TECHNOLOGY INNOVATION PROGRAM
National Institute of Standards and Technology
Gaithersburg, MD 20899

ADVANCED TECHNOLOGIES FOR CIVIL INFRASTRUCTURE

The Technology Innovation Program (TIP) at the National Institute of Standards and Technology was established to assist U.S. businesses and institutions of higher education or other organizations, such as national laboratories and nonprofit research institutions, to support, promote, and accelerate innovation in the U.S. through high-risk, high-reward research in areas of Critical National Need. These areas need government attention because the magnitude of the problem is large and societal challenges are not being sufficiently addressed.

In 2008, TIP published a white paper describing the scope of its first solicitation – "Advanced Sensing Technologies for the Infrastructure: Roads, Highways, Bridges and Water Systems." The solicitation called for implementable, usable, and accurate sensing systems for the effective measurement of infrastructure performance characteristics. In 2009, TIP expanded its second Civil Infrastructure solicitation describing its scope with the white paper "Advanced Sensing Technologies and Advanced Repair Materials for the Infrastructure: Water Systems, Dams, Levees, Bridges, Roads, and Highways". The expanded scope included new technologies for repair and retrofit of existing structures.

Out of 46 applicants to the first Civil Infrastructure competition, TIP selected nine projects for award and announced these decisions on January 6, 2009. On December 15, 2009, TIP selected eight projects for award in the critical national need area of Civil Infrastructure. Awarded projects from these first two Civil Infrastructure competitions demonstrate TIP's commitment to multi-disciplinary approaches and to encouraging broad teaming arrangements. Fifty-one research participants are involved in the 17 projects. Over the life of these 17 awarded projects, they will receive a total of $73 million of TIP funds and $77 million of cost shared funding, for a total investment of $150 million in new R&D.

Projects from the 2008 and 2009 Civil Infrastructure competitions are grouped by technology and application area below.

Sensing and Monitoring Technology for Civil Infrastructure Inspection: Highways - Bridges

- **Acellent Technologies, Inc.** (Sunnyvale, Calif.) plans to develop an extensible and self-powered sensor network using a peer-to-peer communication protocol for nondestructive evaluation and health monitoring of bridges, buildings, pipelines and other major infrastructure components. [2008]

- **Distributed Sensor Technologies, Inc**. (Santa Clara, Calif., Joint Venture Lead) plans to develop an economical, fiber-optics-based system for monitoring the structural health of large infrastructure elements especially bridges without the need for installing large networks of individual sensors. [2008] (Partners: Optiphase, Inc.; Redfern Integrated Optics, University of Illinois at Chicago)

- **Newport Sensors, Inc.** (Irvine, Calif.) plans to develop a novel nondestructive technology for early detection of corrosion in reinforced concrete structures such as bridges. [2008]

- **Physical Acoustics Corporation** dba Mistras Group, Inc. (Princeton Junction, N.J., Joint Venture Lead) plans to develop a novel system for continuously monitoring the structural health of bridges using wireless sensors that "harvest" power from structural vibration/wind energy and assembles data from a variety of sensors for interpretation through damage assessment/reliability algorithms. [2008] (Partners: Univ. of Miami; Univ. of South Carolina; Virginia Polytechnic)

- **University of Michigan** (Ann Arbor, Mich., Joint Venture Lead) plans to develop a comprehensive system for monitoring and assessing the structural integrity of major infrastructure elements such as bridges on a regional basis, with innovations ranging in scale from "smart material"-based sensors, up through structure-level data integration to a regional system for information aggregation and decision support. [2008] (Partner: Li, Fischer, Lepech & Assoc.; Monarch Antenna, Inc.; Prospect Solutions, LLC; SC Solutions; Weidlinger Assoc., Inc.)

- **The University of Texas at Austin** (Austin, Texas, Joint Venture Lead) plans to develop two complementary sensor networks for bridge inspection: (1) an active, self-powered system for continuous monitoring for cracks or defects in fracture critical bridges and (2) a passive system for monitoring corrosion in reinforced concrete bridge decks. [2008] (Partners: National Instruments Corporation; Wiss, Janney, Elstner Associates, Inc.)

