Entergy Storm Hardening Program

T&D Resiliency Initiative

Presented to the 2014 NARUC

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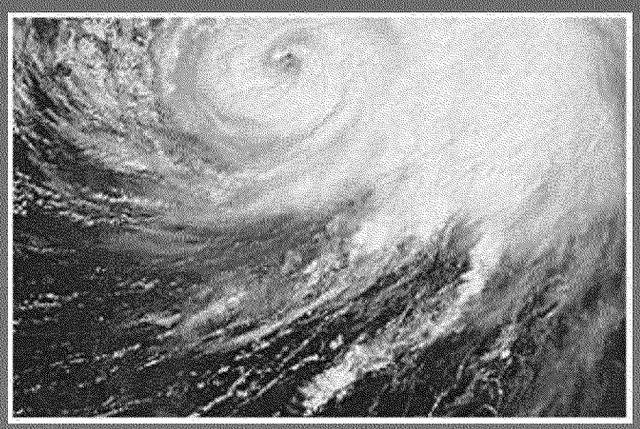
Chris Cooper
System Distribution Asset Planning Manager

Entergy®

THE POWER OF PEOPLE®

We're Experienced at Restoration…

- *Andrew (Aug. 1992) 250,000 customers*
- *Ice Storm (Feb. 2004) 240,000 customers*
- *Georges (Sept. 1998) 260,000 customers*
- *Dual Ice Storms (Dec. 2000) 236,000 and 247,000 customers*
- *Lili (Oct. 2002) 243,000 customers*
- *Cindy (July 2005) 270,000 customers*



…are Recognized as being Good At It…

- *Received the EEI outage response or outage assistance award every year for the last 16 consecutive years.*
- *Received 21 EEI awards in total.*
- *Only utility to have won every year since the awards have been offered.*

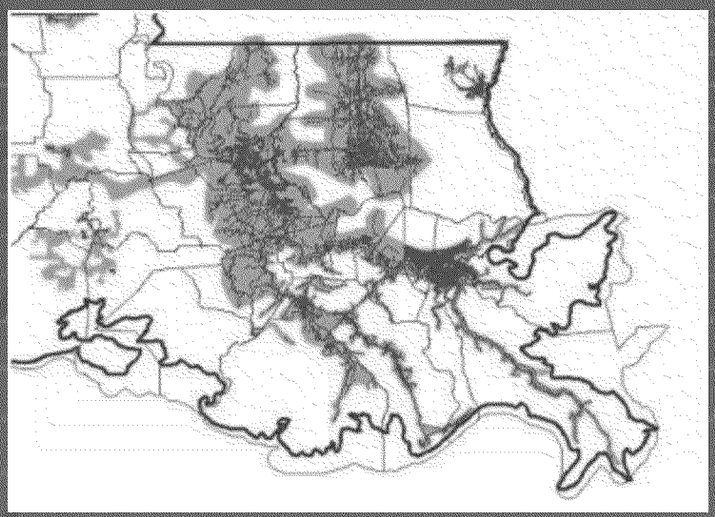
Katrina Resulted in an Unprecedented Impact on Entergy

300,000 Mississippi outages

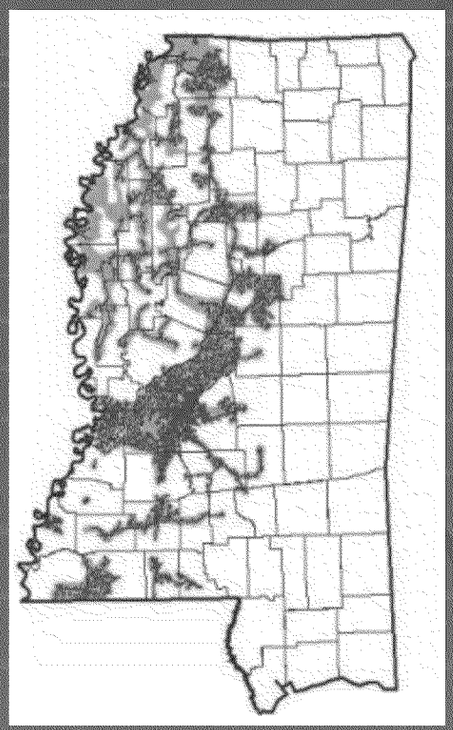
800,000 Louisiana outages

Katrina Storm surge approaches Michoud plant *(photo by Entergy Michoud plant manager Don McCroskey)*

