

## 10 Significant Marine Innovations

# Cargo Handling: Molten Sulphur Tanker Sails Four Years Sans Freeze-Ups

The operator of the world's largest and most modern molten sulphur tanker has enjoyed four years of near-continuous service, thanks in part to the ship's innovative thermal maintenance system. Sulphur Carriers, Inc., a subsidiary of International Shipholding Corporation, keeps M/V Sulphur Enterprise at sea hauling around 24,000 long tons of molten sulphur per trip. "We've had zero freeze-ups and zero maintenance associated with the bolt-on piping and valve heating system," says Peter Johnston, Sulphur Carriers' VP of operations.

For reportedly the first time on any sulphur transport ship, a bolt-on heating system keeps the molten cargo flowing and the ship on schedule by preventing costly delays due to frozen pipes and valves. The innovative thermal maintenance system was engineered and built by Controls Southeast Inc., of Charlotte, N.C. Frozen lines and the resulting delays in loading and unloading can be very costly in lost transit time and additional port charges.

All the cargo-carrying pipes and valves aboard Sulphur Enterprise are surrounded by bolt-on oil-circulating ControTrace pipe heating elements and ControHeat valve jackets from CSI. Yet despite a harsh marine environment and a non-stop schedule, the bolt-on system has required neither repair nor replacement since the ship was launched. More important, it has eliminated the constant maintenance and frequent freeze-ups. ControTrace bolt-on thermal maintenance modules are made of a shaped carbon steel tube, contoured to exactly mate with the outside diameter of process pipe. Sections are strapped lengthwise onto the piping, either individually or in heated, multiple element panels providing for excellent heat transfer.

ControHeat bolt-on jackets fit closely to valves, pumps, and other process system components. They are made up of patented, aluminum cast-to-fit pieces that match the component precisely. Embedded in the casting is a fabricated, steel, pressure-containing chamber through which flows the heating medium — steam, hot water/glycol or hot oil liquid/vapor. Independent pressure boundaries isolate the process stream from the heating medium to eliminate the possibility of cross-contamination.

Together, the ControTrace and ControHeat modules provide an integrated thermal maintenance system for the Sulphur Enterprise. "The success aboard a sulphur transport ship applies directly to land-based sulphur processing, recovery, and transport," says CSI vice president Henry Gaines, "In fact, tanker service is a more demanding test. For sulphur handling today, bolt-on technology is definitely the better choice."

Sulphur Enterprise was built by McDermott Shipyard, and since entering service in October 1994, the vessel has proven itself a maritime and chemical engineering success. According to Mr. Johnston, "The ship and particularly the thermal maintenance system is performing better than we ever expected. Sulphur Enterprise travels faster and discharges cargo faster than anticipated, and it has been really problem-free. For a project of this size and complexity, that's remarkable."

Under long-term charter to Freeport McMoran Sulphur, LLC New Orleans, the 524 ft. (159.7 m) Sulphur Enterprise is one of 16 operational molten sulphur tankers in the world.



ControHeat bolt-on jackets from Controls Southeast Inc., keep valves heated aboard the M/V Sulphur Enterprise. The bolt-on jackets keep the molten sulfur at 278F.

Aboard the ship, four heated, fiberglass-insulated steel tanks in individual holds each contain about 6,000 tons of molten sulphur. They are filled and emptied through 1,345 ft. (410 m) of pipe controlled by approximately 35 wafer or butterfly valves. Like the big tanks, the transfer pipes and valves must be temperature controlled at all times to keep from

freezing shut. The ship maintains its hectic schedule with no downtime for thermal system maintenance.

Sulphur remains liquid at temperatures from 240 to 310F, but quickly increases in viscosity above 320F and freezes at 240F. The bolt-on thermal maintenance system of Sulphur Enterprise is designed to maintain its cargo at 278F throughout load-



TOP: The M/V Sulphur Enterprise carries about 24,000 tons of molten sulphur from Louisiana and Texas to Florida. A sophisticated thermal maintenance system with bolt-on heating elements from Controls Southeast Inc. keeps the molten cargo flowing for loading and discharge.

ing, transit, and discharge. "We're like a great, big floating thermos bottle," says chief engineer Rick King. "If we allowed this cargo to freeze-up, we'd be a long time getting it moving again."

The thermal maintenance system aboard the Sulphur Enterprise, designed by CDI Marine Company in Jacksonville, Fla., uses two hot oil circuits at 425 and 320F. When the ship is underway, the primary circuit is heated to 425F by the exhaust of the 9,840 hp Wärtsilä diesel powerplant. Alternatively, an auxiliary boiler heats the first oil circuit when the Sulphur Enterprise is in port or if more heat is needed. As a safety feature, the high temperature system is designed to dump excess heat into the ocean.

Each molten sulphur tank incorporates 2,200 ft. (670 m) of oil-circulating coils to keep the contents fluid. Sulphur in the transfer lines, above and below the decks, is heated by bolt-on systems with redundant oil paths. Sensors on the return side of the oil loop report oil temperature to six computers in the engineer's office, deck office, and engine room. Display screens cue the ship's engineer to problems, and remote actuators automatically vary the flow of oil to regulate line temperature.

The designers of the Sulphur Enterprise originally specified a welded jacket thermal maintenance system for the ship's transfer pipe and valves. However, the shipyard's estimate of fabrication costs reportedly found double-walled pipe an expensive solution, as the bolt-on system segments promised to be 25 percent cheaper. The 1,300 ft. (396.2 m) of pipe on the Sulphur Enterprise required more than 6,300 ft. (1,920 m) of heating elements. Pipes from .75 to 14 in. in diameter take from one single element to six elements installed as two panels of three elements each depending on the diameter and length of the pipe. ControHeat bolt-on jackets also cover 34 90-degree elbows, 8 and 12 in. diameter, and a collection of valves.

"We've never had to remove any thermal maintenance modules," Mr. King observes, "In the unlikely event we have to make repairs, I can just unbolt one ControTrace module and bolt a new one on. We can replace a small panel without interrupting cargo operations."

Significantly, no bolt-on heating element has required replacement in four years.