PROGRAM AND ABSTRACTS

26th Nuclear Air Cleaning and Treatment Conference

RICHLAND, WASHINGTON

SEPTEMBER 11-12, 2000

Federal Auditorium

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26th Nuclear Air Cleaning and Treatment Conference

Program

Monday, September 11, 2000
Federal Auditorium

8:30 a. m. Welcome and Introductions

Technical Papers:

Session I: Facility Ventilation. James R. Kriskovich presiding.
8:45 a. m. I-1 *Fire Protection Considerations in the Design of Plutonium Handling and Storage HVAC Systems-* **D. Allan Coutts**, Ph.D., P. E., Westinghouse Safety Management Solutions, Aiken, S. C.

9:10 a. m. I-2 *Decommissioning of Filter Plenums* - **J. K. Fretthold**, Kaiser-Hill Co., Golden, Colorado

9:35 a. m. I-3 *Performance of Ventilation Systems During the Los Alamos Wildfire* – **D. J. Erickson**

10:35 a. m. Break

10:55 a. m. I-4 *An Offgas System for a Low Activity Waste Melter* - **Theodore D. Anderson** and **Edgardo Berrios**, BNFL, Inc., Richland, Washington

11:20 a. m. I-5 *Hanford RPP-WTP-HLW Vitrification Offgas System* - **Jim Rouse, Don Larson**, and **Richard Chen**, BNFL, Inc., Richland, Washington.

11: 45 a. m. I-6 *Decomposition of Toluene, Methylene Chloride, and Freon-113 in a Packed Bed Corona Reactor* - **William Heath**, Current Environment Solutions, Richland, Washington, and **Kenneth Rappe**, Battelle Memorial Institute, Richland, Washington.

12:10 p. m. Lunch

Continuation of Facility Ventilation Session, Federal Auditorium
1:15 p. m. I-7 *The Benefits of a Low Flow Containment and Ventilation Design Approach for Nuclear Installations* - **R. Doig**, B. Eng., Ph.D., C. Eng, FCIBSE, BNFL Engineering Ltd., Risley, Cheshire, United Kingdom

1:40 p. m. Radioactive Airborne Emissions, John Glissmeyer and Andrew McFarland Presiding

1:40 p. m. II-1 *Integration of Radioactive Air Emission Monitoring Requirements into Development of a Radiological Material Tracking System* - **M. Y. Ballinger** and **D. L. Edwards,** Pacific Northwest National Laboratory, Richland, Washington

2:05 p. m. II-2 *Management Aspects of Implementing the New Effluent Air Monitoring Standard* - **John Glissmeyer,** Pacific Northwest National Laboratory, Richland, Washington, & **William E. Davis,** Fluor Hanford Co., Richland, Washington

2:30 p. m. Break

2:50 p. m. II-3 *Prediction of Aerosol Particle Losses in Sampling Systems,* **Andrew R. McFarland,** Texas A&M University, College Station, Texas

Joint with NESHAPS Annual Meeting: William Davis and Gustavo Vasquez presiding.

3:20 p. m. *Welcome* – Paul Krupin, U. S. Dept. of Energy Richland Operations, Richland, Washington

3:25 p. m. II-4 *Radioactive emissions from DOE Sites* – **Gustavo Vasquez,** NESHAP Coordinator, U. S. Department of Energy, Germantown, Maryland.

3:45 p. m. II-5 *Status of Amendment for 40 CFR 61 Subpart H* – **Robin Anderson,** NESHAP Coordinator, U. S. Environmental Protection Agency, Washington, D. C.

4:05 p. m. II-6 *Round Table Discussion* – **Robin Anderson, Brent Blunt,** Westinghouse Savannah River Co., **Larry Diediker, John Glissmeyer, Andy McFarland, Gustavo Vasquez.**

6:30 p. m. Conference Banquet

Tuesday, September 12: Federal Auditorium

Filtration and Adsorption Techniques, Ron Scripsick presiding

8:30 a. m. III-1 *Development of Treatment Technology for Dissolver Offgas of Spent Fuel* - **Hideaki Mineo, M. Iizuka, S. Fujisaki, T. Kihara,** and **G. Uchiyama,** Japan Atomic Energy Research Institute, Tokai-Mura, Japan.

8:55 a. m. III-2 *Experimental Investigation of in Situ Cleanable/Regenerable Filters for High Level Radioactive Waste Tanks* – **Michael T. Terry,** P. E., Los Alamos National Laboratory, Los Alamos, New Mexico, & **Duane J. Adamson,** Westinghouse Savannah River Company, Aiken, South Carolina

9:20 a. m. III-3 *Degradation of Filters by Water Carryover* - **J. K. Fretthold,** Kaiser-Hill Co., Golden, Colorado

9:45 a. m. III-4 *Investigation of Velocity-Breakthrough Relationships in Carbon Filters* – **Lyle L. Dauber,** U. S. Army Soldier and Biological Chemical Command, Aberdeen Proving Ground, Maryland; **David R. Peterson,** P. E., and **Carl A. Bettern,** P. E., Science Applications International Corporation, Edgewood, Maryland; & **Kenneth W. Heffley,** Flanders/CSC, Bath, North Carolina

10:10 a. m. Break

10:30 a. m. III-5 *Investigation of Shock/Acceleration Loads on Carbon Filters During Transportation and Handling* - **David R. Peterson,** P. E., and **C. A. Bettern,** P. E., Science Applications International Corporation, Edgewood, Maryland; and **Lyle L. Dauber,** U. S. Army Soldier and Biological Chemical Command, Aberdeen Proving Ground, Maryland.

