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The Trenchless Technology Center (TTC) at Louisiana Tech University was contracted by the Gas Technology Institute (GTI) to provide assistance in the Phase 2 development of the Differential Obstacle Detection Sensor (DIOD.) Further development of the DIOD is needed to improve forward sensitivity.

A project advisory group was also formed to provide feedback throughout the project. In addition to sponsor representatives Traci Case (AwwaRF) and John Jacobi (DOT/PHMSA), the advisory group consists of Kyle Slaughter (Atmos Energy, representing AGA), Christina Sames (AGA), Burt Williams (City of Mesa, representing APGA), and Paul Armstrong (representing NGA.) A kick-off meeting took place on June 1, 2006 at GTI's facilities in Des Plaines, IL. The research team presented the status of the project to date, initial review by TTC of the existing GTI finite element models, and ideas to improve the system. Other design elements to be incorporated with the system were also discussed with the advisory group.

During the first quarter ending June 30, 2006, a literature review of competing technologies currently under development around the world was completed. The literature review identified several competing technologies at various stages of development. The strengths and limitations of each of these technologies were identified. It was also determined that no "see ahead" technology is currently commercially available in North America..

The existing DIOD 2D finite element models using COMSOL Multiphysics (aka FEMLAB) were transitioned to 3-D to allow for more advanced analysis. An analysis of the 3D models included assessing the density and orientation of the current lines and simulating the voltage changes in the sensors due to the presence of a dielectric object within the induced electrical field. The development of an alternative design that can potentially increase the sensitivity of the DIOD to obstacles placed directly in front of drill head was explored. Some preliminary modeling comparing these configurations was performed.

A numerical evaluation the feasibility of supplementing DIOD with a secondary detection system based on the ultra-wideband (UWB) electromagnetic pulse technology was performed. 3-D finite element models of the existing prototype were created. Initial models of the UWB sensor in both 2-D and 3-D demonstrated it is a valid approach for detecting buried objects in the vicinity of an advancing HDD drill head and can potentially complement the DIOD technology for an even more reliable system overall. The 3-D modeling excluded several positions for the placement of the sensor, as the signal-to-noise ratios were determined to be too low for practical applications. The suitability of other positions, closer to the front of the drill head assembly, is currently being examined.