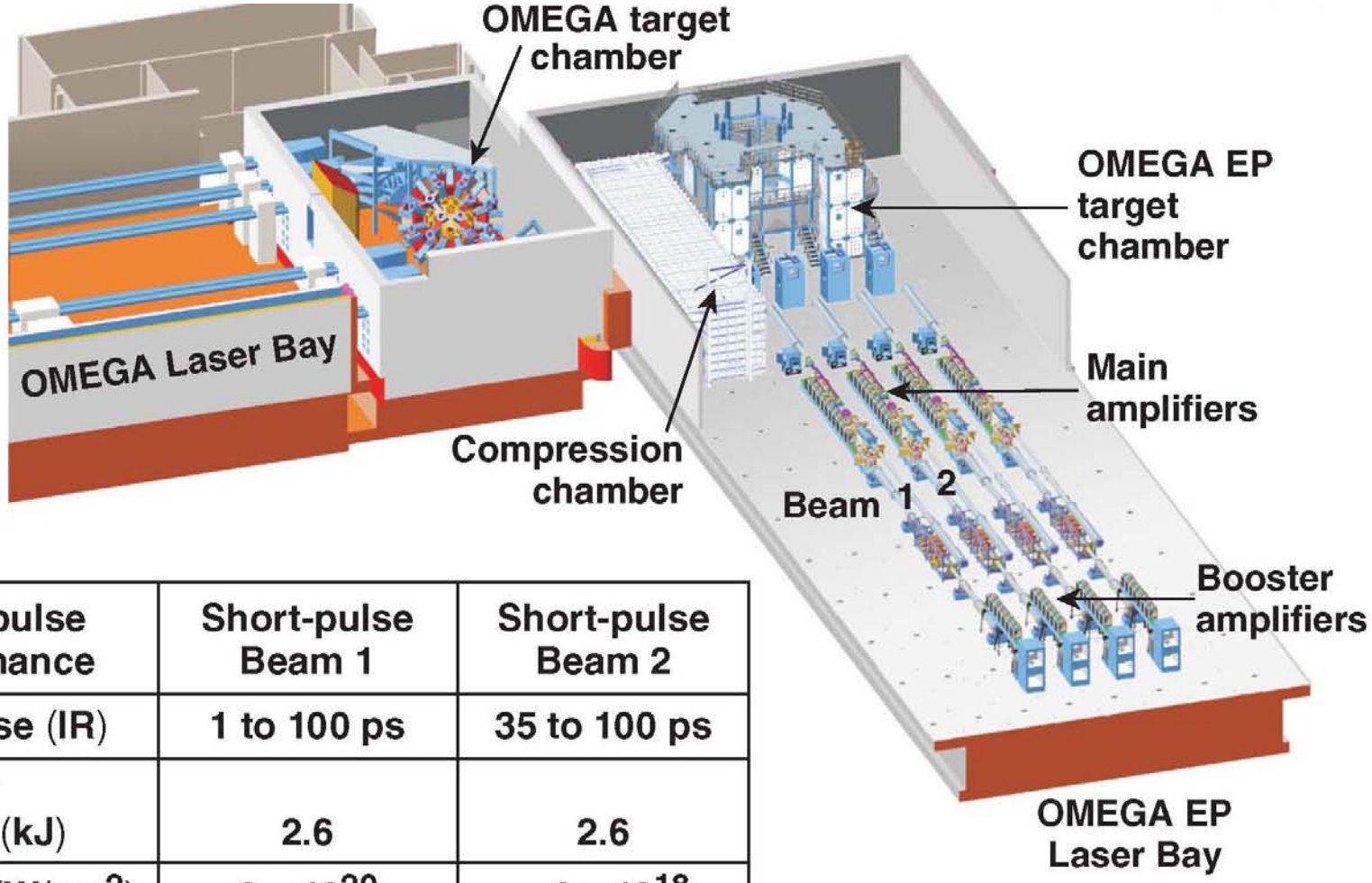
The OMEGA EP laser beams will be located next to the existing OMEGA facility

National Nuclear Security Administration

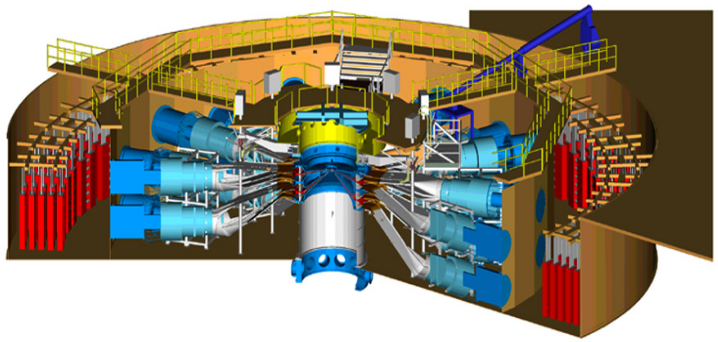


Short-pulse performance	Short-pulse Beam 1	Short-pulse Beam 2
Short pulse (IR)	1 to 100 ps	35 to 100 ps
IR energy on-target (kJ)	2.6	2.6
Intensity (W/cm^2)	6×10^{20}	$\sim 4 \times 10^{18}$
Focusing	> 80% in 20 μm	> 80% in 40 μm

G5546q

OMEGA EP laser bay- August 2006

ZR and Z Beamlet- petawatt are important additions to program capability



- The ZR project is upgrading the performance of Z
  - 18 MA to 26 MA
  - 2x increase in diagnostic access
  - 2x shot rate capability

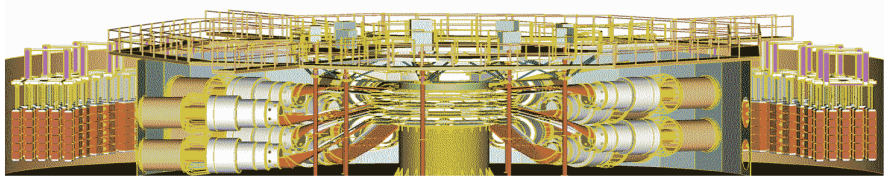
- The Z-Petawatt project is upgrading the capability of Z-Beamlet
  - 2 TW to 1 PW
  - backlighter hv 9 - 25 keV
  - integrated FI experiments on ZR

- The ZR and Z-Petawatt facilities will begin operations in 2007.

