The Actuarial Profession
making financial sense of the future

32nd ANNUAL GIRO CONVENTION

The Imperial Hotel, Blackpool

Gulf Of Mexico Offshore Energy

This workshop will be a bit of a whirlwind tour

- Looking at what offshore structures look like
- Damage that can occur
- Coverage offered
- Hurricane accumulations and modelling

- Useful information for managing a fac book
- Or accepting reinsurance risk

- Hopefully something for everyone novice to expert

Presentation by Tom Jowett
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Energy Cat Modelling

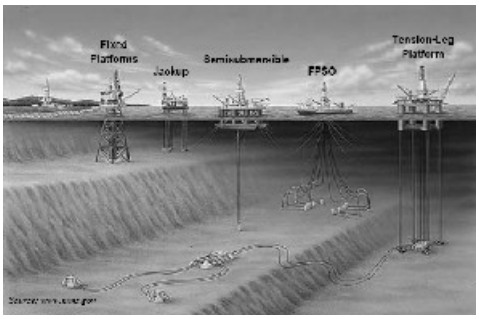
- Why do it?
- Correlations with property
- We've always known that these were there but Ivan, Katrina and Rita have proved the point

Year	Hurricane	# in Path	# major damage	% of exposed
1992	Andrew	700	87	12%
2002	Lili	800	10	1%
2004	Ivan	150	16	11%
2005	Katrina	2,068	79	4%
2005	Rita	793	104	13%

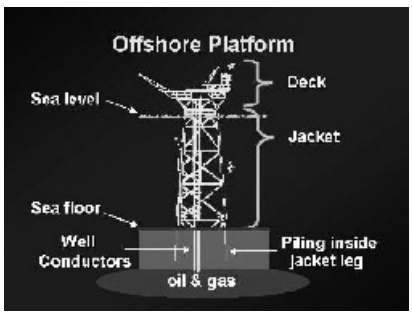
Gulf Of Mexico

- Over 4000 offshore structures
- 33,000 miles of pipeline
- Value approx $150bn offshore property
  - 14 main producing areas
  - 84 named areas
- Most platforms are unmanned – oil is taken off through pipelines
- Interconnectivity of assets – most oil travels through third party assets

Types of Offshore Structure



Anatomy of a platform



Fixed or Immobile Platform

This immobile structure can be built from concrete or steel and rests on the seabed. When oil or gas is located a platform may be constructed to drill further wells at that site and also to produce the hydrocarbon. Although some platforms can be small, most are massive compared to the other types of installations.

Semi Submersible Platform

Has legs of sufficient buoyancy to cause the structure to float, Semi-submersible rigs can be moved from place to place; and can be lowered into or raised by altering the amount of flooding in buoyancy tanks; they are generally anchored by cable anchors during drilling operations, though they can also be kept in place by active steering.

Spar Buoy

A Spar Buoy is a tethered, floating platform deployed in deep water. The characteristic of a spar is its single floating cylinder. They are used for production once the drilling and wellheads are complete. The buoy may have some storage capacity.

In production

Buoy hull ready for topside

Tension Leg Platform

A TLP is a tethered, floating platform deployed in deep water. Its tethers are more widely spread than a spar buoy and it may have multiple floating cylinders. They are used for production once the drilling and wellheads are complete. The buoys may have some storage capacity.

Jackup drilling platform

- A jackup has long leg structures, which it lowers to the seabed raising the rig out of the water. When the legs are raised the structure floats and can be towed to a new location.

Drillship

- As the name suggests this is a ship shaped drilling vessel. Unlike the semi submersible and the jackup, it does not require tugboats to tow it to location. Although they are not as stable as semi submersibles they also drill in very deep waters.