Regulatory Requirements and Documents, R. Bellamy presiding

10:55 a. m. IV-1 *The International Atomic Energy Agency and its Gaseous Waste Management Handbook Activity* – **R. Doig,** B. Eng., Ph.D., C. Eng, FCIBSE, BNFL Engineering Ltd., Risley, Cheshire, United Kingdom **R. Burcl,** International Atomic Energy Agency, Vienna, Austria; **V. Isupov** and **Y. Panteleev,** Khlopin Radium Institute, St. Petersburg, Russia, and **J. L. Kovach,** NUCON, Inc., Columbus, Ohio

11:20 a. m. IV-2 *The Revised NRC Guide 1.52* - **J. Segala,** U. S. Nuclear Regulatory Commission, Bethesda, Maryland.

11:50 a. m. Lunch

1:00 p. m. Federal Auditorium

1:00 p. m. IV-3 *Ventilation Systems and Interactions with Control Room Habitability* – **Don Garbe,** Vermont Yankee Nuclear Power.

1:30 p. m. IV-4 *Round Table: Implications of the Revised Source Term*

2:30 p. m. Break

Operational Concerns. Mark Pest Presiding
2:50 p. m. V-1 *Air Inleakage Testing at Crystal River Unit 3* - **P. L. Lagus**, Lagus Applied Technology, Inc., San Diego, California; **John Taylor** and **Kenneth Anderson**, Florida Power Corporation, Crystal River, Florida, and **John R. Pearson**, NCS Corporation, Columbus, Ohio.

3:15 p. m. V-2 *Air Inleakage Due to Door Opening and Closing* - **Peter L. Lagus**, Lagus Applied Technology, San Diego, California

3:40 p. m.V-3 *Mitigation of the Effects of the U1 Steam Leak on U2 outage and Turbine Building Operations* - **Peter G. Dorosko**, Brunswick Nuclear Power Plant, Southport, North Carolina.

4:05 p. m. V-4 *A Better Understanding of Filtration Systems Through Training and Experience* - **Robert G. Penn**, United States Enrichment Corporation, Piketon, Ohio.

4:30 p. m. V-5 *Training Workers to Use Localized Ventilation for Radiological Work* - **Larry Waggoner & Jerry Eby**, Fluor Hanford, Inc., Richland, Washington

4:55 p. m. Concluding remarks; ISNATT business meeting follows.

26th Nuclear Air Cleaning and Treatment Conference
Abstracts of Technical Papers

Monday, September 11, 2000
Session I: Facility Ventilation

I-1 *Fire Protection Considerations in the Design of Plutonium Handling and Storage HVAC Systems-* **D. Allan Coutts**, Ph.D., P. E., Westinghouse Safety Management Solutions, Aiken, S. C.

Unwanted fire in a facility that handles plutonium must be addressed early in the facility design. Such fires have the potential for transporting radioactive contamination throughout the building and widespread downwind dispersal. Features that mitigate such events can be severely challenged during the fire. High temperatures can cause storage containers to burst; a very efficient dispersal mechanism for radioactive contamination. The fire will also establish ventilation patterns that cause the migration of smoke and radioactive contamination throughout the facility. The smoke and soot generated by the fire will enter the exhaust system and travel to the filtration system where it will deposit on the filters.

The quantity of smoke generated during a typical multi-room fire is expected to blind most High Efficiency Particulate Airfilter (HEPA) media. The blinding can have two possible outcomes. (1) The air movement though the facility is reduced, compromising the negative pressure containment and allowing contamination to leave the building though doors and other openings; or (2) the filters collapse allowing the contamination to bypass the filtration media and exit the building through the filter plenum. HEPA filter blinding during severe fires can be prevented or mitigated. Increasing the face surface area of HEPA filters will increase the smoke filtration capacity of the system, thus preventing blinding.

As an alternative, sand filters can be provided to mitigate the effects of the HEPA filter bypass. Both concepts have distinct advantages. This paper will explore these two design concepts and two others; it will describe the design requirements necessary for each concept to prevent unacceptable contamination spread. The intent is to allow the filter media selection to be based on a comprehensive understanding of the four different design concepts.

I-2 *Decommissioning of Filter Plenums* - **J. K. Fretthold**, Kaiser-Hill Co., Golden, Colorado.

Rocky Flats Environmental Technology Site (RFETS) has approximately 90 exhaust filter plenums. These plenums are located both in the buildings they service, and in adjacent buildings. There are both 2 and 4 stage walk-in type plenums with an average of 30 HEPA filters per stage. The RFETS mission is the closure of the site; part of the closure process is the demolition of facilities. The first major building and associated mechanical buildings were demolished in 1999/2000. Seven exhaust plenums were demolished in place. The method used for the successful demolition is recorded in photos.

I-3 *Performance of Ventilation Systems During the Los Alamos Wildfire* - **J. Ortega** et al.