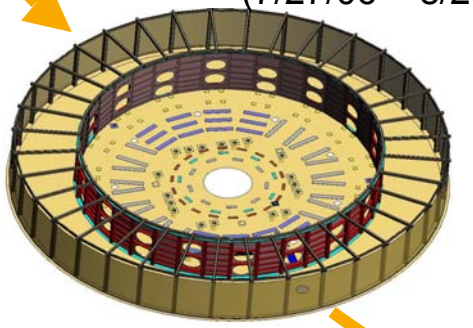
The last Z shot was July 26, 2006; refurbishment is in progress.

Sandia National Laboratories

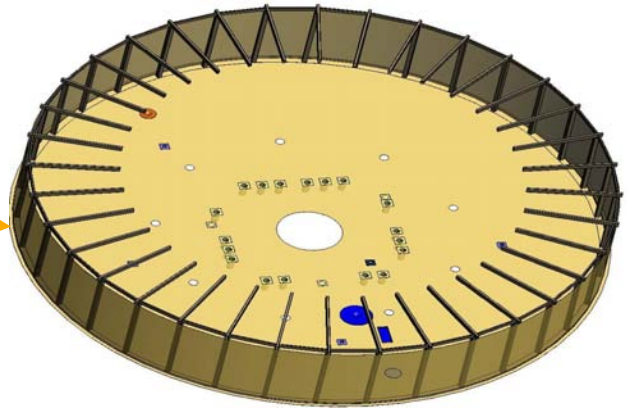
Z



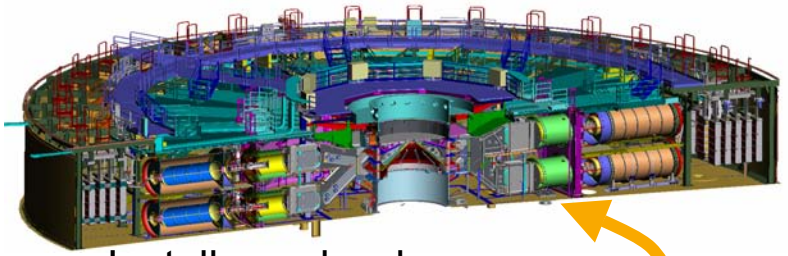
Remove existing hardware
(7/27/06 – 8/23/06)



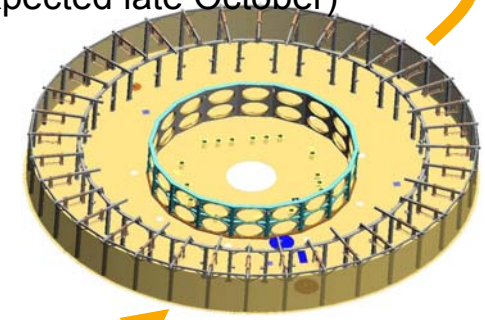
Remove existing oil/water wall
(8/24/06 – 9/18/06)



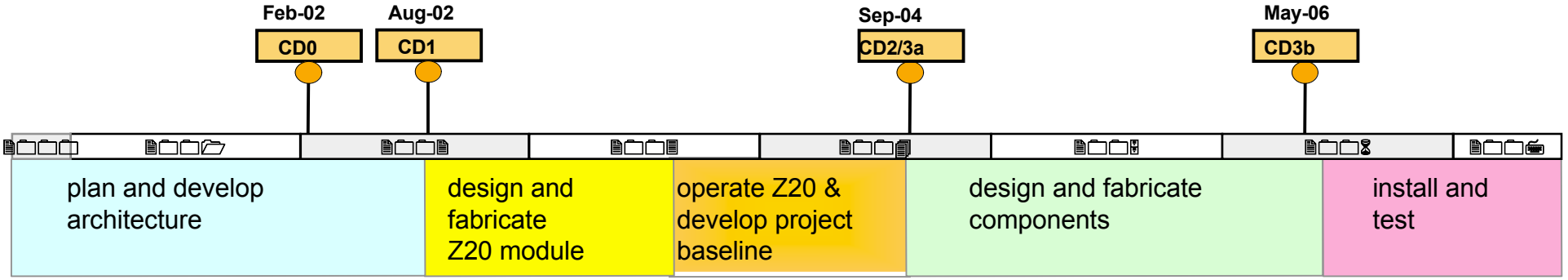
Refurbished Z



Install new hardware
(start expected late October)

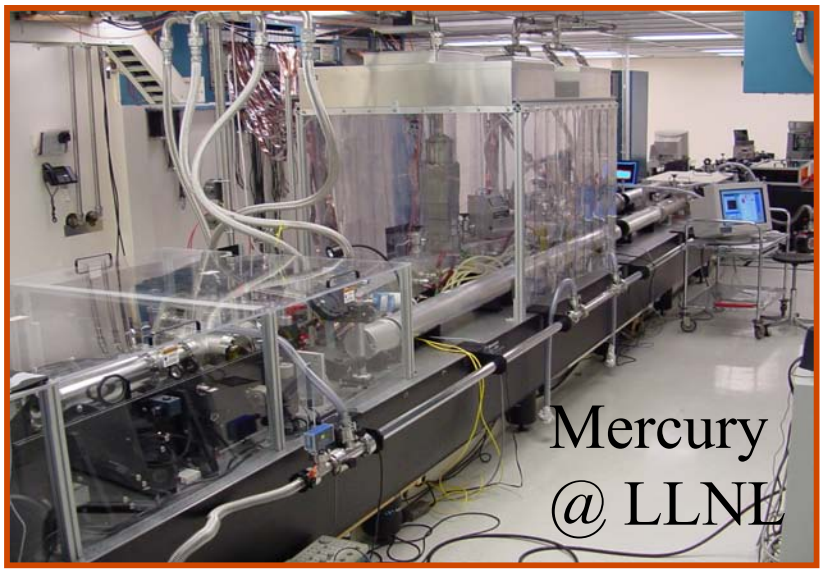


Construct new oil/water wall and reinforce floor structures
(9/19/06 – present)



