Exhibit A

Statement of Work
Idaho State University
Adaptation of the ISIS Induction-Cell Driver to a Low-Impedance Plasma Radiation Source Driver-Thrust Area 1 (FRBAA09-1-2-0034)
September 10, 2010

1) Objective: Design, build and test a system to non-destructively convert the Idaho State Induction Accelerator System (ISIS) induction cell driver (ICD) to a low impedance pulsed power driver for plasma radiation sources (PRS). This system will be designed in such a way to be reversible and minimize the time to switch between the plasma radiation source mode and the normal operation mode of ISIS. Once built, we will continue by developing high-energy-density PRS to study many of the DTRAs core objectives. Specifically, we will provide a plasma radiation source test platform for simulating nuclear weapons effects and relevant science.

2) Scope: This work is in support of the Basic and Applied Sciences Directorate and the JSTO and Thrust Area 1 of HDTRA1-09-14-FRCWMD-BAA. The grantee will construct a plasma radiation source (PRS) driver using existing pulse power equipment at the Idaho Accelerator Center. The grantee will use this PRS driver to optimize the X-pinch for radiography and nuclear weapons effect, as well as provide fundamental science for laser and pulse power driven x-ray source. The grantee will provide a viable platform for future DTRA motivated tests.

3) Background: Plasma radiation sources (PRS) have several ties to DTRA's mission. (1) Contributions to basic science: Many of the fundamental properties of pulsed power driven PRS are extremely similar to those found in laser driven x-ray sources. Radiation mechanisms, radiation transport, spectral properties, instabilities, turbulence are just a few basic properties relevant to laser produced plasmas that can be studied using pulsed power driven PRS. (2) Applications of PRS: (i) PRS can be used for high resolution imaging for composition of small devices, such as small-scale explosives and rapidly evolving systems, such as explosion dynamics. (ii) PRS can be used for weapon effects testing to simulate intense x-ray and/or neutron radiation from WMD. As such we wish to expand the research capabilities at ISU to include PRS. The proposed research will educate students in both pulsed power design as well as pulsed power research. The scope of these projects could be almost entirely handled by the student (including load design, pulsed power diagnostics, x-ray diagnostic, etc.). This will ensure greater educational potential in pulsed power than merely being a pulsed power user. Our short-term goal is to create PRS capability and optimize a PRS (namely an X-pinch source) to use as a high temporal and spatial resolution (less than 10 pico-seconds and 1 μm) radiographic source for imaging other plasmas and small scale devices. This source would be excellent for studying small scale explosion dynamics. Our longer term goal is set the stage for other pulsed power driven plasma research such as basic plasma dynamics relevant to laser driven plasmas and z-pinch physics.

4) Tasks/Scientific Goals:

   a) **Task 1: Design and construction of the PRS chamber (Year 1)**

      i) 1.1 Design and simulation of the plasma radiation source (PRS) chamber shall be completed by the grantee by September of 2011.

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ii) 1.2 Specifications will be handed to the local steel manufacturer (Partner Steel) for finalization of the drawings and fabrication of the PRS chamber with an estimated total cost of $64,749 with an 8-12 week delivery time (see attached quote). The PRS chamber should be in the possession of ISU by November 2011.

iii) 1.3 The grantee shall connect the new PRS chamber to the ICD and have the new PRS driver ready for testing by January 2012.

b) **Task 2: Testing and refinement of PRS chamber (Year 1)** Electrical characteristics of the PRS driver will be tested by grantee and should be completed with any necessary refinement by June 2012. Refinements could include but is not limited to modifications to insulating rings, attachment of the transmission cables, modifications to the reflected pulse suppressor.

c) **Task 3: Preliminary X-pinch tests (Year 2)** Radiation properties of an X-pinch vary greatly depending on material, geometry, and driver characteristics. The grantee will find a suitable range of materials, mass (wire diameter), and geometries to match the new PRS driver. Task 3 shall be completed by September 2012.

d) **Task 4: Assembly of the radiation diagnostics (Year 2)** Task 4 will occur in parallel with task 3. In addition to the rudimentary diagnostics needed for Task 3 we will need more sophisticated diagnostics for Tasks 5-7. The grantee will have all necessary diagnostics in place by January 2013.

e) **Task 5: Optimization of radiation parameters for imaging (Year 2)** Optimizing the X-pinch for imaging requires 1) reproducibility, 2) properly matched energy band, 3) smallest possible source size, 4) highest ratio of bright spot to other radiation, and 5) in some cases shortest possible duration. These parameters can be adjusted by proper choice of wire material, size, and geometry, but fine tuning is time consuming. The grantee will find optimal X-pinch loads for low (<1 keV), intermediate (1-8 keV), and high (8-20 keV) energy bands. Furthermore, the grantee shall characterize a great number of X-pinch materials, sizes, and geometries for future application of specific imaging needs. This task shall be completed by June 2013.

f) **Task 6: Exploration of various PRS geometries to optimize radiation for NWE testing (Year 3)** In order for the X-pinch to be an effective radiation source for nuclear weapons effects testing the grantee shall maximize the total energy output. For these test, source size and duration do not matter. Therefore, the grantee will test geometries outside of X-pinches such as linear and radial arrays. This task will require the manufacture of new load hardware and shall be completed by January 2014.

g) **Task 7: Coupling of weapons effect testing and radiography (Year 3)** In an effort to maximize the utility of this new test platform, we plan to couple the unique radiographic capabilities of the X-pinch to the nuclear weapons effect (NWE) tests. This builds on

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tasks 5 and 6. By driving an X-pinch in parallel with the optimized PRS found in task 6 the grantee shall observe the shocks generated in various materials (mostly low-Z materials). The grantee will use the results to identify radiation resistant materials. This task shall be completed by May 2014.