The Destruction was Widespread…



17,000 square miles affected in Louisiana, 20,000 in Mississippi



Risks are Real Today and Increasing

This is not a climate change problem, it's a problem that gets worse with climate change

- Average annual Gulf Coast losses from wind, storm surge and flooding is $14 bn today
- It grows to $19 bn/yr by 2030 with today's climate
- With scenarios of climate change, it could grow to $23 bn/yr by 2030
- Nearly 8% of investment capital locked into picking up the pieces

- Back to back hurricanes in 2005 & 2008
- Katrina $150 billion in losses & 1,800 deaths
- Number, size and impact of major extreme weather events are increasing dramatically
- $350 bn in Gulf Coast asset losses over the next 20 years are possible

Managing physical risks from climate change is vitally important to the sustainability of the communities we serve

This Risk Can be Managed

- Cost effective investments to avoid economic losses exist
- Prioritized investments that complement customers' actions can achieve 5 to 1 benefit to cost ratios
- Proactive investments along the Gulf Coast can cost-effectively avoid $7 billion/yr in asset losses

Risks Disproportionally affect low income communities

- Low income are least able to bear the losses or invest in resilience
- Live in public and affordable housing vulnerable to extreme weather & floods
- Most exposed to heat island affect impacts
- Most likely to suffer lost wages after storms cause business interruptions

The Focus on Hardening

- *2005* – Hurricanes Katrina and Rita.
- *2006* – Entergy initiates assessment of the performance of the T&D system in coastal areas.
- *2007* - FL PSC adopts hardening rules and requires utilities to file hardening plans.

Entergy's Hardening Strategy

- *2007* – Entergy's Operating Committee approves T&D Hardening Plan and develops strategy
  - Build new transmission lines with steel.
  - Increase wind design speeds in targeted areas.
  - Replace wood poles supporting circuits crossing interstate highways with steel or concrete.
  - Upgrade backbone feeder poles.
  - Increased application of storm guying on distribution poles.

Hardening – Reports & Expansion

- *2008* – Gustav and Ike.
- *2009* – Quanta Technologies is selected by PUCT to analyze and benchmark U.S. and Canadian utilities for hardening and vegetation management practices. Entergy is a participant.
- Quanta's report included recommended actions for:
  - Hardening of distribution electric facilities.
  - Hardening for hazard trees.

Entergy's Proactive Hardening of Distribution Facilities

- Entergy's hardening strategy aligned with the recommendations of Quanta report which included:

✓ Feeder Inspections
  - Examine feeders that will likely lead to an outage.

✓ Attachment Audits
  - Conduct third party attachment audits on all 3Ø main feeder trunks every five years.

✓ Loading Calculations
  - Assess loading when adding new equipment or new attachment discovered.

✓ Like for Unlike Replacement
  - Systems and processes that gradually harden through normal. work processes (replace porcelain insulators with polymer, upgrade to Grade B construction).

✓ Non-wood Poles
  - Have at least one non-wood pole on standards and installed for field experience.

Entergy's Proactive Hardening Through Vegetation Management

- Quanta's recommendations for Vegetation Management included:

✓ Inspection Procedures
  - Establish documented inspection procedures.

✓ Maximize Customer Approvals
  - Desire to obtain customer pre-approval for tree removal.

✓ Manage Backlog
  - Clear goals and processes for removal of hazard trees.

✓ Maintain Pruning Cycle
  - Pruning cycle often primary mechanism for hazard tree identification.

✓ Hazard Tree Data
  - Document hazard trees and collect data on tree related interruptions.

