

# **Coastal & Ocean Engineering Texas A&M University**

**Billy L. Edge**

**March 18, 2009**

**3<sup>rd</sup> Annual DHS University Summit**

# Outline

- Texas A&M
- Ocean Engineering Programs
- Examples of Natural and Human Hazards
- Student capstone design
- Three grand challenges

# TEXAS A&M UNIVERSITY



- **180 Ocean Engineering UG Students**
- **75 Ocean Engineering G Students**
- **13 Ocean Engineering Faculty**
- **Dedicated Oct. 4, 1876; Texas' first public higher education institution**
- **Enrollment**
  - Total = 48,000
  - Engineering = 10,000
- **Faculty 2,800**
- **5,200-acre College Station campus**

# Ocean Engineering, Texas A&M University

## Haynes Coastal Engineering Laboratory



Maroon Harpoon Human Powered Sub



Wave Basin



Tow Carriage



Dredge/Tow Tank

## 2008 Seniors at SNAME MTS Meeting



Offshore Technology Research Center (OTRC)

# B.S. DEGREE IN OCEAN ENGINEERING

## JUNIOR YEAR

CVEN 302 Comp. Appl. in Engr. & Const  
CVEN 311 Fluid Dynamics  
CVEN 336 Fluid Dynamics Lab  
CVEN 345 Theory of Structures  
OCNG 401 Intro. to Oceanography  
Writing Skills Elective<sup>2</sup> \_\_\_\_\_

CVEN 363 Engr. Mech.: Dynamics  
CVEN 365 Intro. to Geotechnical Engineering  
**OCEN 300 Ocean Engr Wave Mechanics**  
**OCEN 462 Hydromechanics**  
OCNG 410 Intro. to Physical Oceanography

## SENIOR YEAR

**OCEN 301 Dynamics of Off. Structures**  
**OCEN 400 Basic Coastal Engineering**  
OCEN 401 Underwater Acoustics  
**OCEN 402 Naval Architecture**  
OCEN 481 Seminar  
Technical Elective<sup>3</sup>

**OCEN 407 Design of Ocean Engr Facilities**  
**OCEN 410 Ocean Engineering Lab.**  
ENGR 482 Ethics and Engineering  
University Core Curriculum Elective<sup>1</sup>  
Technical Elective<sup>3</sup>  
Technical Elective<sup>3</sup>

# M.S. DEGREE IN OCEAN ENGINEERING

- OCEN 671 Ocean Wave Mechanics
- OCEN 672 Coastal Engineering
- OCEN 673 Nonlinear Hydrodynamic Problems
- OCEN 674 Ports & Harbors Engr
- OCEN 676 Dynamics of Offshore Structures
- OCEN 682 Coastal Sediment Processes
- OCEN 683 Estuary Hydrodynamics

