Long-Term, Post-Closure Radiation Monitor

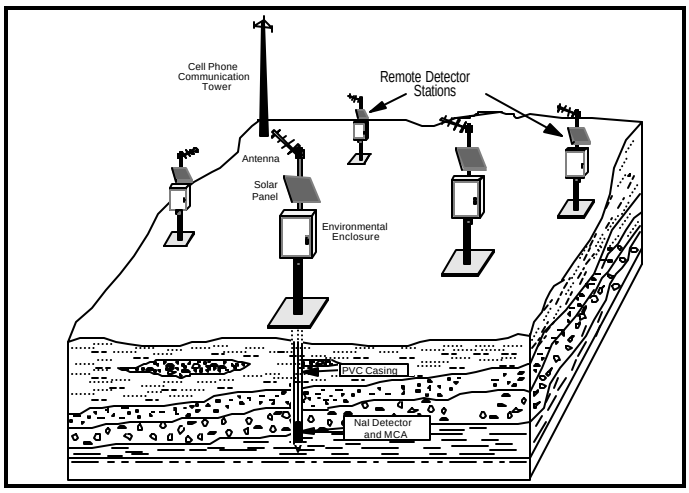
McDermott Technology, Inc.

Technology Need:

Monitoring radionuclides at Department of Energy (DOE) waste sites is necessary to determine if there may be potential impact to human health or the environment based on the characteristics and movement of the radionuclides present. Monitoring will likely continue long after site cleanup has been completed as part of long-term stewardship responsibilities. This post-closure monitoring of radionuclides will require that large numbers of sensors be installed below ground and monitored for long time periods (30 years is typical). Existing monitoring systems are too labor intensive and expensive to be maintained in place for long periods of time.

Technology Description:

The Long-term, Post-closure Radiation Monitoring System (LPRMS) is based on gamma detection and is capable of monitoring to depths of 50 meters below ground level. The radiation probe consists of a sealed assembly which contains a butt coupled, thallium-doped sodium iodide NaI(Tl) scintillator/photomultiplier tube (PMT) and a multi-channel analyzer (MCA). This assembly, termed the Nanoprobe, can be dropped into polyvinyl chloride (PVC) casings which have been pushed into the soil using cone penetrometer technology (CPT). At the surface, solar-powered remote stations at each measurement location incorporate the system power supply and a cell phone modem for communication to an off-site host computer, which could be located hundreds or thousands of miles away. A large number of remote stations can each operate independently and, without human intervention, send their daily or weekly results to the host computer for analysis, data trending and alarming. If required, the Nanoprobes are easily serviceable since they can be readily retrieved from the PVC casing for repair or replacement.



Conceptual drawing of installed system.

This system is designed to be capable of monitoring large numbers of permanently installed probes over long time periods. The above-ground location of most of the electronic components and the absence of below-ground components that require maintenance will minimize long-term costs.

Benefits:

The LPRMS provides several distinct advantages over sample collection and laboratory analysis including:

<LPRMS utilizes commercially available components in a reliable, low-cost, multi-point system for real-time, long-term, unattended monitoring of sites

<LPRMS is configured for measuring a wide range of radionuclides and activity levels in order to be applicable to a large number of potential DOE sites

<Real-time measurement eliminates the long turnaround time thereby providing early warning of changing conditions

<Minimal long-term manpower is required to operate the LPRMS

<Automated data generation minimizes the potential for error from manual sampling, sample tracking, laboratory data generation, analysis, and reporting

<Eliminates generation of potentially contaminated drill cuttings and well development water, which require disposal

<Eliminates potential worker exposure to contaminants

Status and Accomplishments:

Development of this monitoring system has taken place over three phases. Phase I was a proof of concept for an approach using optical fiber waveguide between the scintillator and detector electronics and included a laboratory test program and design of a sub-scale test unit. Phase II was a field demonstration of the optically coupled sub-scale system, and a conventional butt-coupled scintillator/PMT probe. This field demonstration was performed at the Fernald Environmental Management Project (FEMP) in the fall of 1994.

In Phase III, a full-scale prototype system with five measurement probes was fabricated and laboratory tested. Following this, the prototype successfully completed a one-year field trial at the Fernald Environmental Management Project (FEMP) in Fernald, Ohio from February 19th, 1998 to February 19th, 1999.

LPRMS Stations Installed at FEMP Sanitary Landfill.

McDermott Technology, Inc. (MTI) personnel have had discussions with Oxford Instruments (now called Tennelec, a Canberra Company) concerning commercialization of the system.

Interest has been expressed for redesigning the system to allow raising and lowering the Nanoprobe at a controlled rate, which would allow the system to be used for characterization of soils over the entire depth profile. Future system enhancements could include sealing the system to allow long-term use in groundwater, incorporation of sensors for chemical contaminants, improved gamma detection sensors (to lower minimum level of detection), and a tritium sensor.

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Online Resources:

Office of Science and Technology, Technology Management System (TMS), Tech ID # 288
http://ost.em.doe.gov/tms

The National Energy Technology Laboratory Internet address is http://www.netl.doe.gov

The McDermott Technology, Inc. Internet address is http://mtiresearch.com/