Summary of Experiments Conducted in Support of Stockpile Stewardship

August 2011

The U.S. Stockpile Stewardship Program is a robust program of scientific inquiry used to sustain and assess the nuclear weapons stockpile without the use of underground nuclear tests. The experiments carried out within the program are used in combination with Advanced Simulation and Computing (ASC) to continually assess the stockpile to ensure it is safe, secure, and effective. (For links to the ASC program, see: http://nnsa.energy.gov/asc.)

For a link to the Nuclear Posture Review 2010, see: http://www.defense.gov/npr/docs/2010%20nuclear%20posture%20review%20report.pdf.

An extraordinary set of science, technology, and engineering (ST&E) facilities have been established and are active everyday in support of the stockpile stewardship program. This summary presents descriptions of key National Nuclear Security Administration (NNSA) facilities that have conducted stockpile stewardship experiments in the first three quarters of FY2011. Together, they represent the world-class science, experimental capabilities, and engineering resources that are used to support stockpile stewardship and management. While the entire nuclear security enterprise supports the mission, these facilities represent key capabilities needed to sustain the stockpile in the absence of underground nuclear testing. In these quarterly updates, we will summarize the typical activities and highlight experiments using nuclear materials.

Definitions:

- **Integrated, non-nuclear weapons experiments:** Experiments used to obtain information critical to certifying weapons performance in the absence of underground testing. They compare simulations results generated from fundamental data on materials, plasmas, and radiation. They generally take years to plan, days to weeks to execute, and months to analyze.
- **Focused experiments:** Experiments specifically designed to obtain a critical piece of fundamental data. They generally take months to plan, days to execute, and months to analyze. These may involve small quantities of nuclear materials.
- **Subcritical Experiments:** High explosive driven experiments to obtain information critical to certifying weapons performance in the absence of underground testing while still employing nuclear materials. No critical mass is formed due to the amount and characteristics of the nuclear material. As such, no self-sustaining nuclear chain reaction can occur in these nuclear experiments. These are therefore not nuclear explosions. They generally take years to plan, months to execute, and months to analyze. They are all conducted at the NNSS facilities, usually U1a, to take advantage of containment and entombment.

The following experiments were conducted at major facilities in support of NNSA's Stockpile Stewardship program, along with associated confirmatory experiments. Numbers in **(#)** indicate plutonium experiments.

Science Capabilities	*Location*	*Type of Capability*	*Description*	*# Experiments per Quarter*			
				FY11Q1	*FY11Q2*	*FY11Q3*	*FY11Q4*
Dual Axis Radiographic Hydrodynamic Test (DARHT) facility	LANL	Integrated, non-nuclear weapons experiments	DARHT captures high resolution images of moving, non-nuclear weapon assemblies. Experiments are used to obtain information critical to certifying weapons performance in the absence of underground testing. DARHT captures images from two views and at multiple times.	0	0	1	
Contained Firing Facility (CFF)	LLNL	Integrated or Focused, non-nuclear weapons experiments	CFF capabilities include high resolution imaging and high fidelity velocity measurements of moving, non-nuclear weapon assemblies. Experiments are used to obtain information critical to certifying weapons performance in the absence of underground testing. A single image and many velocity measurements are captured per experiment. CFF has a substantially larger field of view than DARHT.	2	2	0	
National Ignition Facility (NIF)	LLNL	Focused experiments: Radiation, plasmas and materials	NIF provides a platform to investigate fundamental properties of material, plasma, radiation, fusion ignition, and thermonuclear burn at temperatures and pressures relevant to those obtained in a nuclear weapon. In the absence of underground testing, these conditions are not possible on any other experimental platform.	64	80	78	
Z-Machine	SNL	Focused experiments: Radiation, plasmas and materials (including plutonium)	The Z Machine provides a platform to investigate fundamental properties of material, plasma, and radiation, and effects of radiation on electronics. Certain advanced certification concepts in parameter regimes of interest have used data acquired on Z.	11 (1)	34 (1)	39	
Omega	UR-LLE	Focused experiments: Radiation, plasmas and materials	Omega provides a platform to investigate HED material properties, plasmas, inertial confinement fusion, and radiation as well as for the development of targets, diagnostics and experimental platforms for the NIF. Omega is uniquely accessible to universities through the National Laser User's Facility. Targets are millimeters in diameter.	303	487	485	

Science Capabilities	Location	Type of Capability	Description	# Experiments per Quarter			
				FY11Q1	FY11Q2	FY11Q3	FY11Q4
High Explosive Application Facility (HEAF)	LLNL	Focused experiments: Explosives, Materials	HEAF provides a platform to investigate fundamental properties and reactions of chemical explosives, as well as gas guns to study materials. Experiments are focused on continually improving the safety of our stockpile.	205	217	162	
The Joint Actinide Shock Physics Experimental Research (JASPER) Facility	NNSS	Focused experiments: Metals (including plutonium)	JASPER provides a platform to investigate the properties of metals, including plutonium, at high shock pressures, temperatures and strain rates. JASPER, LBPG, and TA-55 each cover unique areas of material phase space with some overlap.	0	1	1	
Large Bore Powder Gun (LBPG)	NNSS	Focused experiments: Metals (including plutonium)	LBPG provides a platform to investigate the properties of metals, including plutonium, at high shock pressures, temperatures and strain rates, but with a larger target (size of experiment) than JASPER. JASPER, LBPG, and TA-55 each cover unique areas of material phase space with some overlap. (Note: still in development).	0	0	0	
Los Alamos Neutron Science Center (LANSCE)	LANL	Focused experiments: Stockpile Materials	LANSCE is a linear accelerator that produces neutrons to study fundamental material properties. The Lujan Center conducts materials research and nuclear physics using neutrons.	14	0	24	
Proton Radiography (pRad)	LANL	Focused experiments: Materials	pRad is a beam line and proton optics capability that uses protons to study fundamental material properties. pRad uses the LANSCE accelerator to produce protons for radiography of static and dynamic materials.	12	0	6	
Big Explosives Experimental Facility (BEEF)	NNSS	Integrated, non-nuclear weapons experiments	BEEF is an experimental facility that allows the study and investigation of materials as they are merged together by high-explosive detonations.	1	1	2	
TA-55	LANL	Focused experiments: Metals (including plutonium)	TA-55 provides several platforms to investigate the properties of metals, including plutonium, at high shock pressures, temperatures and strain rates. The TA-55 gas gun is located in a Category 2 nuclear facility, but is limited to Category 3 quantities.	9 (6)	20 (20)	6 (5)	
U1a Facility	NNSS	Subcritical experiments	Provides capability for subcritical physics experiments providing material and system response data.	1 (1)	1 (1)	0	