Abstract not available. The paper will review the title subject.

I-4 *An Offgas System for a Low Activity Waste Melter* - **Theodore D. Anderson** and **Edgardo Berrios**, BNFL, Inc., Richland, Washington

BNFL Inc. has entered into a contract with the U. S. Department of Energy for pretreatment and vitrification of waste stored in underground storage tanks at the Hanford site in Washington State. This project will soon enter the detailed design phase. The wastes retrieved from these tanks will be conditioned in a pretreatment facility and sent to a vitrification facility for immobilization by mixing the waste with glass formers and melting the mixture in up to three Joule heated ceramic melters.

Offgas generation from this vitrification process is dynamic and not steady state. Offgas treatment is carried out in two stages, referred to as the Primary and Secondary Offgas Systems. Each melter has a dedicated Primary Offgas System that cools the offgas and removes most of the particulates and soluble compounds. This system is designed to handle intermittent surges in offgas generation. Components of this system are a film cooler, a submerged bed scrubber, and a wet electrostatic precipitator (WESP).

After the WESP, the dedicated offgas lines are joined together with the vessel ventilation header, and are routed to the secondary offgas treatment system. This system is designed to handle the maximum sustained flow rate from one to tghree melters. Components of this system are HEPA filters with preheater, exhauster fans, a catalytic oxidizer/reducer unit which houses a heat recovery unit, electric preheater, the catalysts for VOC oxidation and NO_x reduction, and a caustic scrubber. Treatment through this system reduces the remaining chemical contaminants, allowing compliant offgas discharge from the stack.

I-5 *Hanford RPP-WTP-HLW Vitrification Offgas System* - **Jim Rouse, Don Larson**, and **Richard Chen**, BNFL, Inc., Richland, Washington

BNFL Inc. has entered into a contract with the U.S. Department of Energy for pretreatment and vitrification of radioactive waste stored in underground storage tanks at the Hanford Site in Washington State. The waste retrieved from these tanks will be conditioned in a pretreatment facility. The high-level waste fraction will be sent to a vitrification facility for immobilization in glass by a Joule heated ceramic melter. The vitrification process offgas will be treated to assure compliance with regulations prior to release.

The offgas from the high-level waste (HLW) vitrification melter is generated by and composed of the following:

- Air from melter bubbler operation and inleakage into the melter,
- Water vapor evaporated from the melter feed,
- Acid gases generated from feed decomposition (i.e., CO_2, NO_x, SO_x, etc.), and
- Aerosols from dried melter feed and melter cold-cap reaction solids.
- Air is also added to the melter offgas from the following:
  - Air Inleakage into the Melter
  - Melter Bubblers
  - Film Cooler Air Inbleed
  - Control Air Added to Regulate Melter Plenum Vacuum

In addition, the HLW melter also generates small quantities of other volatile compounds that may require attention during treatment. These compounds include iodine-129, carbon-14, tritium, and/or volatile organics. Carbon-14 and tritium should be in the form of carbon dioxide and water, respectively. The vessel ventilation offgas is added to the melter offgas during this treatment and discharged together.

Offgas treatment systems are provided to remove aerosols, acid gases, radionuclide contaminates and heat. The system components include:

- Primary HLW Melter Offgas Treatment System
  - Film Cooler
  - Submerged Bed Scrubber (SBS)
  - Wet Electrostatic Precipitator (WESP)
  - High Efficiency Mist Eliminator (HEME)
  - High Efficiency Particulate Air Filter (HEPA)
- Secondary Offgas Treatment System
  - Caustic Scrubber
  - Thermal Catalytic Oxidizer

The vessel ventilation air is combined with the WESP offgas discharge. The combined offgas is further treatment by the primary HEMEs, HEPAs, and the secondary offgas system. After treatment by the secondary offgas treatment system, the combined HLW offgas is discharged to the building ventilation system for final filtration by the facility HEPA filters before being discharged to the environment through the main stack.

I-6 *Decomposition of Toluene, Methylene Chloride, and Freon-113 in a Packed Bed Corona Reactor* - **William Heath**, Current Environment Solutions, Richland, Washington, and **Kenneth Rappe**, Battelle Memorial Institute, Richland, Washington

The team of Current Environmental Solutions and Battelle Memorial Institute completed laboratory tests to determine the ability of the Gas Phase Corona Reactor (GPCR) technology to destroy toluene, methylene chloride and Freon 113 in a simulated soil offgas stream. The simulated stream mimicked a soil-vapor extraction effluent generated during site remediation efforts at a Superfund site.

The GPCR process creates high-voltage electrical fields in a packed bed of dielectric pellets to form nonthermal plasma in the void spaces between the pellets. The typical GPCR device is comprised of a coaxial cylinder with an inner metal electrode, an outer quartz tube, and dielectric pellets filling the annular gap. The inner electrode is connected to a high-voltage alternating-current (ac) power supply. The quartz tube serves as the reaction vessel and as a dielectric barrier to inhibit direct charge transfer between electrodes. A metal screen flush with the outside surface of the quartz tube serves as the ground electrode.

