APPENDIX D
NTS ACTIVITY DESCRIPTIONS

IN SUPPORT OF THE
DIRECTED STOCKPILE WORK RESEARCH AND DEVELOPMENT –
STOCKPILE SYSTEMS AND STOCKPILE SERVICES
FY 2009 PROGRAM IMPLEMENTATION PLAN

Level 2 Milestone (MRT 3189): Support the Joint Plutonium Experiments plan and dynamic plutonium experiment activities identified in the FY09 LANL - LLNL plan by conducting activities in partnership with SNL that provide direct support to current and future LANL - LLNL DPE.

Due Date: September 2009

Activity Description:

SNL Dynamic Plutonium Experiment Research and Development

- Radiographic Integrated Test Stand (RITS): The RITS6 machine will test the efficiency and practicality of diodes operating in the range of 6 to 12 MeV with the goal of producing more than 400 R at one meter with a spot size of 2.7 mm or less. Additional diagnostics will be developed and added to the suite now existing as needed. This effort will support the Sandia National Laboratory and will also be in collaboration with the British Atomic Weapons Establishment. Los Alamos National Laboratory will benefit from RITS work as diode tests are in support of both the U.K. Hydrus program and Cygnus. The Hydrus facility is deemed essential to aiding in DPE decisions in the 2015-2017 time frames. Additionally, near term research related to optimization of the Cygnus machines at U1a will be conducted as required to support LANL experiments.

- Support SNL by providing Z pulse shape analysis with the goal of modeling pulse shape behavior based on machine configuration. The Z machine supports experiments from both LANL and LLNL.

- Assist SNL with Linear Transformer Driver (LTD) radiographic source development by testing, modifying, and improving the various components of the LTD system with a goal of improving functionality and reliability.

Level 2 Milestones/Grading Criteria:

Description
1. Operate the Radiographic Integrated Test Stand on the SNL/NSTec schedule to test the efficiency and practicality of diodes operating in the range of 6 to 12 MeV with the goal of producing more than 400 R at one meter with a spot size of 2.7 mm or less. These diode tests support both the U.K. Hydrus program and Cygnus. 2. Develop and field state-of-the art diagnostics for use on the RITS machine in collaboration with SNL.

Level 2 Milestones/Exit Criteria:

Description	Due Date
1. Obtain concurrence from the SNL Principal Investigator for RITS that NSTec maintained and operated the RITS on the SNL/NSTec approved schedule. 2. Deliver the recorded data to the SNL Principal Investigator.	September 2009

Integration/Interfaces: The SNL experiment plan relies on the National Security Technologies (NSTec) resources at the NTS, Los Alamos Operations, and the Sandia Office to provide support for SNL experiments, provide design and implementation of the diagnostics to obtain the required data from these experiments, and, to a limited degree, process and interpret the data from experiments. The required personnel interfaces are explicit in the NSTec Project plans for each segment of the work.

Risk Identification and Mitigation Strategies: NSTec applies the principles of Project Management to identify and mitigate the risk to each project. This identification and mitigation is explicit in the Project Management plan for each task. The basic risks are those associated with research and development of diagnostics, construction of test beds, and the execution of plans that, by necessity, constantly evolve as the experiments mature.

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Level 2 Milestone (MRT 3187): Support the LLNL plutonium experiments plan and dynamic plutonium experiment activities identified in the FY09 Joint LANL-LLNL Plan.
Due Date: September 2009

Activity Description: The LLNL program continues to concentrate on a series of High Explosive Pulse Power (HEPP) tests. The HEPP program is developing a platform to measure the equation-of-state (EOS) of plutonium over a pressure range of interest. Samples of special nuclear material (SNM) will be immersed in a high magnetic field, which in turn will lead to magnetic pressure that isentropically compresses the sample. To reach the pressures of interest, electrical currents of many mega-amps will be required. LLNL will use an HEPP generator to generate the required current pulses.

National Security Technologies (NSTec) will assist LLNL in defining and executing the series of HEPP experiments to be fielded at the Nevada Test Site (NTS) Big Explosives Experimental Facility (BEEF). These experiments will be the precursors to a series of SNM experiments, which will be performed underground at an as-yet unspecified NTS location.

On August 8, 2007, a validation test of a newly LLNL designed Advanced Helical Generator (AHG) was successfully tested (Helical Hydro Test (HHT1)). On February 14, 2008, FFT2, a fully integrated test, fielding the new first stage generator (AHG) driving a 934 coaxial generator was tested producing increased current outputs. The next test designated FFT3 scheduled March 2009 is to demonstrate pulsed power platform repeatability with the improved voltage standoff recommendations applied.

Future FFT's will evaluate symmetry and efficiency of the drive at the load and culminate in demonstrations of reliability and repeatability using surrogate samples prior to underground testing using plutonium.

