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Feature



Pigging the Diesel Pipeline between the Landmark Red Hill Facility and Pearl Harbor

Navy uses ultrasonic 'smart pig' technology to evaluate integrity of 62-year-old fuel line

By Cynthia Greenwood

The 32-inch, 18-inch, and 16-inch fuel lines inside the harbor tunnel near the underground pump house carry fuel down the 3.5-mile harbor tunnel from the Red Hill Fuel Storage Facility to Pearl Harbor. Photo courtesy of 14th Naval District, Pearl Harbor.

Years before the Japanese attacked the Pearl Harbor fleet in 1941, the U.S. Navy recognized that the aboveground fuel storage tanks near the harbor were a vulnerable enemy target. Searching for a way to replace them, the Navy devised a plan to create an underground fuel storage facility that would serve as an invisible lifeline for battleships during World War II.

The Red Hill Underground Fuel Storage Facility is considered a modern engineering marvel. It is hidden several hundred feet below Red Hill, a mountain of volcanic rock located 7.5 miles north of Honolulu between the Moanalua and Halawa valleys. Built between 1940 and 1943, the facility is made up of 20 huge, capsule-shaped tanks situated vertically underground. To construct the complex, the Navy used advanced mining techniques and employed thousands of laborers to carve out the tank farm's intricate series of shafts, domes, and tunnels out of the volcanic rock. (See sidebar.)

Each storage tank, which holds 12.6 million gallons, is 250 feet high and 100 feet in diameter—large enough to contain a 20-story building. To access the fuel from the tanks, the Navy constructed four pipelines inside an underground tunnel that connects them to a harbor-side pumping station 2.7 miles west of the Red Hill site. During the Second World War, the Navy used the tanks to store fuel oil, jet fuel, aviation gasoline, and diesel fuel.

Today, Red Hill continues to supply the Pearl Harbor fuel depot, which is a vital transfer point and last stop for most Navy warships traveling from points such as Puget Sound and San Diego to conflict zones in the Persian Gulf. Aircrews from Wheeler Air Force Base in central Oahu, Hickam Air Force Base, located between Pearl Harbor and the Honolulu Airport, and the U.S. Coast Guard depend on Red Hill fuel.

"We're the one-stop fuel shop for DoD on the island," said Lt. Commander Tom Gorman, Bulk Fuels Director at the Navy Fleet and Industrial Supply Center (FISC). "If we weren't here, each Service would have to figure out how to get fuel separately. Our shop has consolidated this requirement for everyone, and it's a success economically as well as environmentally."

The Challenges of Pigging the Diesel Fuel Line

For 20 years the Navy has run clean diesel fuel at a high velocity through a 32-inch pipeline encased inside the tunnel that connects the tank farm to numerous fueling piers at Naval Station Pearl Harbor. Since the pipeline was built, the Navy has maintained it through visual inspections and external spot checks using ultrasonic testing methods.

“Without that diesel pipeline, you lose the capacity to serve your Navy ships,” said Tom Tehada, Cathodic Protection Technical Expert in the Naval Facilities Engineering Service Center (NFESC). This fall, the diesel fuel line will be examined internally for the first time using ultrasonic ‘smart pig’ technology. The Navy will fund the project using a \$2.9 million grant from the Corrosion Policy and Oversight Office (in the Office of the Secretary of Defense) and the Defense Energy Support Center.



The underground pumping station, located 2.7 miles west of the Red Hill site, has 11 pumps. Photo courtesy of 14th Naval District, Pearl Harbor.

“We’ll send ultrasonic pulses through the line so we’ll know where any anomalies from corrosion are located,” said Terri Regin, Fuel Facilities Subject Matter Expert at NFESC, who oversees the inspection.

The inspection project presents several technical challenges for Regin and the contractors supplying the equipment. “You rarely come across an old pipeline that is truly piggable,” she said. This fuel line is no exception. One of the most difficult parts of Regin’s job has been locating a pig that will negotiate the miter joints—pipe sections welded together at an angle—which occur throughout the pipe’s entire 2.7-mile length.

“Ultrasonic pigs have only recently been perfected to allow us to go around mitered and tight-radius bends,” Regin explained. For this pipeline, this ultrasonic pig is preferable to older pig technology, which runs on magnetic flux and requires bristles to touch the pipe wall. “Ultrasonic pigs aren’t required to touch the pipeline,” she added.

Initially, the inspection crew will run several foam pigs through the line, at three miles per hour, to remove the debris. “We’re not expecting a whole lot of debris in the line,” Regin said. Next the crew will pump fuel slowly through the line to move the ultrasonic pig through the series of miters and pipe supports located every 40 feet, at each of the tunnel’s 20 concrete walls.

The process is challenging, Regin explained, because the ultrasonic pig is not long and runs very slowly. “The trick is—how do we pump fuel at such a slow rate? We’ll throttle down the valves along the pipeline, if necessary. We estimate that it will take 18 to 24 hours to run the pig through the line. We’ll have to take the pipeline out of service for about a week for all of the pigging.”

Reaching the actual pipeline presents another obstacle for inspection crews. Because it rests inside a tunnel underground, it is not easily accessible. To install the pigs’ launcher and receiver, Regin and her team will have to transport their equipment via a two-mile rail line using industrial ‘golf-style’ carts. “I’m pretty claustrophobic, but I’m usually okay in there, as long as you keep the lights on,” Regin said.

After the initial foam pigs clear out debris from the line, Regin’s crew will have to handle and dispose of the contaminants properly. The use of welding to modify the line will also be a sensitive undertaking, she pointed out. “We’ll bring in marine chemists, and the fire department will give approvals. We’ll be observing all safety standards. The last thing we want is to have a fire in there,” she said.

Balancing Safety without Interrupting Navy Operations

Taking the fuel line out of service while the line is being pigged creates difficulties for the Navy, Gorman said. “We never really looked at the inside of the pipe, because we knew it would impact our operations.”

For security reasons Regin remains circumspect about exactly when the inspection will occur. She estimates that construction for the project will happen in October 2005. The pigging process will occur sometime afterward. “This is an operational facility and we have to make sure Navy operations occur. If some type of interruption occurs, we will have to wait on this project.”

If the fuel lines connected to the Red Hill site should ever experience a major leak, they could contaminate the Pearl Harbor Aquifer, the main source of Honolulu’s water supply.

Regin was first exposed to the Red Hill Storage Facility 10 years ago. At that time there were discussions about pigging the diesel line she is working on now. Besides conducting external spot checks during this period, the Navy has been

diligent about inspecting the pipeline, she recalled. "They have also inspected the pipeline coating system and performed routine monthly walk-throughs to keep it safe," she said, adding that the Navy's routine inspections since her involvement in the Red Hill pipeline have conformed to American Petroleum Institute standards, specifically API 570.

"We expect the line to be in good shape," Gorman said. "We don't expect a lot of corrosion inside the pipe. The pipelines are above ground, enclosed, and in a cool climate much like the inside of a wine cellar, so they've kept the same temperature and humidity." Regin agrees. "The pipeline doesn't get rained on, and it's exposed to very little humidity," she said. "It's a benign atmosphere."

Although the Navy doesn't expect to find any problems with the inspection, Gorman recognizes that its time has come. "We have a fresh water plant at the bottom of Red Hill, and if there were any leakage, we would have found it there. There are a lot of aquifers that support this area. If for some reason we had a leak, it could adversely affect the health of the local drinking water."

"It's become an important business to make sure we're not risking the health of the environment or the health of the people directly around the pipeline, while also fulfilling our mission," Regin said.