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(Poster) TRIPWIRE: Multi-modal Distributed Sensing For Repository Verification

September 2021

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TRIPWIRE: Multi-modal Distributed Sensing For Repository Verification

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This project is developing and demonstrating a multi-modal sensor system, TRIPWIRE, for containment verification in inaccessible radiological and nuclear waste repositories. The TRIPWIRE system will continuously monitor ionizing radiation, electromagnetic fields and vibration in the vicinity of emplaced nuclear materials buried in a repository, reporting on disturbances with a real-time alarm control station.

Ionizing radiation sensing

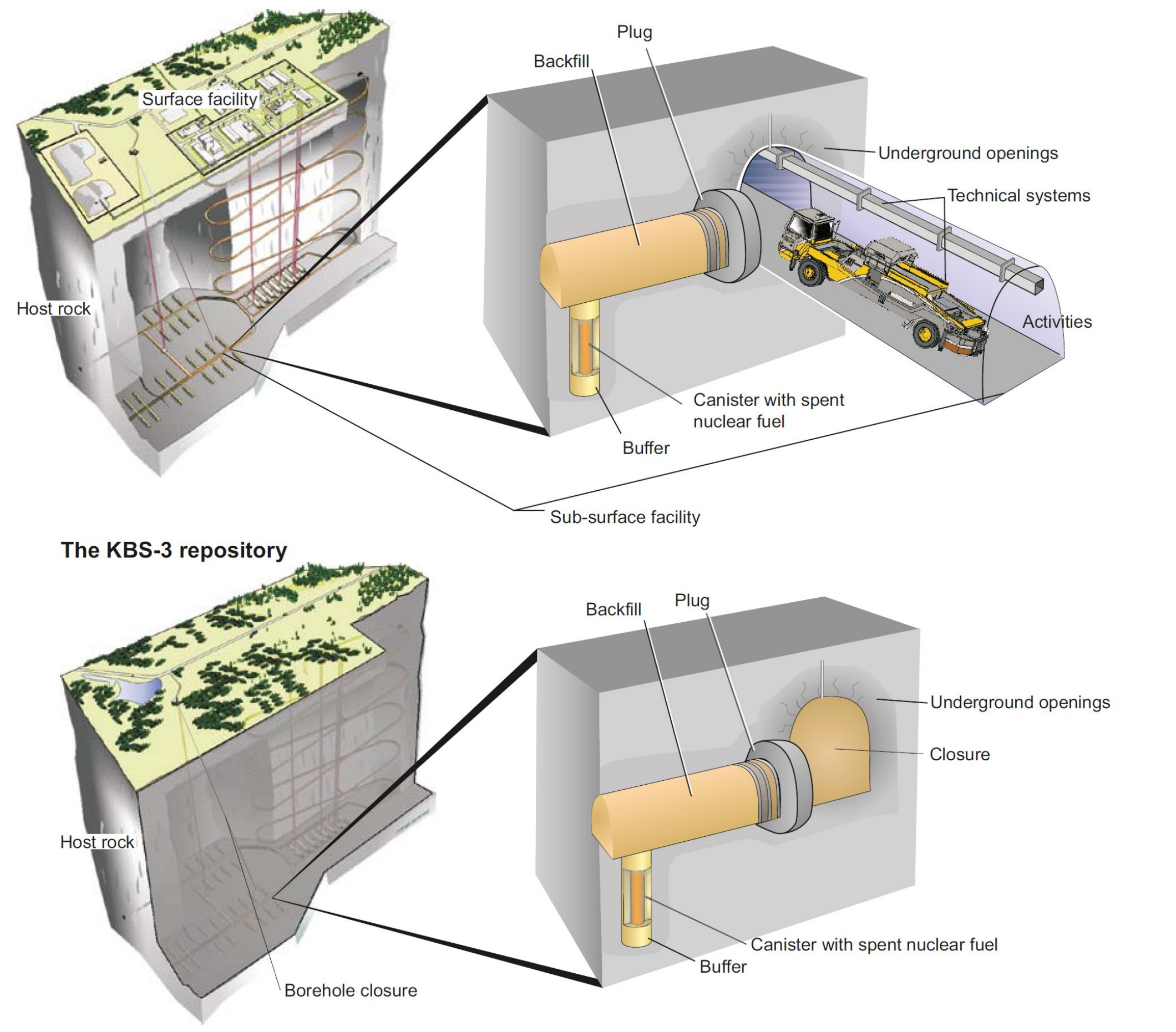
- Using radiation-sensitive plastic scintillating fibers coupled to long-length standard optical fibers
- Fabricated several scintillating fiber test strands of 2.7-m, 2.9-m, 10-m and 50-m
- Evaluating system stability, temperature sensitivity, and initial sensitivity tests
- Developing a modeling and simulation framework using the Monte Carlo N-Particle Transport (MNCP) code to support benchmark test validation.