- **The Droid Works, Inc. dba CyPhy Works** (Framingham, Mass.) plans to develop the technologies required to create small, hovering, Unmanned Air Vehicles (UAVs) for use in the inspection and monitoring of large-scale civil infrastructure elements such as bridges and dams. [2009]

- **Rutgers, The State University of New Jersey** (Piscataway, N.J., Joint Venture Lead) plans to develop a mobile integrated system for nondestructive evaluation and repair of bridge decks, including human-operated and robotic systems that merge novel imaging and NDE techniques together with innovative intervention approaches to arrest deterioration processes. [2009] (Partners: Drexel Univ.; PD-LD, Inc.; Mala GeoScience USA, Inc.; Pennoni Assoc.)

Sensing and Monitoring Technology for Civil Infrastructure Inspection: Highways - Pavement

- **Northeastern University** (Boston, Mass., Joint Venture Lead) plans to develop a novel system based on instrument packages that can be installed on a wide variety of private and public vehicles to assess the conditions of bridges and roadways through several different and complementing methods at regular driving speeds during the course of ordinary use of the vehicles. [2008]**(**Partners: Univ. of Massachusetts Lowell; Univ. of Vermont; Witten Tech., Inc.)

Sensing and Monitoring Technology for Civil Infrastructure Inspection: Water & Wastewater Systems

- **ELXSI Corporation** (Orlando, Fla., Joint Venture Lead) plans to develop a novel, deep-penetrating scanning system for inspecting buried infrastructure such as pipelines that can detect fractures, quantify corrosion damage and determine the presence of voids in the surrounding soil to "see" beyond the structure to prevent accidents. [2008] (Partners: Louisiana Tech University; UltraScan, LLC)

- **University of California at Irvine** (Irvine, Calif., Joint Venture Lead) plans to develop a novel monitoring and inspection system for pipes and pipe networks in water and wastewater systems using wireless sensors incorporated in an advanced networked system using available limited optimal access points. [2008] (Partners: Earth Mechanics, Inc., Irvine Ranch Water District, Orange County Sanitation District, Santa Ana Watershed Project Authority)

- **Optellios, Inc. (Newton, PA)** plans to develop a distributed fiber-optic sensing technology to enable real-time monitoring, identifying and locating disturbances and changes over long stretches of pipelines. [2009]

Sensing and Monitoring Technology for Civil Infrastructure Inspection: Dams & Levees

- **Rensselaer Polytechnic Institute** (Troy, N.Y., Joint Venture Lead) plans to develop a new health assessment framework, ranging from a satellite-based radar system to local sensor arrays to monitor, assess the health, and ensure the safety of levees and other distributed systems of a flood-control infrastructure. [2009](Partner: Geocomp Corp.)

Advanced Repair Technology: Highways – Pavement

- **University of California – Los Angeles** (Los Angeles, Calif.; Joint Venture Lead) plans to develop an innovative pothole repair technology for pavement for warm and cold weather using an ultra-high toughness, nano-molecular resin as a reinforcement or binder for the asphalt-aggregate pothole repair material. [2009] (Partner: Materia, Inc.)

Advanced Repair Technology: Highways –Bridges

- **MesoCoat, Inc.** (Euclid, Ohio; Joint Venture Lead) plans to develop a novel coating technology using a high-intensity infrared light source to fuse and bond nanocomposite metal coatings and claddings to large steel structures such as bridges, oil rigs and pipelines. [2009] (Partners: EMTEC; Polythermics)

Advanced Repair Technology: Water & Wastewater Systems

- **Fibrwrap Construction, Inc**.(Ontario, Calif.; Joint Venture Lead) plans to develop a prototype robot to apply carbon fiber reinforcement inside water transmission pipes, allowing trenchless repair and rehabilitation, even in smaller pipes, as much as eleven times faster than human crews.[2009] (Partners: Fyfe Co.; Univ. of California – Irvine)

- **LMK Enterprises, Inc.** (Ottawa, Ill.) plans to develop a trenchless technology to rehabilitate the nation's network of underground pipes by employing a novel dynamic resin-injection, molded-in-place pipe (MIPP) process, which can incorporate nanomaterials.[2009]