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REMOTE SURVEILLANCE OF FACILITIES AWAITING D&D

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EXECUTIVE SUMMARY

FY 1998 was the first year of the three-year project. Various U.S. Department of Energy (DOE) facilities are in need of a remote surveillance system to monitor the facilities, which are closed and are awaiting decontamination and decommissioning. Such a system should provide continuous and inexpensive monitoring of the facility and reduce the need for labor-intensive and hazardous surveys.

The purpose of this three-year investigation is to develop a remote surveillance system that is capable of collecting data from a DOE site (remote station) and transmitting the data to a central location (base station). The type of data collected will depend on the site-specific needs. From the Site Technical Coordination Group (STCG) and Project Baseline Summary (PBS) needs of various DOE sites, and from the discussions held with DOE management and operations contractor personnel from Hanford, the SRS, and Lockheed Martin Idaho Technology Company (LMITCO), it was learned that most of the sites are in need of monitors for water level, water from leaky roofs, temperature, humidity, air activity, and gamma radiation.

An outline of the remote surveillance system was made. The system consists of sensors of various parameters to be monitored, data collection and transmission modules (data-logger, RF module, and RF transmitter or a telemetry system and a transceiver at the base station with computer for display, storage, and retrieval of data). The system will be capable of collecting and manipulating the data as necessary. Since the closed sites may not have main power supplies, an alternative method of solar-powering the system was considered.

Search of various system components was made. Discussions were held with a number of companies with aim of their participation in the supply of necessary components and possibility of integration into a remote surveillance unit. Price quotes from various component manufacturers/suppliers were obtained.

1.0 INTRODUCTION

Some DOE facilities will be closed in the near future. These contain hazardous/radioactive materials. In the interim period between closure and decontamination, these facilities need to be periodically monitored for various parameters to ensure the safety of the personnel, public, and environment. The monitoring task requires survey personnel to enter the site and perform necessary measurements. These surveys are labor-intensive, expensive, and expose survey personnel to radiation/hazardous materials. Further, these surveys do not provide real-time status of the facility during silent hours. The DOE is therefore in need of systems that can provide real-time information of the status of the facilities to a base station located at a distance. Objective of this project is to design, build, and test such a system and deploy at DOE facilities. The remote surveillance system will consist of four major components: namely, sensors, a data collection and transmission system, a transceiver with computer and software, and a power supply. These components will be assembled to build an efficient remote surveillance system.

1.1 PURPOSE OF INVESTIGATION

The purpose of this investigation is to compile the remote surveillance needs of different DOE facilities and to design and build a system that can measure the required parameters (such as radiation field, temperature, roof leakage), and transmit the data to a base location. The base station with its transceiver, computer, and software will receive, store, retrieve, and manipulate the data so that the values can be graphically represented and trends predicted.

It is also important that the components should be commercially available, so that they can be configured into a user-friendly system. Since the measurements need to be performed over extended periods, mostly unattended, the components and system should be able to withstand adverse conditions, such as varying temperatures and relative humidities, and corrosive and radioactive atmospheres. The integrated system will be tested at Florida International University's Hemispheric Center for Environmental Technology (FIU-HCET) and at a DOE site. Based on these tests, and cost-benefit analysis, plans for deployment of the system will be made.

The closed facilities may not have main power and telephone lines. An alternative method of solar-powering the system with storage batteries has been considered, which would be capable of supplying power to the system for a week in cloudy conditions. RF module and RF radio will be used for transmission of data to the remote station and receipt at the base station.

2.0 PROJECT DESCRIPTION

2.1 OVERALL PROJECT GOALS

The goals of this three-year project are as follow:

- To define specific surveillance needs among the facilities awaiting D&D
- To select appropriate technologies for different facilities and test them for their performance
- To select components of the measuring system, integrate them, and test the performance of the sensors and the system
- To select an appropriate data collection, storage, transmission, and receiving units
- To design a central monitoring unit
- To integrate the different units into a prototype surveillance system and test the system at FIU-HCET
- To test the system at a DOE site
- To deploy the system at a DOE site
- To design and implement a plan for commercialization.

To facilitate the completion of these goals, the following tasks were establishment for FY98:

Project Tasks (FY98)

Task 1. Selection of the facilities awaiting D&D

Task 2. Consulting site survey personnel and regulators

Task 3. Evaluation of available monitoring technologies

Task 4. Selection of suitable technology

Task 5. Assessment of cost-saving and safety improvements expected from the development of the monitoring system

Task 6. Engineering review of the selected remote surveillance technology

Task 7. Procurement of sensors, measurement units, and system integration and tests

The status of the tasks is given below:

Task 1. Selection of the facilities awaiting D&D

DOE management and operations contractor personnel from Hanford, the SRS, and Lockheed Martin Idaho Technology Company (LMITCO) were contacted to determine the remote surveillance needs of their sites and participation of FIU-HCET in development of a system for remote surveillance. It was discovered that most of the sites are in need of monitors for water level, water from leaky roofs, temperature, humidity, air activity, and gamma radiation.

FIU-HCET participated in meetings at Hanford with DOE and contractor personnel to discuss Hanford's specific deployment needs and schedules. Bechtel Hanford personnel have agreed to provide FIU-HCET with detailed information on remote surveillance needs of facilities that will be closed in the next few years. The facilities include various former production reactors. Bechtel also agreed to provide information on desired improvements that they would like to achieve in the existing remote surveillance systems that they have in place in the Redox and Purex facilities. Based on this information, FIU-HCET will identify specific remote surveillance contributions and their timing.

Task 2. Consulting site survey personnel and regulators

This task will be completed as soon as the site at which the remote surveillance system is to be installed is finalized. Needs of various sites in terms of characterization were compiled from the Site Technical Coordination Group (STCG) and Project Baseline Summary (PBS) databases. STCG needs are listed in Table 1, and PBS needs for various operations offices are presented in Tables 2 through 7. These tables also give information about contacts.

Task 3. Evaluation of available monitoring technologies

Discussions were held with a representative of Bechtel Hanford regarding the remote surveillance systems in use at Hanford. Information was received about Redox Facility, 233-SA Building, and U Plant. These facilities have an uninterrupted supply of electric power and hence don't need a solar/wind power supply for operation of their remote surveillance system. F, TR, and 105C reactors may need a solar/wind power supply. The safety-related parameters being monitored at Redox Facility, 233-SA Building, and U Plant are the following:

1. Redox Facility

- Differential pressure-Canyon to atmosphere; Sample Gallery to atmosphere; Canyon to Sample Gallery; Sand filter; HEPA filters; Wind tunnel; Wind Speed
- Sanitary water pressure- High pressure alarm
- Continuous air monitor- High alarm
- Continuous air monitor- Trouble

2. 233-SA Building

- Differential pressure- HEPA filters
- Liquid level for the 233-SA seal pot
- Continuous air monitor- Power on/off and high radiation alarm

3. U-Plant

- Differential pressure-Canyon to atmosphere; Gallery to atmosphere; Canyon to Gallery; Sand filter
- Wind Speed
- Continuous air monitor- High alarm

- Continuous air monitor- Trouble
- Canyon 5-6 tank level

Task 4. Selection of suitable technology

The following criteria are applied to make a final selection of the remote surveillance system for a particular facility:

- It is a commercial technology.
- The technology has one of the constituents (sensors, data transmission and receiving system and power supply).
- The technology, both alone and integrated with other technologies has a high potential of successfully monitoring and characterizing the given facility at an acceptable accuracy.
- The vendor of the technology is willing to work with HCET and DOE to integrate this technology.

Based on the STCG and PBS needs, and discussion with representatives of Bechtel and other site personnel, a survey form (Table 8) was prepared and faxed to vendors of commercially available technologies. Table 9 gives information about various products and their suppliers.

Discussions were also held with a number of companies with aim of their participation in the supply of components and possibility of integration into a remote surveillance unit.

Figure 1 exhibits an outline of the remote surveillance system. Details of the system components are presented in section 2.2.

Figure 1. Outline of the remote surveillance system.

Task 5. Assessment of cost-saving and safety improvements expected from the development of the monitoring system

Data gathered from the reviews of survey requirements and commercial and OST sensing technologies will be used to estimate the advantage to DOE of proceeding with a full design. Following assessments will be performed:

- Cost analysis of the selected technology
- Advantage-cost justification
- Setting basic safety standards for engineering design of the system.

Task 6. Engineering review of the selected remote surveillance technology

Once the remote surveillance and allied technologies are selected general engineering review will be performed. The review may include the following components:

- Hardware analysis to determine feasibility of surveillance monitoring system
- Hardware analysis for data collection and processing
- Verification of hardware performance parameters as per the regulations
- Analysis of material of construction
- Design analysis of the integrated unit.

Task 7. Procurement of sensors, measurement units, and system integration and tests

Details of most of the system components, their specifications, and price quotes have been received. Purchase orders for these components will be placed as soon as a DOE facility where the system will be deployed is finalized.

2.2 SYSTEM COMPONENTS

Sensors are placed in the facility to measure desired properties such as radiation levels, temperature, pressure, humidity, water level, and leak detection. These sensors will sense the intended property and will convert it to a digital or analog output. The analog output may be in the form of current (4-20 mA) and voltage (1-5 V).

The data collected by the sensors are transmitted to a data-logger by transmission cables. Length of the cable should be kept as small as possible in order to reduce the transmission losses. The data-logger will have separate input ports for voltage, current, and digital input sources. The data-logger stores the data for a limited period as programmed by the operator. It can convert the signal to the actual value. The programming capability of the data-logger enables the operator to manipulate different data. Data-logger is connected to a RF transmitter through a RS232 port. Finally, the data will be transmitted by the transmitter.

The base station is designed to receive the data transmitted by the transmitter. Generally, if the terrain is flat, there is no problem in data transmission and receiving. But if the terrain is hilly or covered with forest, buildings, and so on, the transmission is to be enhanced by placing additional antennas. In case of long range, repeaters are to be placed in between to amplify the signals. The receiver is connected to the computer with or without a modem depending on the

nature of the transmitted data. A telemetry system may also be used in place of a data-logger. It converts the analog data to digital and then transmits it to the base station. In this particular case, it is not necessary to have a modem between the receiver and the computer.

Any IBM compatible PC may be used for storing and manipulating data. The software is designed according to the operating system of the computer. Windows 98, Windows NT, and Unix are some of the currently used operating systems.

The software plays an important role in the remote surveillance operation, as it is the interface between the physical components and the operator. The software should have the following properties:

1. Has built-in communication links between the remote facility and the base station
2. Transfers a program to datalogger or the telemetry system
3. Resets the data-logger
4. Controls the data-logger flags and control ports
5. Collects the data from the receiver
6. Displays multiple programs
7. Stores the data
8. Displays trends such as current alarm situations, current values.