Based on limited testing in a laboratory setting, our overall conclusion is that it is indeed feasible to use the GPCR technology as a low-temperature alternative to thermal oxidation of soil vapors extracted during site cleanup efforts. Destruction efficiencies were achieved in excess of 95%, not only for the entire gas mixture, but also for each contaminant. The presence of little or no secondary VOCs in the mass spectra of the reactor effluent further suggests that an overall destruction and removal efficiency (DRE) of 95% can indeed be achieved. The ability to achieve broad-spectrum treatment at low temperatures is key to avoiding catastrophic material failure caused by the exposure of metal surfaces in thermal systems to hydrochloric and hydrofluoric acid mists that are created when CFCs like Freon 113 are decomposed.

I-7 *The Benefits of a Low Flow Containment and Ventilation Design Approach for Nuclear Installations* - **R. Doig**, B. Eng., Ph.D., C. Eng, FCIBSE, BNFL Engineering Ltd., Risley, Cheshire, United Kingdom

Nuclear Ventilation Group of BNFL have published numerous papers in recent years expounding a new low flow design approach to containment and ventilation for nuclear buildings. This approach has been the basis of the ventilation design philosophy for a significant number of new plants built at Sellafield, Cumbria, UK since the early 1980's. The facilities designed and constructed for Sellafield are now operational and beginning to provide feedback on the success of this new design approach. The operational experience is showing that there has been no reduction in radiological safety, and that the low flow designs are providing the required levels of containment and ventilation. This low flow design approach has been exported, and is now being utilized by BNFL for current projects in the USA, which include the River Protection Project, Richland, and AMTWP, Idaho.

The effect of the change of design approach can be seen in AECP 1054, the ventilation bible of the UK nuclear industry. In the 1979 edition of AECP 1054, the recommended air change rates were between 5/hr and 30/hr. The significance of this change becomes apparent when the extract systems of THORP are considered. The plant has an overall airchange rate of 1.25/hr (low flow approach) and the total extract is 1.5 million m^3/hr – a dramatic reduction when compared with the recommended airchanges of 5/hr to 30/hr.

This paper will identify the major buildings that have been constructed at Sellafield since 1980, and compare the actual design information, based on the low flow philosophy, with what the design would have been if it had been based on the recommended airchange rates given in the 1979 issue of AECP 1054. The cumulative effects from the reduction in ventilation airflows in these plants in terms of financial savings on capital for initial plant, running costs, solid and aerial waste production will be examined. In addition, the benefits in terms of reduction of dose to workers, to the public and the reduced impact on the environment, from discharges at the plant and at the power plant, will also be discussed.

Session II: Radioactive Airborne Emissions

II-1 *Integration of Radioactive Air Emission Monitoring Requirements into Development of a Radiological Material Tracking System* - **M. Y. Ballinger** and **D. L. Edwards**, Pacific Northwest National Laboratory, Richland, Washington

The Pacific Northwest National Laboratory (Pacific Northwest) has been using an inventory-based method to determine radionuclide air emission monitoring requirements for the research facilities they operate that contain radioactive material. This method requires an annual collection of inventory information for each facility from custodians and from centralized databases developed for other purposes. The data is obtained in various formats so some reformatting and preprocessing is performed prior to calculating an emission potential based on methods provided in National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations. From the time when the original calculations were performed in 1991, the system used to calculate potential emissions from the inventory data has progressed from spreadsheets to a database. Recent efforts are underway to develop a web-based capability to obtain the inventory information used in the annual assessment. This effort coincides with a Pacific Northwest Lab-wide effort to develop a tool to consolidate radionuclide inventory data to comply with a number of regulatory drivers in addition to radioactive air emissions. This system is being called the Radioactive Material Tracking (RMT) system.

RMT is intended to be used to keep track of the inventory of radioactive materials within a specified building (or buildings) for the purpose of maintaining a set of information that is needed in order to determine compliance with a number of various requirements. These Requirements include facility Operational Safety Requirements (derived from the facility's Safety Analysis Report), Criticality Safety Program, and Safeguards and Security Program in addition to radionuclide air emission monitoring. The various drivers have both unique and overlapping requirements making development of a total system challenging.

A prototype system has been developed using Map Information Tool. This prototype is being tested on the Pacific Northwest-operated facility with the greatest inventory and the most challenging requirements. An example will be provided and capabilities and limitations of the system discussed. The RMT provides a platform to aid custodians in maintaining sufficient inventory information to respond to various compliance program requirements, a tool for facility managers to identify how new operations or movement of materials may affect limiting facility conditions, and a more efficient means to demonstrate compliance.

II-2 *Management Aspects of Implementing the New Effluent Air Monitoring Standard* - **John Glissmeyer**, Pacific Northwest National Laboratory, Richland, Washington, & **William E. Davis**, Fluor Hanford Co., Richland, Washington

The revision to ANSI/HPS N13.1, "Sampling and Monitoring Releases of Airborne Radioactive substances From the Stacks and Ducts of Nuclear Facilities", went into effect in January 1999 -- replacing the 1969 version of the standard. There are several significant changes from the old version of the standard. The revised standard provides a new paradigm where representative air samples can be collected by extracting the sample from a single point in air streams where the contaminants are well mixed. The revised standard provides specific performance criteria and requirements for the various air sampling processes – program structure, sample extraction, transport, collection, effluent and sample flow measurement, and quality assurance. A graded approach to sampling is recommended with more stringent requirements for stacks with a greater potential to emit. These significant changes in the standard will impact the air monitoring programs at some sites and facilities. The impacts on the air monitor design, operation, maintenance, and quality control processes are discussed.

