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Title: Technology Information Profile: Long-Range Alpha Detector (LRAD)

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NATIONAL LABORATORY

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Technology Information Profile:

Common Name of Technology: LRAD (Long-Range Alpha Detector)

Principal Investigator: John Bounds
Affiliation: Los Alamos National Laboratory

Technology Category: Characterization and Monitoring

Developed by: Los Alamos National Laboratory

1. **What is the need for the technology? (If this technology is part of a system of technologies, what is its role in the system and what is the need for the system?)**
For remediation, it is necessary to determine the quantity and extent of radioactive contamination in the environment. Contaminated areas must be cleaned up without wasting resources to remediate that which is already clean.

2. **What are the technology's objectives? (How does it satisfy the needs identified above?)**

a. **What are the objectives of this technology (for example, will this technology destroy volatile organic compounds [VOCs] in groundwater)?**
LRAD technology is a sensitive and efficient form of alpha detection. LRAD soil surface monitors are optimized for detecting low level widespread alpha contamination insitu.

b. **What is the technology that is currently used for this application (baseline technology)?**
Two technologies predominate, but each has its drawbacks. Core sampling is costly, time-consuming, and generates waste streams. Handheld alpha probes are fragile and tedious to use. Low level activities can be readily missed with handheld probes, and results can depend on the skill and patience of the operator.

3. **Process Description (Please describe the technology in terms that can be easily understood by interested members of the public. Include information on where the technology is applied—in place or above ground—what media the technology is used in—soil, groundwater, air— and what contaminants the technology targets)**
An LRAD soil surface monitor is essentially a large, flat box whose open end is placed on top of the soil to be monitored. Radiation from the soil ionizes the air in the box. The amount of ionized air, which is proportional to the amount and type of radiation, is measured. This

method is particularly sensitive to alpha radiation, which is emitted by uranium and transuranic elements.

4. **What is the status of the technology's development?**
LRAD technology has been under development for three years and is relatively mature. The LRAD soil surface monitors have been used to characterize over ten sites and have proven their field worthiness.

5. **Summary of technology advantages (compared with the baseline technology: Is it faster, better, cheaper, safer?)**
LRAD devices are much faster than sample analysis (10 to 15 minutes for LRADS as compared to days or weeks for sample analysis) and just as fast as hand-held alpha counters.
LRAD monitors are 10 to 100 times as sensitive as hand-held counters and are sensitive enough to make all desired soil measurements.
LRAD monitoring is less expensive than core sample analysis.
LRAD monitoring is safer than sample analysis because (1) the immediate result of the monitoring can warn the operator that a contaminated area is being entered; (2) no excavation and transportation of potentially contaminated material are required; and (3) no chemicals or other hazardous materials are used.

6. **Summary of technology limitations (compared with the baseline technology)**
The LRAD soil surface technology only monitors the top of the soil. Buried contamination is more readily detected with core sampling. Handheld detectors are more likely to isolate small hot spots which get averaged out over the one meter sampling area of the LRAD. A segmented LRAD would solve the latter problem but has only begun being developed.

7. **Major Technical Challenges for the Technology**
none

8. **Technical Effectiveness: Performance Criteria**

a. **What contamination will remain after the technology is applied? (Will the mobility of the contamination be reduced? Will the volume be reduced? Will the contaminant be less toxic? This criterion applies primarily to retrieval treatment technologies.)**
The LRAD is an in-situ characterization tool, no change in contamination occurs.

b. **What process waste (secondary waste) does the technology produce? (Is the secondary waste mobile? What is its volume? What hazards are associated with the secondary waste? Can it be recycled?)**
none

c. **Describe the treatment or storage needed for the secondary waste**

and its availability.
not applicable

d. **Describe the requirements for decontamination or decommissioning of equipment.**
Most contamination occurs on the tires of the tractor used to transport the LRAD and on the foam seal around the detector box. These usually can be cleaned by simple brushing or by washing with water.

e. **How must the secondary waste be disposed of? Is disposal available?**
not applicable

f. **What future cleanup options are precluded by this technology? (Applies primarily to treatment technologies)**
not applicable

g. **How reliable is the technology? (Please address potential breakdowns , effectiveness, and sensitivity to operating conditions).**
The LRAD soil surface monitors have been successfully fielded in both high and low temperatures and high and low humidity. Their simplicity reduces the number of breakdowns, which have been all but eliminated in one and a half years of use. The most recent monitoring tasks have been performed with no breakdowns.

h. **If the technology fails, how are the effects of the failure controlled?**
If an LRAD soil surface monitor fails, it is immediately obvious to the operator. Since it is a characterization tool, the effects are only in the time lost on repairs.