After the software displays the data an operator takes appropriate action.

The power system is one of the major concerns in this project. Many DOE sites will not have the regular power supply after their closure. In that case, an alternative power source has to be provided. Most of the devices including sensor, data-logger, and telemetry system can use the DC batteries as alternate power source. But the batteries need to be recharged continuously. For this purpose, various alternatives can be thought of. Solar power, wind power, and generators are a few of these. Any equipment that has a moving part can be a problem in the long run because of the maintenance. For this reason, solar power systems are recommended.

The description of various system components is given below:

Data-Logger (CR23X)

The data-logger is an instrument that measures sensors, drives communication via modems, reduces data, controls external devices, and stores both data and programs in its memory. The CR23X data logger manufactured by Campbell Scientific, Inc., has been selected. Different sensors (like temperature, pressure, radiation, leak detectors,) are connected to the data-logger, which in turn is connected to the RF modem.

The maximum rate at which the CR23X can execute its program is 100 times per second. (The maximum rate a single sample can be measured is 1,500 samples per second.) The CR23X provides a comprehensive set of measurement, processing, math, and program control instructions to create a data-logger program. Programs and data are stored in either non-volatile Flash memory or battery-backed SRAM. The standard 1M memory stores 500,000 data points in two final storage areas. With the 4M option, the CR23X can store over 2 million data points.

Standard operating range is -25° to $+50^{\circ}\text{C}$. With the extended range option, the CR23X's electronics are tested and guaranteed over a -40° to $+80^{\circ}\text{C}$ range.

The table below shows some of technical information about the CR23X Data-Logger.

Differential Analog Channels (a)	12
Maximum Input Voltage (b)	$\pm 5000 \text{ mV}$	
Analog Voltage Resolution	to $0.33 \mu\text{V}$	
A/D Bits	15	
Input Bias Current	$\pm 10 \text{ mA max}$	
Scan Interval	100 Hz	
Excitation Voltage	$\pm 5000 \text{ mV}$	
Voltage Requirements	9.6 to 15 VDC	
Memory		
Program Memory	16 k Flash	
Data Values Stored	500,000	
Current Drain		
Quiescent	2 mA display off	
Processing	45 mA	
Measurement	70 mA	
Temperature Range		
Standard ($^{\circ}\text{C}$)	-25 to $+50$	
Extended ($^{\circ}\text{C}$)	-55 to $+80$	

(a) Each differential channel can be configured as 2 single-ended channels; expandable with multiplexers.

(b) Precision 2:1 and 10:1 voltage dividers are available to extend these ranges.

RF Communication System

The radio telemetry (RF) system supports data retrieval from remotely located data loggers. The data loggers are typically located in remote areas or moving vehicles where communication via cables is costly or impossible. Data from field stations are retrieved at a base station. The base station communicates with up to 254 remote stations over a single frequency. The RF base station is usually connected to a computer. Field stations and repeater stations can be located to allow communication over long distances and rough terrain.

RF data transmission hardware includes radio modems, radios, and antennas.

RF Modems (RF95A): The radio modems convert the signals that are received from the data-logger suitable for transmission, i.e., they modulate the signals. The RF modem is connected to the RF radio (UHF or VHF transceiver) which transmits and receives the signals.

RF Radio (RF300): The RF communication system uses a low-powered transceiver at the remote station(s) and a transceiver connected to a RF base station at the computer. Up to 254 stations can be interrogated over a single UHF or VHF frequency. Any station can serve as a repeater to extend the effective distance. Maximum transmission distance is up to 25 miles between stations (line-of-sight).

Some of the technical data on the RF radio are given below:

Band	UHF
Frequencies	403-430, 430-450, 450-470, 470-480, 480-512 MHz
Power Output	5 Watts
Deviation	2.5 kHz
Channel Separation	12.5 kHz
Current Drain	
Quiescent	30 mA
Active	1.53 A
Data Transfer Rate	60 bytes / second
Voltage Requirements	12 V
Operating Temperature Range	- 30° to + 60° C

Antennas: The antennas are used to transmit and receive the signals at both the remote station as well as the base station.

Power Supplies (Batteries and Solar Panels)

Majority of the data acquisition systems are powered by 12 VDC sources. Power consumption by data-loggers, peripherals, and sensors is minimal, allowing extended operation from sealed rechargeable batteries or set of alkaline cells. Systems that require more power can be supplemented with external rechargeable batteries, regulators, and charging sources (solar panels).

The diagram below depicts the interaction of the components in a power supply system.

Figure 2. Power supply and battery arrangement.

Batteries: The batteries are electrical storage devices. As chemicals in the battery change, electrical energy is stored or released. For this purpose the batteries are charged (by main power or by the solar panels) and provide the equipment at the remote station with the power when required. The Trojan TJ-116 batteries (6V, 350 Amps) have been chosen. These can be configured in series.

Solar Panels (MSX-60): The solar panels are made up of photo voltaic cells, which convert the sunlight into electric energy. The photo voltaic array charges the battery during daylight hours and the battery supplies power to the loads as needed. The charge regulator terminates the charging when the battery reaches full charge. The load center may contain meters to monitor system operation and fuses to protect wiring in the event of malfunction or short circuit. The size of the photo voltaic array and battery will depend upon individual requirements.

The MSX-60 from Solarex has been chosen for this project. Some technical details about the MSX-60 are given below:

Typical Peak Power	60 W
Voltage @ Peak Power	17.1 V
Current @ Peak Power	3.5 A
Operating Temperature Range	- 40° to + 90° C
Operating Humidity Range	- 40° to + 85° C at 85% relative humidity

Sensors

Temperature Sensors

Temperature sensors will be used to collect the ambient temperature data. The sensors will be placed on some key locations, and the data will be collected using a data-logger. The temperature sensor (Model No: 41372V) from Scientific Sales has been chosen for this project. The technical specifications of the sensor are as below:

Power Requirement	8-24 vDC/9mA
Power Output	0 to 1 VDC
Minimum Temperature Sensed	- 50° F
Maximum Temperature Sensed	150° F

Humidity Sensors

Humidity sensors will be used to obtain relative humidity of the ambient air. The humidity sensor generally is combined with temperature sensors. The humidity sensor (Model No: 41372V) from Scientific Sales has been selected.

Power requirement	8-24 vDC/9mA
Power output	0 to 1 VDC
Measuring Range	0 to 100 %
Accuracy	2 to 3 %

Pressure Sensors

Pressure sensors will be used to get barometric pressure at the facility. The sensor will be connected to the data-logger like temperature and humidity sensors.

Manufacturer: Scientific Sales (Model No: 61210)

Voltage Requirements	12 – 30VDC
Current Requirements	200 mA warm up (4 min)
	50 mA operating @ 20°C
Power Output	0 - 5 VDC
Measuring Range	800-1100 mB
Accuracy	±1 mB

Level Monitoring Sensors

The level monitoring sensors will be used to measure level of water or any other fluid on the floor of the facility. This sensor will be placed above the point where fluid level is to be measured. This sensor will be connected to the data-logger.

Manufacturer: Instrument Direct, Inc. (Model No: L-132-000)

Power Requirement	18-36 VDC
Output	4-20 mA, 18-36 VDC
Measuring range	0.5 – 16.5 ft
Accuracy	± 0.25 of span
Operating Temperature	-40 to 140°F

Water Leak Detection Sensors

The leak detection cables will be employed for this purpose. This cable has a water sensitive-layer. Once the leak occur the continuous flow of energy through this cable is reflected from the location of the leak. Thus, the leak and the location of the leak are simultaneously detected.

Power Requirement	110V, 100W (Optional 32V DC)
Output	4-20 mA

Radiation Sensors

Gamma Radiation levels are monitored using gas (or air) filled detectors (ionization chambers, proportional counters, Geiger-Mueller counters) and solid state detectors (scintillation detectors,) phosphors). Identification of radionuclides and radioactivity measurement is performed using

scintillation detectors and semiconductor detectors based spectrometers. Gamma cameras, which provide two-dimensional images of gamma-emitting objects, are also commercially available. Table 9 gives details of the instruments available from various companies.

Telemetry System

A telemetry system is an alternative system for data collection and transmission. The advantage of telemetry system over the data-logger and transmitter assembly is the system is compact. One single unit performs the desired operation. Here the data is collected from the sensors and transmitted to the central unit without any manipulations. The telemetry system is faster than the data-logger-transmitter assembly; therefore, it can be used for real-time monitoring. Price quotes were requested from vendors of the system. The relative costs of the data-logger and of the telemetry system are currently under investigation. Table 10 lists companies contacted for information about the telemetry system. Following are a few details about the telemetry system from Telescada.

Model No.: ARS-16P

COMPONENT	DESCRIPTION
I/O	<ol style="list-style-type: none"> 1. 20 status inputs, 16 analog inputs(each with 4 remotely programmable limits) 2. 20 control outputs 3. 4 serial communication ports
Features	<ol style="list-style-type: none"> 1. Can be operated independently by preset algorithm 2. Communicates with electronic devices with RS232 or RS485 link 3. Communicates with master controller with radio link
Electronics	<ol style="list-style-type: none"> 1. Microprocessor-based remote monitoring 2. Non-volatile memory protects data from loss in case of power surge 3. Provides clock for real-time related applications
Addressing	<ol style="list-style-type: none"> 1. 16-24 bit long
Timing	<ol style="list-style-type: none"> 1. Time of day timer 2. Status inputs sampling time 10 mSec – 2.5 Sec 3. Unit of time scalar. Time scalar is applied to control point timing.
Control Outputs	Contact closure timing is remotely programmable from 10 milliseconds to 55 hrs

COMPONENT	DESCRIPTION
Status Count Input	<ol style="list-style-type: none"> 1. Data recording on two count points 2. Losses of AC power input are internally sensed and reported when AC power is restored. 3. Sampling rate is programmable.
Analog Input	<ol style="list-style-type: none"> 1. 16 analog inputs, single-ended 0-5V, 0-1 mA are standard. 12 bit resolution 2. Each input has four remotely programmable limits. 3. Programmable hysteresis for the limits 4. Analog input sampling time is also remotely programmable. 5. Measurements of battery voltages 6. All internal measurements are reportable.
Communication Protocols	<ol style="list-style-type: none"> 1. Radio port provides interface to an FM two-way radio transceiver. A Bell 202 half-duplex modem is provided as standard. 2. RS 232 host port provides interface with local host. 3. RS 232 user port provides interface to third-party serial intelligent electronic devices. Communication parameters are programmable. 4. RS 485 expansion port provides daisy chain RS485 interface to expansion modules. This allows the module to be located right where the measurements or control points are needed. Optionally, a wireless link between modules could be provided.
Radio Transceivers	<ol style="list-style-type: none"> 1. Purchased from leading manufacturers 2. Commonly used frequencies are: Low band (40 MHz) VHF (135-175 MHz) UHF (450-40 MHz) UHF (920-950 MHz)
Mechanical	<ol style="list-style-type: none"> 1. Dimensions are 17.5" H X 14" W X 8" D 2. Can be wall mounted 3. Weight approximately 24 lbs.
Power requirement	<ol style="list-style-type: none"> 1. AC Power, battery backup (Some manufacturers provide with DC power)
Operating Environment	<ol style="list-style-type: none"> 1. Temperature 20-50° C 2. Humidity 5-95%, non-condensing 3. Altitude 0-10,000 ft

3.0 SAFETY AND REGULATORY CONCERNS

Since measurements related to hazardous and radioactive materials will be involved, Occupational Safety and Health Administration (OSHA) regulations (29 CFR) and the NRC (10 CFR)/state regulations, and DOE order 5400.5 will be applicable.