II-3 *Prediction of Aerosol Particle Losses in Sampling Systems,* **Andrew R. McFarland,** Texas A&M University, College Station, Texas.

Aerosol transport efficiency of extractive sampling systems must be estimated under the requirements of the new ANSI standard for stack emission methodology (ANSI N13.1-1999). The transport efficiency must be at least 50% for 10 micrometer AD aerosol particles and either experimental or calculational procedures may be used to demonstrate compliance with the requirement. The code, DEPOSITION, whichhas been acceptable for this application and which is also acceptable for meeting a similar NRC requirement, has been upgraded. The code has been made more user friendly from the standpoints of improving the protocol for data input and output; and, new models have been included for predicting aerosol particle losses in flow splitters, and in turbulent flow through bends. Also, the graphics, which permit a user to view the sampling system, have been upgraded.

II-4 *Radioactive emissions from DOE Sites* - **Gustavo Vasquez,** NESHAP Coordinator, U. S. Department of Energy, Germantown, Maryland.

Abstract not available.

II-5 *Status of Amendment for 40 CFR 61 Subpart H* – **Robin Anderson,** NESHAP Coordinator, U. S. Environmental Protection Agency, Washington, D. C.

Abstract not available.

II-6 *Round Table Discussion* - **Robin Anderson, Brent Blunt,** Westinghouse Savannah River Co., **Larry Diediker, John Glissmeyer, Andy McFarland, Gustavo Vasquez.**

Tuesday, September 12, 2000

III-1 *Development of Treatment Technology for Dissolver Offgas of Spent Fuel* - **Hideaki Mineo, M. Iizuka, S. Fujisaki, T. Kihara,** and **G. Uchiyama,** Japan Atomic Energy Research Institute, Tokai-Mura, Japan.

Dissolution experiments using unirradiated UO2 pellets, PWR spent fuel (8000 MWd/t and 29000 MWd/t) have been conducted in an alpha-gamma cell to investigate the behavior of iodine and carbon-14 during nuclear fuel reprocessing. Also, an adsorbent consisting of hydrogenated-mordenite impregnated with sodium hydroxide has been under investigation by cold tests for carbon-14 removal from dissolver off-gas.

Distribution of iodine over a dissolution process in the cell consisting of a dissolver, a condenser, a scrubber, a HEPA filter and iodine adsorption columns containing AGS (silica-gel impregnated with AgNO3) was determined using iodine-131 as tracer during the dissolution of about 306 g of unirradiated UO2 pellets which simulated spent fuel with 45000 MWd/t burnup. The column consisted of 14 cartridges. Each cartridge had the size of 25 mm i.d. and 10 mm thick and contained 3.4 g of AGS. The results of the experiment showed that 0.37% iodine remained in the dissolver solution and 1.30% remained in insoluble residue. Almost all iodine was removed to the dissolver off-gas, 74.06% was collected by the iodine adsorbent column, 11.33% and 0.10% was collected in a HEPA filter and dissolver off-gas scrubber, respectively. The remaining iodine was found to accumulate on the surface of the off-gas piping.

Dissolution test using spent fuels in the same rig detected iodine-129 in the AGS columns and it was shown that the fraction of iodine adsorbed by AGS was almost the same value as it was obtained in the dissolution of unirradiated UO2 pellets. In the dissolution tests of 8,000 MWd/t and 29,000 MWd/t spent fuels, the amount of adsorbed iodine accounted for about 62 % and 69 % of total amount of iodine-129 estimated by ORIGEN2, respectively. No significant amount of iodine-129 was found in each dissolver solution, although the iodine contained in insoluble residue has not been measured because of high radioactivity. Based on the distribution result of the above iodine-131 experiment, it seemed that the rest of iodine was trapped by the HEPA filter and was also accumulated on the surface of the off-gas piping.

Carbon-14 was measured by a beta-liquid scintillation counter after separating carbon-14 as CO_2 by KOH aqueous solution from the dissolver off-gas of the spent fuel. It was shown that the evolution of carbon-14 during the dissolution occurred along with the release of Kr-85. The concentration of nitrogen-14 initially contained in the fuel was estimated to be less than 10 ppm.

The adsorbent consisting of hydrogenated-mordenite impregnated with sodium hydroxide (Na-H-M) showed a capacity of 1.4 gCO2/50g Na-H-M which was about 4.3 times higher adsorption capacity than hydrogenated mordenite for the carbon dioxide. The capacity was decreased when concentration of NO_x gas increased up to 1% and relative humidity increased up to 8 %.

Dissolution test will be carried out using 1.2 kg of 45,000 Mwd/t spent fuel. Behavior of iodine and carbon-14 will be investigated in the same way.

