3.5 Internal Duct Characterization System

Technology Needs

Across the DOE complex there are numerous facilities identified for D&D that have been placed on the contaminated list because of the risk of internal contamination in duct work. Most of this duct work is inaccessible because it is buried underground, encased in concrete, or runs through hot cells. Duct work characterization is extremely difficult because of airflow control devices, varying sizes and geometry of the work, and numerous changes in duct direction. Characterization of this work is essential before, during, and after D&D activities. The identification and mapping of contaminants is a major concern during facility deactivation. An understanding of the types and extent of contamination will be primary drivers for decisions regarding decontamination and/or dismantlement. These decisions will affect initial deactivation cost, ongoing surveillance and maintenance risk and cost, and eventual D&D strategy and costs. Identifying sections of the ducts that are not contaminated can greatly reduce the amount of material sent to waste handling facilities for decontamination/disposal. Conventional methods have been applied to the characterization of duct work with some success, but this has been at the risk of human exposure to high levels of contamination. Commercially available remote duct work characterization systems are limited in their capabilities. A robotic/remote duct characterization system with extended travel capability that can perform chemical and radiological contaminant characterization and selected hot spot decontamination or partial duct work dismantlement is needed.

Technology Description

The Internal Duct Characterization System (IDCS) activity provides for the design, fabrication, procurement, and demonstration of a remotely operated system for visually inspecting ventilation duct work and characterizing selected chemical and radiological contaminants that are internally located in ventilation duct work. The IDCS, shown in Figure 3.5-1, consists of a control station, a reel-mounted tether for data communication, and a pipe crawling vehicle. The IDCS vehicle can travel over 200 feet in round ducts six inches in diameter and larger, and in rectangular ducts six inches square and larger. The vehicle visually inspects the interior condition of ducts using a high-resolution color video camera, and has an integrated radiation sensor to detect significant levels of radioactivity. The entire vehicle is made from stainless steel and is designed to be decontaminated. The IDCS system also provides limited contaminant sampling and decontamination capabilities.

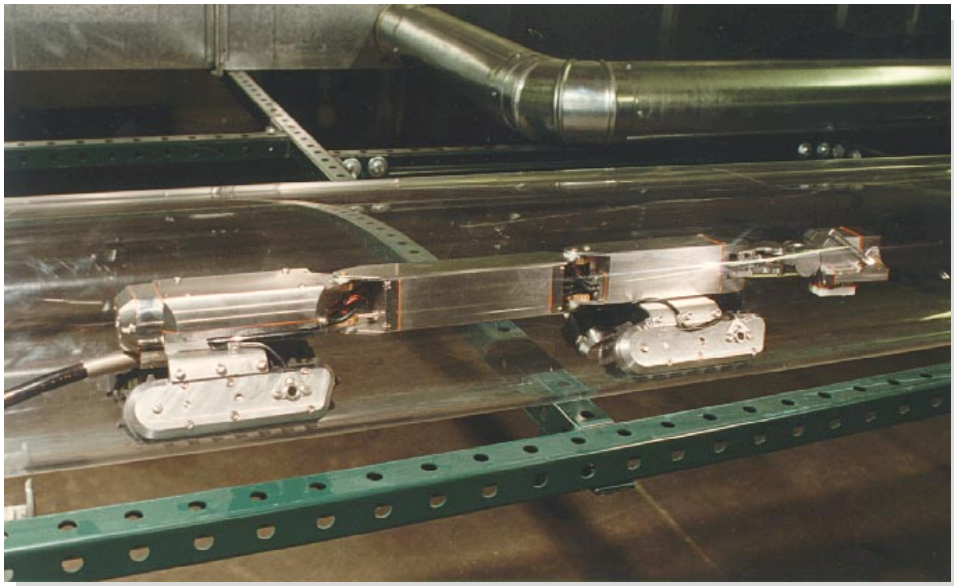

Figure 3.5-1. Internal Duct Characterization System in 8-inch Round Duct.

Benefits

This technology allows characterization of duct work that otherwise could not have been characterized. Determining the absence or presence of contamination and the extent of contamination in duct work will reduce the costs of D&D activities by allowing the duct work to be handled appropriately as opposed to treating all work as contaminated. It will also reduce the amount of secondary waste generated since uncontaminated duct work will not need to be decontaminated. It will reduce human health risk because sections of duct work that pose health risks will have been identified prior to exposure. Using this technology to perform in situ decontamination would provide additional benefits in the areas listed above.

Collaboration/Technology Transfer

This technology has been developed by INEL in collaboration with private industry. Performance requirements for this task were developed at INEL, but much of the design and fabrication was performed by a team of two Canadian companies: Inuktun Services, Ltd., and Automation Systems Associates, Ltd., both located in British Columbia. All the technology developed under this activity is now commercially available, with the patent rights for everything except the drive reconfiguration mechanism held by the industrial partners.

Accomplishments

- The IDCS was used to inspect over 200 feet of contaminated offgas ducting at an operating DOE facility.
- The IDCS control system was upgraded to provide for the addition of sensors and motors.
- A drive reconfiguration mechanism was designed, built, and installed to allow "on the fly" adaptation to varying duct sizes and geometries.
- A vertical travel carriage was designed and built through an industrial procurement.
- The improved IDCS was demonstrated at a major programmatic technology demonstration.

TTP Information

The Internal Duct Characterization System is funded under the following TTPs:

TTP No. ID75C121, "Robotics INEL Rollup"
TTP No. OR15C141, "Robotics ORNL Rollup"

Contacts

Dennis C. Haley
D&D Coordinator
Oak Ridge National Laboratory
P.O. Box 2008, Building 7601
Oak Ridge, TN 37831-6304
(423) 574-5691
e-mail: haleydc@ornl.gov

Walter D. Willis
Principal Investigator
Idaho National Engineering Laboratory
P.O. Box 1625
Idaho Falls, ID 83415-2220
(208) 526-8613
e-mail: davew@pmafire.inel.gov

Bibliography of Key Publications

McKay, Mark D., and Walter D. Willis. *Internal Duct Characterization System, Specification Number* R0007098, Rev. 3. (1994).