Electromagnetic field monitoring

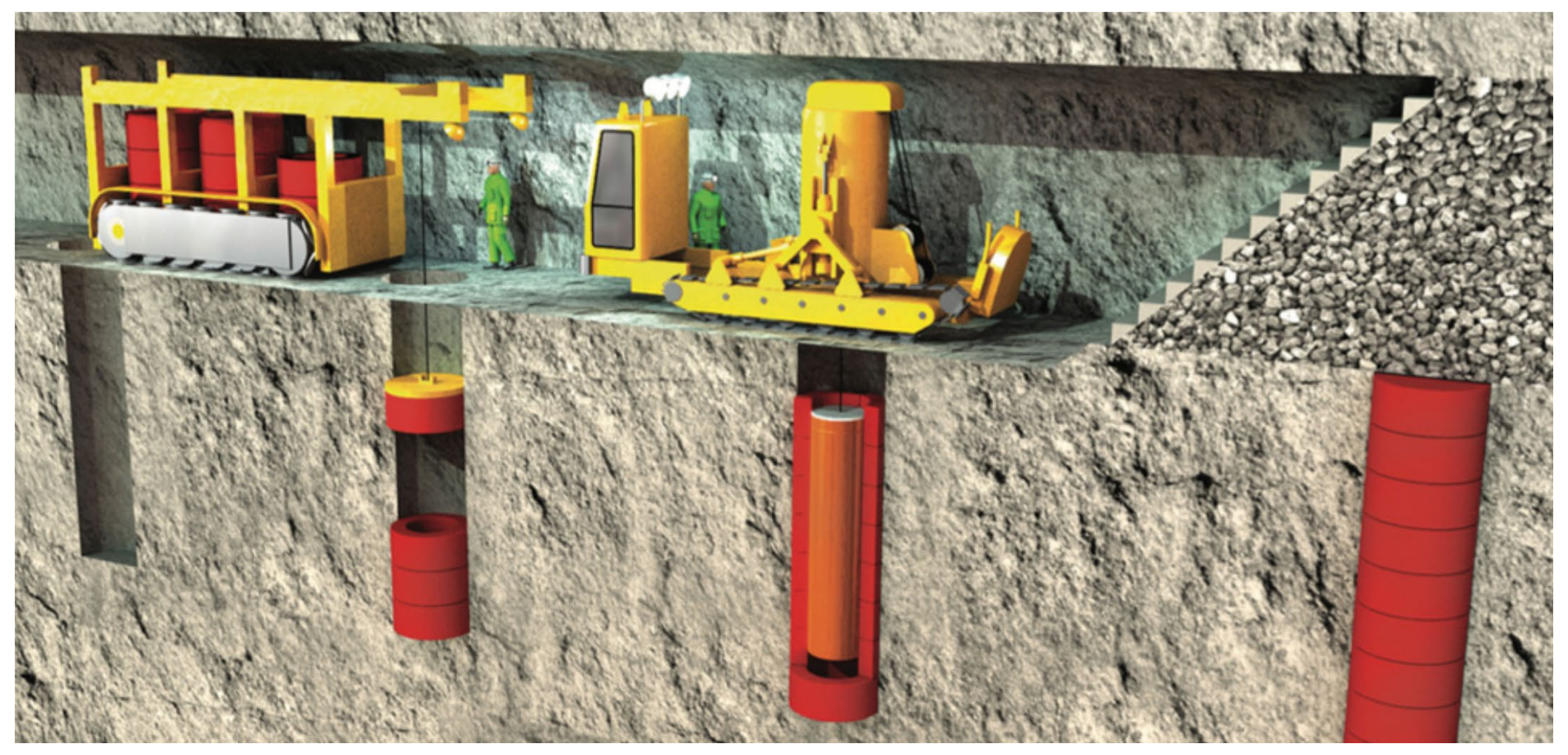
- Using ported ("leaky") coaxial cable (PCCs)
- PCCs are used as buried intrusion detection sensors and are commercially available
- If anything alters the electrostatic field near the cables the received signal is altered, resulting in an alarm condition
- Currently evaluating system sensitivity and configuration capabilities
- Integrating the alarm system to our custom alarm console

