

Insulated Conductors Committee

Educational Program

Fall 2006

Nov 01, St.Petersburg, Fl



Impact of Hurricanes on Electric Grid Infrastructure



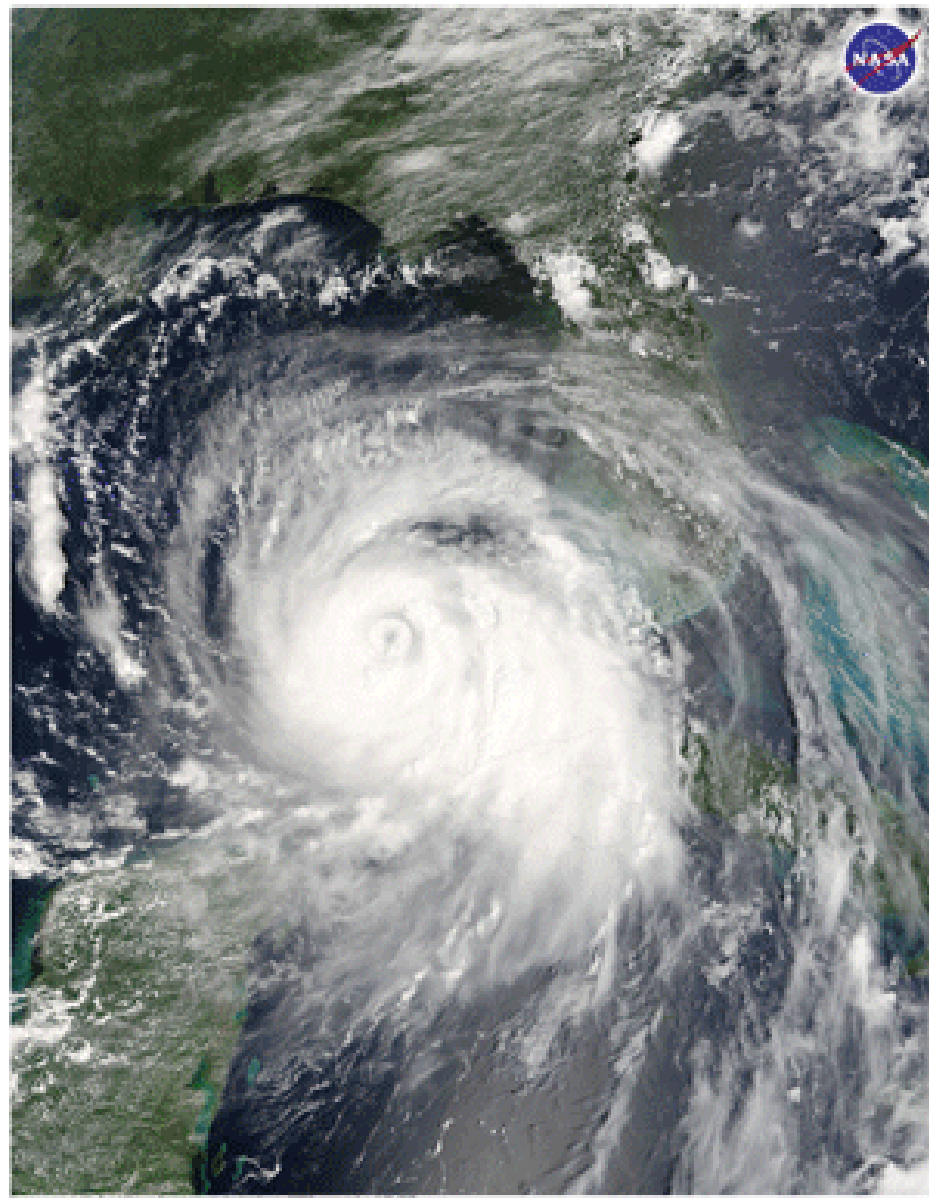
System Recovery, Restoration,
Preparedness

HURRICANE **KATRINA**

The 2005 hurricane season will long be remembered both for the record-breaking number of early storms and the emergence of a powerful Category 5 hurricane in the central Gulf of Mexico—Hurricane Katrina.



Seventeen days after Katrina flooded New Orleans, much of the city is still under water. In this pair of images, the affected areas can clearly be seen. The flooded parts of the city appear dark blue, and the areas that have dried out appear light blue gray.




Hurricane Katrina strengthened into a powerful Category Five hurricane with sustained winds of 160 mph. The boost came just hours after Katrina reached Category 4, with wind of 145 mph, as it gathered energy from the warm water of the Gulf of Mexico. Here it continues on its path towards the Louisiana-Mississippi coastline.

2005 Hurricanes

- <http://edition.cnn.com/SPECIALS/2005/hurricanes/interactive/fullpage.hurricanes/>

Atlantic Cyclone Names

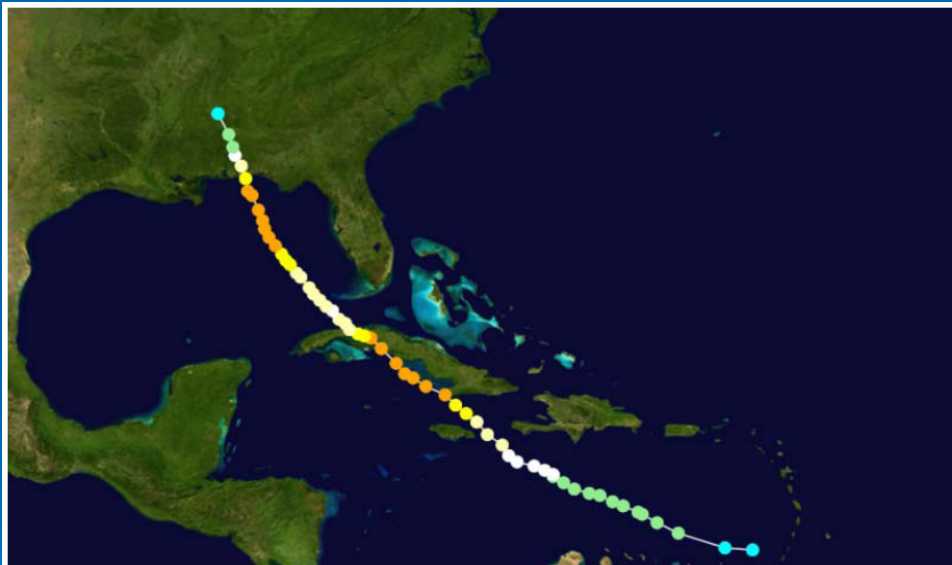
- Since 1953, names from lists originated by the National Hurricane Centre
 - Name list maintained by an International Committee of World Meteorological Organization
 - Six lists of 21 names used in rotation
 - Men's names introduced in 1979
- 

| 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|-------------|-------------|-------------|-------------|---|
| Alberto Beryl Chris Debby Ernesto Florence Gordon Helene Isaac Joyce Kirk Leslie Michael Nadine Oscar Patty Rafael Sandy Tony Valerie William | | | | | Arlene Bret Cindy Don Emily Franklin Gert Harvey Irene Jose Katia Lee Maria Nate Ophelia Philippe Rina Sean Tammy Vince Whitney |

Hurricane Classification

- Saffir-Simpson Hurricane Scale
- Category 1-5 with wind speed as determining factor
- Category 5
 - Wind speed >155 mph
 - Damage - Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. All shrubs, trees, and signs blown down. Complete destruction of mobile homes. Severe and extensive window and door damage
 - Effect of storm surge

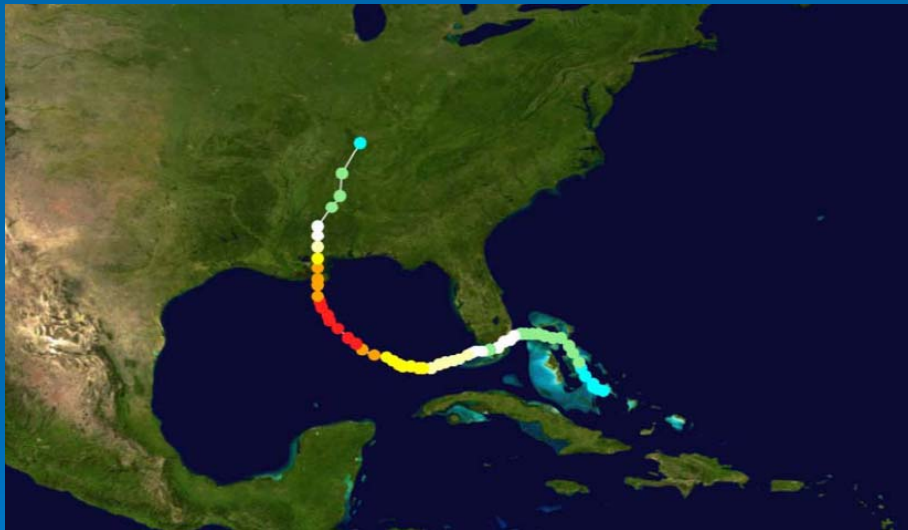
Dennis



Hurricane Dennis Quick Facts

| | |
|------------------------|---|
| Formed | July 4 - 13, 2005 |
| Highest winds | 150 mph (240 km/h) sustained |
| Lowest pressure | 930 mbar |
| Damages | \$2.23 billion in the U.S.; \$4-6 billion total (2005 USD) |
| Fatalities | 41 direct, 30 indirect |
| Areas affected | Grenada, Haiti, Jamaica, Cuba, Florida, Alabama, Mississippi, Georgia, Tennessee and Ohio Valley regions |