III-2 *Experimental Investigation of in Situ Cleanable/Regenerable Filters for High Level Radioactive Waste Tanks* – **Michael T. Terry**, P. E., Los Alamos National Laboratory, Los Alamos, New Mexico, and **Duane J. Adamson**, Westinghouse Savannah River Company, Aiken, South Carolina

The Westinghouse Savannah River Company located at the Savannah River Site (SRS) near Aiken, South Carolina, is currently testing two types of filter media for application as in situ regenerable/cleanable filters on high-level radioactive liquid waste tanks. Each of the 1.3 million-gallon tanks are equipped with an exhaust ventilation system to provide tank ventilation, and to maintain the tank contents at approximately 1-in. water gauge vacuum to prevent the release of radioactive material to the environment. These systems are equipped with conventional, disposable, glass-fiber, HEPA filters that require frequent removal, replacement, and disposal. The routine replacements are often caused by structural weakening or accelerated filter loading due to the moisture in the operating environment. This is not only costly, but subjects site personnel to radiation exposure and possible contamination.

The types of filter media being tested, as part of a National Energy Technology Laboratory procurement, are sintered metal and monolith ceramic. The media were subjected to a hostile environment ot simulate conditions that challenge the tank ventilation systems. The environment promoted rapid filter plugging to maximize the number of filter loading/cleaning cycles that would occur in a specified period of time. The filters were challenged using simulated high level waste materials (no radioactive materials) and atmospheric dust; materials that cause filter pluggage in the field. Cleaning solutions tested included water, mild nitric acid, and caustic solutions.

The study found that both filter media were insensitive to high humidity or moisture conditions and were easily cleaned in situ. The filters regenerated to approximately clean filter status even after numerous plugging and in situ cleaning cycles. The filters were leak tested using poly alpha olefin aerosol at the beginning, middle, and end of the test campaign. Both the sintered metal and ceramic filters passed the challenge test with an efficiency of a conventional HEPA filter (99.97% or greater) each time.

III-3 *Degradation of Filters by Water Carryover* - **J. K. Fretthold**, Kaiser-Hill Co., Golden, Colorado

The Defense Nuclear Facility Safety Board raised the concern that water carryover could degrade HEPA filters when the automatic deluge plenum fire systems are tested. Rocky Flats Environmental Technology Site (RFETS) has approximately 600n HEPA filters installed in zone II and III filter plenums. These plenum systems are credited in the control of airborne releases to the environment during normal operations and potential accidents. Tests of the plenum demister systems were performed. The purpose of the testing was to verify that the type of demisters currently in use at RFETS perform their intended functions, and to determine if the first stage HEPA filters would be degraded by exposure to water during the testing of the automatic deluge fire sprinkler system.

III-4 *Investigation of Velocity-Breakthrough Relationships in Carbon Filters* - **Lyle L. Dauber**, U. S. Army Soldier and Biological Chemical Command, Aberdeen Proving Ground, Maryland; **David R. Peterson**, P. E., and **Carl A. Bettern**, P. E., Science Applications International Corporation, Edgewood, Maryland; & **Kenneth W. Heffley**, Flanders/CSC, Bath, North Carolina

Using *performance* specifications (vice design specifications) the Army has acquired V-bed carbon filter cells of two types - some having 8 ea. 1 $^3/_8$" carbon beds and others having 6 ea. 2" carbon beds. The two types have an identical casing and an identical calcualted "residence time". Both have performed well. To maximize filter life and minimize overall costs, this Army-sponsored study determined time-to-breakthrough, T_b, and velocity, V, relationships for both cell types. Investigators challenged each cell with 50 vppm R-11 at rated throughput, 1000 cfm. Breakthrough was defined as a downstream-upstream concentration ratio (C_d/C_u) of 0.10%. Investigators measured T_b and V in nine separate zones in each bed.

For both cell types, velocity profiles were uniform throughout the leading 2/3 of the bed. The average velocity through the trailing 1/3 of the bed was about ½ the velocity at the leading portion. The lesser velocity through the trailing portion can be attributed to increased flow resistance as the flow channel narrows and adjacent beds converge.

For each cell type, T_b was nearly equal in the leading 1/3 and the center 1/3 of the bed. However, in the trailing 1/3 of the bed T_b was reached earlier - by a factor of 2 - than in the leading 2/3 of the bed.

From test data, cells with the thicker (2") beds outlasted the thinner (1 $^3/_8$") beds by a factor of two. Further, from test data one may arguably infer a near-direct relationship between V and T_b, i. e., the greater the velocity the longer the time to breakthrough. This inference is inconsistent with the prevailing "residence time" concept. Using basic and advanced fluid dynamics principles, investigators provide a theory for this inconsistency and consider design and cost implications.

III-5 *Investigation of Shock/Acceleration Loads on Carbon Filters During Transportation and Handling* - **David R. Peterson**, P. E., and **C. A. Bettern**, P. E., Science Applications International Corporation, Edgewood, Maryland; and **Lyle L. Dauber**, U. S. Army Soldier and Biological Chemical Command, Aberdeen Proving Ground, Maryland.

