OBJECTIVE: Develop an innovative, remote sensor technology for measuring peak pressure and dynamic pressure differentials inside large caliber gun tubes.

DESCRIPTION: For propellant engineers and internal ballisticians, accurate measurement of internal cannon pressures (during a firing event) is crucial for research and development purposes. Of special importance are the measurement of the peak pressure in the chamber and the calculation of differential pressure [1] (the difference in pressure between two points) across the chamber section of cannon gun tubes.

Currently, internal chamber pressure is measured using piezoelectric transducers [2]. The transducers are installed such that the piezoelectric sensor is exposed to the internal volume of the chamber, thus requiring the gun tube and/or breech assembly to be drilled and tapped. Ballistic pressure data is recorded at high frequency (>250 KHz) and plotted to form Pressure vs Time Graphs. For prototype weapons, it may be impractical to drill the gun tube to accommodate traditional pressure gages. This topic seeks an innovative solution for collecting internal ballistic pressure data, without modifying the system under test.

The measurement of the peak pressure in the chamber and the calculation of differential pressure may be achieved by one application of the remote sensor technology or by two different applications/methods.

The system developed under this effort must meet the following key system attributes (KSAs):

- Pressure Range: 0 – 150kPsi
- Sampling Frequency: = 250 KHz
- Resolution: = 0.5%
- Temperature Range: 0 – 3,600 °F
- Ability to withstand explosive shock and high G-forces resulting from explosive charge detonations
- Robust design capable of surviving impacts by foreign materials during detonations

PHASE I: Evaluate novel applications of advanced pressure sensor materials and data acquisition technologies for use in a ballistic environment. Desired outcomes; Design a concept for remote monitoring of internal pressures, with the potential to meet the KSAs, without requiring any modification to the gun tube (e.g., drilling a hole), further refine the KSAs and conduct an analysis of alternatives to select the best combination of materials and data acquisition technologies for prototypes to be delivered in Phase II.

PHASE II: Subject the most promising material solutions (identified in Phase I) to testing, simulating live fire conditions. Desired outcomes; Produce at least one prototype using the selected sensor / data acquisition system combination, subject the "as manufactured" prototype to simulated firing conditions to assess performance against the KSAs and perform final design refinements. Document the final solution and manufacturing process in the form of a technical data package. TRL: (Technology Readiness Level) TRL Explanation Biomedical TRL Explanation TRL 6 - System/subsystem model or prototype demonstration in a relevant environment.

PHASE III DUAL-USE APPLICATIONS: Conduct a live fire demonstration of the final prototype in an operational environment with participants from various U.S. Government agencies and contractors from the weapons and defense industry. Explore potential applications for both military and private sector customers. This technology could be used for monitoring pressure vessels, steam turbines, oil & gas pipelines, and aerospace applications.

REFERENCES:

