Here's the Dirt on Soil Assay at Plum Brook

Advanced radiological measurement technology is deployed at NASA reactor facility.

By Alex Lopez

Technology to assay radiologically impacted soils is being used in decommissioning a National Aeronautics and Space Administration (NASA) reactor facility. The technology is quickly helping the environment by returning clean soil to the local ecosystem.

During its operations, NASA's 60-MW Plum Brook Reactor Facility in Sandusky, Ohio, conducted more than 70 experiments, most of which studied the effects of radiation on various materials. NASA closed down the reactor in 1973, placed it into a "safe storage" mode, and monitored it until initial decommissioning work began in 1998.

Orion ScanSort, a soil sorting system developed by Mactec Development Corp., deploys advanced scanning spectrometer technology to provide soil measurement and sorting services at the facility. The technology has been proven and has been accepted by the U.S. Nuclear Regulatory Commission and the Environmental Protection Agency.

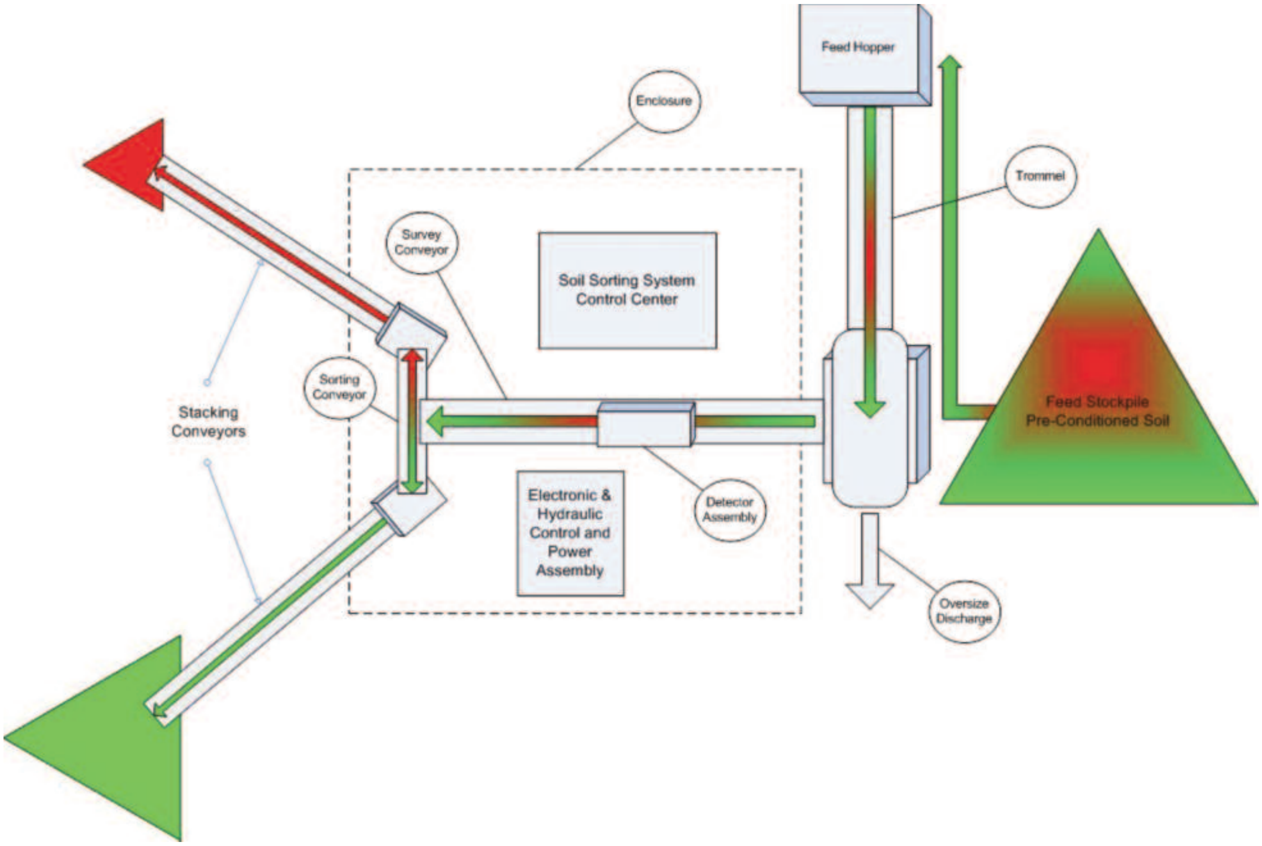
More than 160 million pounds of potentially contaminated soil material is being sorted. The soil being processed is from the facility's hot retention basin shielding; an emergency retention basin dike; cold retention basins; storm drains; and other buried piping, foundations, and underground storage tanks.