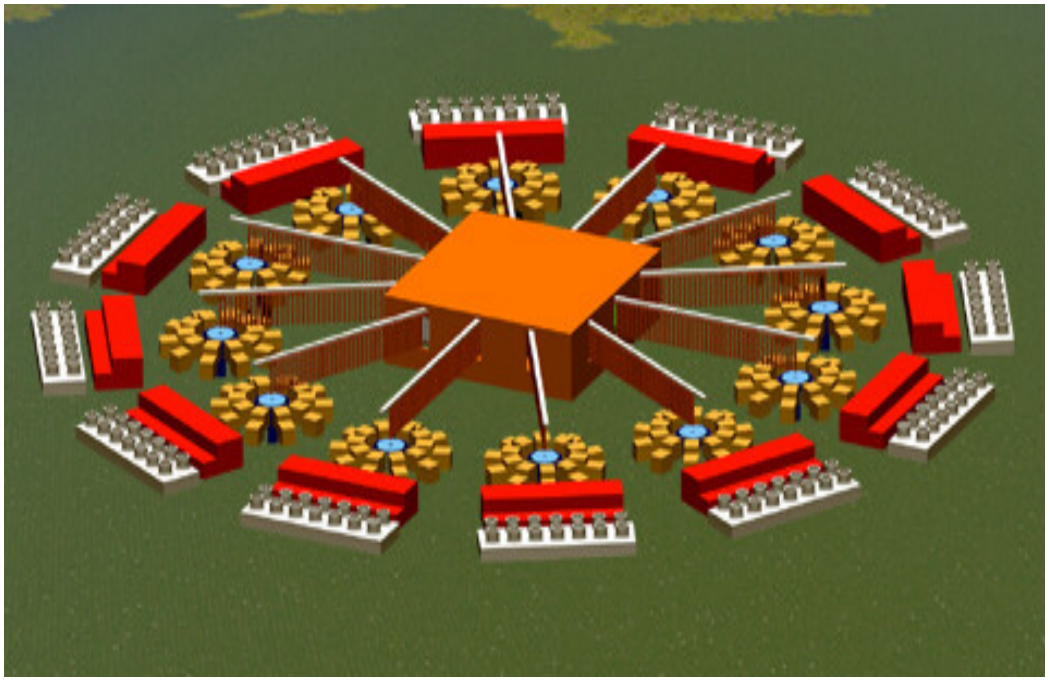
MAS: 9/26/06

High Average Power Laser Program is a Congressionally funded program within NNSA



Review report from OFES/NNSA review of NRL FTF program to be available shortly

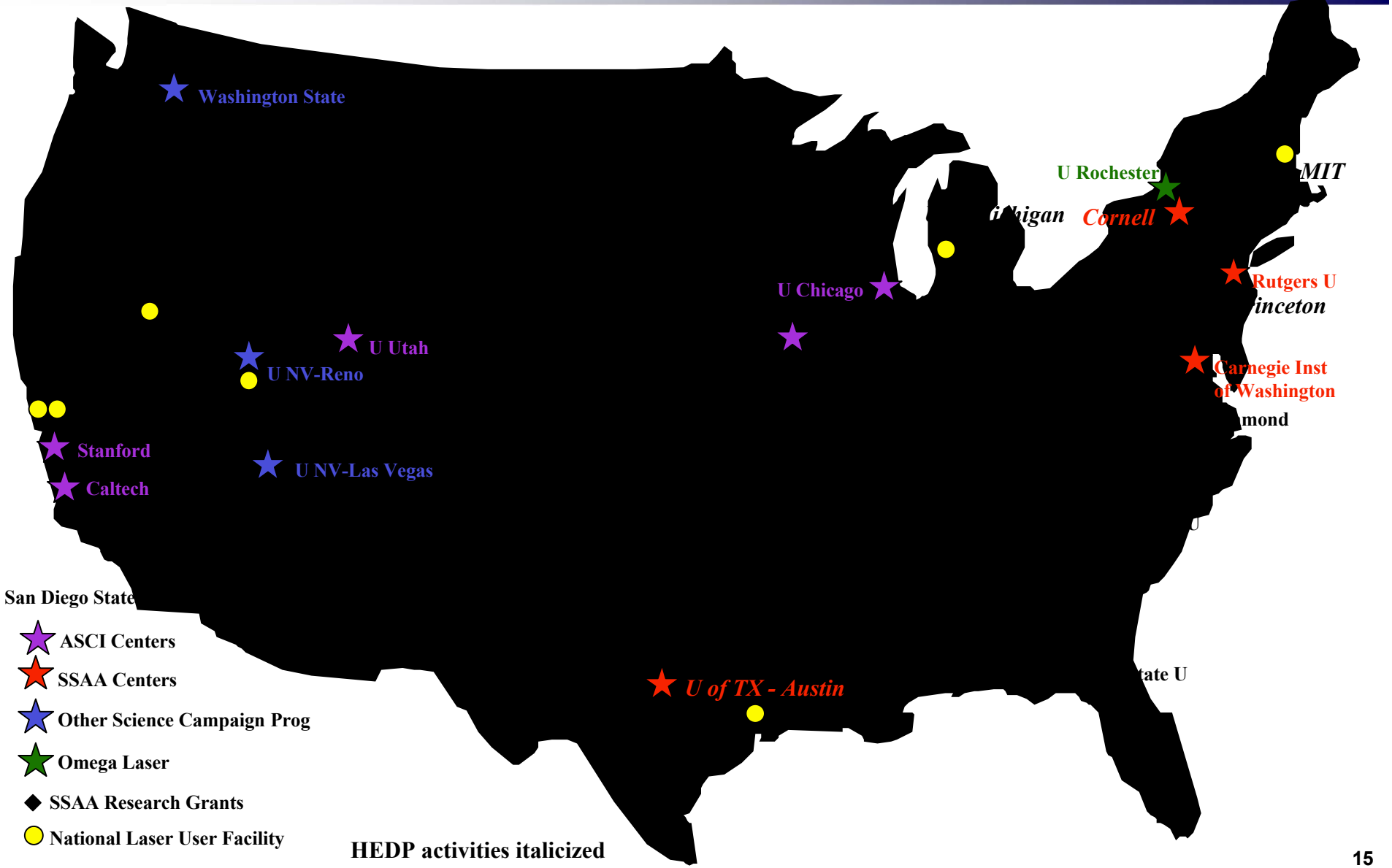
The *long-term* goal of Z-Pinch IFE is to produce an economically attractive power plant using high-yield z-pinch-driven targets (~3 GJ) at low rep-rate per chamber (~0.1 Hz)