i. **How easy is the technology to use? (Please describe the level of skills and training required to use the technology.)**
Proper operation of an LRAD soil surface monitor, including instructions on driving the tractor, can be learned in 30 minutes or less. No advanced knowledge is required, although in its current configuration some familiarity with Macintosh computers is helpful.

j. **What infrastructure (buildings, power sources, personnel) is needed to support the technology?**
The LRAD soil surface monitor is electrical in nature. Currently the detector and its electronics are powered in the field from a car battery which must be recharged from an AC outlet overnight. The detector and electronics are best kept out of inclement weather and free of dew.

k. **How versatile is the technology? (That is, can it be applied to other types of contamination, in other media, or at other locations?)**
In addition to soil surfaces, the LRAD can be applied to nearly any other level object (concrete, gravel, floors, walls, etc.) to monitor for alpha contamination or to monitor for some low energy beta emitters.
Another branch of LRAD technology which relies on airflow over and/or through objects extend alpha monitoring to tools and objects leaving

contaminated areas and can detect alpha radiation at a distance of tens of centimeters.

l. Describe the technology's compatibility with other elements of the system? (Please include a general description of the system that the technology is part of.)

The LRAD soil surface monitors are stand-alone systems which complement any other measuring systems. Given the tractor's load carrying ability, other detectors could be "piggybacked" for more extensive measuring capabilities.

m. Can the technology be procured "off-the-shelf"? (Is it an innovative use of an existing technology?) Which components are available and which must be developed?

As part of the DOE technology transfer effort, LRAD detectors are now commercially available.

n. How difficult is the technology equipment to maintain? (Please include information on frequency as well as ease of maintenance. Also describe the level of skill or training required to maintain the technology.)

The LRAD tractor-mounted soil surface monitor is rugged and relatively easy to maintain. The tractor is operated only to move the detector and is not operated during measurements. The tractor accumulates operating hours rather slowly. The detector care and maintenance consists mostly of dusting off the detector and electronics occasionally and checking the battery for proper voltage. In routine operation this amounts to essentially unskilled labor.

o. What equipment safety measures (such as automatic shutdown devices) are needed and in place to protect workers and the public?

The LRAD tractor is a commercial unit and has standard tractor safety features. The detector is an essentially passive device and requires no special safety measures.

p. Describe the technology's ability to function as intended. (Does the technology work as intended? If not, describe functional problems.)

It works. Well.

q. What are the scale-up issues and how are they being addressed?

At one square meter, the LRAD soil surface monitor is already large enough for most tasks. The monitor can be scaled up to a larger size in a straightforward manner but there are no plans to do so.

9. Cost (Please include assumptions on which you base your estimates.)

a. What is the start-up cost of the technology (including development costs, procurement and construction, permitting, and other costs necessary to begin operation)?

An LRAD tractor-mounted soil surface monitor costs about $30k, with costs nearly evenly divided between the tractor, the electronics, and the detector box with tractor adapter. Having an enclosed trailer to house the tractor at work sites has proved very practical; such a trailer costs about $12k. The LRAD monitor is nearly complete in its development and quite capable in its current form with no further development needed.

b. **What are the operations and maintenance costs of the technology?**
Operation costs are mostly time for personnel. There is a small cost for recharging batteries and for running the tractor, estimated to be less than $100 per year.

c. **What are the life cycle costs of the technology (including facility capital cost; startup, operation, and maintenance; decommissioning, regulatory, or institutional oversight; and future liability)?**
After the initial $30k for the tractor, almost all costs are personnel time for operations. Decommissioning costs would at most involve cleaning up and/or disposing of the tractor,detector and trailer.

10. Time

a. **When will the technology be available for commercial use or use at other sites?**
LRAD detectors developed at Los Alamos are currently available for use at DOE facilities. For commercial use or use at other non-DOE sites, the Los Alamos technology transfer partner, Eberline Instruments, can build commercial units, and their sister company, TMA/Eberline, can perform the monitoring.

b. **What is the speed or rate of the technology? (Please use metrics)**
The tractor-mounted soil surface monitor averages one square meter per 15 minutes.

c. **At the speed or rate identified in 10(b), what is the total time required for the technology to achieve its objectives?**
The LRAD does what it does as fast as it does; the total time required to monitor a site is directly proportional to the number of sampling points.