4.0 BENEFITS

The implementation of the remote surveillance system for a given facility will provide a new dimension to the personnel protection. It will provide the following benefits:

- Significant reduction in routine and tedious work of surveying the facility
- Saving of personnel exposure from hazardous/radioactive/toxic materials
- Efficient, accurate, and real-time data collection and management at a central console
- Saving on cost of surveys.

5.0 RESULTS

This three-year project was initiated in November 1997. The progress on the remote surveillance project was presented at the CMST mid-year review in Gaithersburg, Maryland.

Following are the main results:

5.1 STCG AND PBS NEEDS OF DOE FACILITIES

STCG needs in the area of remote surveillance and characterization were compiled for the following sites/facilities: Savannah River, Los Alamos National Laboratory, Rocky Flats, Richland Operations Office/Hanford, Fernald, Ohio/Mound, Oakland Operations Office/Lawrence Livermore National Laboratory, Nevada Operations Office, Idaho Operations Office, Oak Ridge National Laboratory, Chicago Operations Office/Princeton Plasma Physics Laboratory.

PBS needs analysis for the following operations offices were completed: Albuquerque Operations Office, Carlsbad Area Office, Nevada Operations Office, Ohio Operations Office, Richland Operations Office, Rocky Flats Operations Office, Savannah River Operations Office, Idaho Operations Office, Oak Ridge Operations Office Headquarters.

Tables 1 through 7 show a summary of the STGC and PBS needs. It can be seen that main radionuclides/elements of concern are fission products (Cs-137, Sr-90, TC-99), U-235, U-238, depleted U, transuranic waste (TRU) (Pu-238, Pu-239, Pu-241, Am-241), mixed TRU, Th-232, H-3, Ni-59, Co, lead, and Be. The main equipment/facilities that require remote surveillance/characterization are vessels, pipes, ducts, concrete and metal surfaces, tank waste, waste containers, boxes, bore holes, transportation packages, soil, ground water, buried drums (structural integrity without removing them from the ground), dry canisters (monitoring of structural integrity), TRU vs. low-level surface contamination segregation.

- A list of current and upcoming remote surveillance needs was received from representatives from Bechtel, Hanford. FIU-HCET will use this list and provide a remote surveillance system that meets Hanford needs.

5.2 CONTACT PERSONNEL

FIU-HCET contacted DOE personnel to determine their technology needs.

- In the Deactivation and Decommissioning Focus Area (DDFA), FIU-HCET obtained a list of contact personnel from whom to assess the monitoring needs of different sites.

These sites were "N" reactor at Hanford, Heavy Water Components Test Reactor at SRS, and INEEL. The needs identified for most of the sites were detection and measurement of water level, water from leaky roofs, temperature, humidity, air activity, and gamma radiation. It was further learned that the sites might have no electric power and presumably no telephone facilities, which means solar energy may have to be used for powering the instruments and data transmission may have to be through RF transmitter.

- Representative from Bechtel, Hanford provided the needs for Redox Facility, 233-SA Building, and U Plant.
- Representative from Bechtel, Hanford agreed to provide FIU-HCET detailed list of current and upcoming remote surveillance needs.

5.3 CMST DATABASE

A list of remote surveillance and characterization technologies was obtained from CMST database.

5.4 COMMERCIAL TECHNOLOGIES

A survey form was prepared and sent to nearly 300 technology vendors to obtain consistent data about their technologies (Table 8). Review of the technologies for which catalogs or information is available was performed. A summary of the technologies and their functions was prepared from the survey responses/catalogs received (Table 9). Sensors for temperature, pressure, and humidity and their vendors were identified. Vendor for data-logger and transmitter was also identified. Power requirement for the assembly of sensors and data-loggers was calculated. Solar power panels are considered as the main source of power for facilities where main power will not be available.

For leak detection, different vendors were contacted. Detailed quotes for different units were requested from Ronan, Red Jacket, Emco, Onyx Energy, Intelligent Controls, Inc. Among these, Ronan has previously installed tank-monitoring units in Brookhaven laboratories. Their system is suitable for monitoring radioactive slurry in the tanks.

Thirteen manufacturers of batteries were contacted for technical specification. The requirements for current rating were provided to them and quotations from two vendors were received.

Manufacturers of radiation monitors were contacted, and price quotes were received from a few vendors.

Detailed quotations for data-loggers were received from Campbell Scientific and J.S. Instruments, Inc. Quotations for solar power supply and backup batteries were received from Campbell and Stationary Power. Quotes for pressure, temperature, relative humidity, and pressure and radiation sensors and for a leak detection system were also received.

Evaluation of the capabilities of various components (data-loggers, RF modem, RF transmitter, solar system, and power supply) and sensors (temperature, relative humidity, leak detection, radiation) was performed.

Talks were held with the representatives of companies named PermaAlert for leak detection and Stationary Power for battery supply. These talks provided the detailed information about the products, practical limitations of the products, and actual benefits of the products.

5.5 COMPONENT DESCRIPTION

The following evaluation of the capabilities of the components and sensors has been performed:

- * A scrutiny of various data-loggers available in the market was carried out. Data-loggers from Campbell Scientific were found most suitable for the remote surveillance operation. Campbell data-logger has 48 input channels, which can be further extended by using multiplexers. It takes input in the form of current, voltage, and also in analog and digital form.
- * A RF Modem from the same manufacturer was found suitable for transmission of data from the data-logger to the RF transmitter.
- * A RF transmitter from the same manufacturer was found suitable for the purpose of transmitting data from the monitoring station to the remote surveillance station.
- * Power requirements for the data-logger, modem, and the transmitter were calculated to be 25 W/day.
- * Sensors for temperature, pressure, and humidity from the same manufacturer were found suitable as most suitable for the remote surveillance application. Suitability is decided on the basis of compatibility of the sensors with the data-logger.
- * Besides meeting performance evaluation, the data-logger, RF modem, and the transmitter from Campbell Scientific were found to be cost-effective. Formal quotations were requested from the vendor.
- * The cumulative power requirement of the sensor assembly was calculated to be 25 W/day.
- * With one solar power system of 25 W/day used for each assembly, 4 solar panels of 52" x 23" x 1.5" size will be needed to supply uninterrupted power supply for a week. It is assumed that during this time there will be enough sun-light to produce the required solar power.
- * The data-logger, RF modem, and the transmitter need 25 W/day of power.
- * The price quotes from manufacturers/distributors of solar panels were received.
- Majority of the instruments in the system use 12V-power supply, and hence a 12V-battery supply was decided upon. A few sensors use 3V-power supply, and so they can be supplied power using potential dividers. This will lead to loss of power, and hence alternatives are being worked out. Compatibility between solar system and battery system, an important factor, is being discussed before deciding on a system.
- The sensors need less than 50 W/day of power.

6.0 ACTIVITIES PLANNED FOR FY99

Following are the activities planned for FY 1999:

Task 1. To purchase the system components, assemble them into a remote surveillance system, and test the system at FIU-HCET

Task 2. To test a remote surveillance system at a DOE site

Task 3. To update the system design

Task 4. To perform system evaluation

Task 5. To finalize deployment plan

Task 6. To prepare commercialization plan

Task 7. To prepare year-end report

7.0 CONCLUSIONS

- Based on the STCG and PBS needs, information, and talks held with DOE contact personnel, it was concluded that the remote surveillance should measure the following: temperature, pressure difference, humidity, radiation level, leak detection, and tank level.

Other needs like intrusion detection for security purposes and air quality consideration were also identified.

- The sensors to be used should consume minimum power.
- The analog output range of the sensors should be 4-20 mA or 1-5 V.
- The suitable power requirement of the sensors should be in the range of voltage 16-32 VDC and current requirement within 100-300 mA (or less). This requirement can be met using inexpensive solar power panels.
- In order to save power, the data acquisition system should be able to cut off the power of the sensors when not required.
- The transmitter should be powerful enough to transmit the signals without any disturbance over a distance of five miles.

8.0 RECOMMENDATIONS

- FIU-HCET recommends the temperature and humidity sensors from Campbell Scientific. These sensors are cheapest as compared to those provided by other companies.
- Pressure sensor from Scientific Sales is recommended for the same reason.
- Data-logger from Campbell Scientific is recommended for the data acquisition and transmission.
- Considering the power-saving requirement, use of a telemetry system is recommended. The main advantage is the power of the sensors can be cut off using the output ports of the system. Evaluations of the merits of the data-logger and telemetry system will be performed, and one of these will be retained for use in the system.