Z-Pinch IFE DEMO (ZP-3, the first study) used 12 chambers, each with 3 GJ at 0.1 Hz, to produce 1000 MWe

The *near-term* goal of Z-Pinch IFE is to address the science issues of repetitive pulsed power drivers, recyclable transmission lines, high-yield targets, and thick-liquid wall chamber power plants

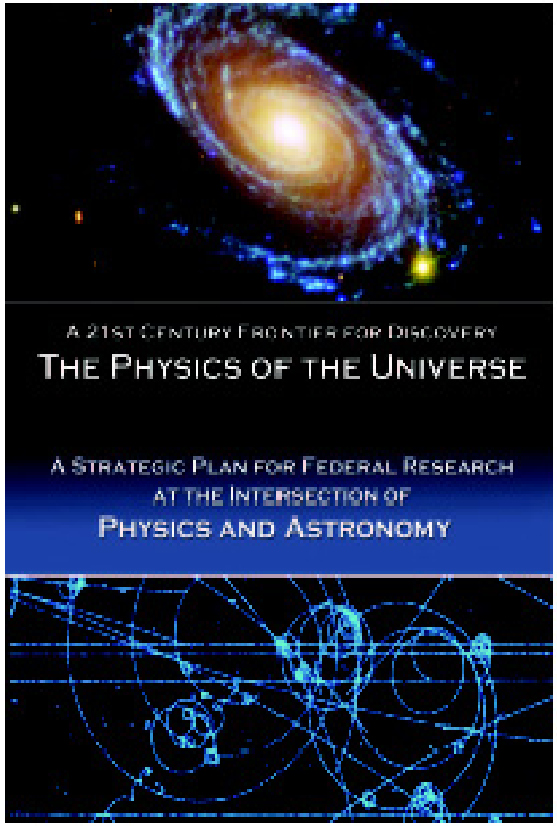
Academic Alliances



ICF Program FY2007 Budget Status

MTE	FY06 Approp	FY07 Presid	FY07 House	FY07 Senate
10.1 Ignition	74,859	79,763	79,763	69,763
10.2 Stock Sup	19,673	5,872	5,872	25,872
10.3 Diagnostics	42,578	45,959	55,959	42,578
10.4 Pulse Power	10,902	10,603	10,603	10,603
10.5 Universities	7,623	8,903	8,903	0
10.7 Targets & Ops	63,977	43,021	58,021	53,021
10.8 Inertial Fusion	47,520	0	40,000	0
10.10 Petawatt	34,650	2,213	14,213	0
10.9 Demo	101,307	143,438	143,438	129,000
NIF Construction	140,494	111,419	111,419	81,419
Total	543,583	451,191	528,191	412,256

Federal vision for basic HEDP is under development



FRONTIERS FOR DISCOVERY IN

HIGH ENERGY DENSITY PHYSICS

Prepared for

Office of Science and Technology Policy

National Science and Technology Council

Interagency Working Group on the

Physics of the Universe

Prepared by

National Task Force

on High Energy Density Physics

July 20, 2004

OSTP chartered interagency task force (C. Keane, D. Kovar, chairs) will produce report by end of CY2006

Key points

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  - **High energy density physics- essential piece of Defense Programs long term science and technology base**
  - **Logic: increase margin/uncertainty**

- **The next 10 years will offer extraordinary new opportunities for inertial fusion and high energy density physics**
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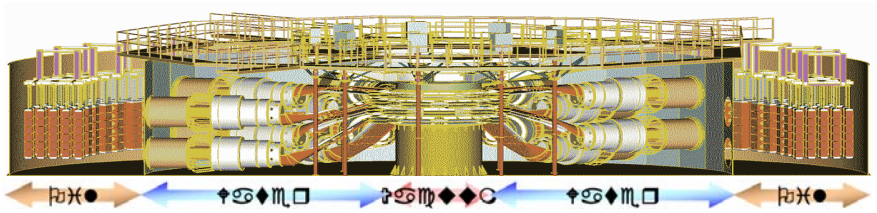
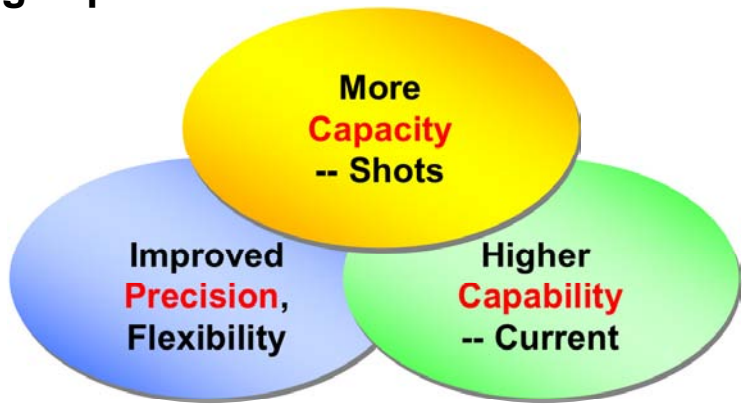
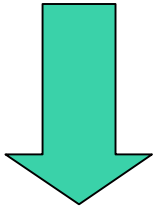
Backups