Vibration sensing

- Using optical fiber system perimeter detection technology
- Detects and locates seismic disturbance due to vibration
- Integrating a commercial system designed to support installation up to 50-km in length



SKB, "Design and production of the KBS-3 repository", SKB Technical Report TR-10-12, Svensk Kärnbränslehantering AB (2010)



https://spectrum.ieee.org/energy/nuclear/finlands-nuclear-waste-solution

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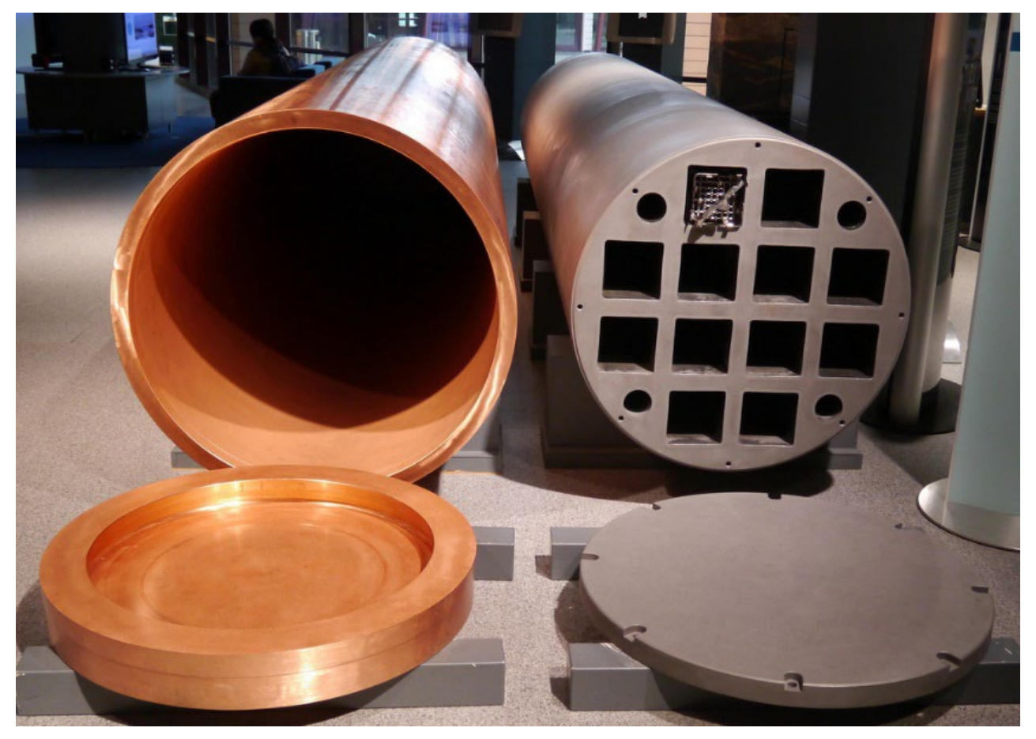