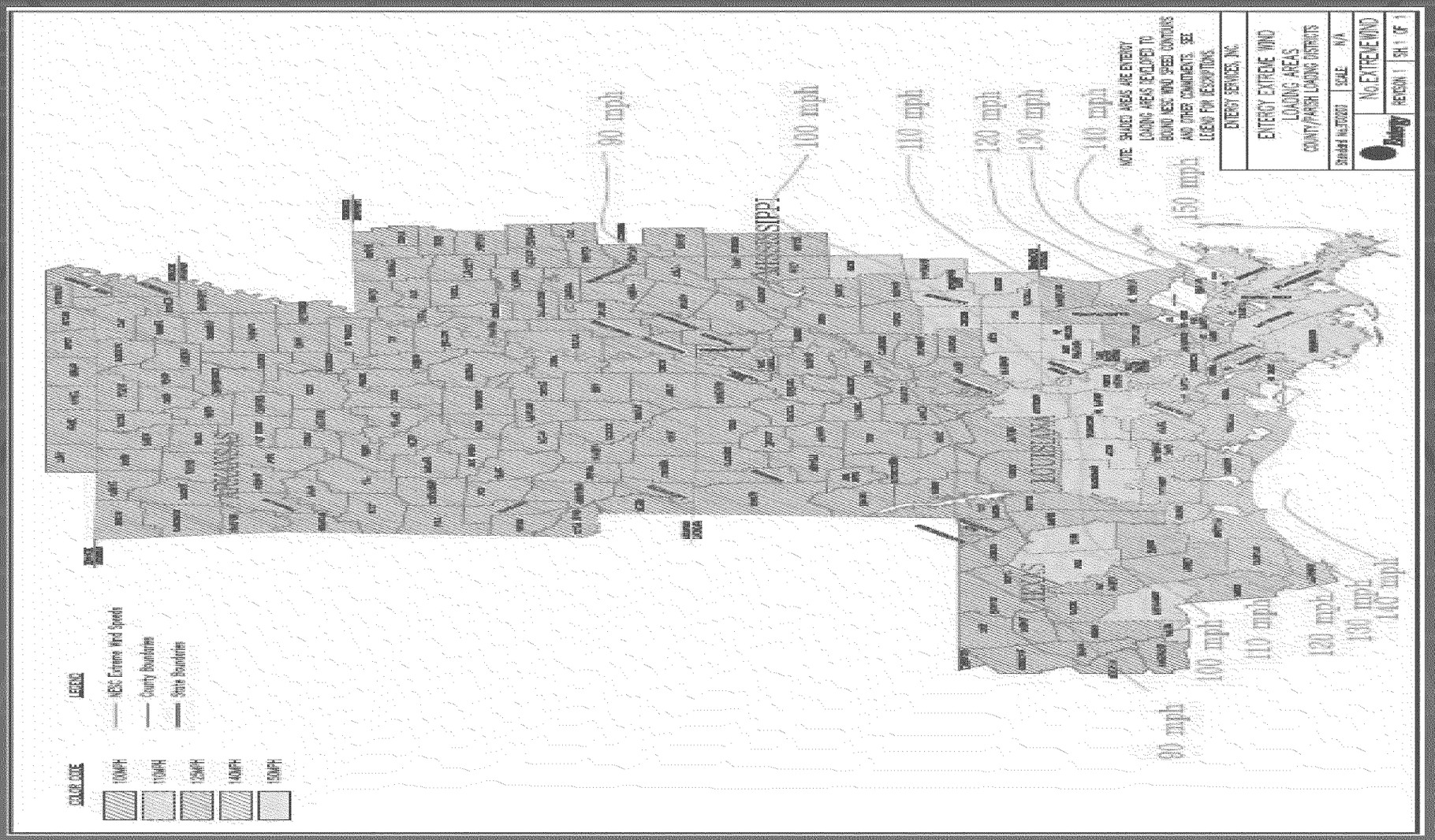
Entergy's Proactive Approach for Hardening Transmission Structures

- Use extreme wind load criteria on new or rebuilt lines south of I-10. NESC requires a 140 or 150 mph extreme wind loading in Parishes and Counties adjacent to the Gulf Coast, dropping to 125 mph north of those Parishes and Counties. Entergy utilizes this criteria in Parishes and Counties south of I-10 to harden the lines in this vital transportation, industrial and urban corridor.
- Replace wood structures over evacuation routes.
- Use concrete and steel structures exclusively for Transmission projects system-wide.

Entergy's Proactive Approach for Hardening Substations

- Use the 100-year Flood Elevation as appropriate for new substations
  - In the past, substations were built to surrounding topography, equal to or slightly above existing grade.
- Elevate critical substation components (control houses, switches, breakers, etc.) as needed.
- Targeted substations include those where outages would have national significance (identified or concurring with the analysis of the T&D Resilience Team).