The series of tests planned by LLNL are designed to test the Phoenix device components, which consist of the following parts:

- Capacitor Banks: Generates a seed flux for the explosive generator systems.
- Advanced Helical Generator (AHG): The initial explosive driven pulsed power generator, early in the program generators, used to amplify the seed currents.
- Coaxial Generator (934): A high performance generator used to drive the flux compression stage within the Isentropic Compression Experiment (ICE) load.
- Pulsed Power Diagnostics: The combination of B-dot probes, Rogowski coils, and Pearson probes that measure current in the various generator stages.
- ICE Load: The structure that integrates the sample under test, the diagnostic support/shielding structure, the flux injector port, and the flux compression system.
- ICE Load Timing and Diagnostics: The ensemble of diagnostics used to verify the performance of the flux compression stage within the ICE load.
- Fiber Channel Tests: Tests included on the various experiments to verify the performance of VISAR in the presence of very harsh electro-magnetic interference (EMI) environments.

- Fast Switch: In the injector it is necessary to deliver the energy from the helical generator to the ICE load in a very short time. The fast switch combines a storage inductor and a number of explosive driven switches to accomplish this step.
- VISAR Diagnostic: The diagnostic used to measure the velocity of the sample under test. The equation of state information is derived from this measurement.

LLNL is planning three Full Functional Test FFT experiments in FY09 with two experiments planned by the conclusion of 3Q FY 09 focused on characterization of symmetry and efficiency of the load. This information will be used to validate the numerical models used to calculate the performance of the load and the complex interactions between the load, generator and power flow systems. The Phoenix FFT experiments utilize a high performance explosive pulsed power system capable of delivering 100 million amps of current to the load.

Work scope for FY09 includes project management; FFT experiments; test bed design, development, and construction; procurement; and development and operation of diagnostics systems. Also included are diagnostic development activities required to support future experiments, including control systems, data acquisition, and data analysis.

Engineering and construction resources will focus on the test bed requirements and preparation work at BEEF. This will primarily involve preparing the shot table and modifying the BEEF facility and infrastructure to support FFTs, including:

- Design and place concrete pad on shot table.
- Erect and install environmental enclosure tent over experiment.
- Install/connect utilities (power, HVAC, etc.) to support enclosure and shot table.
- Post-shot site cleanup.
- Design, fabricate, and install experimental lifting and support structures by engineering/construction

Drawings are generated by NSTec Engineering to define the construction activities for the Phoenix Project. These drawings are based on criteria furnished by LLNL. Engineering design and analyses including studies, calculations, and walk-downs are conducted to ensure that the LLNL criteria and BEEF safety requirements are met to safely conduct the experiments.

Design and development of diagnostics will require the use of engineering techniques to prototype and finalize applications. Project tasks that are assigned to be NSTec responsibility are documented in drawings, reports, and logbooks. Final versions will be formally documented in drawings.

Diagnostic leads will work with LLNL to design and upgrade diagnostics, build fixtures, and implement control system interfaces to meet specific experiment requirements. In addition, Diagnostic personnel will participate in the LLNL component conceptual design reviews.

The Diagnostic and Control System work scope may include pending specific experiment requirements:

- Design, procure, assemble, and maintain a Faraday Cage composed of EMI conduits, EMI boxes and an isolated Faraday box inside the bunker.
- Design, assemble, and maintain auxiliary systems (flush gas, compressed air, and vacuum).
- Design, procure, assemble, fabricate, install, and maintain fire set interface system and mechanical cable cutters.
- Provide and maintain BEEF control system, including development of each FFT-specific controls and the ability to control remotely control experiments (at a location other than the BEEF bunker).
- Fabricate, field, support, and/or record the following diagnostics:

    1. B dot probe current data measurements
    2. Pearson probe current data measurements
    3. Rogowski coil current data measurements
    4. High-speed video camera(s)
    5. LLNL Event Timing Diagnostic
    6. LLNL TimeX Diagnostic

- Maintain, field, and operate the PM10 Monitoring system.
- Design, assemble, field, and record the following diagnostics:

    1. Faraday rotation system
    2. VISAR system
    3. Shock Arrival Diagnostic.

- Design, procure, and field a dry run system.
- Design, fabricate, maintain, update, and field a capacitor seed bank.
- Design, field, and operate a BEEF data acquisition system.
- Provide fiber optic transmission system.
- Support fielding of experiment and data acquisition.

Preparations for future FFTs will be conducted during FY09, with the NSTec performing similar work scope to that outlined above. In addition, the work scope continues with the design and testing of a new control system for the BEEF, planning the extension of the remote control capability of BEEF shots from Control Point (CP) and diagnostic development for future experiments. Investigations into alternative underground locations will also be conducted.

Level 2 Milestones/Grading Criteria:

Description
1. Build test beds and support the execution of Phoenix Dynamic Plutonium Experiments (DPE).
2. Develop state-of-the art diagnostics for LLNL DPE.