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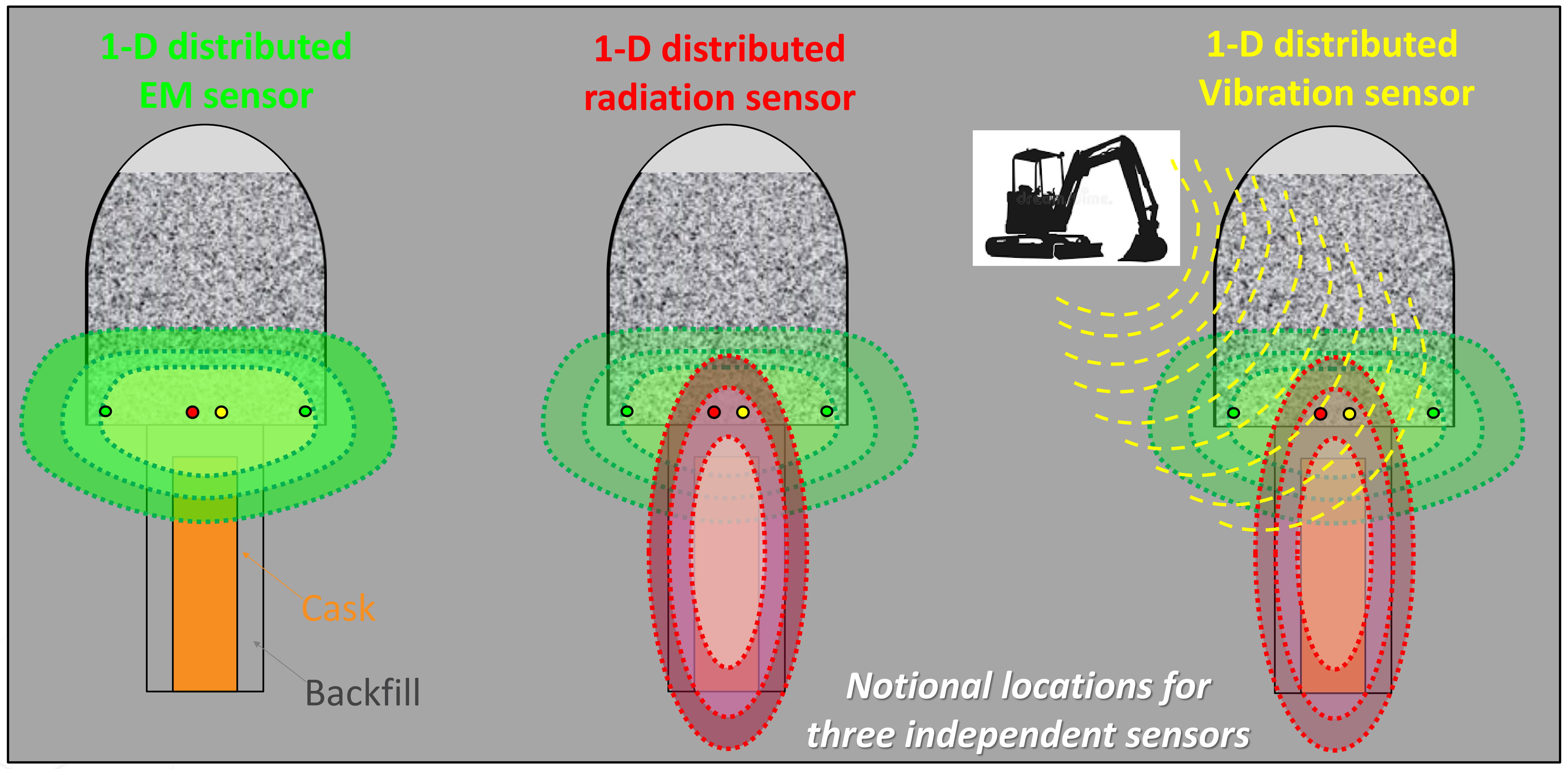

Notional locations for three independent sensors

- All electronic readout systems will remain outside of the repository, above ground in an accessible area; no user-serviceable components would exist in the repository itself
- Flexible installation, suited for wall-, floor-, or ceiling-mounted configurations
- Real-time multi-modal data streams with algorithms to support monitoring and alarming