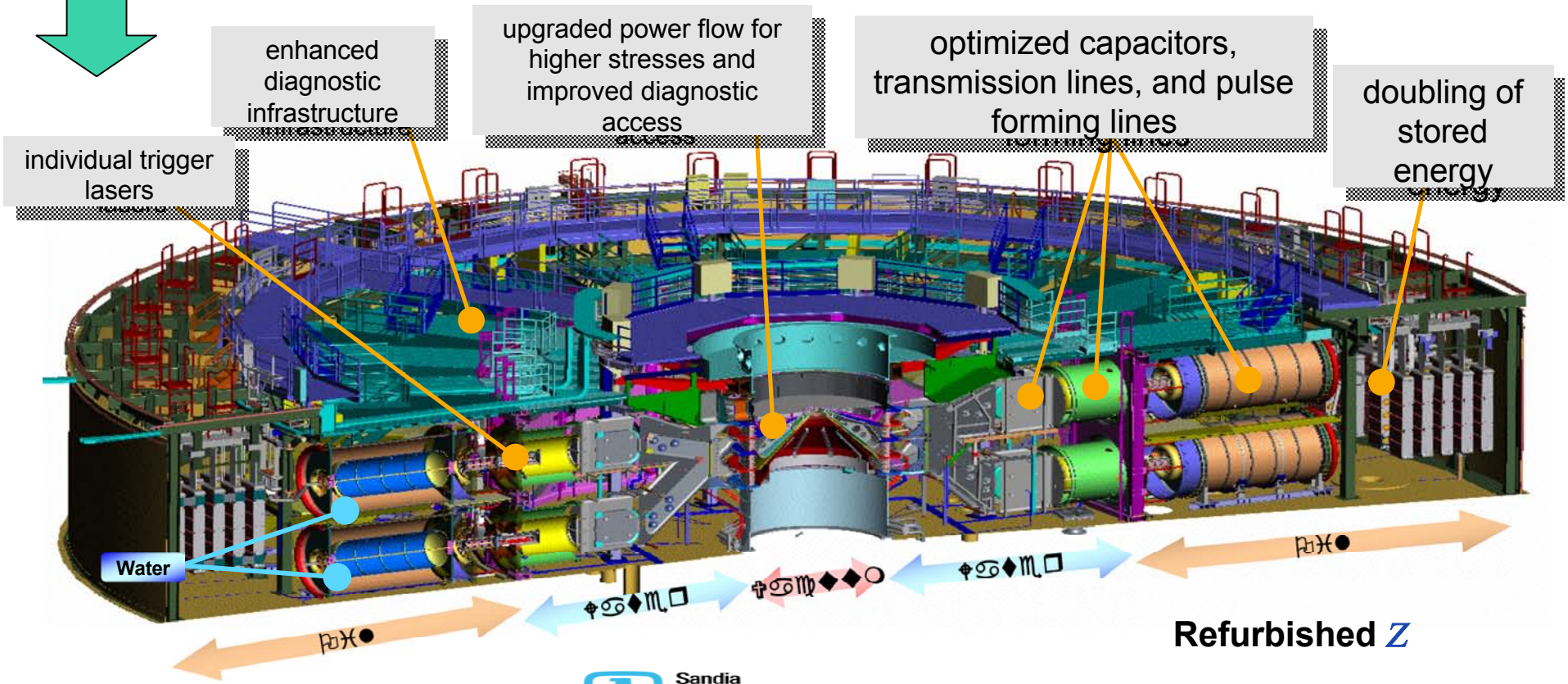
The objectives of the ZR Project are to extend Z's life in a balanced way and to exercise SNL's pulsed power research and engineering capabilities for future endeavors.

Z









Refurbished Z

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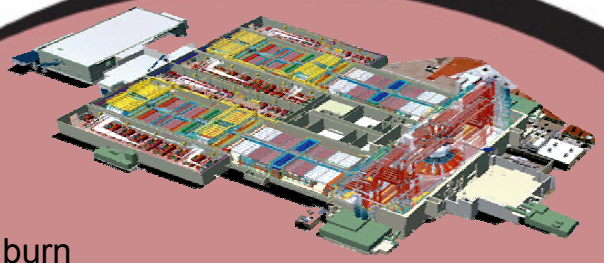
The major ICF facilities provide unique capabilities



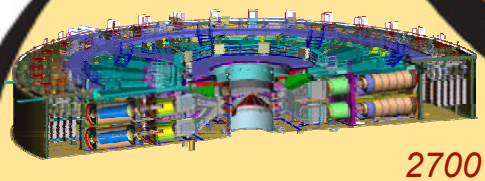
- ignition and burn
- highest temperatures
- highest pressures

1800 kJ

NIF
(2010)

complementary capabilities

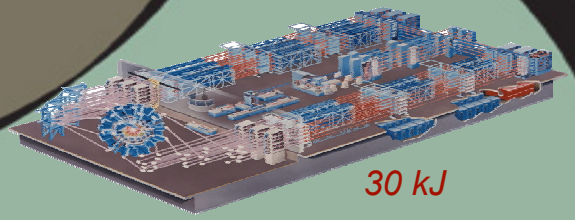
radiation flow
radiation hydrodynamics
instability and mix
opacity
equations of state
ICF target physics
alternative fusion concepts



2700 kJ

- magnetically-driven implosions
- highest precision equations of state
- weapons effects tests

Z
ZR (2007)



30 kJ

- direct-drive ICF target physics
- fast ignition proof-of-principle

OMEGA
OMEGA EP (2007)

Cost, availability, diagnostics, reproducibility, precision, and flexibility ultimately determine which facilities are used for specific experiments.