This paper will discuss the second phase of an Army-sponsored two-phase effort to establish reasonable G-force requirements for carbon filters. In the first phase, shock/acceleration measurements (multi-directional) were taken during production. Investigators found shock/acceleration forces on 24" x 24" x 16" v-bed cells to be about 50 G's using one manufacturer's standard production procedures. The Army has established a tentative 20G multi-directional G-force production shaking requirement for these filters. During the second phase, investigators will have measured the shock/acceleration forces experienced by the same type filters during transportation and handling. This work will be completed during March 2000. Test outcomes will affirm or deny the appropriateness of the tentative 20G requirement. Present industrial specifications require shaking at a frequency of 200 cpm for 10 minutes, but no G-force level is set. Owing to differences in weight and resiliency of colliding bodies, G-force levels experienced by different types of filters can vary widely. In the absence of an industrial G-force standard, this two-phase project will establish for the Army a reasonable G-force performance requirement for one particular type cell and, hopefully, create an interest by others in establishing such requirements for still other filters.

IV-1 *The International Atomic Energy Agency and its Gaseous Waste Management Handbook Activity* - **R. Doig**, B. Eng., Ph.D., C. Eng, FCIBSE, BNFL Engineering Ltd., Risley, Cheshire, United Kingdom **R. Burcl**, International Atomic Energy Agency, Vienna, Austria; **V. Isupov** and **Y. Panteleev**, Khlopin Radium Institute, St. Petersburg, Russia, and **J. L. Kovach**, NUCON, Inc., Columbus, Ohio

The IAEA Nuclear Fuel Cycle and Waste Technology is preparing a document *Retention, Conditioning and Storage of Gaseous Radionuclides from Nuclear Fuel Cycle Activities*. It is expected that the document will be issued in 2001. The plans are to have it available in both CD form and in a hard copy. The document is aimed at those technical and regulatory people who, while familiar with general nuclear technology, need a "primer" on the application of specific technologies for the air and gas treatment systems involved in the nuclear fuel cycle, starting with nuclear fuel fabrication, and ending up with waste processing. A team of technical experts from member countries has reviewed and contributed to the document during its three years of preparation. There were three consultants' meetings in Vienna preparing drafts of the document. All sections of the document are now prepared in draft form, and editing is in progress.

IV-2 *The Revised NRC Guide 1.52* - **J. Segala**, U. S. Nuclear Regulatory Commission, Bethesda, Maryland.

This paper will report the status of the revised guide and the procedures being followed for its review.

IV-3 *Ventilation Systems and Interactions with Control Room Habitability* - **Don Garbe,** Vermont Yankee Nuclear Power

Control Room Habitability (CRH) is the term used to describe the systems, structures, and analysis used to protect commercial nuclear power plant Operators and control room equipment and provide a safe environment during normal and accident conditions. Over the past 40 years in the United States this concept (i.e., CRH) has evolved tremendously from that of protecting Operators from the effects of an accidental radiation release to providing a control room that can be occupied 24 hours a day during all manners of events; both natural and man made. During the past 40 years the effects of the ventilation system on CRH has not always been fully understood or only understood by a few individuals. This is compounded by the practice of many in the commercial power production industry as considering the CRH a low priority system. Additionally, there have been numerous documented instances where the CRH ventilation systems have been given little maintenance resulting in degradation of the CRH boundary to such an extent that the existing analysis could not support the actual plant configuration. The CRH issues peaked in 1998 when the NRC/NEI/NHUG held a CRH workshop in Washington, D. C. This workshop presented the issues facing the industry in all facets of CRH. Chief among the facets were the ventilation systems serving the CRH boundary. Following the workshop the NEI formed a TF to address CRH. This TF is currently working directly with the NRC to develop a voluntary document that can be used to assess CRH. This paper presents the issues specific to the ventilation systems as they now appear in the development of NEI 99-03, "Control Room Habitability Assessment Guidance," and how these systems interact and affect CRH. It also discusses the resolution of issues pertinent to ventilation systems and CRH and proposes what is considered a good design for a CRH ventilation system.

IV-4 *Round Table: Implications of the Revised Source Term*

Operational Concerns. Mark Pest Presiding

V-1 *Air Inleakage Testing at Crystal River Unit 3* - **P. L. Lagus**, Lagus Applied Technology, Inc., San Diego, California; **John Taylor** and **Kenneth Anderson**, Florida Power Corporation, Crystal River, Florida, and **John R. Pearson**, NCS Corporation, Columbus, Ohio

In order to assess the amount of air inleakage into the Control Complex Habitability Envelope (CCHE) at the Crystal River Unit 3 Nuclear Generating Station, tracer gas tests were performed during October 1997, and again in September 1999. The CCHE consists of a six-story structure that is located physically between the turbine building and the auxiliary building. In case of either a High Rad or Toxic Gas event, the emergency ventilation system isolates and enters a recirculation mode.

Because of the physical extent and location of the CCHE, air inleakage testing was undertaken only after the adjacent ventilation systems were configured to provide a minimum of 0.125 in. w.g. across the CCHE. Inleakage data generated at this differential pressure condition were used to constrain a parametric inleakage calculation. Allowable inleakage values were extrapolated to a differential pressure of 0.2 in. w.g. across the CCHE. Dose analyses were calculated assuming this operating condition was bounding.

Air inleakage rates were inferred using procedures based on the methodology described in ASTM Standard E741-93 "Standard Test Method for Determining Air Change Rate in a Single Zone by Means of a Tracer Gas Dilution". Sulfur hexafluoride (SF_6) was used as the tracer gas. Sulfur hexafluoride concentrations were determined using measurement specific analyzers optimized for detection of SF_6.