NESC Wind Loading Vs. Entergy's Wind Loading Areas



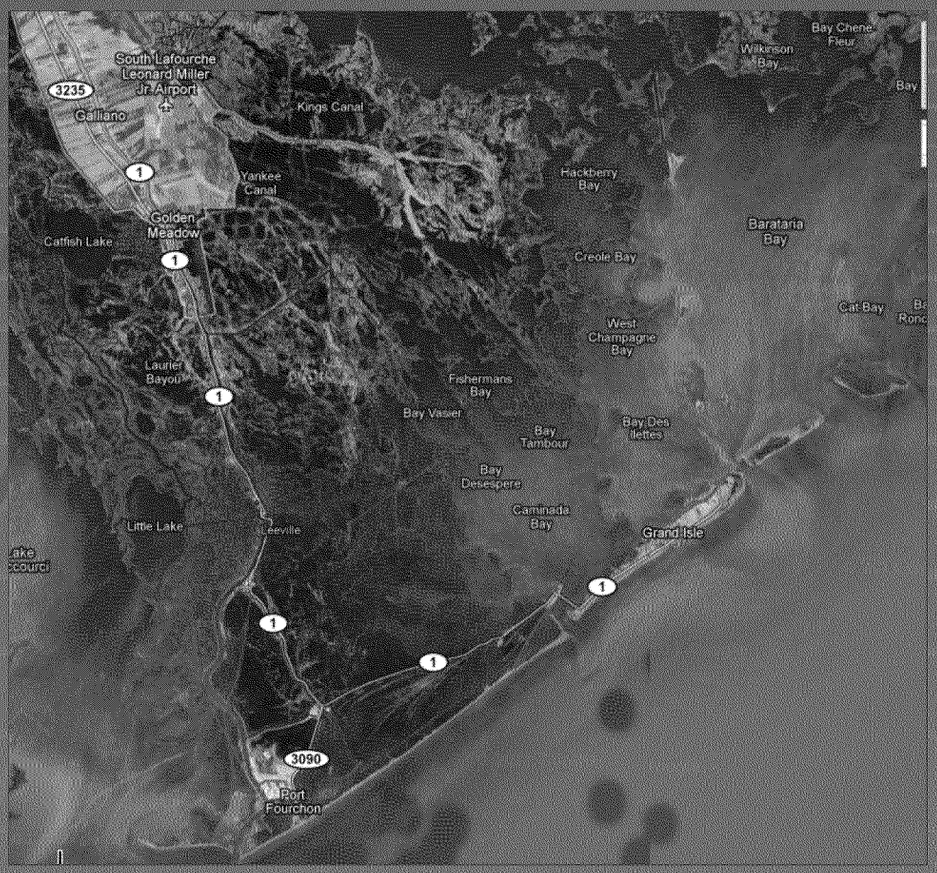
Entergy Expands Hardening to Include Resiliency

- *2011* – Gulf Coast Adaptation Study issued on climate adaptation in the Gulf Coastal region. Study sponsored by Entergy and America's Wetland Foundation.
  - ➢ Includes Entergy's coastal service area
    - A series of Town Hall type meeting.
      - Customers, local/state officials and other interested parties.
      - Leveraged outside consultants to perform an assessment of potential economic losses.
  - ➢ T&D Resiliency Team formed.
  - ➢ Develop Hardening Strategy for:
    - Port Fourchon, La.
    - Port Arthur, Texas.


