Motor Vehicle Fire Research Institute
Awarded Contracts

Title: Failure Evaluation of a Compressed Hydrogen Storage Tank

Contractor: Southwest Research Institute

Duration: May 14, 2003 – July 30, 2003

Purpose:

The purpose of this program is to perform a failure evaluation, in general accordance with FMVSS 304, of a compressed hydrogen storage tank. FMVSS 304 is a standard test for compressed natural gas cylinders with a pressure relief device installed. The test exposes the containers to standard fire conditions for up to 20 minutes. The cylinder must either safely relieve its contents or withstand the increased pressure caused by the fire exposure over the 20-minute period. This program will expose a compressed hydrogen storage tank in a similar manner, but without a pressure relief device, until failure occurs. The objective is to determine what effect the hydrogen has on the severity of the event, following the initial burst of the tank.

SwRI will acquire a composite Type IV hydrogen storage tank with a polyethylene liner rated for 5000psig for testing. The tank will be filled to 100% capacity with hydrogen gas prior to testing. SwRI will fill the tank and support it over the fire source. A bonfire source of natural gas will be used. The fire will be ignited remotely from a control room where testing will be viewed with monitors. The bonfire will be sufficient to engulf the entire dimensions of the tank. Three thermocouples will be placed underneath the tank along its longitudinal axis in order to measure the exposure temperatures throughout the test.

The tank will be instrumented with a static pressure transducer and thermocouple by the manufacturer. Pressure and thermocouple measurements will be logged continuously throughout the test to determine the rate of temperature and pressure rise inside the tank under the exposure conditions, and the conditions at which the tank bursts. Four piezoelectric pressure transducers will be placed on the ground, facing upwards, in a line extending outward from the tank. These pressure transducers will serve to measure the atmospheric pressure impulse as a function of time and distance from the tank. They will also be able to determine whether there is a second pulse from the ignition of hydrogen.

The static pressure transducer and thermocouples will be connected to a single data acquisition system and logged at 2-second intervals throughout the test. The four transient pressure transducers will be connected to a separate high-speed data acquisition system capable of sampling at 100 kHz. The system will be triggered by a pressure spike of sufficient magnitude. In the event that the pressure spike is not of sufficient magnitude, SwRI will attempt to manually trigger the data acquisition system in order to collect as much data as possible.

Documentation of the failure event will include two standard video views, and two thermal imaging (infrared) views. High-speed digital video recording of the failure event will also be performed.