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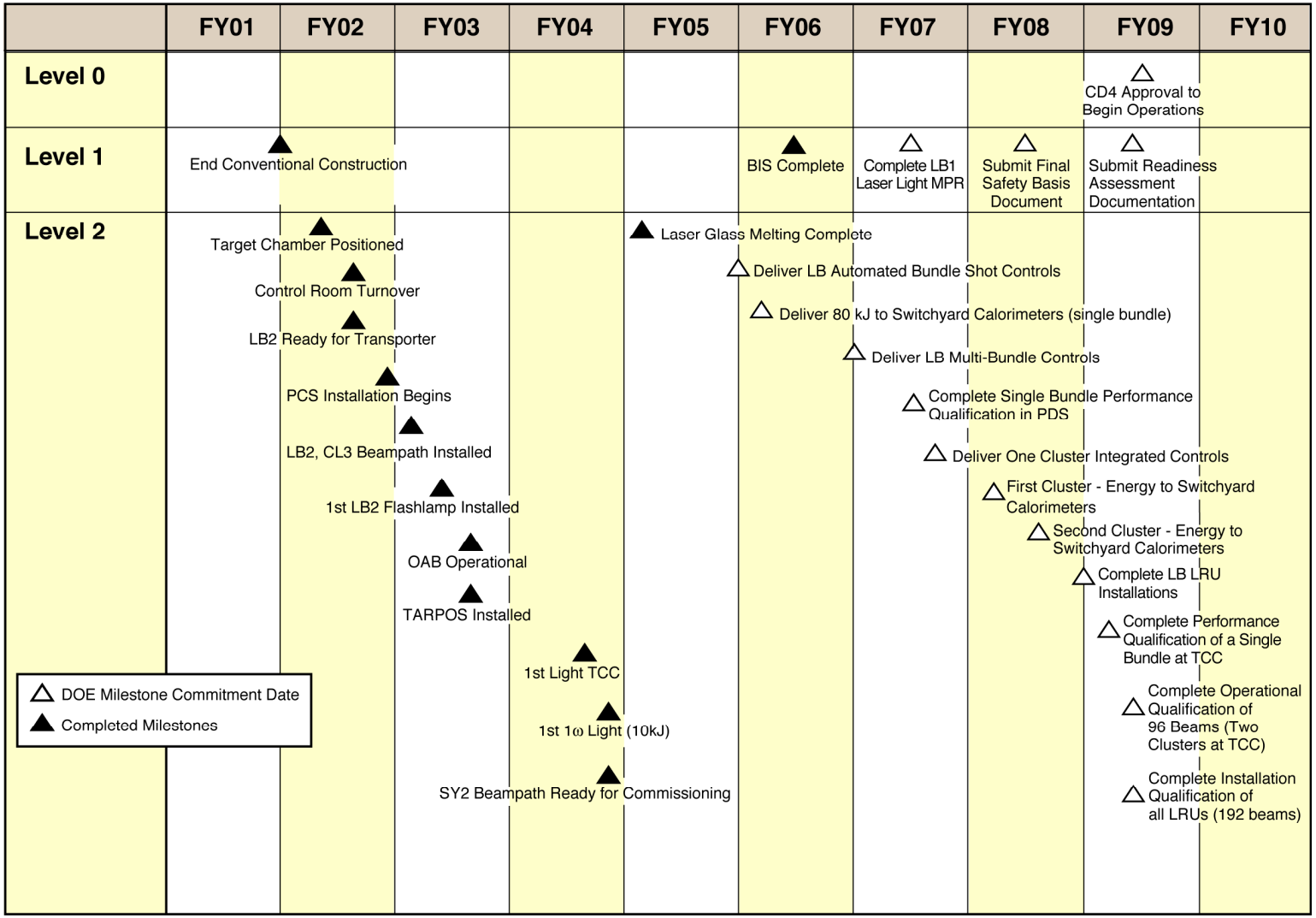
The revised NIF Project baseline completes in Q2FY2009 and supports Ignition 2010

