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Title:	P-23 Highlights 6/10/12: Cygnus Dual Beam Radiographic Facility Refurbishment completed at U1A tunnel in Nevada NNSS meeting Level 2 milestone
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P-23 Highlights 6/10/12: *Cygnus Dual Beam Radiographic Facility Refurbishment completed at U1A tunnel in Nevada NNSS meeting Level 2 milestone*

A moratorium was placed on U.S. underground nuclear testing in 1992. In response, the Stockpile Stewardship Program was created to maintain readiness of the existing nuclear inventory through several efforts such as computer modeling, material analysis, and subcritical nuclear experiments (SCEs). As in the underground test era, the Nevada National Security Site (NNSS), formerly the Nevada Test Site, provides a safe and secure environment for SCEs by the nature of its isolated and secure facilities.

A major tool for SCE diagnosis installed in the 05 drift laboratory is a high energy x-ray source used for time resolved imaging. This tool consists of two identical sources (Cygnus 1 and Cygnus 2) and is called the Cygnus Dual Beam Radiographic Facility (Figs. 2-6). Each Cygnus machine has 5 major elements: (Marx Generator, Pulse Forming Line (PFL), Coaxial Transmission Line (CTL), 3-cell Inductive Voltage Adder (IVA), and Rod Pinch Diode. Each machine is independently triggered and may be fired in separate tests (staggered mode), or in a single test where there is sub-microsecond separation between the pulses (dual mode). Cygnus must operate as a single shot machine since on each pulse the diode electrodes are destroyed. The diode is vented to atmosphere, cleaned, and new electrodes are inserted for each shot. There is normally two shots per day on each machine.

Since its installation in 2003, Cygnus has participated in: 4 Subcritical Experiments (Armando, Bacchus, Barolo A, and Barolo B), a 12 shot plutonium physics series (Thermos), and 2 plutonium step wedge calibration series (2005, 2011), resulting in well over 1000 shots. Currently the Facility is in preparation for 2 SCEs scheduled for this calendar year - Castor and Pollux. Cygnus has performed well during 8 years of operations at NNSS. Many improvements in operations and performance have been implemented during this time. Throughout its service at U1a, major maintenance and replacement of many hardware items were delayed due to programmatic requirements. It is anticipated that Cygnus will be in service at U1a for another 5 years. With this assumption, it was realized that significant resources and effort should be allotted to bring the hardware back to its original condition, or even to improve elements when appropriate. The Cygnus Refurbishment & Enhancement Project started in April, 2011 with the intent to encompass a major overhaul of Cygnus.

Major topic areas / task items for refurbishment and enhancement include the following.

IVA Cells New insulating rings, new tie rods, improved procedure for high-voltage stacked ring assembly, re-anodized electrode surfaces (Figs. 7-8)

Diagnostics Improved vacuum voltage monitors, new TLD dosimetry diagnostic, re-calibration of vacuum voltage and current monitors

High Voltage Diode Improved cathode plates, new x-ray shield, improved rod position measurement

Other areas that received inspection, cleaning, seal replacements, upgrades, and other miscellaneous work are the: Marx Generator, Pulse Forming Line, Coaxial Transmission Line, IVA Oil Manifold, and Vacuum System. The progress of 32 Task Items were evaluated and tracked on a weekly basis during refurbishment and enhancement.

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The project consisted of 3 three milestones given below.

A. Refurbish Milestone — Cygnus hardware assembled – complete November 3, 2011

B. X-ray Shot Milestone — First x-ray shot executed – complete December 1, 2011

C. Imaging Milestone — Multiple x-rays shots executed with project ready configuration- complete March 1, 2012

Based on successful completion of the 32 Task Items and successful operational performance on the 20 shots, Cygnus was certified as ready for Project Gemini on March 1, 2012.

This project led by John Smith of P-23 and included members from P-23/LANL, NSTec and Sandia National Laboratory. It was funded by the Dynamic Plutonium Program under Jeffrey Paisner.

