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The Effect of Hurricane Ivan on Oil and Gas Production in the Gulf of Mexico

by

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Weather often increases demand for heating oil and natural gas during cold winter months and can seriously affect demand for electricity during the summer cooling season. Weather also has distinct short term effects on the energy supply.

In late summer and early fall 2004, the Gulf of Mexico experienced several tropical storms. Seven storms formed in August and five in September. There were three that reached hurricane force, Frances (Category 4), Ivan (Category 5), and Jeanne (Category 2), and arrived in rapid succession, impacting many of the same areas of the Gulf.

Not to downplay the effects of any tropical storm that enters the Gulf, or makes landfall near populated areas, however, Hurricane Ivan was particularly disastrous because it blew through one of the more active oil and gas exploration and producing areas and disrupted the business of supplying energy.

Prior to Hurricane Ivan, repeat alarms from Tropical Storm Bonnie and Hurricanes Charley and Frances, with subsequent storms Hurricane Jeanne and Tropical Storm Matthew only served to worsen the situation.

Damage from Hurricane Ivan is, so far, the most expensive for the Gulf of Mexico oil and gas industry. The U.S. Department of Energy estimated the gas shut-in from Hurricanes Lilly and Isidore, combined, totaled 85 BCF - 90 BCF in 2002, although damage to platforms and pipelines was much less extensive. Some of the reported damage by Hurricane Ivan included the destruction of seven platforms.

Hurricane Ivan has caused 120 BCF (2.7% of the Gulf of Mexico annual production) of gas and 29.9 MMBLS (4.9% of the Gulf of Mexico annual production) of oil shut-in, thus far, and extensive damage to delivery pipelines. The effect of Hurricane Ivan on producers' cash flow is enormous. They were hit by lost production when the price of oil and gas is at its highest.

The U.S. Minerals Management Service (MMS) stated that Ivan, at its high, forced the evacuation of 574 platforms (75% of the Gulf's manned platforms) and 69 rigs (59% of the

Gulf's drilling rigs). Daily oil production was shut-in at 83% and gas production shut-in at 53% of operations. As of November 15, 2004, a total of nine platforms and one rig remain evacuated. Thirteen percent of oil daily production and 6% of gas daily production remain shut-in due to delivery and gathering pipelines problems.

Damage to the infrastructure by Hurricane Ivan cannot be adequately measured in terms of how many platforms or rigs were destroyed. The most damage was discovered in the pipeline routes. It was reported that some pipelines in the mouth of the Mississippi River were moved 3,000 feet while others remain buried under 30 feet of mud and cannot be found. It could take as long as 6 months and a significant amount of effort to locate and repair these pipelines.

Hurricanes are highly complex weather systems capable of generating incredible amounts of energy. Damage to lives and property is due to high speed winds, water, and tornados precipitated by the weather system.

Depending on duration and storm intensity as the hurricane approaches land and the water becomes shallower, it begins to push large amounts of water in front of it called storm surge. Storm surge, combined with normal tides, creates a hurricane storm tide which can increase the mean water level 15 feet or more.

This rise in water level can cause severe flooding in coastal areas, particularly when the storm tide coincides with normal high tides. Most of the Louisiana Gulf Coast elevation is equivalent to mean sea level, thus, the danger from storm tides is tremendous. The level of surge in a particular area is also determined by the slope of the continental shelf. A shallow slope off the coast will allow a greater surge to inundate coastal communities.

Storm surges of 20 - 25 feet are not unheard of. In 1969, Hurricane Camille produced a 25-foot storm surge in Mississippi; in 1989, Hurricane Hugo generated a 20-foot storm tide in South Carolina. When the water from these surges strike land it swamps low lying areas and causes severe damage to unprotected coastal areas. Models have predicted that a slow moving category 4 hurricane could produce a surge sufficient to flood the New Orleans Vieux Carre with six feet or more of water.

The wetlands infrastructure is, also, adversely affected. Any storm path with a category 5 intensity coming onshore between Vermilion Bay and Fourchon would place the NE quadrant over the most production intense part of the marsh. The Louisiana Offshore Oil Port's (LOOP) Fourchon pumping station would disappear. Port Fourchon would disappear and the bayou would fill with sediment. It would take months to assess the extent of the recovery job, mobilize to begin dredging, dredge, locate missing pipelines, re-stabilize the foundations (for pumping stations and for underwater pipelines), repair and/or replace the pipelines, and rework wells and restart flow.