As of May 2010, more than 80 000 tons had been processed, and soil processing for the project is expected to be completed by August 1, 2010. The targeted daily production rate was 550 tons/day. In the summer and fall months, with minimal weather delays, typical production rates were nearly 1500 tons/day; in winter months, production rates averaged about 500 tons/day.

Soil material is loaded into the screener for removal of large debris. The screened material is then discharged onto the Orion ScanSort survey belt for radiological assay.

Material on the survey belt with nuclear measurement gauge (yellow box) and spectroscopy detectors (white box).

Proprietary Orion ScanSort reversing conveyor. Following radiological assay by spectroscopy detectors, the reversing conveyor sorts material to “un-impacted” or “contaminated” stockpiles.



Schematic diagram of soil material movement through the ScanSort.

How It Works

The conveyor-based soil handling system surveys and monitors excavated soils at high throughput rates. Multiple detectors are arrayed above material conveying equipment that provides real-time radiological data and material sorting. A variety of material conveying equipment can be used to handle most common waste forms.

The system supports gamma spectrometers of any size and up to 12 auxiliary detectors (radiological or otherwise) for additional material characterization and control. In its current configuration, it detects gamma-emitting radionuclides as the soil on the belt moves past the active area of the detector (belt speed, depth, and density of the material are continuously monitored for measurement accuracy).

The software automates and controls measurement and sorting processes. Some key features include the following:

- Improves the signal-to-noise ratio in selected areas with real-time spectral stripping.
- Monitors multiple isotopes simultaneously.
- Evaluates radiological concentrations against multiple volumes simultaneously.
- Auto-generates process summary reports.
- Offers automated quality assurance for measures and reporting.
- Shows real-time system status over WiFi.

Putting the System to Work

Following the physical setup of the system and supplemental material conveyors, Mactec utilized calibration standards material excavated from known radiologically impacted areas for site-specific calibration. Following the completion of setup and calibration, two operators remained onsite for the duration of the soil-sorting field operations. Onsite setup, integration, and calibration took about two weeks.

Here's a snapshot description of how the process unfolds each day: Heavy equipment such as a front-end loader brings in potentially contaminated material, which is then sifted to remove large debris and conveyed to the system's weather-tight spectroscopy unit housing. As the material passes beneath the housing, radiation detectors measure the emitted radiation signal and send the data to a computerized monitoring station. The detector outputs are then compared with established radiation thresholds.

If the radioactivity of surveyed material does not meet specifications, a divert signal is generated, and a reversing conveyor quickly switches direction, sending the offending material to the contaminated material conveyor for future offsite disposal. Clean material is sorted down a different conveyor for return to the environment as excavation backfill. Meanwhile, the system continues assaying incoming material for its radiological concentration.

Overhead view of ScanSort operations. Un-impacted material is stockpiled for reuse as onsite backfill material, while contaminated material is stockpiled for future offsite disposal.

> *The system is expected to reduce the volume of radioactive waste by up to 95 percent, compared with that from simply excavating it and disposing of it as radioactive waste.*

Benefits

Advantages include the following:

- Large-volume detectors with superior sensitivity.
- Isotope-specific measurements.
- Spectral stripping for improved accuracy.
- Multiple decision criteria.

Also, the system controls the speed of the assay conveyor and the direction of the proprietary reversing conveyor with a unique electric motor, rather than with slower hydraulic actuators. The motor enables precise/instantaneous conveyor control.

To date, the system has assayed and segregated in excess of 160 million lb of radiologically suspect soil from NASA's Plum Brook Reactor Facility into material that may either stay onsite for use as backfill (less than half of the release limit for cesium-137 in soil) or shipped offsite for permanent disposal as radioactive waste. The system is expected to reduce the volume of radioactive waste by up to 95 percent, compared with that from simply excavating it and disposing of it as radioactive waste. The technology is forecasted to result in substantial cost avoidance and savings in shipping and burial charges and will permit NASA to compress its decommissioning schedule. ■

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