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## Hurricanes and Energy Infrastructure in the Gulf of Mexico: Impacts and Challenges

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### EXTENDED ABSTRACT

Recent Hurricanes Katrina and Rita created considerable damage to a wide range of energy infrastructure along the Gulf of Mexico. The storms were unique in that the combined storms: (a) impacted a much broader region of the Gulf coast than any other previous combination of storms; and (b) did considerably more damage to a wide range of energy infrastructure that was not limited to traditional exploration and production activities alone. This paper reviews the challenges associated with each storm and highlights the wide range of energy infrastructure that was impacted. This includes a survey of offshore production damage, refinery damage, petrochemical industry damage, pipeline damage, gas processing damage, and power generation and transmission damage. A second theme of the paper is to highlight the interrelated nature of energy infrastructure along the Gulf and to show how outages in one infrastructure area can impact others. The cascading failures created in the system by the hurricanes are highlighted. The third theme of the paper is to highlight the broad impact of the hurricanes on U.S. and global energy markets. The importance of the Gulf of Mexico infrastructure to those markets is emphasized. Outages and interruptions, and their impacts on energy supplies and prices throughout the U.S., are examined. This paper also addresses the industry challenges during the entire course of the storms and lessons learned from those activities. Insights and reflections are offered on the past hurricane season as well as the outlook for the upcoming tropical season.

Hurricanes Katrina and Rita impacted offshore production, gas processing, oil refining, and power generation. Both storms made landfall as Category 3 hurricanes, with winds exceeding 125 and 115 mph, respectively. More than 45 platforms in the Gulf of Mexico were destroyed and 20 platforms sustained extensive damage from Katrina's August 29, 2005, impact. The storm was indiscriminate in the damage it created to both older and new structures. Shell's Mars tension leg platform ("TLP"), worth more than \$500 million and handling close to 150,000 barrels oil per day and 160 million cubic ft of gas per day, was entirely shut-in following Hurricane Katrina and may be a total loss (Rigzone, 2005). Katrina destroyed four offshore rigs, extensively damaged others, and set several adrift. Offshore oil and gas production peak shut-in rates post-Katrina reached 95 percent and 88 percent, respectively. Three weeks out from Hurricane Katrina, 55 percent of oil production and 34 percent of gas production remained shut-in, underscoring the severity of infrastructure damage (Minerals Management Service, 2006). By comparison, three weeks out from Hurricane Ivan, which made landfall in September, 2004, shut-in oil and gas production were at less than 30 and 15 percent respectively.

Hurricane Rita struck the Gulf Coast as a Category 3 storm on September 24, 2005, while the Gulf states were still reeling from the impacts of Hurricane Katrina, thereby exacerbating the existing damage to energy infrastructure and contributing to increased shut-in production for an extended length of time. Offshore oil and gas production peak shut-in rates post-Rita reached 99 percent and 72 percent, respectively (Minerals Management Service, 2006). In early November, more than one month out from Hurricane Rita, 51 percent of oil production and 44 percent of gas production remained shut-in. Again, older and smaller platforms sustained the most damage, but damage also occurred to modern facilities such as Chevron's Typhoon TLP. Hurricane Rita ripped the Typhoon from its moorings, overturning it and leaving it floating upside down.

More than 15 refineries with processing capacities generally over 100,000 barrels per day were impacted by Hurricane Katrina. This amounts to 4,931,000 barrels per day impacted along the Gulf Coast and into the Midwest, which is 30 percent of U.S. operating capacity. Impacts ranged from reduced runs at ExxonMobil's Baton Rouge facility, with almost 500,000 barrels per day processing capacity, to complete shutdowns at Gulf Coast refineries operated by ChevronTexaco, ConocoPhillips, and Marathon, all with more than 200,000 barrels per day processing capacities (Energy Information Administration, 2005). This resulted in substantial gasoline price increases across the country. In the period following Rita's landfall, total refinery impact reached more than 5,000,000 barrels per day (Energy Information Administration, 2005). The total impacts of Katrina and Rita resulted in a loss of 188 million barrels of refined product, or over five percent of the total, by the end of 2005, an amount equal to close to 14 days of total U.S. refining capabilities.

Eight natural gas processing facilities throughout Louisiana, Mississippi, and Alabama sustained damage from Hurricane Katrina. While some processing facilities sustained serious damage and were shut down for months after the hurricanes, others suffered from temporary pipeline outages or were constrained by electric power availability, underscoring the interrelated nature of energy infrastructure in the Gulf Coast. Hurricane Rita created further damage, impacting more than 75 percent of the region's natural gas processing facilities.

The impacts associated with oil and gas supply interruptions created by the hurricanes went beyond the region's economy by impacting both national and international energy markets. These oil and gas supply interruptions occurred during perhaps one of the most inopportune times in the recent history of energy markets. The shut-in production and limited refining capacities resulting from the hurricanes put added pressure on already tight energy markets. As of early 2006, 22 percent of oil production and 13 percent of gas production remained shut-in in the Gulf of Mexico (Minerals Management Service, 2006). It is unknown when this production will become online. If crude and natural gas production returns follow a path similar to Hurricane Ivan, the industry could experience production shut-ins for some time. Refining capacity is returning to normal, but similar to the lingering shut-in oil and gas production, there will be a stubborn five percent of total capacity that has an unknown return date.

Hurricanes Katrina and Rita inflicted considerable economic damage on the Gulf Coast economy and clearly showed the interrelationship of all types of energy infrastructure – production, processing, pipes and power. Impacts to domestic and global energy markets were far-reaching, given the high concentration of energy infrastructure in the Gulf Coast region, highlighting the region's significance to the entire country. It is unlikely that energy markets will be back to normal functionality before the next hurricane season, adding an extra element of uncertainty to price and supply forecasts.

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