EXPLOSIONS: *a fresh look at Chernobyl, Three Mile Island, the Gulf Oil Spill and Fukushima Daiichi*

by Robert A. Leishear, PhD, P. E.

There is a probable relationship between explosions in pipelines during well publicized industrial accidents, which include, but are not limited to, Chernobyl, Three Mile Island, Fukushima Daiichi, and the Gulf Oil Spill (the Macondo Well). To relate these accidents in nuclear reactor facilties and deep sea oil pipelines, a new theory was invented to explain explosions in industrial pipe systems.

This innovative fluid dynamics theory was first presented at the 2010, American Society of Mechanical Engineers (ASME), Pressure Vessels and Piping Division Conference and published in more detail in the August, 2013, ASME Mechanical Engineering Magazine ("Pipeline Explosions, A New Theory", 2013, R. A. Leishear) and in the October, 2013, ASME, Journal of Pressure Vessel Technology ("A Hydrogen Ignition Mechanism for Explosions in Nuclear Facility Pipe Systems", R. A. Leishear). The theory states that if a pipe contains a flammable gas, and that if there is an inrush of liquid into the piping or gas filled space, the gas can compress and heat up to its auto-ignition point (similar to a diesel engine). Then the gas ignites and may explode if there is a sufficient quantity of gas.

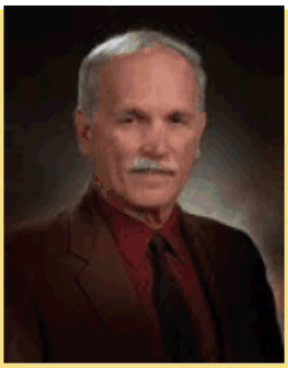
Accordingly, numerous industrial explosions share several common factors: 1) Fluid transients were known to occur, 2) Trapped flammable gases were known to collect in the piping, 3) Fluid transients can cause sudden pressure changes to above 1000 psi which are sufficient to auto-ignite flammable gases, and 4) Explosions in pipelines occurred with causes that are not yet well understood. In short, conditions at each of these accidents were consistent with this new theory, and the theory provides probable explanations for explosions that occurred during these accidents and many other less publicized fires and explosions.

For example, during explosions in nuclear reactor cooling systems, flammable hydrogen gas first forms in the piping systems. Then, a fluid transient due to intentional flooding of the system, or another cause, can compress the gas to ignition and explosion. One method to prevent this type of explosion is to change the rate of water addition. By adding cooling water more slowly to a gas-laden piping system, the pressures and temperatures may be reduced to prevent gas ignition.

During explosions in oil pipelines, flammable natural gas may be compressed to ignition between slugs of oil piped from below the sea floor to oil rigs at the surface, where slugs of oil traveling at different flow rates trap and compress the flammable gases.

"Swish, run, boom" is a common refrain reported by oil rig personnel during fires and explosions. "Swish" describes the sound heard from oil accelerating up toward an oil rig after ignited, exploding gas propels the oil slug upward in the pipeline. "Run" describes the time available to the operators to escape before the fiery explosion "Booms" at the oil rig.

Significant safety and environmental implications of this new theory warrant additional research. Even though financial support for research is presently unavailable, this discovery of major threats to public safety and the environment certainly demands further investigation and prevention.



American Mensan Robert A. Leishear, PhD, P. E., is a Fellow Engineer at Savannah River National Laboratory in Aiken, South Carolina. Dr. Leishear earned his Bachelor's degree in Mechanical Engineering from Johns-Hopkins University (1982) and his Master's (2001) and PhD degrees (2005) in Mechanical Engineering from the University of South Carolina. He joined Mensa this year, and is a member of the American Society of Mechanical Engineers (ASME), B31.3 Process Piping Committee. He led projects which yielded more than 48 million dollars in savings to Savannah River Site, which is a Department of Energy operated facility. Supporting these savings, he published forty conference and journal papers through ASME and the American Institute of Chemical Engineers, where topics included fluid dynamics, structural dynamics, machinery dynamics, failure analysis, mass transfer, and piping explosions. He also published a book through ASME Press ("Fluid Mechanics, Water Hammer, Dynamic Stresses, and Piping Design") in 2013.