

**Nuclear Explosion Monitoring Research and Engineering (NEMR&E) Program  
Quarterly Report - BAA06-36; DE-FC52-06NA27322**

**Research Title: A Multi-Layer Phoswich Radioxenon Detection System**

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**Reporting Period: 04/01/07 – 06/30/07**

**Technical Progress:**

Description of Activities Conducted this Reporting Period:

Further work was performed in optical modeling of the modified (dual planar) XEPHWICH design. Modeling capabilities and understanding were expanded through the performance of three additional simulations. The efficiency of the entire optical modeling process was increased by developing custom software to interface with both the input and output of the simulation program.

Work continues on the design and implementation of the analog portion of the read-out system. This component is being prototyped and is nearing completion. The PCB (printed circuit board) is in its design phase for the two-channel digital pulse processor, necessary for the dual planar XEPHWICH. System components are being selected for the signal processor based on a balance of cost and our expectations of quality.

Outside the scope of the grant, but entirely related, we continue to work on developing a source of fission-product xenon gases that will be produced in the OSU TRIGA reactor. The amount of HEU necessary to provide the needed activities of xenon fission products, as well as build-in times for each isotope of importance following irradiation, have been calculated. Irradiation times in the TRIGA have been determined. We've finalized our design of the xenon-fission-product collection chamber and initiated in-house fabrication. PNNL will be supplying the thin foils of enriched uranium necessary for xenon production.

Progress/Deliverables Required by this Reporting Period per Contract:

The proposed schedule shows that, by the end of the fifth quarter, the planar XEPHWICH response with the existing DPP1 would be in progress (Phase 1, Task c), the design and construction of DPP2 would be complete (Phase 2, Task a), the DSP and FPGA programming is continuing (Phase 2, Task b), and the dual (saddle) XEPHWICH design/construction would be continuing (Phase 3, Task c).

Reason for Differences in Cooperative Agreement Statement of Objectives/Deliverables and Actual Progress/Deliverables, Corrective Actions:

We continue to progress with our DPP1/XEPHWICH response work. The first prototype, single-channel digital pulse processor responds as expected and is proving to be rugged in its design. With the setback of having to hire a new electrical engineering student last fall, we have yet to complete the DPP2 design and construction. That work is still progressing and we are planning for an end-of-summer completion date. The sampling frequency of the DPP2 has been increased to 250 MHz, using cutting-edge ADC technologies. Such a very high sampling rate will allow us to have a more in-depth analysis of the signal pulses in which three timing components may be superimposed. Two digital control features, offset and gain, are also being added to the design of each channel of the DPP2 to obtain maximum dynamic range from the ADC.

The proposed saddle design has been replaced with a dual, planar design and construction (by St. Gobain) of the first side of that detector is nearing completion. The dual planar design is simpler and more easily manufactured, yet will provide a better signal, more uniform light output, and better resolution.