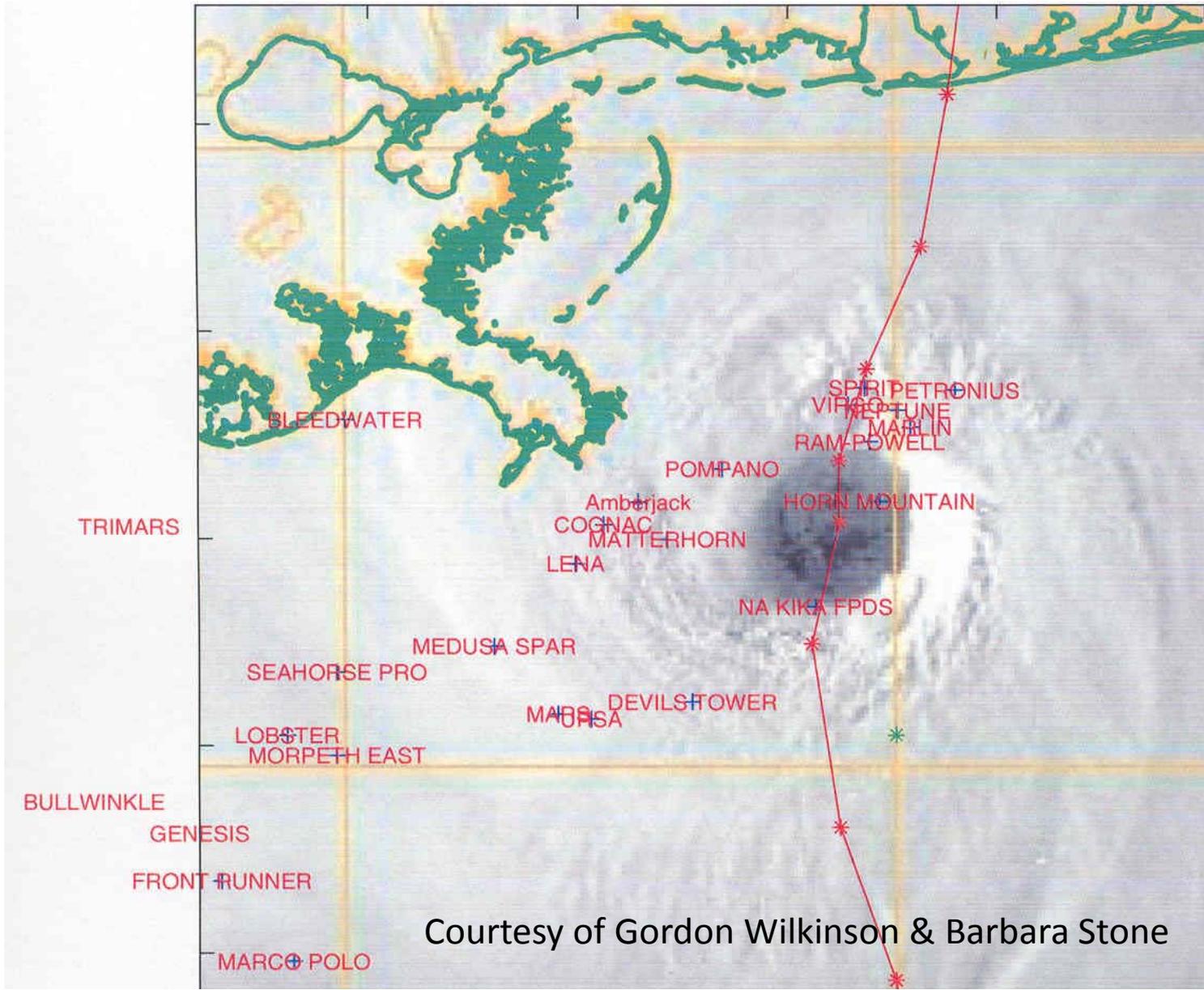
# Rogue Waves



# OFFSHORE MISHAPS



# IVAN STORM TRACK 2004



Courtesy of Gordon Wilkinson & Barbara Stone

# NAKIKKA Delivery



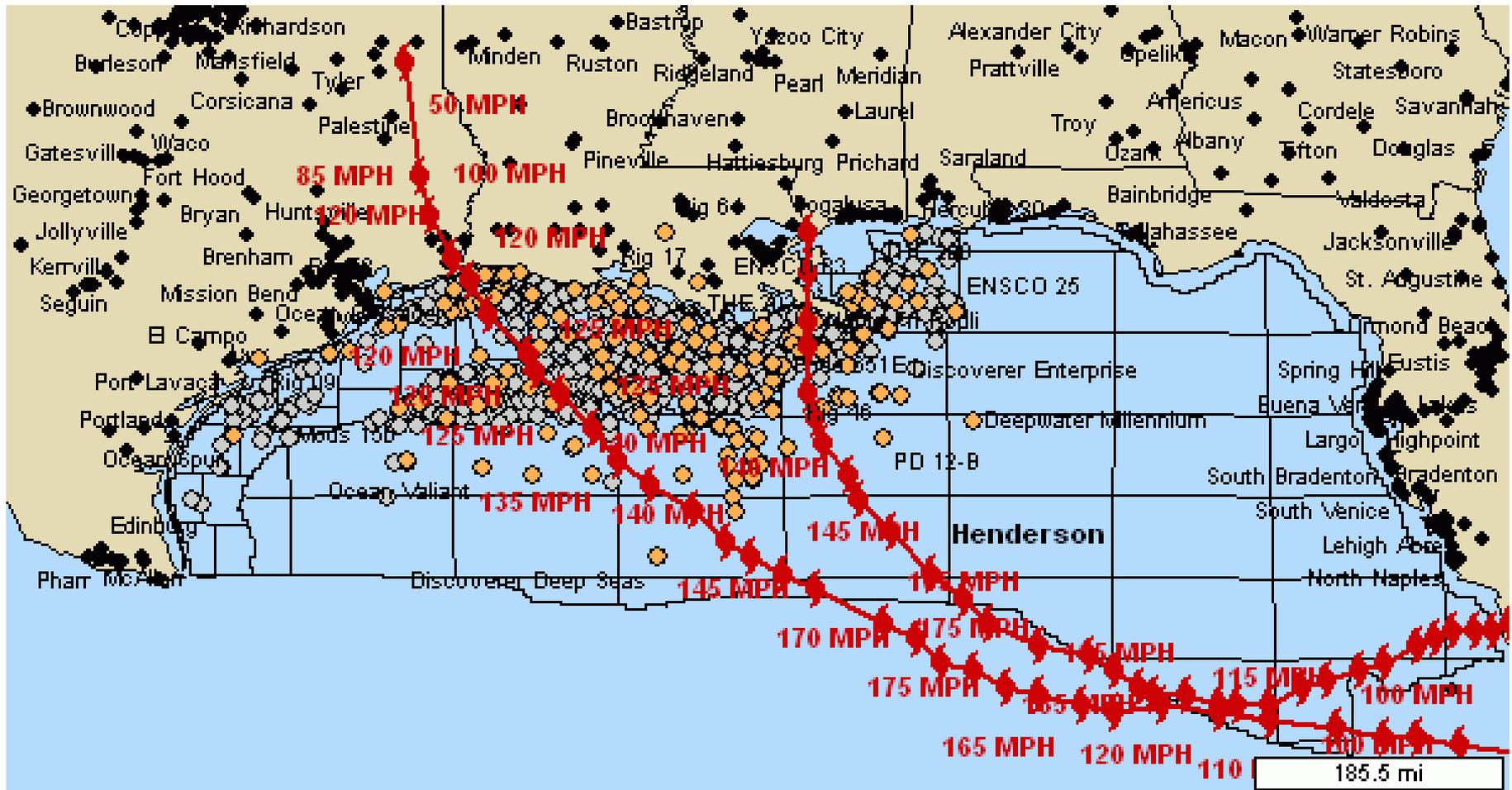
# NAKIK A Lower Deck Damages



# Medusa Spar Damages



# KATRINA & RITA TRACKS (2005)



# Katrina and Rita Offshore Facts

- 2900 platforms in path of Katrina & Rita
- Katrina – 46 platforms & 1 drilling rig destroyed, Rita – 63 platforms & 4 drilling rigs destroyed.
- Katrina – significant damage to 20 platforms & 9 drilling rigs, Rita – significant damage to 30 platforms & 10 drilling rigs.
- Platforms destroyed were near the end of their design life (~20 years).
- No loss of life or significant oil spills



# Hurricane Katrina Onshore Facts

- In New Orleans and southeast Louisiana
  - ~1,100 people killed, >135 still missing
  - Flooding covered 80 percent of the city to depths of 10+ feet (3+ m)
  - 400,000 people fled
  - 125,000 jobs lost
  - \$21 billion in damages to residences and businesses
  - \$7 billion in damages to infrastructure
  - Total communities destroyed



