Hurricane Evacuation vs. Shelter-in-Place for Nursing Homes: Impact of Katrina and Other Recent Storms on Decision Making

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Katrina’s Impacts on Nursing Homes

• Insufficient communication, supplies, evacuation plans

• St Rita’s Nursing Home
  – 34 residents perished

• Lafon Nursing Home
  – 22 residents perished due to lack of electricity and supplies

Source: Boston Globe
Hurricane Rita Evacuation Casualties

• Bus transporting nursing home evacuees caught fire
  – 23 casualties
• 18 additional casualties of nursing home residents from stress of evacuation
• Long evacuation times in the greater Houston area
Evacuation Issues

- Logistics
  - Long lead times needed to acquire transportation
  - Contingencies if planned transportation becomes unavailable
- Long potential evacuation times
  - Partially eliminated by staged evacuations and Contraflow
- Vulnerability of residents
  - Heat exhaustion
  - Medical needs
Shelter in Place Issues

- Structural Safety
- Staff availability
- Supplies
- Potential isolation
  - Blocked access roads
- Loss of power
  - Possibly for extended time period
- Potential loss of other utilities
  - Water, Gas, Communication
Changes in Emergency Planning

• Before Hurricanes Katrina and Rita
  – Many evacuation plans inadequate or non-existent
• Emergency (evacuation) planning process was rethought
Changes in Emergency Planning

• New evacuation planning requirements were mandated in Louisiana
• Act 540 detailed new guidelines for emergency plans
• Nursing homes must evacuate in a mandatory evacuation
Changes in Emergency Planning

• Nursing homes must have a yearly evacuation plan approved by DHH which include:
  – Verified shelter site outside area of risk
  – Proof of transportation
  – Proof of staffing ability, including contacts

• DHH will coordinate transportation of medically complex residents or in the event that transportation becomes unavailable

• Evacuate when in cone of error?
Consider Evacuation?

- Forecast as strong Category 4 at 120 hour (5 day) forecast

Source: National Hurricane Center (NHC)
Consider Evacuation?

- Eventual landfall in Southern Mexico as Cat. 5
Changes in Emergency Planning

• National Criteria for Evacuation Decision-Making in Nursing Homes
  – Developed by Florida Health Care Association and University of South Florida
• General decision-making criteria
• In continuous development
Shelter in Place Studies

• Performed shelter in place studies for DHH
  – Reviewed 45 nursing home facilities
  – Trained DHHS personnel to perform site surveys

• Based off of Least Risk Decision Making (LRDM) methodology
Shelter in Place Studies

- LRDM summarizes sheltering criteria into 15 areas of flood, hazmat, and structural risk
- Data from the 15 criteria are analyzed and categorized as either:
  - Preferred
  - Less Preferred/Marginal
  - Further Investigation/Mitigation Required
- Criteria categorized Further Investigation/Mitigation are the most serious concerns
Shelter in Place Studies

- Aerial analysis of facility site

Source: Google Maps
Shelter in Place Studies

• Facility walk-through and on-site investigation
Shelter in Place Studies

- Rainfall and storm surge flooding analysis
<table>
<thead>
<tr>
<th>Shelter in Place Studies</th>
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<tbody>
<tr>
<td>Preferred</td>
</tr>
<tr>
<td>Storm Surge Inundation</td>
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<tr>
<td>Rainfall Flooding</td>
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<tr>
<td>Hazmat and Nuclear</td>
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<tr>
<td>Lay-down Hazard</td>
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<tr>
<td>Wind and Debris Exposure</td>
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<tr>
<td>Wind Design Verification</td>
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<tr>
<td>Construction Type/Loadpath</td>
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<tr>
<td>Building Condition</td>
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<tr>
<td>Exterior Wall Construction</td>
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<td>Window Protection</td>
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<td>Interior Safe Space</td>
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Shelter in Place Studies

