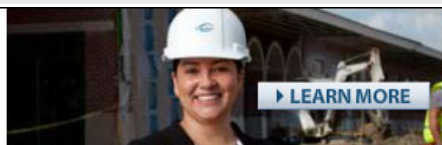


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New York Oil Supply: How Sandy Taught Empire State A Tough Lesson About Fuel

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By Joshua Schneyer and Selam Gebrekidan

NEW YORK, Nov 27 (Reuters) - At 4 p.m. on Oct. 29, as heavy winds battered the East Coast ahead of Superstorm Sandy's landfall, the Coast Guard's regional command center on Staten Island lost power and its hulking backup generators hummed into action.

Commander Linda Sturgis, who oversees emergency prevention at the Port of New York, was buzzed through two thick security doors into the Port's hive-like vessel traffic center, the maritime equivalent of an air traffic control tower. The Port had been bracing for Sandy for days, and a few hours earlier, its Captain had halted all commercial vessel traffic, an emergency lockdown known as Condition Zulu.

Shipping delays during storms are common. What few people could foresee was how Sandy's 16-hour assault on a major oil hub would result in the worst regional fuel supply collapse in decades, delaying disaster relief, triggering panic-buying, and raising questions about energy security in the country's most densely populated area.

The storm's destructive powers were bad enough - knocking out equipment and power at oil terminals and other energy infrastructure, while disrupting shipping for days because of debris in the harbor. But a series of decisions over recent years had also made the region much more vulnerable. The shuttering of regional oil refineries, decisions by companies to keep fuel low stocks because holding extra supply has become expensive or unprofitable, a recent government downsizing of emergency reserves, and the heavy reliance of fuel terminals on a vulnerable electric grid all played into the supply squeeze.

As Sandy approached, Sturgis and her staff were in a unique position to watch it hammer the harbor. On dozens of blinking monitors that track marine vessels by satellite, they verified that oil tankers, barges, container ships and recreational boats were hunkered down. Then, around 8 p.m. on Monday October 29, Sturgis's sense of alarm began to rise with the tide.

Since the September 11, 2001 terror attacks on New York, surveillance of the 1,300 or so vessels that transit the New York Harbor each day has been beefed up. Live feeds from military cameras in secret locations allowed Sturgis to watch Sandy raise sea levels by as much as 14 feet. That, she knew, would submerge low-lying zones, with frightening implications for residents. But Sturgis, who also holds a business degree in supply chain management, recognized another threat too.

"When I saw that surge, I knew it would impact oil supplies," she says. "The public probably doesn't realize how critical the harbor is. It's the epicenter of fuel distribution for the whole Northeast."

Sandy's death toll stands at 132; thousands have been left homeless; economic damage estimates top \$50 billion, and more than 8 million homes and businesses lost power, some for weeks. But in some respects, it is Sandy's impact on oil supplies that posed the biggest and most unexpected challenge to resuming day-to-day activities, including in areas only lightly damaged.

Experts worry the scenario could become more frequent, in part due to climate change and a lack of flood protection, but also due to oil market changes that have eliminated supply safeguards. Some worry that policy-makers are doing little to address the threats.

"What really happened with oil supplies here hasn't been discussed enough," said Malcolm Bowman, oceanographer and storm surge expert at

State University of New York at Stony Brook.

As the heart of the East Coast fuel market, the harbor covers an area of 125 square miles in New York and New Jersey and takes in around 1.5 million barrels a day of oil from the U.S. and overseas. From tanks that hold up to 75 million barrels, harbor facilities send fuel back out - by barge, tanker, pipe, truck and rail - to consumers from New Jersey to Maine. The region of 60 million, which consumes 6 percent of the world's oil, relies in part on harbor supplies.

THE DAY AFTER

Panic buying depleted stocks at fuel pumps even before Sandy hit. MasterCard Inc. data shows the volume of fuel sales in the mid-Atlantic region in the pre-storm weekend topped average levels by 65 percent. And that was at a time when two-thirds of Northeast refining capacity was already shut and pipelines were idled in preparation for Sandy, meaning less fuel was flowing in the region.

