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Process Safety Beacon

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Cold Embrittlement and Thermal Stress

A pump that supplied hot oil to a heat exchanger in a gas processing plant stopped for several hours. With no flow of hot oil to the exchanger, the temperature in the heat exchanger, normally 100°C (212°F) or higher, dropped to 48°C below zero (54°F below zero). Ice was observed on the outside of the heat exchanger. The hot oil pump was re-started, and hot oil flow resumed to the heat exchanger. The low temperature had caused the steel heat exchanger to become brittle, and the 150°C temperature differential from the sudden flow of hot oil caused additional stress. This resulted in a brittle fracture of the heat exchanger. A vapor cloud estimated to contain more than 10 tons of flammable gas was released, and subsequently ignited by a heater. The explosion and fires killed 2 workers, injured 8 others, and the fire burned for 2 days. The gas supply to a large part of Australia was disrupted for nearly 3 weeks, impacting the lives of an estimated 4 million people. Total economic loss was estimated at over $1 billion Australian dollars.

Do you know?

- Some steels and other metals can become brittle when exposed to very low temperatures.
- Cold embrittlement can result in failure of process equipment such as vessels, heat exchangers or piping. This failure can be rapid and catastrophic, resulting in the release of a large amount material.
- Introduction of hot material into a cold pipe, vessel or other process equipment causes stress because of the temperature gradient, and this stress may be sufficient to cause equipment damage, or even failure of the equipment.

What you can do

- Know the design temperature range of the equipment in your plant — both the high and the low temperature limits for safe operation.
- Know if you have any equipment in your plant that might be subject to cold embrittlement.
- Understand and follow all procedures that are required to ensure that equipment is not exposed to excessively high or low temperatures, or to excessive temperature gradients that might stress and damage the equipment.
- Learn more about this incident by searching the Internet for “1998 Esso Longford gas explosion”.

Know the temperature capability of your plant — both high and low!

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