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<tbody>
<tr>
<td>Storm Surge Inundation</td>
<td></td>
<td>-Dry for TS, Cat 1, Cat 2</td>
<td>- Subject to inundation from Cat 3 and higher</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Emergency roof access</td>
<td>- Isolated access routes from surge flooding</td>
</tr>
</tbody>
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<thead>
<tr>
<th></th>
<th>100-year flood event, rainfall</th>
<th>Hurricane</th>
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<tbody>
<tr>
<td></td>
<td>ABFEc</td>
<td>Cat 1</td>
</tr>
<tr>
<td>1st Floor</td>
<td>2.6</td>
<td>DRY</td>
</tr>
<tr>
<td>2nd Floor</td>
<td>DRY</td>
<td>DRY</td>
</tr>
<tr>
<td>3rd Floor</td>
<td>DRY</td>
<td>DRY</td>
</tr>
<tr>
<td>Roof</td>
<td>DRY</td>
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<tr>
<td><strong>Rainfall Flooding/ Dam Considerations</strong></td>
<td></td>
<td>- Subject to isolation from 100-yr flood</td>
<td>- Possible flooding from levee breach</td>
</tr>
<tr>
<td><strong>Hazmat and Nuclear Power Plan Considerations</strong></td>
<td>- Not located within 10 EPZ of nuclear power plant</td>
<td>- Located within precautionary zone for facilities manufacturing hazardous materials</td>
<td>- Further review needed to determine specific chemicals or hazardous materials</td>
</tr>
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<td>Lay-down Hazard Exposure</td>
<td>- Not exposed to lay-down hazard (facility and access routes)</td>
<td></td>
<td></td>
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<tr>
<td>Wind and Debris Exposure</td>
<td>- Building located in sheltered area</td>
<td>- Potential debris source within 300 feet from neighboring residential structures</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- No significant debris source within 300 feet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wind Design Verification</td>
<td></td>
<td></td>
<td>- Design Documentation unavailable</td>
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<tr>
<td>Construction Type / Loadpath Verification</td>
<td>- Reinforced concrete frame with steel frame roof</td>
<td></td>
<td>- Loadpath could not be verified visually. Structural plans unavailable</td>
</tr>
<tr>
<td>Building Condition</td>
<td>- Structure is in good condition with no observable deterioration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exterior Wall Construction</td>
<td></td>
<td></td>
<td>- Masonry with brick veneer. Reinforcement unknown</td>
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<td>Window Protection</td>
<td></td>
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<td>- Unprotected window and door assemblies not certified to withstand debris impact</td>
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- Easy mitigation
- Significantly improves overall facility safety
## Shelter in Place Studies

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<td>Roof Construction/Slope</td>
<td></td>
<td></td>
<td>- Structural metal deck of unknown thickness and fill</td>
</tr>
<tr>
<td>Roof Open Span</td>
<td>-Max span less than 40 feet in shelter areas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roof Drainage/Ponding</td>
<td>-No roof drainage confining parapets or curbs</td>
<td>-No evidence of ponding</td>
<td></td>
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<tr>
<td><strong>Interior Safe Space</strong></td>
<td></td>
<td>- Interior masonry walls extend to upper floor or roof decking</td>
<td>- Unknown reinforcing in masonry walls</td>
</tr>
<tr>
<td><strong>Emergency Access</strong></td>
<td>- Potential shelter areas have access to flat roof via stairway to roof penthouse</td>
<td></td>
<td></td>
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Shelter in Place Studies
Hurricane Gustav Evacuation

• Large-scale evacuation
  – 500-600 medical patients sent out of state
  – 8200 residents from 92 nursing homes evacuated

• Evacuation Issues
  – Many individual nursing home evacuation plans fell through
  – DHH stepped in with helicopter transportation

• 28 casualties from excess stress
Gustav – Outside Evacuation Zone

- Rapids Regional Medical Center
  - Located in Alexandria, Louisiana
  - Heavy rainfall from Hurricane Gustav caused extensive flooding in basement

Source: HCA Delta Division Hospital Network
Gustav – Outside Evacuation Zone

- Rainwater entered air handler room, electric room, and water system
- Loss of electric and water
- Replacement of transformers and steam generator required

Source: HCA Delta Division Hospital Network
Changes in Emergency Planning

- Additional changes proposed for 2009
- Logistics very difficult for large-scale evacuation
  - Consider shelter in place options for non-coastal nursing homes
- Risk assessment conducted to determine suitability for shelter in place
  - Nursing Facility Minimum Licensing Standards Emergency Preparedness (LAC 48:I.9729)
Future of Evacuation/Shelter Decision Making

• Large uncertainties in current decision process
  – Hurricane track and intensity forecast
  – Small changes in track and intensity greatly affect local conditions

• Should be accounted for and quantified in the decision making process
Future of Evacuation/Shelter Decision Making

- Probabilistic approach better quantifies uncertainty
- Provides more quantifiable information on likely storm hazards and the exposure of a population to these hazards
Future of Evacuation/Shelter Decision Making

- Considering forecast uncertainties provides more quantifiable risk-based decisions
- Hurricane landfall, wind speed, and storm surge flooding can be combined with life-safety and structural fragility curves

Source: HAZUS
Future of Evacuation/Shelter Decision Making

• Provides ability to quantify risk to a population from an approaching storm
• Risks from evacuation and sheltering in place can be compared
• Information-driven decision can be made

1. Calculate expected storm surge flooding for approaching hurricane
2. Determine timeline for onset of flooding and rise-rate
3. Calculate probable flood depth and wave environment for study-site
4. Determine physical structure and population vulnerabilities
5. Based on exposed population, make evacuation/shelter decision
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QUESTIONS?

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