# US 90 between Bay St Louis & Pass Christian (West View)

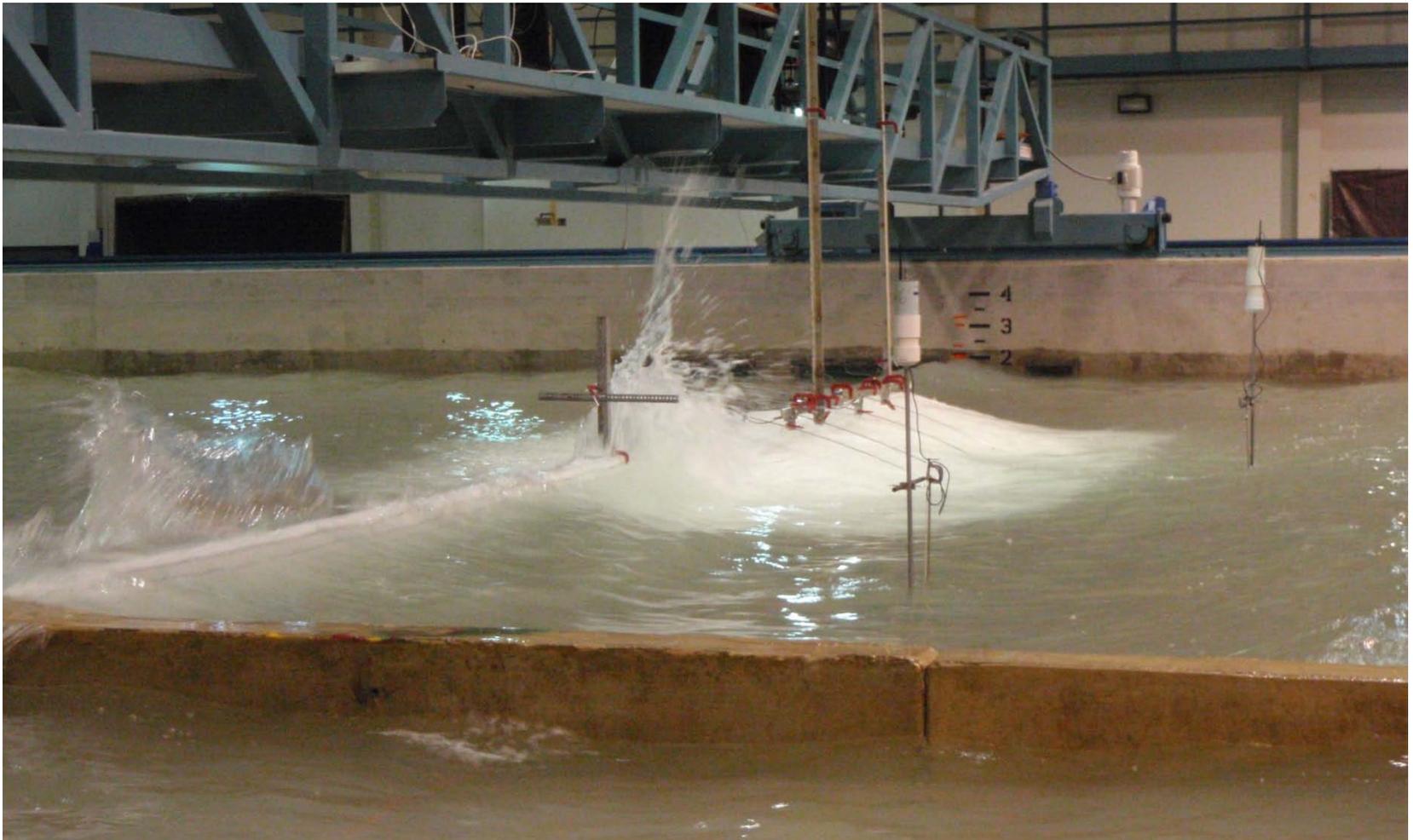


## Forensic Engineering

# Katrina Flooding



# Levee Transitions



# Hurricane Ike





# Design for Waves or Ice?

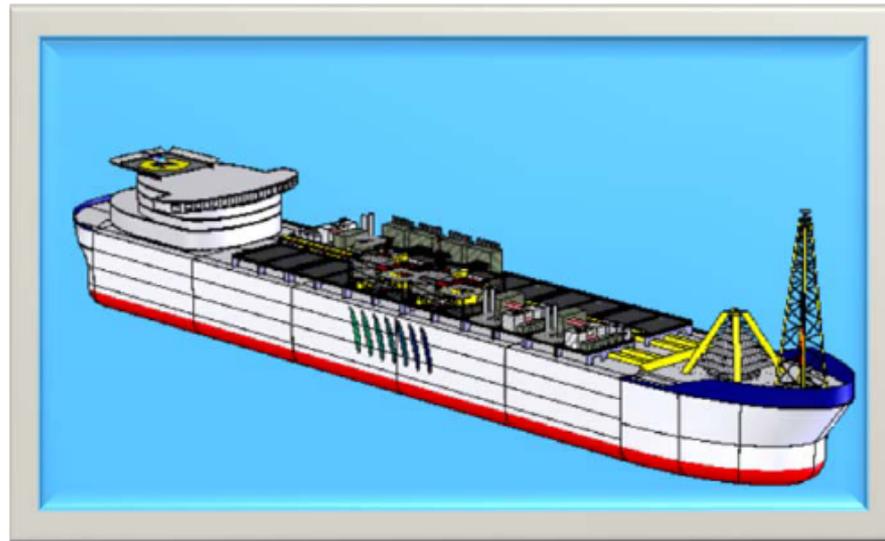


# Offshore Capstone Design



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Presents