Table 1.
Summary of the STGC needs

NO.	NEED TITLE	BRIEF DESCRIPTION OF NEED	RANKING	SITE	SITE CONTACT PERSON	DOE CONTACT PERSON
1	In situ methods of characterization of tank waste	In situ methods to provide characterization information without physically removing and transporting the material from the waste characterization for retrieval and waste pretreatment (e.g. fissile isotops of U and Pu, Cs-137 and Sr-90, Na(+)).	3 of 26	Savannah River SR-2003	Mathew E. Jamison 803-208-1553	Thomas S. Gutmann 803-208-7408
2	Waste sorting and characterization	Need mechanism for non-intrusive drum characterization for radioactive and RCRA organics, and a remote drum opening and sorting system	18 of 34	Albuquerque LANL	Don Leske 970-248-6008 John Wage Tony Stanford	
3	Remote handling and viewing capability	A classified waste landfill covers 2.5 acres. The landfill contains a large variety of weapon-related components like radioactive nickel, strontium, and tritium, metals including lead, depleted uranium, and beryllium.	25 of 34	Albuquerque SNL	Rarilee Conway 505-284-2547	Mark Jackson 845-6288KAO
4	Mobile assay and hazard evaluation for residues	There is a need for improved non-intrusive methods to enable characterization of the current inventory of the residue materials. A self-contained mobile analysis system is needed to determine distribution of actinides within the drum, free liquids, and detect an interior package breach of contaminant.	13 of 45	Rocky Flats		

NO.	NEED TITLE	BRIEF DESCRIPTION OF NEED	RANKING	SITE	SITE CONTACT PERSON	DOE CONTACT PERSON
5	Plutonium interim storage surveillance	Develop a technical basis for the interim plutonium storage program which minimizes surveillance requirements, DOE-STD 3013 containers, and life-cycle surveillance costs. Non-invasive and intrusive techniques are required.	8 of 45	Rocky Flats RF-SNM08		
6	Special nuclear material holdup measurement capabilities	Mobile, rapid and accurate measurement techniques are needed to non intrusively quantify the fissile material held up in process piping, ductings, and equipment	5 of 45	Rocky Flats RF-SNM09		
7	Characteriza-tion of contaminated surfaces TRU versus low -level segregation	Improved mobile, field deployable characterization methods which have certified accuracy and precision for the determination of the actinide contamination on process equipment, structural materials, and other property.	7 of 45	Rocky Flats RF-DD01		
8	Chracteriza-tion of contaminated surfaces (Low-level versus free release segregation)	-do-	16 of 45	Rocky Flats RF-DD02		
	Self monitoring apparatus for radiological safety	Monitoring of workers for actinide contamination prior to exiting a radiological control area.	24 of 45	Rocky Flats RF-DD05		
10	Characteri-zation Technologies	Characterization technologies are needed for determining radiation level in situ. Differentiation between TRU waste and non-TRU waste is main concern. In addition, a verifiable method for determining that materials qualify for free release is necessary. Leak identification strontium and cesium storage tank is required.	High	Richland OO Hanford Site RL-DD02	Gary McCormick et.al. 509-372-8173	Rick Gonzalez 509-373-9922

NO.	NEED TITLE	BRIEF DESCRIPTION OF NEED	RANKING	SITE	SITE CONTACT PERSON	DOE CONTACT PERSON
11	Radiation hardened automated deployment system	Remote handling methods are needed for high radiation areas as hot cells. Automated systems are needed to deploy decontamination, characterization, and cutting technologies.	Medium	ROO, Hanford RL-DD-07	Keith Pauley 509-376-4086	Dave Langstaff 509-372-4013
12	Technium-99 analysis in low-level waste feed	An accurate, robust production laboratory method for the measurement of technitium-99 concentration in waste tank material is needed.	High	Richland RL-WT-02	J.J. Huni 509-372-8183	James A. Poppiti 509-376-4550
13	Real time, in situ detection of strontium-90, Chromium, carbon tetrachloride, and uranium	In- situ monitoring of strontium - 90.	High	RL- Hanford RL-SS05	Jared D. Isaacs 509-372-9381	Donna M. Wanek 509-376-5778
14	Fast effective surveying of transportation packages	Develop and demonstrate technologies that would decrease the time of survey waste packages. Objective of this need is to develop safer and more rapid methods or surveying transportation packages for radiological release and reuse	Low	ROO/ Hanford RL-MW010	Mike Coony 509-376-9774	Joe Warning 509-373-7687
15	Rapid waste characterization tools	Rapid yes/no evaluation of volatile hazardous components (e.g. radionuclides and carcinogens) is needed to assure adequate storage and retrieval.	5.1 (low)	Hanford RL-WT038-S	Catherine Louie 509-376-0893	
16	In situ, remotely operated, NDE/NDA chemical and Radionuclide mapping methods	Methods are needed that will isolate hot spots in high radiation areas so that decontamination can be targeted. The most common contaminants of concern are cesium-137, strontium-90, plutonium, and uranium.		Hanford	Jim Goodenough 509-376-0893	
17	Technitium 99 detector / analyzer (SSC)	Needs exists for mechanism/ device to quickly and reliably detect the presence of technitium-99 in the soil samples.	4	Fernald OH-F004	Larry Stebbins 513-648-4040	Rod Warner 513-648-3156

Table 2.
Results of the PBS needs for Idaho Operations Office

No	Need Title and ID	Need Description	Point of Contact
Idaho Operations Office			
1	<p>WAG 2 TRA - Test Reactor Area Assessment/Cleanup</p> <p>Ops/Field Office: Idaho Operations Office</p> <p>Site Project Id:ID-ER-02</p> <p>HQ Project Id:0165</p>	<p>The 13 operable units are composed of known and suspected releases from disposal ponds, waste lines, underground storage tanks, and other incidental releases as a result of facility operations at the TRA. Contaminants of concern include radionuclides, metals, organics, and polychlorinated biphenols (PCBs).</p> <p>Assessment of WAG 2 includes characterizing potential hazardous substance release units to determine the nature and extent of contamination; determining and documenting whether or not any contamination found constitutes unacceptable risk to human health and the environment. Determining the feasibility of various remedial alternatives to reach consensus on a proposed cleanup action with the regulatory agencies; and reach a Record of Decision. Currently, all waste release sites at WAG- 2 have been evaluated to determine whether or not contamination still exists at the site, and if so, whether the contamination is present at concentrations which pose an unacceptable risk to current workers and/or future human receptors which may inhabit the site.</p> <p>Scope:</p> <p>* Perform monitoring of the perched waters below the Test Reactor Area as required in the Operable Unit (OU) 2-13 Record-of-Decision.</p>	<p>N. Jensen</p> <p>Phone:208-526-0436</p> <p>Fax:208-526-0598</p> <p>EMail:JENSENNR@INEL.gov</p>
2	<p>WAG 3 ICPP – Idaho Chemical Processing Plant FFA/CO Remediation</p> <p>Ops/Field Office: Idaho Operations Office</p> <p>HQ Project Id:0166</p> <p>Site Project Id:ID-ER-03</p>	<p>The purpose of this project is to complete assessment, remedial design/remedial action cleanup, and long-term monitoring and maintenance activities for the Idaho Chemical Processing Plant (ICPP), Waste Area Group (WAG) 3, at the INEEL. The ICPP includes facilities for spent nuclear fuel storage, a waste solidification facility, and related waste storage bins, remote analytical laboratories, and a coal-fired steam generation plant. 93 potential release sites divided into 13 Operable Units based on the nature of the potential release comprise WAG 3. These sites include contaminated pits,</p>	<p>T. Jenkins</p> <p>Phone:208-526-4978</p> <p>Fax:208-526-0598</p> <p>EMail:JENKINTW@INEL.gov</p>

No	Need Title and ID	Need Description	Point of Contact
		French Drains, perched and aquifer water, percolation ponds, rubble piles, spills, storage areas, tanks, an injection well, and windblown areas. Contaminants of concern include radionuclides, metals, organics, and acids. Assessment of potential release sites at ICPP includes	
		characterizing the nature and extent of the contamination at each potential release site; determining and documenting impacts to human health and the environment; and evaluating various alternatives for remediation of the sites that pose unacceptable risk to human health and the environment.	
3	WAG 7 Idaho Operations Office HQ Project Id:0169 Site Project Id:ID-ER-06	Assessment and cleanup activities for the Waste Area Group 7 (Radioactive Waste Management Complex) are necessary to evaluate the risk to human health and the environment posed by radioactive and hazardous wastes buried at the site and to remediate the site to prevent future spread of contamination. Scope: Waste disposed at the Subsurface Disposal Area includes mixed low-level radioactive waste, and transuranic contaminated mixed waste, all of which is contained in various forms and packages buried in the 97-acre Subsurface Disposal Area. The assessment phase will investigate, characterize, and quantify the nature and extent of contamination.	Alan T. Jines Phone:208-526-7524 Fax:208-526-0598 Email: JINESA@INEL.gov
4	WAG 10 Idaho Operations Office HQ Project Id:0171 Site Project Id:ID-ER-08	This project covers the assessment and remediation of Waste Area Groups (WAG) 6 and 10 at the INEEL. WAG 6 consists of the Experimental Breeder Reactor (EBR-1) and the Boiling Water Reactor Experiment (BORAX) areas. Implement long-term INEEL groundwater monitoring as per the OU 10-04 Record of Decision.	P. Kroupa Phone:208-526-8419 Fax:208-526-0598 EMail:KROUPAPC@INEL.gov
5	Decontamination & Dismantlement (D&D) Idaho Operations Office	Two reactors at the Test Reactor Area (TRA) and three reactors at Argonne National Laboratory-West (ANLW) are still operational, but most have been deactivated or decommissioned to varying degrees. Along with these reactors are the numerous ancillary facilities and	A. Mikkola Phone:208-526-0725 Fax:208-526-0598

No	Need Title and ID	Need Description	Point of Contact
	HQ Project Id:0173 Site Project Id:ID-ER-10	<p>structures required for support services. All facilities awaiting D&D require surveillance and maintenance (S&M) funding to maintain containment and alleviate the industrial hazards associated with degrading facilities/structures. Characterization/Assessment includes Pre-Characterization ==> Historical Research, Sampling & Analysis Plan, Building Survey Plan, Sampling and Surveys (Radiological and Hazardous Materials), Characterization and Decision Analysis Report Waste Characterization ==> Sampling & Analysis Plan, Sampling and Surveys (Radiological and Hazardous Materials), prepare waste transportation/disposal forms Post-Characterization ==> Sampling & Analysis Plan, Sampling and Surveys (Radiological and Hazardous Materials), prepare Post-Characterization Report D&D/Cleanup includes Documentation ==> Environmental Permitting - National Environmental Policy Act (NEPA)- [EC, CX, EA, EIS], State Historic Preservation Office (SHPO), Hazard Classification, Safety Analysis Report, Health & Safety Plan, D&D Plan, Generator Treatment Plan, Transportation Plan, Waste Documentation, Work Permits (Safe Work Permits, Integrated Planning Sheets, Radiological Work Permits, Burn Permits, Confined Space Permits, Excavation Permits) Physical Work Tasks ==> Removal of Clean Equipment, Removal of Loose Contamination, Removal of Contaminated Equipment, Asbestos Abatement, Removal of Fixed Contamination, Removal of Hazardous Waste and/or Mixed Waste, Facility/Structure Dismantlement, Site Cleanup & Restoration. The current D&D projects are as follows: Auxiliary Reactor Area (ARA) Boiling Water Reactor Experiment (BORAX) Loss of Fluids Test Mobile Test Assembly</p> <p>(LOFT-MTA) Test Reactor Area (TRA) Test Area North (TAN) Chemical Processing Plant (CPP) FY97 ==> ARA-I, II, III, BORAX-V, LOFT-MTA, TAN-616, CPP-631/709/734, TRA-751/645 FY98 ==> LOFT-MTA, TAN-616, ARMF, TRA-704&705..... FY99 ==> LOFT-MTA, TAN-616, ARMF, TRA-755 and Design INEEL On-Site LLW Disposal Facility</p>	EMail:mikkolaw@inel.gov