In 1997, the air inleakage of the CCHE was measured as 439 $^+/_-$ 17 CFM in the toxic Gas Mode, and as 442 $^+/_-$ 20 CFM in the High Rad Mode. In 1999, the air inleakage of the CCHE was measured as 501 $^+/_-$ 15 CFM in the Toxic Gas Mode, and as 450 $^+/_-$ 13 CFM in the High Rad Mode.

To our knowledge, these data represent the first retest of Control Room Envelope air inleakage using tracer gas techniques. The measured inleakage was unchanged for the High Rad mode, but increased 14% for the Toxic Gas Mode. This increase may be due to the fact that the emergency system for the Toxic Mode was modified slightly after the 1997 testing.

V-2 *Air Inleakage Due to Door Opening and Closing* - **Peter L. Lagus**, Lagus Applied Technology, San Diego, California

With the recent interest in a more accurate assessment of inleakage into operating nuclear power plant control rooms, the question of the actual inleakage due to door opening and closing has come under scrutiny. SRP 6.4 recommends 10 cfm of additional inleakage for those control rooms that do not have airlock-type double doors. The 10 cfm value does not appear to have any theoretical or experimental basis. For many plants this additional inleakage does not pose difficulties in achieving compliance with the safety criteria included in the plant control room habitability analysis. However, for a number of plants, the 10 cfm value may represent a significant challenge to the attainment of a suitable habitability analysis.

This paper provides a review of the basic physics involved in air interchange into a room caused by door opening and closing. During door movement an amount of air is entrained in the door wake. This entraining action can pump a quantity of air out of the room initially as the door opens and then pump a quantity of outside air back into the room as the door closes. Additionally, the temperature difference between air inside and outside of the room can influence the air interchange during door movement. A format for estimating actual air interchange (inleakage) due to opening and closing of a single door is provided for both pressurized and unpressurized control rooms.

V-3 *Mitigation of the Effects of the U1 Steam Leak on U2 outage and Turbine Building Operations* - **Peter G. Dorosko,** Brunswick Nuclear Power Plant, Southport, North Carolina.

In early April 1999, Brunswick U2 was in a refueling outage. On April 19, 1999, a severe steam leak occurred and caused the airborne activity levels to increase substantially. Increasing iodine levels in the Turbine Building as a result of the steam leak, coupled with the residual effects of a prior fuel leak in U1 (at 100% power), created very undesirable conditions. The elevated activity levels resulted in substantial delays for personnel working in the Turbine Building when they exited the protected area. The increase in exposure and the negative impact on the outage schedule were unacceptable.

After reviewing the problem, I determined that if the effluent from the steam leak could be diverted to the swamp cooler room (spray wash system in the Turbine Building Supply Fan Room) the spray would remove iodine and other isotopes from the supply air going to the Turbine Building. This would reduce the airborne activity level and result in reduced time for workers leaving the protected area.

The activity levels in the air decreased and increased in the water in the swamp cooler basin as expected. This resulted in a substantial improvement in the offgas levels. It was stated in Steve Taylor's "Outage Update Report" to E&RC on April 25, 1999, "Offgas Mitigation: The U/1 steam leak under the Main Turbinehas been successfully diverted into the ventilation system. There has been a very noticeable improvement resulting from this effort."

V-4 *A Better Understanding of Filtration Systems Through Training and Experience* - **Robert G. Penn,** United States Enrichment Corporation, Piketon, Ohio.

This paper will discuss two HEPA filtration systems at the United States Enrichment Corporation's Portsmouth Gaseous Diffusion Plant. Topics will include initial inspection, initial installation configuration flaws, project upgrades, establishment of design bases, and the implementation of a HEPA filtration systems program. This paper will also illustrate and discuss certain features of the inadequate original designs, and the corrective measures that were taken to bring the systems into compliance with the newly implemented HEPA filtration program. A better understanding of the principles laid out in industry standards was gained. Also, the need for trained technicians who are knowledgeable of the testing methods and standards was recognized.

V-5 *Training Workers to Use Localized Ventilation for Radiological Work* - **Larry Waggoner & Jerry Eby,** Fluor Hanford, Inc., Richland, Washington

Work on radiological systems and components needs to be accomplished using techniques that reduce radiation dose to workers, limits contamination spread, and minimize radioactive waste. ALARA (As Low As Reasonably Achievable) programs at the Hanford nucear facilities emphasize the use of engineered controls to accomplish radioactive work. One of the prime methods used to control contamination at its source is to use localized ventilation to capture the radioactive material and keep it from spreading into the worker's breathing zone and work area. The Fluor Hanford ALARA Center of Technology teaches workers how to use ventilation effectively, and feedback, from the workers on lessons learned, has been positive. The increased use of localized ventilation has resulted in a reduction in the use of respirators, improved work practices, minimized the impact on adjacent work operations, and decreased the amount of radiological waste generated. This presentation will emphasize how workers are trained to recognize when localized ventilation can be used effectively, and the work practices necessary to capture radioactive material near the source.

Demonstrations using HEPA filtered ventilation systems will show the actual techniques taught to radiological workers. A discussion of lessons learned from jobs where localized ventilation was used will show the value of this engineered control, and how the workers are finding better ways to use it effectively.