11. Environmental Safety and Health: Worker Safety

a. **What potential is there for workers to be exposed to hazardous materials and/or other hazards? Describe those materials and hazards.**
LRAD technology does not add to the hazards of a site except for the use of the tractor. No hazardous materials are used.

b. **What are the physical requirements for workers?**
There are no extraordinary requirements on the workers other than being in good health and being able to work in field conditions. Some disabilities may preclude operating the tractor.

c. **How many people are required to operate the technology?**
The LRAD tractor-mounted soil surface monitors operate best with two people - one to drive the tractor and one to direct the positioning of the detector on the ground.

12. Environmental Safety and Health: Public Health and Safety

a. **What is the technology's history of accidents? (Has there been a history of accidents and, if so, what was the nature of the accidents.)**
There have been no accidents involving personal injury and no accidents involving loss of property since operations began in June 1992.

b. **Does this technology produce routine releases of contaminants?**
no

c. **Are there potential impacts from transportation of equipment, samples, waste, or other materials associated with the technology?**
no

13. Environmental Impacts

a. **What impact will this technology have on the ecology of the area (for example, wildlife, vegetation, air, water, soil, or people)?**
To obtain accurate data, it is necessary to scalp the vegetation in the area to be measured. This scalping leaves a bare spot which should grow back in due time. No other impact is anticipated.

b. **What aesthetic impacts does the technology have (for example, visual impacts, noise)?**
The detector is mounted on a commercial farm tractor which is operated when moving the detector from spot to spot. Usually a string weed-cutting device (e.g., a WeedEater) is used to clear the spot to be monitored.

c. **What natural resources are used in the technology's development, manufacture, or operation? (Address energy resources in 14[d].)**

not applicable

d. What are the technology's energy requirements? (Use metrics)

The detector electronics' battery supply is recharged on 110 VAC nightly. The tractor runs on diesel fuel.

14. Socio-Political Interests: Public Perception

a. What is the reputation of the technology's developer and/or user? (Principal investigators: this is a point of discussion for stakeholders; do not answer.)

b. How familiar is the technology to the public?

LRAD technology is not yet common knowledge.

c. How easy is the technology to explain to the public?

LRAD technology is unusually simple and hopefully can be understood by most people.

15. Socio-Political Interests: Tribal Rights/Future Land Use

a. How will the technology affect future unrestricted use of land and water?

no effect

16. Socio-Economic Interests

a. What are the potential economic impacts of this technology? (For example, what are the effects on the economic base of the community? Are there infrastructure requirements?)

none

b. How will the technology affect labor force demands?

Minimal impact is expected.

17. Regulatory Objectives

a. Describe the technology's compatibility with cleanup milestones.

The LRAD soil surface monitors provide real-time characterization information.

b. How familiar are regulators with this or a similar technology ?

LRAD technology is relatively new and unknown to regulators. Passive monitoring, to which LRAD compares, is well known.

c. **What is the technology's regulatory track record?**
LRAD, through the Uranium In Soils Integrated Demonstration, is just now entering the regulatory arena.

d. **How does the technology comply with applicable regulations?**
The LRAD soil surface monitors are able to monitor down to and beyond the levels specified in DOE order 5400.5.

18. Industrial Partnerships

a. **What is the name of the industrial partner?**
Eberline Instruments

b. **What is the rationale for this partnership?**
Eberline Instruments is an international company known for its health physics instrumentation. Its proposal for cooperation was accepted over nearly one dozen others based on its merits.

c. **What is the contract mechanism?**
Los Alamos National Laboratory has a CRADA with Eberline.

d. **Are there other potential partners?**
Eberline Instruments' sister companies are considered partners as well. These include, but are not limited to, National Nuclear (who specializes in custom built orders) and TMA (who specialize in services and have expressed interest in taking over monitoring tasks).

e. **Are there potential international partners?**
Eberline Instruments has branches worldwide.

19. Intellectual Property

a. **Who owns the patent for this technology?**
Various LRAD patents are under the names of the developers at Los Alamos National Laboratory. The laboratory's contracting agency, the University of California, actually owns the patents. Eberline Instruments has the license to use these patents.

b. **Are there other patent owners?**
no

c. **Is there a patent number for this technology?**
LRAD technology includes several patents both accepted and pending.

20. Cost Sharing

a. **What is the background of this technology? (Where did the idea come from? Who else is doing similar work? What have the results been to date? What is the most significant competitor to this technology?)**

One of the patent developers noticed that ions in air can transport several meters before recombining. The idea to develop some sort of radiation detection using this knowledge was passed down and after extensive and ground-breaking development, practical and sensitive devices were invented that are particularly sensitive to alpha radiation. Well over twenty different LRAD detectors have been successfully built and plans exist for many more. No parallel work is known to exist, and the ability to detect alpha radiation at such distances is unequaled.