No	Need Title and ID	Need Description	Point of Contact
6	Decontamination & Decommissioning (D&D) - Mortgage Reduction Idaho Operations Office HQ Project Id:0174 Site Project Id:ID-ER-11		A. Mikkola Phone:208-526-0725 Fax:208-526-0598 EMail:mikkolaw@inel.gov
7	INEEL Spent Nuclear Fuel Programs Idaho Operations Office HQ Project Id:0176 Site Project Id:ID-SNF-02	The purpose of the Idaho National Engineering and Environmental Laboratory (INEEL) Spent Nuclear Fuel (SNF) Program (ID-SNF-02) is to, per the Settlement Agreement, ensure safe and stable interim storage of spent nuclear fuel at DOE-ID managed facilities at the INEEL and at the Fort St. Vrain storage facility in Colorado and prepare and ship the SNF for final disposal in a repository by 2035. Scope: Specific work to be accomplished by ID-SNF-02 includes activities that fall under the following main categories:1. Facility Surveillance, Maintenance and upgrades - to ensure worker and public safety and environmental compliance. 2. Fuel monitoring activities such as fuel inventories, inspections, corrosion monitoring, etc.	R.C. Stump Phone:208-526-1448 Fax:208-526-0553 EMail:stumprc@inel.gov
8	TAN Underwater Spent Fuel Removal Idaho Operations Office HQ Project Id:0178 Site Project Id:ID-SNF-04	The purpose of ID-SNF-04, Test Area North (TAN) Underwater Spent Fuel Removal is to remove spent nuclear fuel (SNF) from the TAN pool and place it in modular dry storage in accordance with the Settlement Agreement between DOE, Navy, and the State of Idaho. Scope: Fuel monitoring activities such as fuel inventories, inspections, corrosion monitoring, etc.	R.C. Stump Phone:208-526-1448 Fax:208-526-0553 EMail:stumprc@inel.gov
9	LLW Contact Handled Off-site Disposal Idaho Operations Office	Offsite LLW Disposal: The remaining active Idaho National Engineering and Environmental Laboratory (INEEL) Radioactive Waste Management Complex (RWMC) Subsurface Disposal Area (SDA) low-level Waste (LLW) disposal pit is forecast to be filled to	Karl J. Hugo Phone:208-526-5375

No	Need Title and ID	Need Description	Point of Contact
	HQ Project Id:0182 Site Project Id:ID-WM-02	capacity in FY2006. Several scenarios have been identified that could prematurely shut down disposal at the RWMC. Ongoing environmental monitoring of the RWMC may show migration of radionuclides toward the aquifer. It is anticipated that off-site disposal of contact-handled (CH) LLW can be relatively easily accomplished after being designated as a generator to an offsite DOE facility.	Fax:208-526-1184 EMail:hugojt@inel.gov
10	INEL Transuranic Waste Idaho Operations Office Site Project Id:ID-WM-07 HQ Project Id:0187	Modification and upgrade of existing facilities and nondestructive waste characterization systems will be completed to support implementation of WIPP requirements and improve operational capability to ensure about 15,000 55-gallons of untreated TRU waste can be certified for shipment and disposal at WIPP by December 31, 2002, in accordance with SA Requirements.	Jerry L. Wells Phone:208-526-5296 Fax:208-526-0160 EMail:wellsjl@inel.gov
11	INEL Site-Wide Environmental Monitoring, Transportation, and Oversight Idaho Operations Office HQ Project Id:0190 Site Project Id:ID-WM-10	The purpose of the Environmental Monitoring Program (EMP) is to provide timely, reliable information about radioactive and Non-radioactive contaminants in the environment that are associated with past operations as well as current activities at the Idaho National Engineering and Environmental Laboratory (INEEL). The EMP is in compliance with applicable regulations and standards and provides and interprets data needed to help ensure protection of human health and the environment. This is accomplished by interpreting and implementing applicable city, state, and federal regulations, such as the City of Idaho Falls Pretreatment Agreement, State of Idaho Wastewater Land Application Permits, Safe Drinking Water Act, Clean Water Act, DOE Orders (5400.1, 5400.5, etc.), Clean Air Act, etc. Compliance to these regulations is maintained by establishing monitoring/surveillance programs, reporting the results and maintaining project files according to 1-Quality Assurance Management System-005. The EMP is divided into three control accounts: Environmental Surveillance Program (ESP), Water Resources (WR), and Compliance Monitoring (CM). The ESP conducts radiological sampling of air, water, soil, biota, and performs ambient radiation monitoring both onsite and at select offsite locations. SO2/NOx monitoring as well as	Greg E. Hula Phone:208-526-9899 Fax:208-526-0598 EMail:hulaga@inel.gov

No	Need Title and ID	Need Description	Point of Contact
		<p>tasks associated with the NESHAPs annual report are also part of the overall ESP. WR includes both surface water and groundwater activities. These activities include obtaining and overseeing Wastewater Land Application Permits, Storm Water Pollution Prevention Plans, Groundwater Monitoring Plans, Comprehensive Well Survey, etc.</p> <p>The CM control account includes the INEEL drinking water, liquid effluent, stormwater monitoring program, as well as the special request sampling program. Also included in the CM control account are program support and documentation activities, document handling and control for Standard Operating Procedures (SOPs), program manuals, necessary training for</p> <p>personnel (OSHA, etc.), configuration management (Program Management Plans), and self-assessments by safety and quality personnel. In addition, the EMP supplies the equipment necessary to conduct field operations, maintains a laboratory for sample preparation and shipping, and provides vehicle support. P&T - To maintain compliance with the DOT, and provide safe packaging for the INEEL, the P&T Department has identified the following key areas.</p>	
12	<p>Long Term Surveillance & Maintenance</p> <p>Idaho Operations Office</p> <p>HQ Project Id:0192</p> <p>Site Project Id:ID-WM-12</p>	<p>This project is the continuation project beyond 2006 for the Environmental Monitoring, Transportation, and Oversight activities. The purpose of the Environmental Monitoring Program (EMP) is to provide timely, reliable information about radioactive and non-radioactive contaminants in the environment that are associated with past operations as well as current activities at the Idaho National Engineering and Environmental Laboratory (INEEL).</p> <p>Rest of the things are the same as the previous one.</p>	<p>Greg E. Hula</p> <p>Phone:208-526-9899</p> <p>Fax:208-526-0598</p> <p>EMail:hulaga@inel.gov</p>
13	<p>Pre-FY2006 Surplus Facilities Deactivation Project</p> <p>Idaho Operations Office</p> <p>HQ Project Id:0213</p>	<p>The purpose of deactivation is to reduce the cost and risk associated with surplus contaminated facilities. Deactivation activities include the following: removal of radioactive and hazardous materials, removal of uranium and other fissile materials, and isolation of the surplus facilities from ongoing operating and utility systems. Deactivation</p>	<p>D.J.Sanow</p> <p>Phone:208-526-1049</p> <p>Fax:208-526-9150</p>

No	Need Title and ID	Need Description	Point of Contact
	Site Project Id:ID-OIM-09	occurs either directly following facility shutdown or may occur sometime later when funding becomes available. The relationship to other PBS activities is prior to and during deactivation the facility will need surveillance and maintenance called Pre-Deactivation Surveillance and Maintenance (S&M), ID-OIM-11.	EMail:sanowdj@inel.gov
14	Post-FY2006 Surplus Facility Deactivation Projects Idaho Operations Office HQ Project Id:0214 Site Project Id:ID-OIM-10	The purpose of deactivation is to reduce the cost and risk associated with surplus contaminated facilities. Deactivation activities include the following: removal of radioactive and hazardous materials, removal of uranium and other fissile materials, and isolation of the surplus facilities from ongoing operating and utility systems. Deactivation occurs either directly following facility shutdown or may occur sometime later when funding becomes available. The relationship to other PBS activities is prior to and during deactivation the facility will need surveillance and maintenance, called Pre-Deactivation Surveillance and Maintenance (S&M), ID-OIM-11.	D.J.Sanow Phone:208-526-1049 Fax:208-526-9150 EMail:sanowdj@inel.gov
15	Pre-Deactivation Surveillance and Maintenance (S&M) Idaho Operations Office HQ Project Id:0215 Site Project Id:ID-OIM-11	The purpose of surveillance and maintenance (S&M) is to maintain surplus contaminated facilities in a safe condition and meet the requirements found in CFR41-101.47.400 which prohibits abandonment of surplus facilities. Surveillance and maintenance activities include the following: maintaining these facilities in a condition that meets requirements for reduced risk to the public, site personnel, and the environment from release of radiological and hazardous materials is accomplished by maintaining facility and site HEPA filtered off-gas systems, cleaning up and containing contamination 'creep', preventing and cleaning up inflow of environmental liquids, and maintenance of the equipment necessary to accomplish this task. This program also maintains criticality controls in areas that have significant quantities of high-enriched fissile materials by preventing inflow of environmental liquids and maintenance of instrumentation required meeting Criticality Safety Requirements. Monitoring and maintaining instrumentation required by RCRA regulations is also required in several of the facilities. Surveillance and Maintenance is performed on the following surplus facilities: · CPP601 - This facility contains process cells contaminated	D.J.Sanow Phone:208-526-1049 Fax:208-526-9150 EMail:sanowdj@inel.gov

No	Need Title and ID	Need Description	Point of Contact
16	Post-Deactivation Surveillance and Maintenance Idaho Operations Office HQ Project Id:0216 Site Project Id:ID-OIM-12	<p>with radioactive and mixed hazardous materials along with the low-level liquid waste storage, sampling and transfer system, and chemical transfer system. The facility has permitted RCRA storage tanks which must be monitored. CPP640, CPP633, CPP627.</p> <p>The purpose of surveillance and maintenance (S&M) is to maintain surplus contaminated facilities in a safe condition and meet the requirements found in CFR41-101.47.400, which prohibits abandonment of surplus facilities. This project meets the obligation to maintain the facilities in a condition that reduces the risk of release of hazardous and/or radioactive materials, which could harm the public, site personnel, or the environment. Surveillance and maintenance activities include the following: maintaining these facilities in a condition that meets requirements for reduced risk to the public, site personnel, and the environment from release of radiological and hazardous materials is accomplished by maintaining facility and site HEPA filtered off-gas systems, cleaning up and containing contamination 'creep', preventing and cleaning up inflow of environmental liquids, and maintenance of the equipment necessary to accomplish this task.</p> <p>Post-deactivation surveillance and maintenance activities maintain these nuclear facilities in a safe condition awaiting decommissioning: Activities include daily surveillance of transition and restoration facilities for leak detection and response; daily surveillance of the facilities for ventilation control; monthly surveillance of the facilities for operability of safety equipment necessary for routine occupancy; operational and maintenance response to any abnormalities; maintain surplus facilities per CFR41-101.47.400</p>	D.J.Sanow Phone:208-526-1049 Fax:208-526-9150 EMail:sanowdj@inel.gov