Since there are numerous pipelines offshore bringing flow from the many platforms and wells, the marsh is the area of flow consolidation. There are probably three natural gas pipelines and three oil pipelines which are most vulnerable. These include Henry Hub, St. James terminal and LOOP pipeline; Shell pipeline from St. James, LA to the Midwest, Venice gas processing plant

and pipeline; Baldwin gas processing plant and pipeline; Garden City gas processing plant and pipeline; and refineries and their associated pipelines along the Mississippi River. Additional crude access would entail transfer of oil from very large crude carriers (VLCC) to lighter vessels and barges.

Anecdotal evidence provides a glimpse into the power of Hurricane Ivan when damage to one offshore rig was done nearly 80 feet above the Gulf's surface. This and other evidence suggests the possibility of a rogue wave also contributing to the storm damage. Hurricane Ivan was not an ordinary hurricane; national weather and industry sources indicated wave damage that would be on the extreme high end for a category 5 hurricane.

MMS reported five Mobile Offshore Drilling Units were set adrift and one mobile unit sustained extensive damage, seven fixed platforms were destroyed, four others were extensively damaged, and 13 pipeline leaks were located, including one that resulted in a fire which burned itself out. Individual companies estimated down time from 10 - 21 days. Potentially, some of the more severely damaged platforms are permanently lost. Some mobile units have been moved to ship yards to undergo inspection and repair; their outage is still to be determined.

Almost all of the information on oil and gas production disruption in the Gulf of Mexico was provided by MMS. That data focuses in the outer continental shelf, but does not account for data pertaining to the state regulated near shore areas. MMS requires damage reports from producers while the state does not. Production losses for the storm in the Louisiana regulated coastal waters are, at this point, undetermined. It is hoped that it will be less severe than that in the OCS.

Storms such as Ivan damage production facilities leaving the energy production infrastructure more vulnerable to catastrophic loss. This vulnerability to damage increases as Louisiana's protected marshes and barrier islands disappear. Buried oil and natural gas pipelines are subject to irresistible bending forces from hurricanes' movement of sediment. As storms move from deeper water onto the shallower shelf, and as the storm pressure lowers (thus, the greater the storm category), the greater is the damage due to underwater erosion. This could be thought of as the equivalent of an avalanche of snow, except it is an avalanche of sediment on the marsh or shelf bottom.

Loss of platforms near the shore has been a factor in the offshore industry from the beginning. The mouth of the Mississippi River has a very unstable bottom. Pipelines have disappeared in other storms as well. The unstable Gulf bottom areas of the Louisiana shelf run from the mouth of the Mississippi to near Vermilion Bay. The shelf bottom becomes a bit more firm to the west, but the marsh all across the state from the Mississippi River to the Texas state line is unstable.

Damage to oil and gas pipelines in the coastal zone has been unusually high. Even if offshore production was available, moving it onshore to process and market would be more difficult due to pipeline loss.

As a note aside, not all weather related disruption to production is due to hurricanes. Louisiana, in particular the southern portion, is noted for its subtropical climate and moderate winter

temperature. Temperatures below 30° F in the southern parishes are uncommon, lasting only a few hours or days of the year. If the temperature drops ten degrees below that, and stays for an extended period, it can create another unusual set of conditions since very little equipment is designed for sustained cold temperatures.

It is not uncommon during winter months (usually November – February) for weather fronts from the north to reduce oil and natural gas production in both north and south Louisiana, including production over marsh lands and open water. The combined effect of temperature and wind lowers the effective temperature which can cause control valves on production equipment and well heads to freeze and blow out burners used to heat water baths for heat exchange. The result is a reduction in available production at the time of highest market (heating) need.

As these winter fronts pass through the state, they drive the water (tides) from the bayous and marsh waterways rendering transportation by boat an unreliable source for access to the downed facilities. Remedial action to unfreeze the equipment and restart production may have to wait added days at this critical time. It is possible that as much as 25% of the nation's oil and natural gas production could be substantially disrupted.

Weather is a variable that needs to be factored into the effects on oil and gas supply. Infrequent, but regular, weather events like Hurricane Ivan will cause serious supply reductions and resultant short term price increases.