Consumers were right to be worried. Around 8 a.m. on Tuesday, October 30, the Coast Guard held the first of many post-storm conference calls with shippers, fuel terminal operators, and other harbor stakeholders. Reports from the field were sobering.

Sturgis said Phillips 66, operator of the 238,000 barrel per day Bayway refinery in Linden, New Jersey, reported that a 13-foot surge of corrosive saltwater had inundated parts of the plant. Its power was out, and the plant - known among oil traders as "the gasoline machine" because it produces enough fuel to meet half of New Jersey's demand - had no timeline for restarting.

Another low-lying Harbor refinery, Hess Corp's 70,000 barrel-per-day plant in Port Reading, New Jersey, was also incapacitated by power outages. Along the coast, two dozen major fuel terminals were inoperable. Tanks at the terminals store and blend oil to ship around the region.

Some faced urgent problems. At the Motiva fuel terminal in Sewaren, New Jersey, partially owned by Shell, two storm-damaged tanks were leaking diesel - nearly 380,000 gallons in total - into the Arthur Kill waterway. Phillips and Kinder Morgan, reported smaller spills.

Underground pipes like Colonial Pipeline, which usually delivers 800,000 barrels per day to the harbor from Houston, were not damaged but remained shut for days after terminals lost power.

The Coast Guard told shippers that harbor channels were still too hazardous to navigate. Buoys were blown out of place, and debris posed threats to tankers and barges.

"We had to clear debris and chart the bottom," said Gordon Loebel, Captain of the Port. "Without doing that, tankers could run aground and create a major oil spill."

The navigational ban also sidelined some 100 petroleum barges that usually transit the harbor. Some of the flat-hulled workhorses, which also carry fuel up the East Coast, reach the length of two football fields and carry up to 100,000 barrels of fuel - 120 times more than any fuel truck.

RACE TO RECOVER

Following the storm, oil workers were ready to spring into action, and the Coast Guard, with help from Army engineers and private pilot vessels, raced to re-open the port. But many operators found there was no quick fix to the harbor's broader problems.

"It was really bad," said Scott Hellmann, a petroleum barge dispatcher for Harley Marine, whose work trailer in Brooklyn's Navy Yard was destroyed. "For about a week, barges just stopped." Fuel terminals couldn't receive them.

Much of Linden, New Jersey, a city of 41,000 thirteen miles southwest of Manhattan, was severed from the Northeast fuel supply chain. Perched beside the hard-hit Arthur Kill, Linden is the harbor's pipeline crossroads and a staging point for oil shipments. Storm surges left boats piled up along the town's main industrial street.

Terminals in the area store bulk deliveries from tankers, refineries and pipelines and ship them out to 4,000 filling stations in the region. Power wasn't restored to many Linden fuel terminals until Nov. 11. Five terminals remained completely shut as of Monday, government data shows.

SEARCHING FOR GAS

Three days after Sandy, more than 70 percent of filling stations in New York and New Jersey had no gas for sale, according to Travel group

AAA. As temperatures dropped to near freezing, the supply of heating oil was also strained.

"Idle harbor terminals were a main bottleneck," said AAA's Michael Green. "Many had fuel, but it was stuck in storage."

Thousands of fuel truckers were forced to improvise. One national shipper, Mansfield Logistics, diverted trucks for hundreds of miles in every direction, bringing fuel from as far as North Carolina to northeastern customers, some located just a few miles from the harbor's tanks.

The crunch was worsened because many regional filling stations lacked generators and couldn't dispense gasoline.

TOO LITTLE, TOO LATE

Government officials tried several fixes. The Environmental Protection Agency eased clean fuel standards, allowing emergency vehicles and generators to run on dirtier fuel oil, and federal officials approved Jones Act waivers to lure fuel cargoes on foreign-flagged tankers usually barred from transiting between U.S. ports. BP Plc diverted a Liberian-flagged ship to the harbor, but only a few other cargoes arrived quickly.

Ultimately, New Jersey imposed fuel rationing based on license plate numbers. New York City following suit six days later.

"In New York the rationing was too little, too late," said Columbia University Business School Professor Awi Federgruen, an expert on supply chains. "Panic buying took over and people had no faith that supplies would come back soon. The storm exposed big faults in the supply chain."

DEFENSES DOWN BEFORE SANDY

Most shipping lanes and facilities around the harbor are now operating normally, and power has been restored to millions. The Bayway refinery is restarting, trade sources said.

But Sandy's fuel supply collapse has left a policy conundrum for officials, now more aware of the region's vulnerability.

New York Governor Andrew Cuomo and New York City Mayor Michael Bloomberg have said they believe climate change is increasing the frequency and force of storms in the area.

Cuomo has said he will request federal funding for new emergency fuel reserves and to build a "smart" power grid that could restore power quickly after future storms, at a cost of \$30 billion.

Bowman, the oceanographer, proposes surge barriers. Retractable panels he calls "saloon doors" could close during storms. But the system could cost \$20 billion.

Long before Sandy, cracks had begun to appear in the harbor's energy security. Even as oil and gas drilling booms in U.S. shale formations, the East Coast has grown less capable of supplying its own fuel.

Citing poor profit margins, oil companies shuttered three northeastern refineries over the past two years, eliminating 24 percent of regional capacity. That increases reliance on supply from tankers and Colonial's pipeline.

Oil companies' penchant for just-in-time fuel deliveries raises further supply concerns. East Coast gasoline inventories were already near record seasonal lows before the storm, government data shows.

Traders that handle fuel in the harbor's wholesale market have little incentive to keep a surplus in tanks. Oil prices in the \$100-a-barrel range mean it costs millions to store extra supplies. And since economic malaise has been reducing East Coast fuel demand, oil companies are less eager to compete for market share, storing fewer barrels.

Also discouraging surpluses is a market condition known as backwardation, where gasoline supplies for spot delivery fetch a premium to those committed for delivery later on. That prompts companies to keep just enough supply to maintain flexible operations in normal times.

As Sandy approached, East Coast tank farms held enough gasoline to meet normal demand for 22 days, 12 percent below a five-year average level.

The U.S. government has its own emergency fuel stocks, but federal budget cuts led to a 50 percent reduction in the Northeast heating oil reserves this year to just 1 million barrels, enough to meet East Coast demand for only a few days.

And over the last decade, several fuel terminals got rid of their diesel generators and connected to the regional electric grid instead, increasing their vulnerability, according to Captain Andrew McGovern of the Sandy Hook Pilots, who help direct vessels through the harbor.

LESSON FROM TEXAS, ROTTERDAM

After two hurricanes hit the New York region in less than two years, the region could look south for energy security ideas. When Hurricane Ike hit Texas in 2008, energy companies and emergency responders near a refining hub were ready, after storms Katrina and Rita in 2005 had hammered the energy industry.

As Ike approached, state governments and oil companies stationed fuel storage tanks and pumping trucks along evacuation routes. Utilities gave priority to restoring power to refineries, fuel terminals and gas stations, after tending to hospitals and relief centers. Some oil companies took the precaution of installing barriers or levees around their operations. Others readied meals and housing for their personnel to bring plants back quickly.

"Power and people, these are the two key things after a storm. To get the infrastructure going again, get power restored and get people to run it," said Bruce Bullock of the Maguire Energy Institute at Southern Methodist University in Dallas.

Japan, where last year's tsunami triggered a nuclear meltdown and a fuel squeeze, is spending \$2.4 billion to enhance energy security, including expanding emergency oil reserves.

In Rotterdam, Europe's top oil port, energy infrastructure is located at least 10 to 20 feet above sea level for protection. Fuel terminals have back-up generators, and a 450 million euro floating barrier can be closed when waters rise.

In Holland, "(w)e are born with the idea that the sea is a threat," said Jentsje Van der Meer, a Dutch coastal engineer who helped Chevron build a levee that protected its Mississippi refinery from Katrina.

"We're prepared even for the storm that only happens once every 10,000 years."