# An Optical Sensor and Communication Network for Facility Real-Time Earthquake Response Data

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After a major earthquake, critical facility owners and programmatic stakeholders can face challenging questions and emergency response decisions in terms of the condition of the facility and its capacity to perform core functions. Examples include if the facility is capable of maintaining continuity of operations and ensuring safe containment of materials, and decisions on the ability for essential personnel to continue occupancy versus immediate and sustained evacuation. Post-earthquake experience has shown that appropriate risk-informed decisions can be significantly complicated by the fact that walk-downs and visual inspections of the facility can be inconclusive due to the condition that core structural elements are often hidden behind architectural walls and partitions or extensively coated by fire-proofing materials and not immediately visible. The ability to quantitatively measure actionable earthquake response data, and provide rapid and reliable transmission of that data to the facility owners and stakeholders, can provide a powerful tool for informing post-earthquake response.

The U.S. Department of Energy Nuclear Safety Research and Development (NSRD) Program has supported the development of a new type of laser-based optical sensor system that can directly measure facility interstory drift, which is a key earthquake design parameter and facility earthquake response observable. The optical *Discrete Diode Position Sensor* (DDPS), has undergone multiple sets of extensive shake table testing to validate the accuracy and reliability of drift measurements and the latest version of the DDPS can measure biaxial drift in a facility. In addition to the sensor, NSRD has supported the development of a data transmission network using both radio frequency communications and facility WiFi to rapidly and reliably send building story drift data immediately after an earthquake event. Data is transmitted to the cloud, and through the Internet of Things can be immediately distributed to a desktop computer graphical data display application developed specifically for DDPS data, or to a smartphone app that has been developed specifically for display of DDPS data. Both the desktop application and phone app are easy to use with a functional display readily interpretable by any facility stakeholder or owner.

This presentation will describe the key capabilities of the DDPS sensors, the architecture and features of the new data communication network, and the operational field reliability and performance of the system since the initial deployment in a DOE facility in September 2019.