Table 3.
PBS needs of Rocky Flats Operations Office

No.	Need Title and ID	Need Description	Site Contact Person
1	HQ Project Id:0383 Site Project Id:RF032 B886 Cluster Decommissioning - Privatization	This project comprises the privatized portion of the decommissioning [decontamination and demolition] of the Building 886 Cluster facilities, i.e., removing radiological and industrial contamination, physically reducing the structures to rubble, and inerting the underground utilities such that the site may be transferred to Environmental Remediation for execution of site closure tasks. The Decommissioning of the B886 Cluster will consist of characterizing the actinide and industrial [lead, asbestos, etc.] contamination in the buildings [locations, types and quantities] at the start of Decontamination, throughout decommissioning and at the conclusion of demolition.	Jessie Roberson Phone:303-966-2263 Fax:303-966-4775 Email: ten.year.plan@rfets.gov
2	HQ Project Id:0202 Site Project Id:RF001 Buffer Zone Closure Project	Predecessor projects include Groundwater/surface water monitoring and operations, OU 1 Closures, OU 3 Closures, OU 5 closure and OU 6 closure. Note: The buffer zone closure project encompasses more activities than the previous projects indicate. The buffer zone closure project will involve operation of groundwater and surface water monitoring stations until D&D and capping activities are complete.	Jessie Roberson Phone:303-966-2263 Fax:303-966-4775 EMail:ten.year.plan@rfets.gov v

Table 4.
PBS needs for Oak Ridge Operations Office

No.	Need Title and ID	Need Description	Point of Contact
1	<p>Low-Level-Waste Treatment</p> <p>Ops/Field Office: Oak Ridge, Weldon Spring</p> <p>HQ Project Id:0298</p> <p>Site Project Id:OR-38105</p>	<p>The scope of this project includes the treatment of 350,000m³/yr of Liquid Low Level Waste, treatment of 2,800 m³ of Solid LLW to reach a point where LLW is stored with the sole purpose of accumulating sufficient quantities to facilitate treatment, storage, or disposal. The LLW waste streams included in this scope are wastewater, containerized inventories LLW liquids, dry active waste, radioactive scrap metal, process residues, and special case waste. This project involves the treatment of LLW generated on the ORR. Capabilities utilized to accomplish the goal of reaching the steady-state by the end of FY1999 include onsite wastewater treatment facilities such as the Process Waste Treatment Complex, the Liquid low-level Waste Evaporator, the Waste Feed Preparation Facility at Y-12, the SWSA-5 North compactor at ORNL, the Drum Crusher at K-25 and commercial treatment services which include super compaction, incineration, and metal melting for recycling. Project scope addresses the operation and maintenance of the on-site facilities and the related support functions such as collection & transportation, characterization, certification, data collection, payment of commercial treatment costs and reporting listed previously.</p>	<p>William C. Gilbert</p> <p>Phone:423-576-1817</p> <p>Fax:423-576-5333</p> <p>Email: gil@ornl.gov</p>
2	<p>Y-12 East Fork Poplar Creek Remedial Action</p> <p>Oak Ridge, Weldon Spring</p> <p>HQ Project Id:0306</p> <p>Site Project Id:OR-42101</p>	<p>The purpose of the Y-12 East Fork Poplar Creek (EFPC) Remedial Action grouping of projects is to address environmental hazards that have been identified within the Upper EFPC watershed (the main Y-12 Plant area) and associated waste disposal sites located to the south of the Y-12 Plant on Chestnut Ridge and to take the watershed and associated sites through the CERCLA process.</p> <p>The remedial action projects in this grouping are in various states of completion with most needing additional characterization and/or data evaluation prior to remedial action decisions.</p>	<p>Mike A. Travaglini</p> <p>Phone:423-576-0848</p> <p>Fax:423-576-6074</p> <p>Email: travaglinima@oro.doe.gov</p>
3	<p>Y-12 Bear Creek Remedial Action</p>	<p>The purpose of the Y-12 Bear Creek Remedial Action grouping of projects is to address environmental hazards that have been identified within the Bear Creek watershed (waste management areas west of the</p>	<p>Mike A. Travaglini</p> <p>Phone:423-576-0848</p>

	Oak Ridge, Weldon Spring HQ Project Id:0307 Site Project Id:OR-42102	main Y-12 Plant area) and to take the watershed and associated sites through the CERCLA process. Six of the seven projects in this grouping are associated with the Bear Creek Valley Characterization Area and include the Watershed ROD project and five associated forecast remedial action projects. Numerous waste disposal areas are located in the Bear Creek Watershed and these disposal areas were predominately used to dispose of both liquid and solid wastes from operations conducted at the Y-12 Plant.	Fax:423-576-6074 Email: travaglinima@oro.doe.gov
4	K-25 D&D Oak Ridge, Weldon Spring HQ Project Id:0315 Site Project Id:OR-44303	The Scope included in the K-25 Decontamination and Decommissioning (D&D) Project includes several subprojects that will address all the primary sources of contamination and risk at the K-25 Plant site. K-25 Decommissioning Surveillance & Maintenance - Periodic inspections, correction of deficiencies, and activities to limit liability and reduce the numbers of inspections.	Clayton S. Gist Phone:423-576-6821 Fax:423-576-6074 Email: gistcs@oro.doe.gov
5	Paducah Remedial Action Ops/Field Office: Oak Ridge, Weldon Spring HQ Project Id:0317 Site Project Id:OR-45301	Surveillance of all Paducah ER facilities (30 separate structures), and RA sites (208 SWMUs) to determine status and ensure compliance with program requirements.	James C. Hodges Phone:502-441-6806 Fax:502-441-6801 Email: hodgesjc@oro.doe.gov
6	Paducah Waste Management Oak Ridge, Weldon Spring HQ Project Id:0318 Site Project Id:OR-45302	The TSCA Incinerator shipments include characterizing and shipping of 190,000 pounds of liquid wastes to the TSCA Incinerator located in Oak Ridge. This activities support requirements of the LDR FFCA, FFC Act and TSCA FFCA. The Storage WBS includes Storage Operation (Base Operations), RCRA closure of certain Waste Management Facilities, and upgrading the Waste Information Tracking System.	James C. Hodges Phone:502-441-6806 Fax:502-441-6801 Email: hodgesjc@oro.doe.gov
7	Portsmouth Remedial Action Oak Ridge, Weldon Spring HQ Project Id:0319	This project will complete the DOE portion of the Environmental Restoration program for the site and continue with the long-term Surveillance and Maintenance Program for the site. Conduct long-term Surveillance and Maintenance of the Remedial Action units and D&D facilities in accordance with all regulatory and DOE requirements.	Gene Gillespie Phone:614-897-2001 Fax:614-897-2982

8	<p>Portsmouth Remedial Action
Oak Ridge, Weldon Spring
HQ Project Id:0319
Site Project Id:OR-46301</p>	In addition, following work will be performed as part of ongoing Surveillance and Maintenance activities. Sitewide D&D Surveillance and Maintenance long-term Surveillance and Maintenance Groundwater Protection Program. Predecessor Project: During the cold war, the Portsmouth Gaseous Diffusion Plant was constructed to enrich uranium in support of both government and private programs. The plant is currently operational under a lease agreement with the United States Enrichment Corporation (USEC) which produces Low Enriched Uranium for commercial applications. Following are one of the main purposes of the project is to conduct long-term Surveillance and Maintenance of the Remedial Action units and D&D facilities in accordance with all regulatory and DOE requirements. Scope: The project will complete assessment and/or cleanup of 156 units which have been identified during the course of the RCRA Corrective Action Process for the site. The units have been organized into area groupings and the major projects are: Quadrant I, II, III & IV Assessments Corrective Measures Studies and/or Corrective Measures Implementation for Sitewide Surface Drainage, X-749/X-120 Area, 5-Unit Area, Peter Kiewit Landfill, X-701B Area, X-705A/B Area, 7-Unit Area, Quadrant II Balance, Supplemental Environmental Project, X-740 Area, Quadrant III Balance, X-611A Lime Sludge Lagoons, Quadrant IV Balance. In addition, following work will be performed as part of ongoing Surveillance and Maintenance activities. Sitewide D&D Surveillance and Maintenance long-term Surveillance and Maintenance Groundwater Protection Program.	<p>Gene Gillespie
Phone:614-897-2001
Fax:614-897-2982</p>
9	<p>Weldon Spring Waste Treatment
Oak Ridge, Weldon Spring
HQ Project Id:0321</p>	Scope: The scope of this project includes characterization and environmental documentation required to support the raffinate pits remediation, dewatering of the raffinate pits, consolidation and removal of raffinate pit debris, consolidation and dredging of raffinate pits sludge,	<p>Steven H. McCracken
Phone:314-441-8978
Fax:314-447-0739</p>

- Site Project Id:OR-47202 design/construction & operation of both pilot and full-scale Chemical Stabilization and Solidification (CSS) plants, treatment of the raffinate pits wastes in the full-scale plant prior to placement in the disposal facility and restoration of the raffinate pits sites.
- 10 Weldon Spring long-term Surveillance and Maintenance
Oak Ridge, Weldon Spring
HQ Project Id:0322
Site Project Id:OR-47203
- Purpose:**
The purpose of this project is to maintain and evaluate the performance of the WSSRAP disposal facility after its closure in 2004. Monitoring will ensure the continuing protection of the public and the environment.
- Scope:**
This is an operations project, which will provide the long-term maintenance and surveillance at the WSSRAP disposal facility after its completion and closure. Grounds and facility maintenance and security as well as required long-term environmental monitoring are included. This project is scheduled to begin in FY2005 under the current ten-year Plan assumptions.
- Steven H. McCracken
Phone:314-441-8978
Fax:314-447-0739
- 11 Offsite Remedial Action
Oak Ridge, Weldon Spring
HQ Project Id:0323
Site Project Id:OR-48101
- Please refer to the PBS.
- A. B. Perkins
Phone:423-576-2552
Fax:423-576-6074

Table 5.
PBS needs for Oakland Operations Office and Oak Ridge National Laboratory