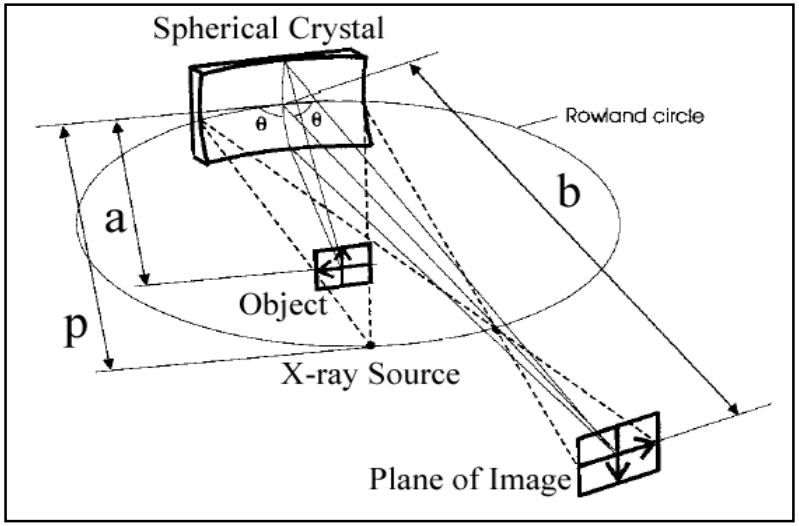


NIF-0402-04478_r12.ai
052605/cc

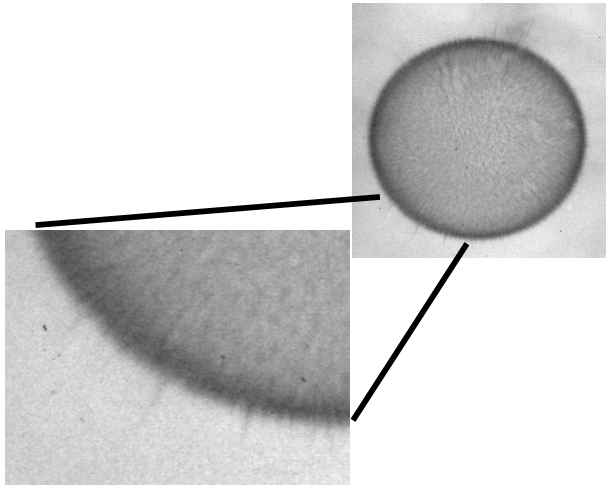
High resolution x-ray backlighting is an important new diagnostic now in routine use on Z

National Nuclear Security Administration

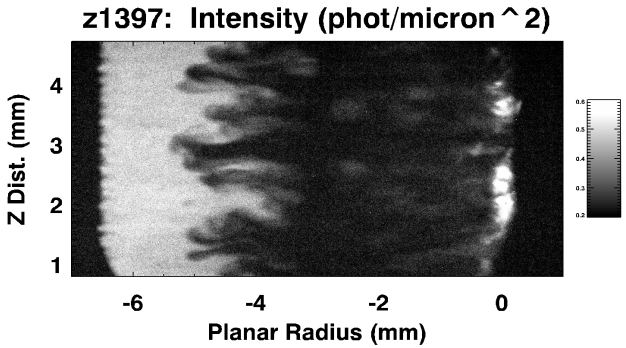
X-ray backlighting using a bent crystal imaging detector system



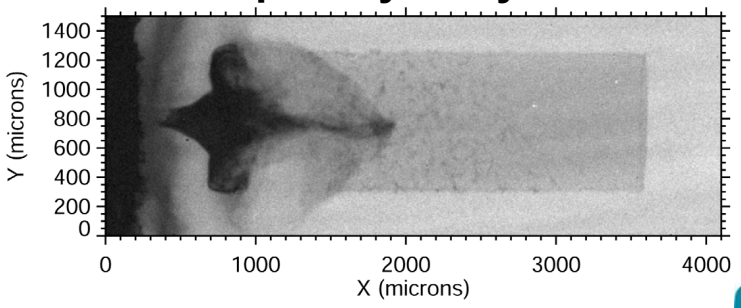
3.2 mm dia. capsule radiograph (C_r = 1.7)



Z-pinch implosion



Complex hydrodynamics



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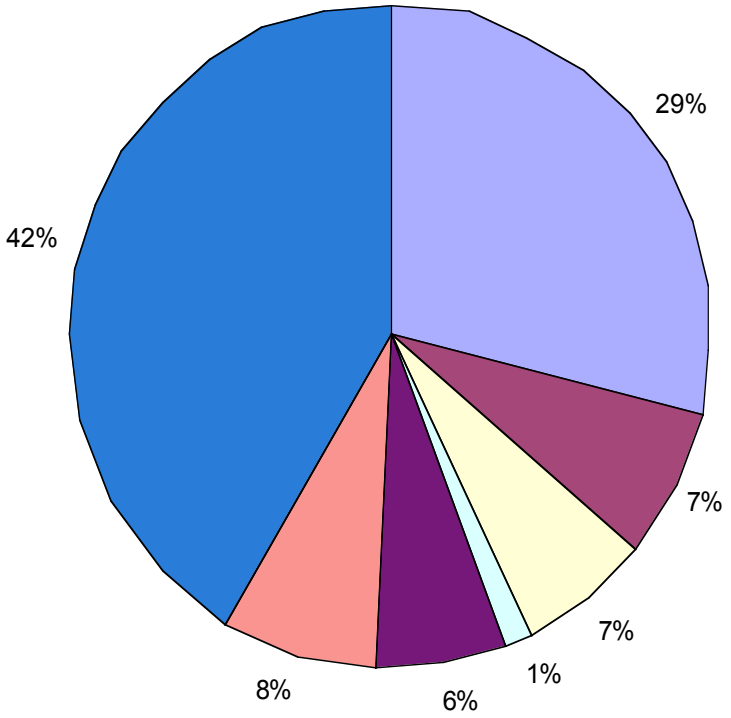
ICF FY 2005 Budget by Element