Southeast Texas Coastal Resilience

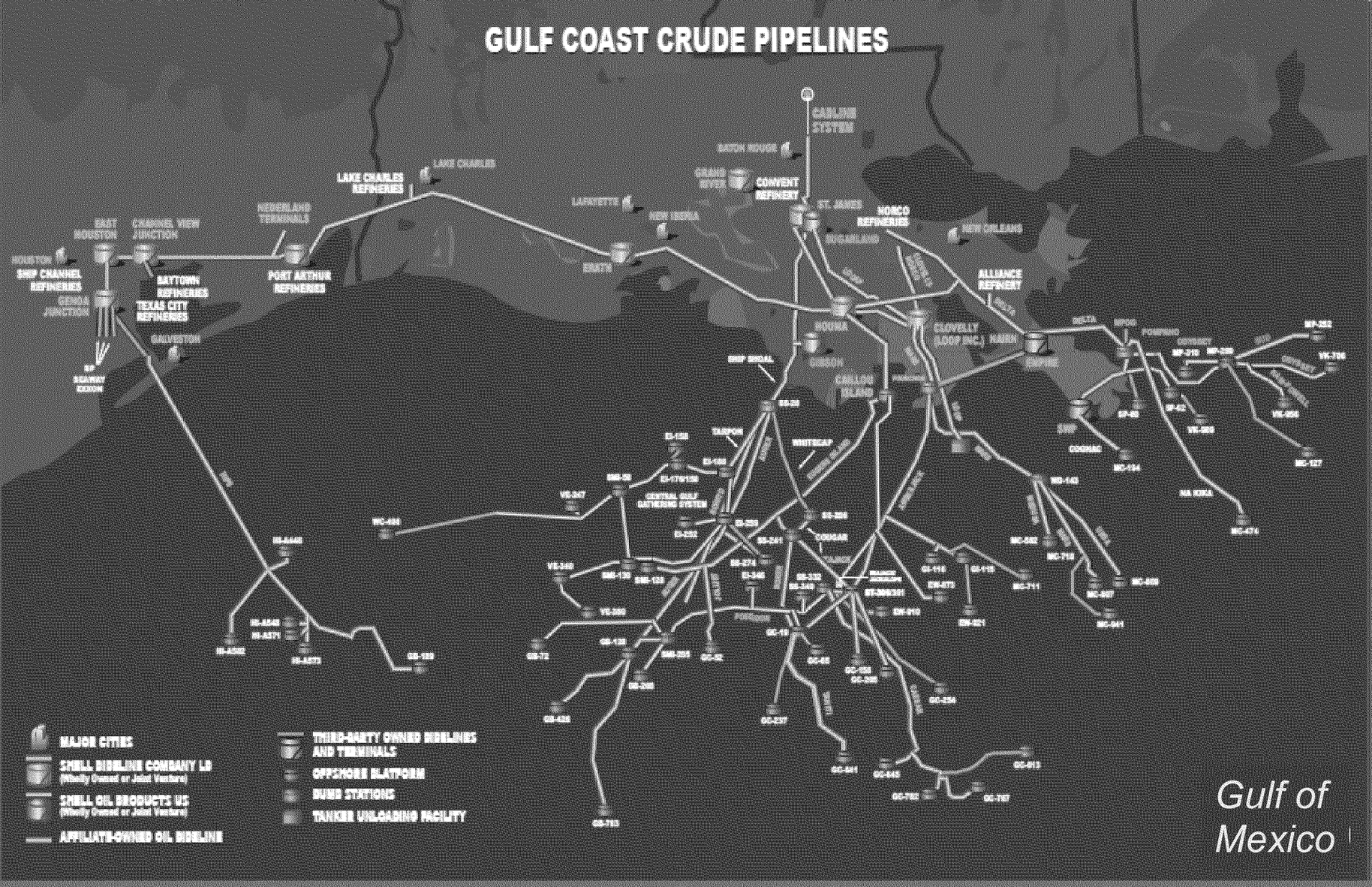
Fourchon Parish and Port Arthur Satellite Images

Fourchon Parish



Port Arthur

Each location is similar but with unique differences. The remainder of the presentation will focus on the Port Fourchon, La. effort.



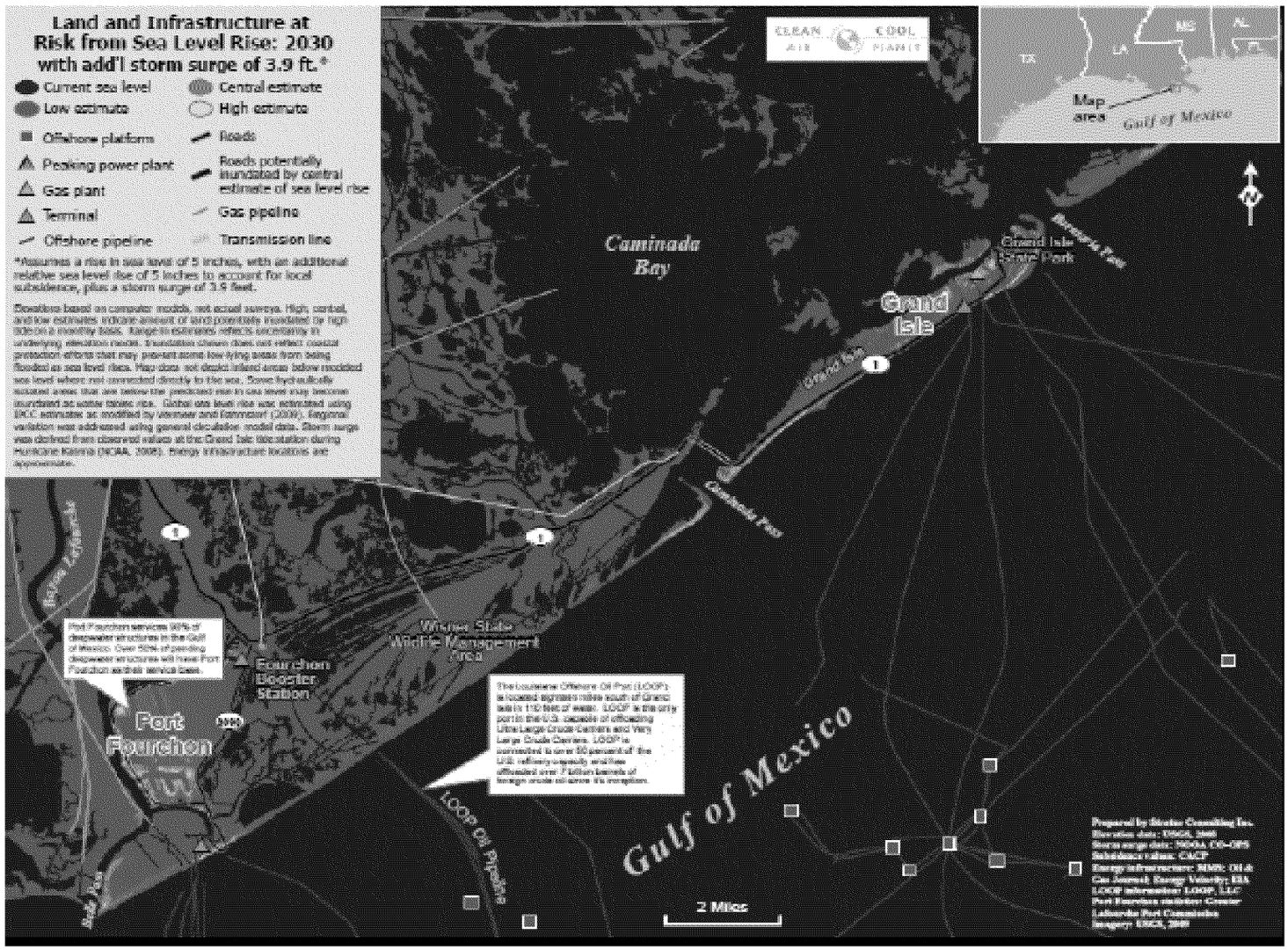
Key Implications of Sea Level Rise In The Port Fourchon Area

- Parish elevation ranges from 3 ft to 16 ft.
- The Louisiana Offshore Oil Port handles 1.2 million barrels per day of oil, or about 13% of national imports.
- Region is home to over 100,000 people.
- Region is the source of over 40,000 jobs.
- The wetlands in the area support over 400 at-risk species and the livelihoods of commercial fishers.

Economic Assets and Value at Risk

- 2030
  - $6.9B of economic assets at risk.
  - $1.1B of energy-related assets at risk.
  - $1.8B of GDP at risk.
- 2050
  - $8.6B of economic assets at risk.
  - $1.1B of energy-related assets at risk.
  - $2.4B of GDP at risk.
- 2100
  - $21.7B of economic assets at risk.
  - $5.2B of GDP at risk.