No.	Need Title And ID	Brief Description Of Need	Site Contact Person Doe Contact Person
1	Mobile non-Destructive assay for waste boxes	The assay system will consist of a passive measurement system, which will have the ability to qualify Pu 238, 239, 240 and americium 241 isotopic mass ratio, total Pu 239 fissile equivalent, total alpha curie content, and thermal power of the waste in the container. Results will be paper and electronic format in accordance with the Performance Demonstration Program requirements.	John Bowers Phone: 510-422-7756 Roy Kearns Phone: 510-422-1168
2	Innovative technology to determine the structural integrity of buried drums without removing them from ground.	Need innovative technologies to determine structural integrity of buried drums without digging them up and puncturing them.	John Ziagos Phone: 510-422-5479 Donna Spencer Phone: 510-423-6718
3	Need ID: DD-01	Improved radiological characterization of contaminated equipment and facilities to enable D&D crews to determine which radionuclides are present and at what level. It needs to be real-time, or nearly so, to guide decontamination efforts, to be sensitive enough to allow the free release of deconned materials and to be non-manpower intensive. Desired end state would be field deployable equipment which would allow a single operator to rapidly survey and record rad contamination on facility surfaces, process equipment surfaces (both interior and exterior) and other complex surface.	Dave Neiswander Phone: 423-241-3639 E-mail: neiswanderw@ornl.gov
4	Need ID: TK-01	To develop equipment capable of comprehensive characterization of waste, waste tanks, containers, piping systems and surrounding soils are needed. Sludge/debris surface mapping equipment capable of profiling surfaces below the supernatant liquid is also needed. Complete portable characterization equipment including samplers, sensors, controls, analyzers and devices are needed. The contaminants included are alpha, U and TRU.	Sharon Robinson Phone: 423-574-6779

5	Need ID: WM-17	Characterization capabilities for site specific waste are needed. Characterization capabilities for TRU waste are needed. Transportable characterization capabilities for the radioactive waste are needed. A comprehensive NDT program to characterize low level-waste is needed.	Sladjana Crosley
Phone: 423-574-1666
E-mail: swl@ornl.gov
6	Need ID: WM-23	Methods to fully characterize the soil contaminated with hazardous and radioactive species are needed.	Sladjana Crosley
Phone: 423-574-1666
E-mail: swl@ornl.gov
7	Need ID: WM-24	Better methods for detecting heavy metals process waste water needed.	Sladjana Crosley
Phone: 423-574-1666
E-mail: swl@ornl.gov

Table 6.
PBS needs for Chicago Operations Office

No.	Need Title	Brief Description of Need	Site Contact Person
			DOE Contact Person
Chicago Operations Office			
1	Characterization for decontamination/decommissioning	Characterization methods must be effective in identifying the quantity and location of radioactive contamination. At the same time, the method should be such that, during their application exposure of workers to radiation should be kept as low as reasonably possible (ALARA) and within occupational limits. In addition, there should be no impact on the health and safety of other personnel and general public.	William Gunther Phone: 516-344-7961 Angela Harvey Phone: 516-344-5345
2	Real time field instrumentation for characterization for radioactive and metal contaminated soil.	Real time field instrumentation for characterization, excavation control, and cleanup verification of radionuclides and metal contaminated soil. Most soils are destined for a repository. Soils entering this repository must meet certain regulatory requirements. Field instrumentation is required for rapid and accurate determination of weather soils being excavated can go to the repository without treatment. The instrument must reliably quantify Cs-137 at 16 pCi/g, Sr-90 at 60 pCi/g, Co-60 at 1.8E+5pCi/g and Eu-152 at 140 pCi/g. Analysis must be completed within 15 minutes.	Doug Greenwell Phone: 208-526-0858 Fax: 208-526-9473 E-mail: frg@inel.gov Nolan Daum Phone: 208-526-0436 Fax: 208-526-0598 E-mail: Gensenr@inel.gov
3	Digface characterization to reduce volume of waste to be remediated.	A technology or combination of technologies that would allow locating specific COCs in buried waste as the waste is being removed for processing is needed so that site specific risk drivers could be removed with the minimum volume of secondary, uncontaminated waste. The technology or the system supplies should be able to detect one or more of the following contaminants: actinides (especially U, Pu, and Am) C-14, Tc-99, Sr-90, Ni-59.	Duoglas Joregenson Phone: 208-526-7022 Fax: 208-526-6852 E-mail: dkj@inel.gov Nolan Jeanson Phone: 208-526-0436 Fax: 208-526-0598 E-mail: jeasennr@inel.gov

No.	Need Title	Brief Description of Need	Site Contact Person
			DOE Contact Person
4	In-situ characterization of tank waste	A method is needed for in-situ characterization of tank contents, including capability of detecting small heavy particles lying on the bottom of the tanks (i.e., not suspended in the slurry or sludge). Method should be able to obtain data at distance up to 50 feet from tank opening and from regions of the tanks with restricted access, and in sumps and baffles. There are currently 11 buried waste tanks and potentially contaminated soil, containing TRU and mixed waste.	Doug Kuhns Phone:208-526-8226 Fax:208-526-6852 E-mail:dkh@inel.gov Nolan Jeanson Phone:208-526-0436 Fax:208-526-0598 E-mail: jeasennr@inel.gov
5	NDA methods for SNF using gamma neutron	Develop NDA methods for spent fuel in order to determine both quantitatively and qualitatively the radioisotope inventory in the SNF. Gamma and neutron techniques could be modified and used. DOE owns 250 different types of SNF.	Claude Kimaball Phone:208-526-3695 Fax:208-526-4902 E-mail:ckimball@inel.gov Dan Rivas Phone:208-526-1212 Fax:208-526-5678 E-mail:rivasd@inel.gov
6	Develop NDE technology	To develop non-destructive examination technology to detect fuel deterioration that will reduce risk of jeopardizing the use of basins through release of fission products and to prevent increased expense of SNF retrieval due to fuel degradation. This includes identification of appropriate sensors and deployment strategies. Also in-situ measurement of SNF and ability to sense the integrity of the canisters and the configurations of SNF, significant cladding breaches, sludge formation, fuel disruption and/or fuel deformation.	Claude Kimaball Phone:208-526-3695 Fax:208-526-4902 E-mail:ckimball@inel.gov Dan Rivas Phone:208-526-1212 Fax:208-526-5678 E-mail:rivasd@inel.gov
7	Develop technologies to measure integrity of dry storage canisters.	To examine the contents of the dry canisters to assure safe conditions exists for long-term storage of SNF. The technology must be able to determine the deterioration of the canister either in-situ or with minimal handling requirements.	Claude Kimaball Phone: 208-526-3695 Fax: 208-526-4902 E-mail: ckimball@inel.gov Dan Rivas Phone: 208-526-1212 Fax: 208-526-5678 E-mail: rivasd@inel.gov

Table 7.
PBS needs for Nevada and Ohio Mound Operations Office

No	Need Title	Need description	Site contact person DOE Contact person
Nevada Operations Office			
1	Non-intrusive survey of pipes and vessels	A method is needed for identifying and qualifying materials inside pipes and vessels from only one exterior side of the pipe or vessel. A portable system with real time output that is capable of detecting, characterizing, and quantifying from only one exterior side of the pipe or vessel is desired.	Clayton Barrow(ERD) Bill Wilborn(ETD)
2	Improved detection and characterization of large concrete and metal surfaces	A cheaper, faster, and/or safer method for characterizing the large concrete and metal surfaces are required. Characterizing radioactive contamination on the walls and the surfaces of buildings and equipment using instruments held inches from the wall or the surfaces is extremely time and labor-intensive. It can lead to accidents. The requirement for this need include a portable system, remote detection and characterization, and real-time visual display.	Clayton Barrow (ERD) Bill Wilborn(ETD)
3	Real time monitoring for radiation (Mainly tritium) in monitoring bore holes.	The need is for durable, reliable, and accurate system that will monitor relatively low level of radiation in deep monitoring wells. Tritium is the major radionuclide of interest, but other radionuclides associated with underground testing are also of interest. The detection limit for Tritium is 1000 pCi/l or ALARP.	Robert M. Bangerter (ERD) Clayton W. Brown
Ohio-Mound			
4	Real time cost effective field screening/characterization	Currently, Mound has no method for quantifying contamination in the soil in the field. The radionuclides of concern are Pu-238, Thorium-232. Other radionuclides are also to be removed if in excess of the risk-based cleanup values. The contamination quantifying method must detect Plutonium-238, and thorium-232 and other relevant radionuclides and be able to distinguish between those radionuclides.	Richard Baur James Johnson

No	Need Title	Need description	Site contact person DOE Contact person
5	Improved facility survey techniques	<p>Some of the existing buildings are to be transferred. During the transition efforts, characterization of the buildings is required. To enable much decision points.</p> <p>The detection levels must be sensitive enough to detect radionuclides below the current unconditional release standard.</p>	Richard Bauer James Johnson
6	Gamma scintillation counting system	<p>Develop a gamma scintillation counting system that can be placed in a hole in a ground and qualify and quantify in-situ radionuclides sufficient to withstand the vigor of verification sampling. This system must be able to detect Pu-238, Thorium-232, as well as other radionuclides and be able to distinguish between them. Must be sensitive to levels well below the established cleanup criteria. Must be timely and reasonably portable.</p>	Craig Ferguson James Johnson
7	Counting system that accepts a slug	<p>Develop a counting system that can accept a soil slug (e.g. from a geoprobe in a plastic tube), not required sample preparation, and give a radioisotopic characterization sufficient to withstand the rigor of the sampling QA/QC. The system should have the following performance requirements:</p> <p>Gamma spectroscopy system that accepts the soil core boring of varying diameter. Must produce results in 15 minutes or below.</p>	Craig Ferguson James Johnson

Table 8.
Technology survey for remote measurement of radiation and other parameters

Vendor	Name	
	Address	

Contact Person	Name	
	Phone	
	Fax	
	E-mail/ URL	

Specialized In	Sensors		Data Logger		
			Data Transmitter	Power Supply	Integrated Unit

Technology Applicable to Measurement of:

Radionuclides	Detector	Sensitivity	Dynamic Range	Applicable Distance from Source in Feet
U-235				
U-238				
Pu-238				
Pu-239				
Pu-241				
Am-241				
Cs-137				
Sr-90				
Tc-99				
C-14				
H-3				
Ni-59				
Eu-152				
Other Non-radioactive Property				
Animal/Personnel Intrusion				
Hazardous Material Contamination				
Water/Liquid Intrusion				

Technology Applicable to Measurement of (continued):

Leak detection system (for underground as well as above ground tanks)				
Soil monitoring system				
Air quality monitoring system				
Weather monitoring system				
Structural Integrity Monitoring System				

Applicable to Forms/Storage Vessels in which Radioactive Material is Detected

Tanks	
Soil	
Air	
On Surface (Walls, Equipment, etc.)	
Groundwater	
Surface water	
Debris	

Details of Related Component Technologies/Integrated System

Technology Name	Description
Data Loggers	
Data Transmitters	
Data Port Available Yes/No	
Data Type (Analog/Digital)	
Power Supply	
Integrated Unit	

Data Transmission Systems

1. Telephone	Yes / No
2. Radio Frequency Communication	Yes / No
3. Cellular phone	Yes / No
4. Multi-drop Interface (coaxial Cable)	Yes / No
5. Satellite	Yes / No
6. Other	Yes / No

Demonstration Performed/Current Users

Site(s)/Companies/ Institutions	Results/Performance Evaluation Report from Users

Limitation Related To

Quantity of Waste	
Container of Waste	
Radiation Background, Chemicals, etc.	
Atmospheric Conditions (Temperature, Humidity)	
Utilities Required (Power requirement, etc.)	
Other	

Table 9.
Summary of the vendors and their products

Number	Name of the Company	Product Name	Product Description
1	AIL	1. Air monitoring system 2. Gamma radiation imaging	Air monitoring system for wide range of hazardous material (detector: Mercury Cadmium Telluride (MCT)) Gamma imaging (High-density terbium activated scintillating glass).
2	Analogic	1. Data acquisition	Data acquisition for sensors for temperature, pressure, moisture, liquid level, flow
3.	Aptec	1. Hand cuff and foot monitor 2. Whole body surface contamination monitor 3. Contamination monitors 4. Gamma spectrometers	1. Proportional counters, GM, Scintillators 2. Hp Germanium and NaI (Tl) detectors for x and gamma rays
4	Aware Electronics	5. α , β and γ detectors 6. Data loggers 7. Radio and cellular modems 8. Integrated unit 9. Power supply 10. Software Support	Detector types: Geiger tubes, NaI (Tl)
5	Bicron-NE	1. Portable monitors	Portable monitors for monitoring gamma dose/contamination levels
7	BOC, Edward Vacuum Technology	1. Leak Detectors	Leak detectors for pumps
8	Brodersen Control System	1. Data loggers 2. Data transmitter 3. Integrated unit	

Number	Name of the Company	Product Name	Product Description
9	Bubble Technologies Industries, Inc.	1. Radiation detection 2. Data logger 3. Wireless data transceiver 4. Integrated unit	Type of detectors are: β , γ , X-ray
10	Campbell Scientific, Inc.	1. Weather monitoring system 2. Data loggers 3. Data transmission 4. Power supply 5. Integrated unit for some applications	Wind speed, direction, solar radiation, temperature, precipitation, snow depth Telephone modems Batteries, solar chargers Weather stations
11	Canberra	1. Detectors and accessories 2. Modular electronics	Detector type: Hp Germanium and NaI (TI) detectors for x and gamma rays, Si (Li) X-ray detector system, PIPS (Passivated Implanted Planer Silicon) detectors for continuous air monitoring for alpha and beta radiation, custom designed Modular Electronics Type: amplifiers, analog to digital converters (ADC), alpha spectrometer
12	Coastal Environmental Systems	1. Data Loggers 2. Data transmitters	Accepts analog/digital data Cable, radio, telephone and satellite transmission
13	Dosimeter Corporation of America	1. Direct reading dosimeters 2. Area monitors	Radiation detector type: x and gamma rays x and gamma radiation up to 300 ft from the instrument location
14	EG&G Ortec	Alpha and gamma spectroscopy, and radiation survey meters	Detectors: Hp Germanium and NaI(Tl), ultra ion-implanted detectors, surface barrier detectors, Gm and proportional detectors, and integrated units

Number	Name of the Company	Product Name	Product Description
15	F&J Specialty Products Inc.	<ol style="list-style-type: none"> 1. Digital air sampler 2. Radioiodine collection filter cartridges 3. Personal air samplers 	
16	Free Wave	<ol style="list-style-type: none"> 1. Spread spectrum radio transceiver 2. Wireless data transceiver 	
17	Grayline instruments Inc.	<ol style="list-style-type: none"> 1. Level and flow measurement 2. Integrated unit available 	Ultrasonic sensors for level and flow measurement
18	Industrial Process Measurement Inc.	<ol style="list-style-type: none"> 1. Data loggers and recorders 2. Level and flow instrumentation for leak detection 3. Temperature, humidity sensors for environmental monitoring 	
19	In-situ, Inc.	<ol style="list-style-type: none"> 1. Water quality monitor 2. Water level monitoring probe 3. Data logger and integrated unit 	
20	Keithley Radiation Instruments	<ol style="list-style-type: none"> 1. Digital hand-held survey meters 2. Dosimeters 	For x and gamma rays
21	LND	<ol style="list-style-type: none"> 1. Detectors for α, β and γ radiation 2. Neutron counters 3. Large area α, β and γ detectors 	GM counters, proportional counters, BF3 counters

Number	Name of the Company	Product Name	Product Description
22	Logical Beach Inc.	1. Data Loggers 2. Software supply for the data loggers	Manufacture and sale of portable and remote site data logging instruments
23	Ludlum	1. α , β and γ contamination monitors, counters and survey meters	GM detectors, NaI (TI), plastic scintillators proportional counters
24	National Nuclear Corporation	1. Portal monitors, conveyorized contamination monitors, neutron counters, surveymeters	GM detectors, NaI (TL), plastic scintillators, proportional counters
25	Oxford	1. REGIS 2. α -spectroscopy 3. γ -spectroscopy 4. Data logger, transmitter and receiver 5. Integrated unit available	Scintillation based γ spectroscopy system with data transmission to remote station and receiving capability, for remotely radiological monitoring Ion -implanted detectors, Hp Ge detectors and integrated spectrometers
26	Rados	1. Online dose rate measurement 2. Mobile dose rate measurement system with GPS 3. Area monitoring system	For γ and x radiation α contamination monitoring β contamination monitoring
27	Reuter-Stocks	1. Environmental monitoring stations 2. Data loggers 3. Integrated unit 4. Gamma radiation sensors	Monitoring for wind speed, direction, moisture content, precipitation, snow fall, temperature

Number	Name of the Company	Product Name	Product Description
28	SAIC	1. Electronic dosimeters 2. Air monitoring and sampling devices 3. Multifunction radiation survey meter	For γ radiation measurement For measuring airborne β particulate radioactivity For α , β , γ , x-ray, and neutron monitoring
29	SBT Designs	1. Whether stations 2. Telemetry system	Weather monitoring station, telephone, cellular and satellite data transmitters.
30	Scientific Sales, Inc.	3. Weather stations 4. Data logger 5. Integrated unit	For monitoring wind speed, direction, moisture content, precipitation, snow fall, temperature
31	SE International	1. Dosimeters 2. Survey meters for α , β , γ , x radiation	Radiation detectors (NAI (TL) and GM type)
32	Victoreen	1. Area survey meters 2. Data loggers 3. Integrated unit	GM detectors for γ and x-ray monitoring

Number	Name of the Company	Product Name	Product Description
33	Vindicator technologies	Electronic security systems 1. Video motion/non-motion detection 2. Active infra red beam sensor 3. Power supplies 4. System integration 5. Video smoke detectors for fire detection 6. Data logger and network communication links	
34	ThermoNutech	1. Radiological mapping Laser assisted ranging and data system	Provides survey reports for clear and concise representation of location and quantity of the contamination

Table 10.
List of companies contacted for telemetry system

No.	COMPANY	PHONE
1	3M	800-364-3577
2	Advanced telemetric International Inc.	937-848-6948
3	Atmospheric Instrumental research	303-499-1701 X300
4	Aydin	215-968-4271
5	Barger Norman Products	937-344-1100
6	Belford Instruments	410-342-2626
7	Brinsfield Engg. Inc.	800-524-3327
8	Bristol Babcock	860-945-2200
9	COASTAL INSTRUMENTATION AND TELEMTRY	805-497-7570
10	Commtech	609-655-2277
11	Comtech Corp.	609-655-2277
12	Dolch Computer Systems	1-800-538-7506
13	DPL	506-635-1053
14	ENVIROMETREX	416-928-0917
15	GLOBAL TELEMTRY SYSTEMS	904-609-1777
16	INTEGRATED TELEMTRY SYSTEMS	39-438-492340
17	J&S	888-564-3282
18	LSI Controls Inc	888-722-2191
19	Marshal Electronics Division	800-959-1217
20	Navigation Science Corp.	818-919-9794
21	Pribusin Inc.	734-677-0459

No.	COMPANY	PHONE
22	RADCOM	781-938-6663
23	REMTRON INC.	760-737-7800
24	Syncicom	888-529-8695
25	Telescada Inc.	781-740-0226
26	US Filter Control Systems	800-224-9474
27	Wireless Data Corp.	650-967-9100
28	Young Design Inc.	703-237-9090

Table 11.
List of other companies contacted

No.	Name of Company	Product Name	Product Description
1	Home Automation System Inc.	1. IR beam Sensors 2. Animal Repellers 3. Video Cameras 4. Weather Monitoring 5. Exterior Motion Detector	
2	Marlin P. Jones & Associates Inc.	Components for Electronic Devices	
3	Troxel	1. Sensors for Temperature 2. Sensors for gas 3. Sensors for level 4. Sensors for pressure 5. Sensors for motion	
4	Klestbay	Characterization & monitoring of ground water conditions and contamination plumes	
5	Vindicator	Electronic Security Systems	
6	IO-Tech	Data Loggers & software	
7	Newport	Displays for various properties like temperature, strain gauges, etc.	

No.	Name of Company	Product Name	Product Description
8	HP	Handheld Instruments for temperature & pressure	
9	Datataker	Data Loggers	
10	New England Instruments	Position Sensors (Rotary & Linear)	
11	Vernier	Software Sensors for temperature Sensors for motion with data transmission. Barometers	
12	Thermo-Environmental Instruments Inc.	Gas Analyzer with remote Surveillance & monitoring capabilities	
13	L.I. System	Leak detection of gas using Laser Imaging	
14	Dorlen Products	Roof Leak detection systems & alarms	
15	Supercircuits	Video Cameras for surveillance Video remote monitoring & network technology	

No.	Name of Company	Product Name	Product Description
16	Onyx Energy Services	Fuel Management	
17	Ronan	Leak detection systems for underground slurry tanks	
18	Intelligent Controls Inc.	Automatic Tank gauge systems	
19	EECO System	Continuous leak detection monitoring & tank inventory management system	
20	ENMET	Continuous gas monitoring systems	
21	Gillian	Air Sampling monitors (Hand held)	
22	Hydro Technics	3-D ground water flow velocity vector.	
23	Response Rentals	Gas analyzers	Portable aerosol monitors, VOC mercury, H2S, O3, SO2, COx, NOx, THC, Methane-non-Methane analyzer.
		Weather stations	Multigas monitors with dataloggers
		Data loggers	Weather stations, meteorological sensors and datalogger

No.	Name of Company	Product Name	Product Description
24	Sensidyne	Gas Monitors	Customized datalogging and transmission operations Detection for O2, Cl2, CO, CH4, NH3, HCl, H2S, NH2, Br2, SO2, F2, HCN
25	SKC Inc.	Indoor air quality monitor	Monitor for CO, temperature, humidity
26	Red Jacket	Tank monitoring software Fuel management systems Continuous leak monitoring systems Level measurement systems	Tank gauging and leak detection
27	Tracer research Corporation	Leak detection cables Tank bottom leak detection system	Continuous automated leak detection systems