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QUARTERLY STATUS REPORT

FAST-RESPONSE ISOTOPIC ALPHA CONTINUOUS AIR MONITOR (CAM)

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Contractor:

Thermo Power Corporation
Advanced Technologies Group
45 First Avenue
P.O. Box 9046
Waltham, MA 02454-9046

Principal Investigator: Keith D. Patch

Prepared for:

National Energy Technology Laboratory
U.S. Department of Energy
628 Cochrans Mill Road
P.O. Box 10940, MS 921-143
Pittsburgh, PA 15236

Contracting Officer's Representative: Richard P. Bush
Contracting Officer: Randolph L. Kesling
Specialist: Martin J. Byrnes

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Project objective

The objective of this effort is to develop and test a novel Continuous Air Monitor (CAM) instrument for monitoring alpha-emitting radionuclides, using a technology that can be applied to Continuous Emission Monitoring (CEM) of thermal treatment system off gas streams. The CAM instrument will have very high alpha spectral resolution and provide real-time, on-line monitoring suitable for alerting workers of high concentrations of alpha-emitting radionuclides in the ambient air and for improved control of decontamination, dismantlement, and air emission control equipment.

Base Phase I involves the design, development, and preliminary testing of a laboratory-scale instrument. Testing will initially be conducted using naturally-occurring radon progeny in ambient air. In the Optional Phase II, the Base Phase I instrument will be critically evaluated at the Lovelace Respiratory Research Institute (LRRI) with characterized plutonium aerosols; then an improved instrument will be built and field-tested at a suitable DOE site.

Major milestones

- Design criteria and specifications defined — Completed
- Prototype unit operational — Completed
- Performance of prototype unit demonstrated — Completed

Accomplishments and technical progress

<u>January 2000</u>

In May, the prototype CAM instrument became operational, and initial data was taken using the instrument. Modifications to improve the prototype CAM instrument's performance that were begun during June were completed in August. This work included an improved detector mount for enhanced alignment of the detectors to the film, and an enhanced film tracking system to improve alignment of the film to both the ESP and the detectors. Several changes to the film transport system were also made to accommodate the enhanced film tracking system.

The complete prototype ESP CAM instrument was successfully operated this month to obtain additional performance and reliability data. In brief, these were tests that included all the major operational features of the instrument:

- Two large area diodes, to maximize instrument sensitivity;
- The improved, parallel-flow airflow arrangement described recently;
- Automatic libration of the instrument, to provide a sub-one minute response time for acute alarms of radionuclide levels;
- Automatic film feeding, to provide an archival record of radionuclide levels.

Unit operation included an extended comparison test, where the operation of the laboratory instrument was compared with that of conventional filter analysis. The purpose of this side by side comparison test was to quantify the variability inherent in both analysis methods. Analysis results (Figure 1) illustrate that the results obtained with the prototype ESP CAM instrument compare quite favorably with the concentration of radon progeny determined with a conventional filter analysis.