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Toby Anderson
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Also contributing greatly to the Refurbishment & Enhancement Project are:.

Joey Falquez
Paul A. Flores
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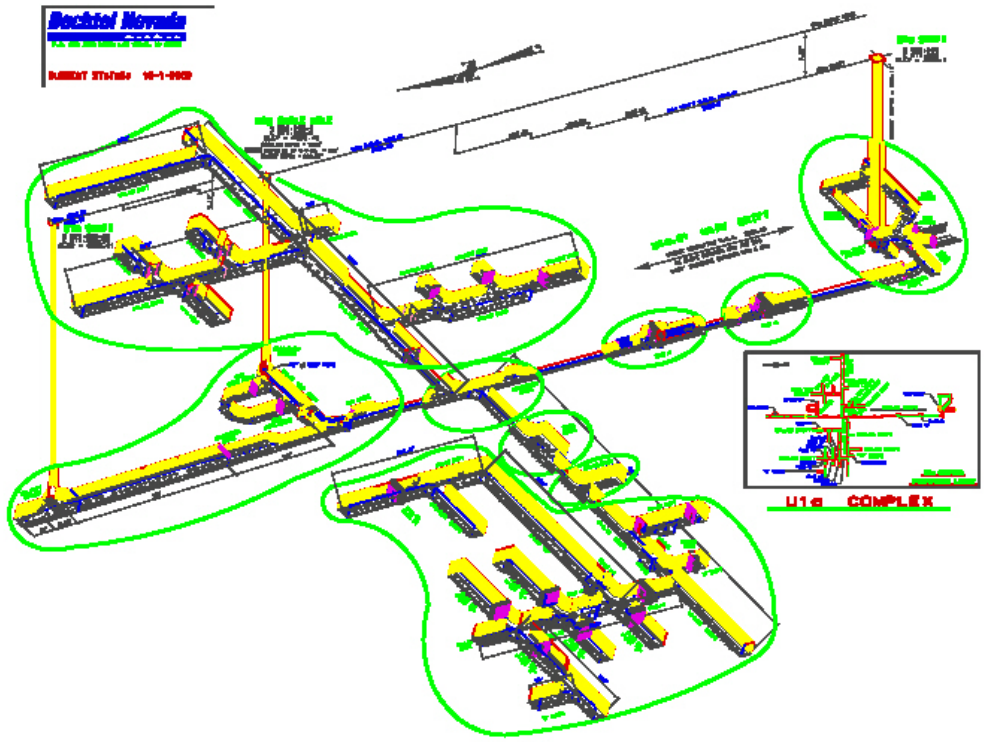

Figure 1. U1a Complex at the Nevada National Security Site. Approximate depth below surface level is