Katrina



Hurricane Katrina Quick Facts

| | |
|------------------------|---|
| Formed | August 23, 2005 |
| Highest winds | 175 mph (240 km/h) sustained |
| Lowest pressure | 902 mbar |
| Damages | \$75 billion (costliest cyclone of all time) |
| Fatalities | 1383 (potentially more) |
| Areas affected | Bahamas, South Florida, Cuba, Louisiana, Mississippi, Alabama and the Florida Panhandle |

Wilma

Hurricane Wilma Quick Facts

| | |
|------------------------|--|
| Formed | October 15-25, 2005 |
| Highest winds | 175 mph (280 km/h) sustained |
| Lowest pressure | 882 mbar (Lowest pressure ever recorded in Atlantic hurricane.) |
| Damages | \$18 – 22 billion |
| Fatalities | 28 direct, 32 indirect |
| Areas affected | Jamaica, Haiti, Cayman Islands, Cuba, Honduras, Belize, Yucatan Peninsula, Florida, Bahamas, Atlantic Canada |



Challenges for Power Engineers

- Very high volume of work with limited information
- Damage situation assessment
- Communications
- Sequential and parallel priorities between regional power control centres and local control centres
- Generating plants and equipment damages
- Not only members of the recovery team but also the victims of the storm

Edison Electric Institute Awards

- Emergency Response Award
- Emergency Assistance Award
- Emergency Recovery Award

EEI Emergency Response Awards 2005

- **Mississippi Power Company (Katrina)**
- **Alabama Power Company (Katrina and Dennis)**
- **CenterPoint Energy (Rita)**
- **Cleco Power (Katrina and Rita)**
- **Entergy (Katrina and Rita)**
- **Florida Power & Light (Katrina and Wilma)**
- **Gulf Power Company (Dennis)**
- **Indiana Michigan Power (for January 2005 Ice Storm)**

EEI Emergency Assistance Awards 2005

- **Alabama Power** (Katrina, Rita, and Wilma)
- **Georgia Power** (Katrina, Rita, and Wilma)
- **American Electric Power** (Katrina and Wilma)
- **Gulf Power Company** (Katrina, Rita, and Wilma)
- **CenterPoint Energy** (Dennis, Katrina, Rita, and Wilma)
- **National Grid** (Wilma)
- **Cinergy** (Katrina, Rita, and Wilma)
- **Progress Energy** (Katrina, Rita, and Wilma)
- **Entergy** (Wilma)
- **TXU Electric Delivery** (Katrina, Rita, and Wilma)
- **Florida Power and Light Company** (Rita)

EEI Special Emergency Recovery Award

- Caribbean Utilities Company for their efforts in recovering from Hurricane Ivan

Agenda

1. Impact of Katrina on System Restoration – Logistical Challenges, by Wilson W. Melvin, Mississippi Power Company
2. Progress Energy's Transmission System Major Storm Restoration, Rodney N. Hutcherson, Progress Energy
3. Texas Utility System Hardening Recommendations to Lessen Future Storm Damage, Erich F. Schoennagel, CenterPoint Energy
4. WAR and Electrical Infrastructure, Alex Domijan, Univ. S.Florida



Resources

- <http://gis.esri.com/library/userconf/feduc06/index.html>
- http://www.purc.org/documents/Finalreport_Hardening_0606.pdf
- <http://www.nae.edu/NAE/bridgecom.nsf/0754c87f163f599e85256cca00588f49/85256e8d00838af385257137007019da?OpenDocument>
- http://uaelp.pennnet.com/Articles/Article_Display.cfm?Section=ARTCL&ARTICLE_ID=245987&VERSION_NUM=2&p=22
- <http://www.todaysengineer.org/2005/Sep/katrina.asp>
- <http://www.utilitytrainingsolutions.com/emergency-restoration-plan.php>

The Soul of New Orleans

- http://www.usatoday.com/news/nation/2005-09-29-power-grids-mess_x.htm