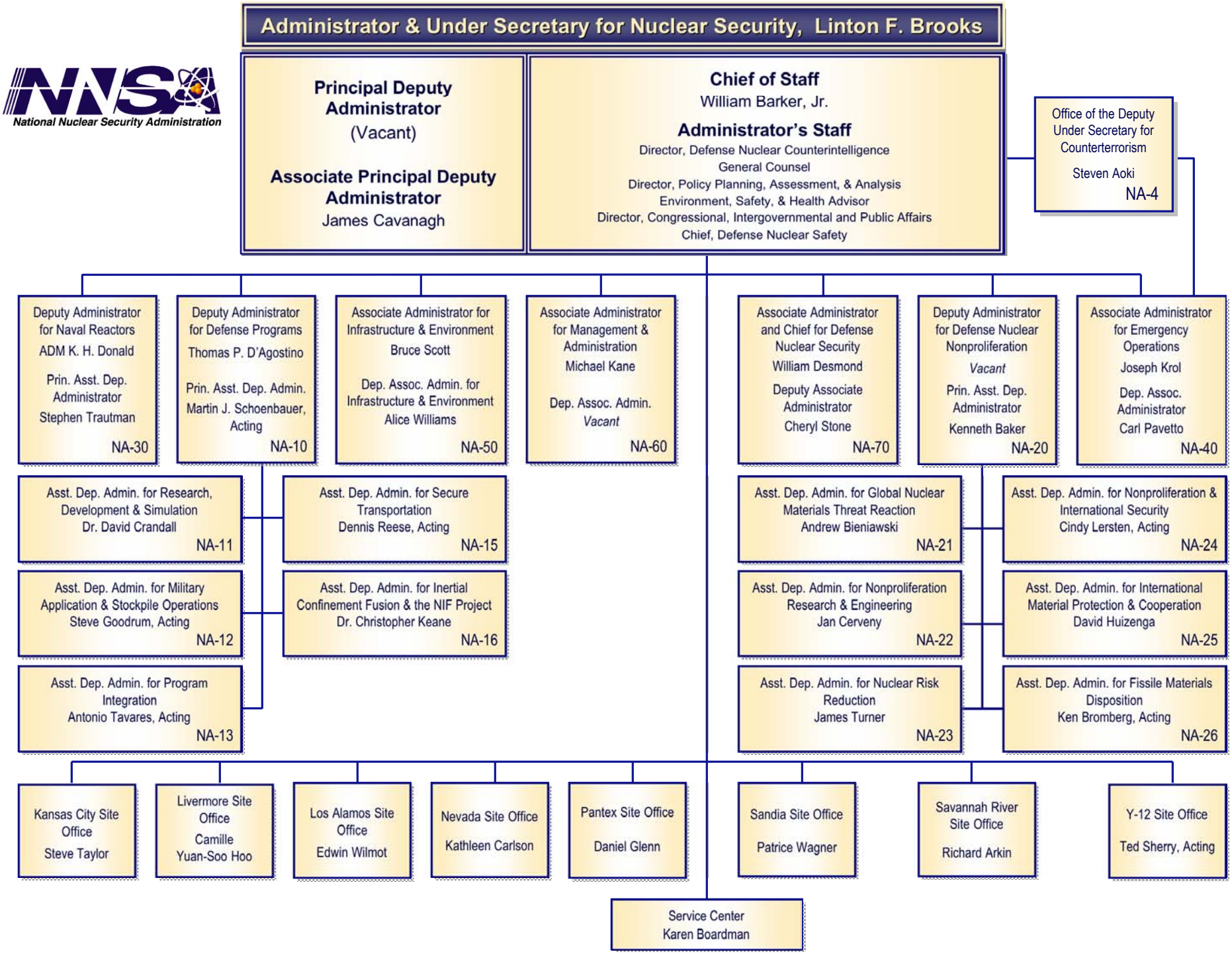


Total Budget = $536.7 M

- NIC
- Weapons Physics
- Pulsed Power
- University Grants
- Inertial Fusion Technology
- Petawatt Laser Development
- NIF Project

RTBF Z Operations – 11.8M

RTBF Z-backlighter laser – 13M


National Nuclear Security Administration
Administrator & Under Secretary for Nuclear Security, Linton F. Brooks
Principal Deputy Administrator
(Vacant)
Associate Principal Deputy Administrator
James Cavanagh
Chief of Staff
William Barker, Jr.
Administrator's Staff
Director, Defense Nuclear Counterintelligence
General Counsel
Director, Policy Planning, Assessment, & Analysis
Environment, Safety, & Health Advisor
Director, Congressional, Intergovernmental and Public Affairs
Chief, Defense Nuclear Safety
Office of the Deputy Under Secretary for Counterterrorism
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Deputy Administrator for Naval Reactors
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Prin. Asst. Dep. Administrator
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NA-30
Deputy Administrator for Defense Programs
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Associate Administrator for Infrastructure & Environment
Bruce Scott
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Associate Administrator for Management & Administration
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Dep. Assoc. Admin.
Vacant
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William Desmond
Deputy Associate Administrator
Cheryl Stone
NA-70
Deputy Administrator for Defense Nuclear Nonproliferation
Vacant
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Kenneth Baker
NA-20
Associate Administrator for Emergency Operations
Joseph Krol
Dep. Assoc. Administrator
Carl Pavetto
NA-40
Asst. Dep. Admin. for Research, Development & Simulation
Dr. David Crandall
NA-11
Asst. Dep. Admin. for Secure Transportation
Dennis Reese, Acting
NA-15
Asst. Dep. Admin. for Military Application & Stockpile Operations
Steve Goodrum, Acting
NA-12
Asst. Dep. Admin. for Inertial Confinement Fusion & the NIF Project
Dr. Christopher Keane
NA-16
Asst. Dep. Admin. for Program Integration
Antonio Tavares, Acting
NA-13
Asst. Dep. Admin. for Global Nuclear Materials Threat Reaction
Andrew Bieniawski
NA-21
Asst. Dep. Admin. for Nonproliferation & International Security
Cindy Lersten, Acting
NA-24
Asst. Dep. Admin. for Nonproliferation Research & Engineering
Jan Cerveny
NA-22
Asst. Dep. Admin. for International Material Protection & Cooperation
David Huizenga
NA-25
Asst. Dep. Admin. for Nuclear Risk Reduction
James Turner
NA-23
Asst. Dep. Admin. for Fissile Materials Disposition
Ken Bromberg, Acting
NA-26
Kansas City Site Office
Steve Taylor
Livermore Site Office
Camille Yuan-Soo Hoo
Los Alamos Site Office
Edwin Wilmot
Nevada Site Office
Kathleen Carlson
Pantex Site Office
Daniel Glenn
Sandia Site Office
Patrice Wagner
Savannah River Site Office
Richard Arkin
Y-12 Site Office
Ted Sherry, Acting
Service Center
Karen Boardman

NIF Funding Profile