**DESIGN OF 1,000 MMBL FLOATING, PRODUCTION, STORAGE, AND  
OFFLOADING (FPSO) FACILITY, LOCATED IN THE EASTERN GULF  
OF MEXICO AT 152 M DEPTH**

# FPSO Capstone Design

- Floating Production Storage and Offloading
- 1 billion barrels
- 150 m water depth
- On station during 10 year
- Run during 100 year event
- ABS & DNV guidelines
- Loadings
- Stability

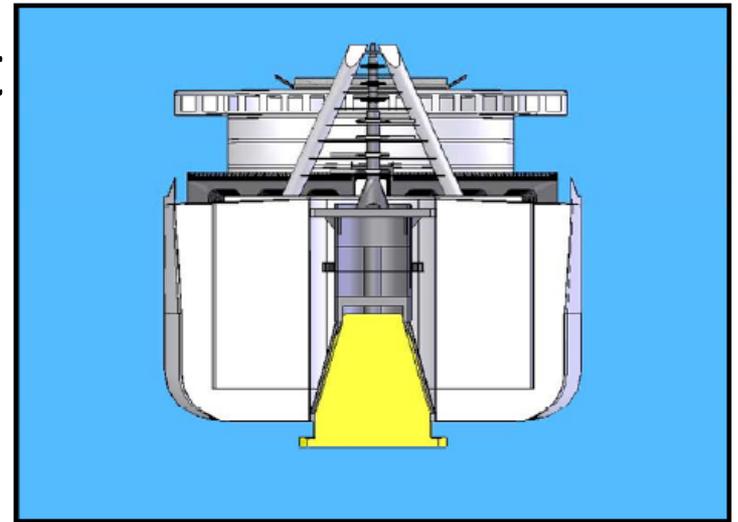
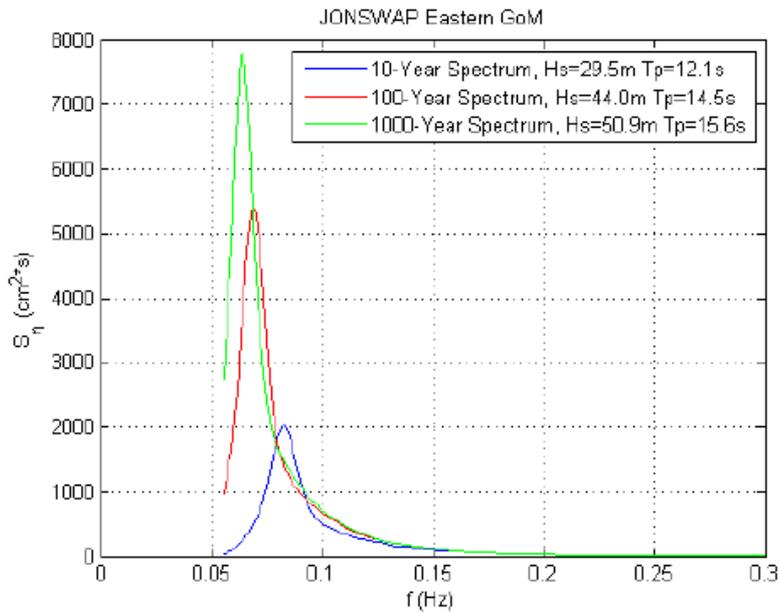