Grand Isle – Port Fourchon , 2030 – SLR + Storm Surge

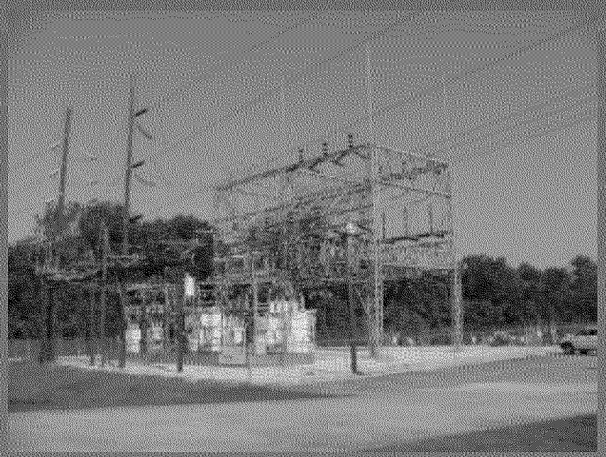


Components of A Hardened Infrastructure

Transmission

Distribution

Substation



Entergy's Transmission System

Proactive Approach to Hardening Develop Hardening Phases

- T&D Resiliency Team develops three phases to implement hardening.
- **Phase 1** reflects projects within existing budgets.
  - **Phase 1** – Entergy Pursues Current Plans.
- **Phases 2 & 3** accelerate hardening improvements (not currently funded).
  - **Phase 2** – Implement Enhanced Plans (*incremental to Phase 1*).
  - **Phase 3** – Implement Remote Operation and Automation Plans (*incremental to Phases 1&2*).

Entergy's Proposed Proactive Hardening Strategy for Port Fourchon

- Utilizes Entergy's defined three phases for hardening.
- Incorporates the recommendations of the Quanta Report.
- Phase 1 projects are planned and budgeted.
- Implementation of complete strategy is over 10 year period.

Port Fourchon - Phase 1*

- **Distribution** $ 2.29M
  - 10% / year replaced for 10 year program (≈ 76 poles/year)
  - Upgrade Backbone Feeder Poles
  - Add Storm Guys
  - Avian Protection
- **Transmission** $66.60M
  - Rebuild Leeville – Golden Meadow 230kV line & Elevate Leeville Substation
- **Vegetation Management** $ 2.56M
  - Six Year Trim Cycle
- **Total Phase 1 Expenditures** $71.45M

* Costs are in 2011 dollars

Port Fourchon Area Phase 1 Planned Transmission Improvements

- Golden Meadow to Leeville transmission line rebuild (21 miles).
  - Build along Hwy 1.
  - Build to 230kV standards (operate 115kV).
  - Build to NESC extreme wind loading (150mph).
- Leeville Substation.
  - Elevate equipment and control house.
- Project Cost: $66.6M.

Golden Meadow – Leeville Project

Port Fourchon - Phase 2*

- **Distribution** $7.24M
  - 10% / year replaced (≈ 340 poles / year)
  - Upgrade remaining Backbone Feeder Poles
  - Upgrade Lateral Poles
  - Upgrade Equipment Poles
  - Reinforce Pole Groundline Support with Pilings
  - Avian Protection
- **Transmission** $38.11M
  - Rebuild Golden Meadow – Valentine Line
  - Rebuild Clovelly – Shell Loop Line
- **Vegetation Management** $2.16M
  - Incremental cost to reduce trim cycle from 6 years to 3 years
- **Additional Expenditures Beyond Phase 1** $47.51M

* Costs are in 2011 dollars

Port Fourchon - Phase 3*

- **Distribution** $0.38M
  Install distribution automation (Alternate Loop Transfer) - two projects.

- **Transmission**
  No additional incremental spending required beyond Phases 1 and 2.

- **Vegetation Management**
  No additional incremental spending required beyond Phases 1 and 2.

- **Additional Expenditures Beyond Ph. 1 & 2** $0.38M

* Costs are in 2011 dollars

Port Fourchon Hardening Summary

Phase 1	$ 71.45M
Phase 2	$ 47.51M
Phase 3	$ 0.38M
Total	$119.34M

Hardening Entergy's Coastal Service Area (20 miles inland)

LA T&D	$ 299M – T $ 10M – S $ 50M – D $ 5M – V
Total LA	$ 364M *
Port Fourchon	$ 119M * (33%)

* Costs are in 2011 dollars

Next Steps

- Complete the pilot (in progress).
- Assess and quantify:
  - Lessons learned.
  - Success of the pilot.
  - Affirm the valuation case.
- Revisit the Technical Conference.
  - Share the success of the project.
- Work with regulators to develop the best path forward.