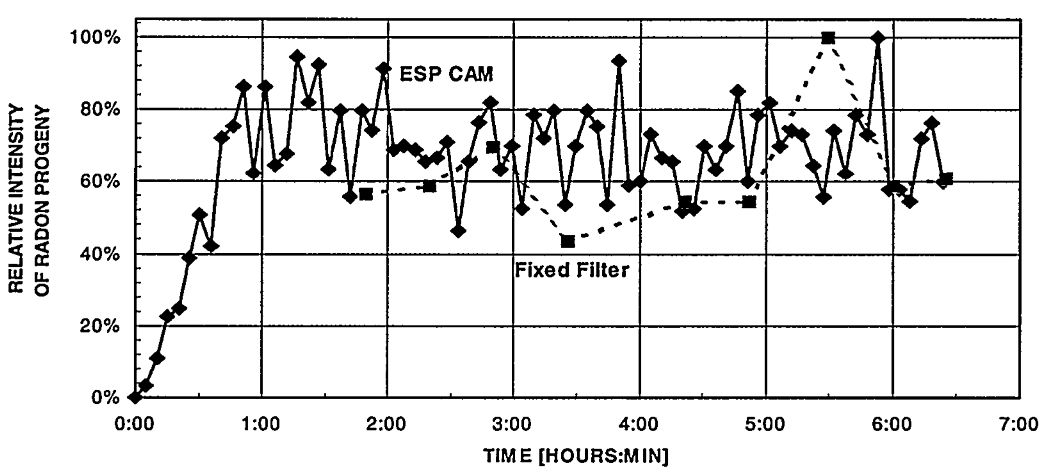

Figure 1 Similar Variability of ESP CAM and Conventional Fixed Filter

Table 1 contains the summary statistics for the two methods. The prototype ESP CAM produced an average intensity of radon progeny that was higher than the conventional fixed filter (70.3% vs. 61.8%), with a lower standard deviation (11.5% vs. 15.9%). Consequently, the ESP CAM instrument clearly demonstrated a lower variability in its measurement of relative radon intensity, when compared to the conventional fixed filter analysis method.

Table 1 ESP CAM Has Less Variability than Conventional Fixed Filter

Method	Average Relative Intensity of Radon Progeny	Standard Deviation
Prototype ESP CAM	70.3%	11.5%
Conventional Fixed Filter	61.8%	15.9%

Additional testing will be conducted in order to provide additional characterization of the prototype CAM system's operation and performance. For example, a determination will be made of the response of the CAM system to various changes in sample air flow rate.

February 2000

In May, the prototype CAM instrument became operational, and initial data was taken using the instrument. Modifications to improve the prototype CAM instrument's performance that were begun during June were completed in August. This work included an improved detector mount for enhanced alignment of the detectors to the film, and an enhanced film tracking system to improve alignment of the film to both the ESP and the detectors. Several changes to the film transport system were also made to accommodate the enhanced film tracking system.

The complete prototype ESP CAM instrument was successfully operated this month to obtain additional performance and reliability data. In brief, these included tests that included all the major operational features of the instrument:

- Two large area diodes, to maximize instrument sensitivity;
- The improved, parallel-flow airflow arrangement described recently;
- Automatic libration of the instrument, to provide a sub-one minute response time for acute alarms of radionuclide levels;
- Automatic film feeding, to provide an archival record of radionuclide levels.

Unit operation included a non-librating comparison test, where the laboratory instrument's operation over an extended test period was compared with that of conventional filter analysis. The purpose of this side-by-side comparison test was to verify that accurate results are obtained with the prototype ESP CAM instrument whether or not the side-to-side libration motion is used. The most notable difference between the librating and non-librating modes of instrument operation should be the time delay prior to measuring radioactivity with non-librating operation. Analysis results (Figure 2) clearly illustrate the 30 minute delay in instrument response. In addition, the results obtained with the prototype ESP CAM instrument compare quite favorably with the concentration of radon progeny determined with a conventional filter analysis.