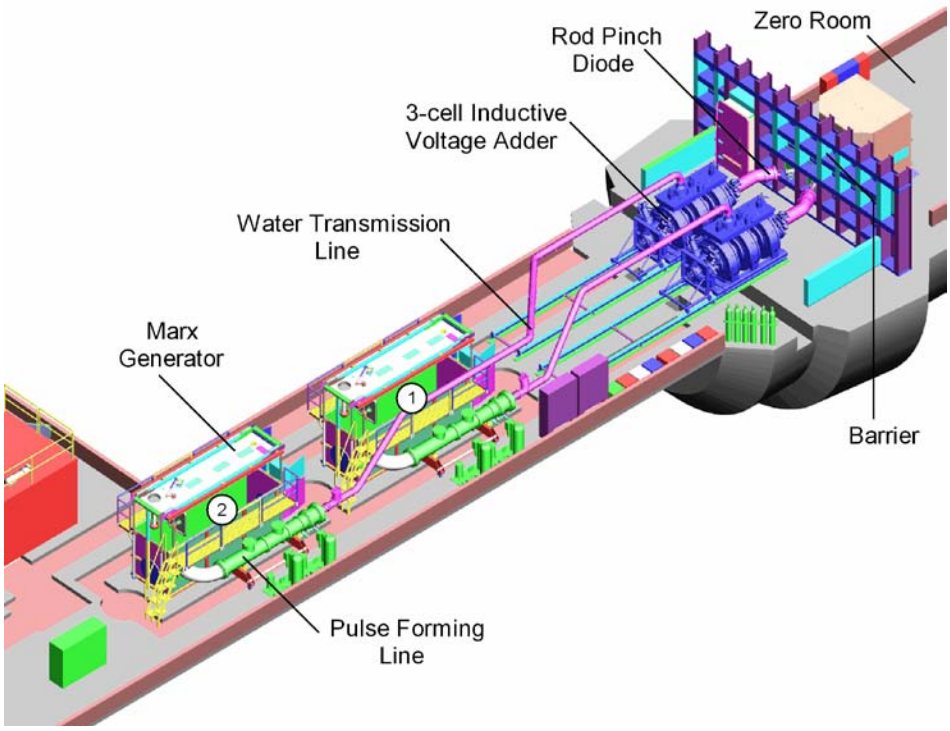

Figure 2. Cygnus Dual Beam Radiographic Facility. Also shown is the Barrier and Zero Room.

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Figure 3. Cygnus 1 Marx Generator in the background (with lid raised), and Cygnus 2 Marx Generator in the foreground.

Figure 4. Cygnus 1 IVA (right) and Cygnus 2 IVA (left).

Figure 5. Cygnus 1 X-ray Diode (background, left), and Cygnus 2 X-ray Diode (foreground, left), with the barrier on the far left.

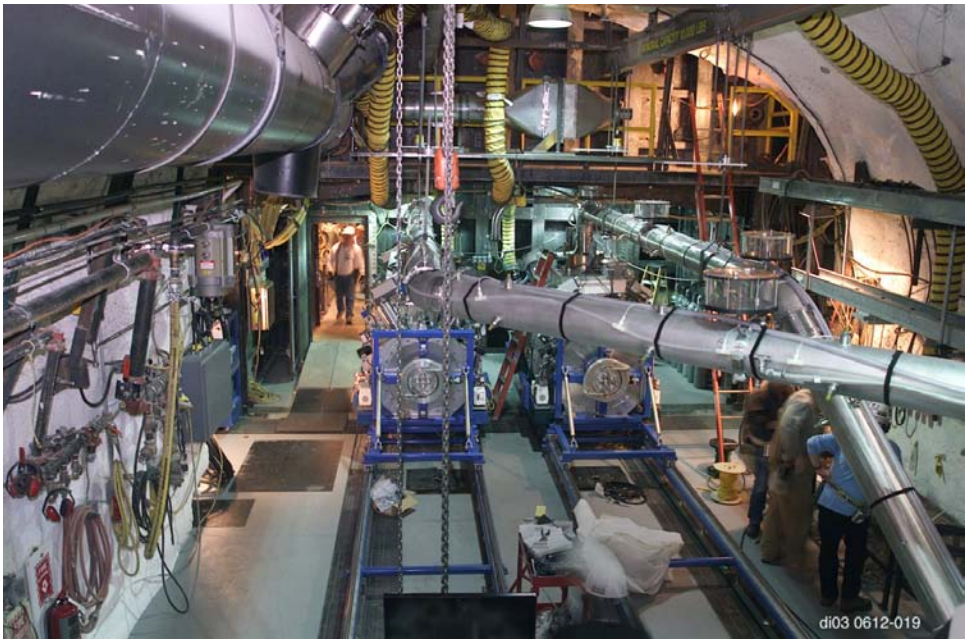

Figure 6. View of the 05 Drift tunnel expanse with the Cygnus IVAs shown in the center. The barrier is located in the background. The Coaxial Transmission Lines are also prominent.

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Figure 7. All six Cygnus IVA Cells mounted on individual work stands in the 05 drift awaiting refurbishment. Cygnus 1 cells are on red stands, and Cygnus 2 cells are on blue stands.

Figure 8. Assembly.

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