Figure 20: Cross Section of Turret

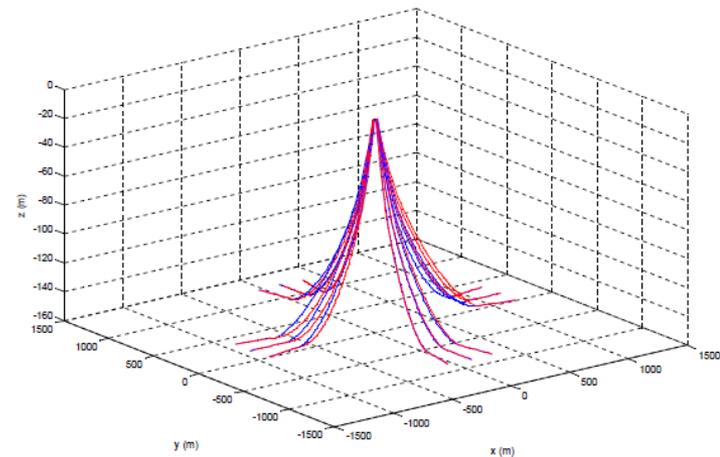
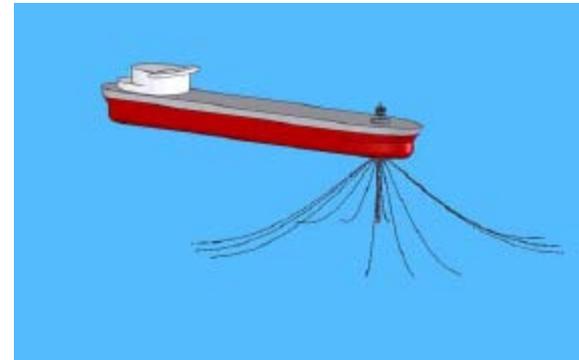
# 1<sup>st</sup> Place 2008 SNAME Offshore Design



$$S(f) = AH_s^2 T_p^{-4} f^{-5} e^{-1.25(T_p f)^4} \gamma e^B$$

$$A = \frac{0.0624}{0.23 + 0.0336\gamma - 0.185(1.9 + \gamma)^{-1}}$$

$$B = \frac{-(T_p f - 1)^2}{2\sigma^2}$$



12 – Leg System

# The Grand Challenges

1. Growth of Coastal Population
2. Global Climate Change
3. Future Engineer Shortage



# Challenges-1

- Rehabilitation of coastal infrastructure
- Inland impacts of tsunamis and storm surges
- Physics based sediment transport in surf zones
- Sand starved shorelines (muddy coasts)



# Challenges-2

- Determine the prudent return period (risk)
- Population of storm events
- Rapid bathymetry in the “forbidden zone”
- Sustainable Coastal Development
- Modeler or Engineer