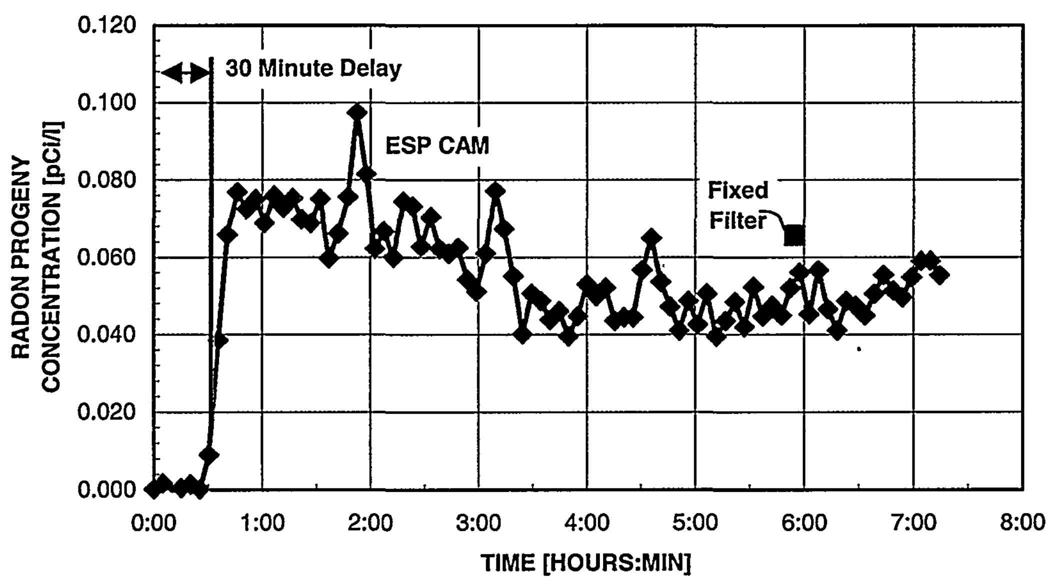

Figure 2 Non-Librating ESP CAM Results Compare Well to Conventional Fixed Filter Test

March 2000

In May, the prototype CAM instrument became operational, and initial data was taken using the instrument. Modifications to improve the prototype CAM instrument's performance that were begun during June were completed in August. This work included an improved detector mount for enhanced alignment of the detectors to the film, and an enhanced film tracking system to improve alignment of the film to both the ESP and the detectors. Several changes to the film transport system were also made to accommodate the enhanced film tracking system.

In order to improve the mechanical support of the film, a new film platen was fabricated, installed and tested this month. The new platen was designed to be wider, in order to support the film for more of its travel through the instrument. In addition, the new platen was fabricated to produce a more even surface, with end to end surface elevation difference of less than 0.008". The more even surface was desired in order to decrease the gap between the detectors and the film, in order to improve the isotopic resolution of the laboratory prototype ESP CAM instrument. As a result of the more even surface, it was possible to reduce the detector gap from 0.030" to 0.020".

The modified ESP CAM instrument was successfully operated this month to obtain additional performance and reliability data. In brief, these tests included all the major operational features of the instrument:

- Two large area diodes, to maximize instrument sensitivity;
- The improved, parallel-flow airflow arrangement described recently;
- Automatic libration of the instrument, to provide a sub-one minute response time for acute alarms of radionuclide levels;
- An improved film support platen to provide improved isotopic resolution;
- Automatic film feeding, to provide an archival record of radionuclide levels.

Analysis results clearly indicated the improved spectral response provided by the reduced detector-film spacing. For a Po-214 peak height of 100 counts, the full-width at half-maximum (FWHM) improved by 20.8%, from 0.24 to 0.19, while the full-width at tenth-maximum (FWTM) improved by 20.2%, from 0.89 to 0.71. In other words, whereas a spectrum acquired with the old 0.030" air gap ESP CAM required 1768 Po-214 counts to reach a peak height of 100, the new 0.020" air gap ESP CAM only requires 1443 Po-214 counts. This translates into the modified laboratory prototype ESP CAM requiring 22.5% fewer Po-214 counts in order to produce a Po-214 peak height of 100 counts.

Assessment of current status

The project is on schedule. Base Phase I work has been completed on budget. Work has been begun at risk on an increased scope of work, involving a field test of the laboratory prototype ESP CAM and the design and fabrication of an advanced prototype ESP CAM. Measures are being negotiated with DOE NETL that should implement the increased scope of Phase I work of in the near future.

Plans for the next two months

An increase in the Scope of Work will be put into place that includes field testing the Laboratory Prototype ESP CAM.

The Laboratory Prototype will be prepared for field testing at Los Alamos National Laboratory's TA-54 LSDDP site.

A Topical Report will be submitted that summarizes the work conducted during the project's original Phase I.

PI: Keith Patch, Thermo Power Corp. (Advanced Technologies Group), (781) 622-1022

FETC COR: Richard Bush (412) 386-6426