

Long-Term Monitoring of a Deep Underground Science and Engineering Laboratory

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A deep underground research facility presents a unique opportunity to create new sensor technologies and monitoring strategies. Advances in these areas are critical for furthering discovery and technology development in most engineering and science disciplines. Establishing the infrastructure for sensor development and monitoring networks, and promoting interdisciplinary education/outreach programs, should be an integral part of the DUSEL planning process. Research community input is necessary so that a wide range of science and engineering needs are met. The paragraphs below describe broad research needs.

Sensor research. New remote and direct sensing technologies are needed for engineering and biogeochemical characterization, and long-term experimental monitoring. Additional sensor development in human health and safety could permit tracking of personnel underground. Advances are needed in multiplexing, interrogation, signal enhancement, power management and embedment/placement technologies.

Geomechanical health monitoring. A DUSEL provides the unique combination of stress range and material heterogeneity required to advance the practice of underground construction at any depth. A network of georeferenced sensors could be deployed over the entire facility during construction to detect changes in rock properties, in-situ stresses, acoustic emissions and deformations over the life of the facility. Advances in sensor technology could permit close device spacing, providing a degree of detail never before available. Health of the facility would be assessed through a framework of limit states and performance criteria. Remedial action or alarm levels would be established based on geomechanical analysis. Sensor data would then be used by facility operation and management staff for hazard assessment and for posting safety alerts within access shafts/tunnels or experimental drifts.

Education and outreach. Educational opportunities should target high school to post graduate students. Priority should be given to education programs for students in rural, disadvantaged areas such as the southern Appalachian region. Remotely and directly sensed data would be available on a real-time basis to students and teachers. Ultimately, dedicated experiments could be controlled and monitored by students and teachers over the internet.