FPSO

- Floating production and storage vessels attach themselves to the well heads and oil is stored in the vessel. Tankers offload the oil periodically.
- Not currently permitted in GOM

13 /49

Coverage

- Physical Damage
- ROW - removal of wreck
- COW – Control of Well
- OEE – Operator's Extra Expenses
- BI – Business Interruption
- CBI – Contingent Business Interruption
- Third party & pollution Liabilities
- Plus lots of others

14 /49

Large Risk Losses

Piper Alpha 6 July 1988
North Sea

167 men died and 62 men were pulled from the sea following a catastrophic explosion and fire

15 /49

Large Risk Losses

Explosion and fire killed 11 men. In the fire fighting effort a ruptured fire main filled the pontoon legs with water. It capsized and sank four days after the fire started.

P36 March 2001
Off Brazil

Hurricane Damage

- We are concerned about accumulation
- Platforms are shut in and all personnel evacuated prior to a hurricane

- Wind damage
- Wave damage
  - My personal belief that most platform damage is caused by waves rather than wind.
- Mudslides

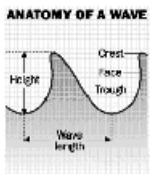
How Big Are the Waves?

- On September 16 last year when Hurricane Ivan stormed across the Gulf of Mexico and tore into the coast of Alabama, accompanied by 130mph winds and storm surges 8ft high.
- While still out at sea, oceanographers report, the hurricane also produced a series of giant waves, one of which stood 91ft (27m) from crest to trough, the height of a ten-storey building and a new world record for a wave recorded by instruments.
- But science, like old salts' tales, is fallible. The seabed instruments that measured the surge were turned off at the moment the winds reached their peak, and scientists from the Naval Research Laboratory at Stennis Space Centre, Mississippi, have had to employ a computer model to predict that, while they were not looking, at the height of the storm the wave reached 131ft.

The Times 15 June 2005

Wave size is a function of:

Water depth
Wind Speed
Wind duration
Fetch



Rogue Waves

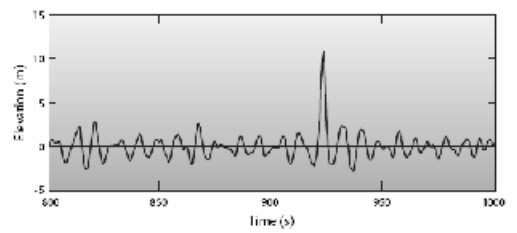


Figure 2. Wave record at November 17, 1984 from the Gorm platform in the central North Sea (Sand et al., 1990). The wave that stands out, through clearly having a crest height of over 11 m, clearly exceeds the significant wave height of the background by a factor of two. Another famous wave record is the Draupner wave or "New Year's Wave" where a rogue wave of 25.6-m height was measured in a 10.8-m sea on New Year's Day 1995.

http://www.tos.org/oceanography/issues/issue_archive/issue_pdfs/18_3/18.3_muller_et_al.pdf

MMS Design Criteria for Deck Height

- Pre 1971 and shallow water structures - deck must clear the 25-year wave
- 1971 increased to a min of 35 feet
- 1988 such that it clears (is above) the 100-year storm wave with a minimum 50 foot air gap
- 1988 Annual above water structural inspections plus post event inspections
- 2006? 100 year wave re-defined?

IVAN Sept 2004

Jackup rig Enseco 64 minus legs !!!

The derrick has also collapsed

Hurricane Dennis

- BP Thunder Horse platform
- Although happened at the same time as Dennis this was coincidence
- Not insured
- But the platform was righted

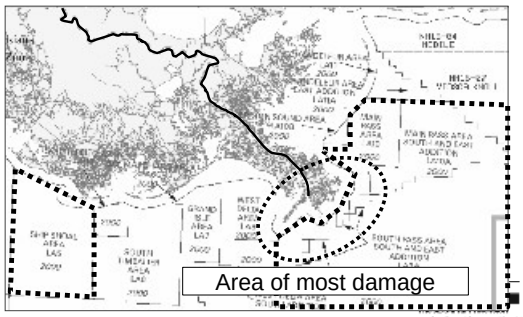
22 /49

Hurricane Ivan

- Petronius, 50% owned by Chevron and 50% by Marathon Oil, returned to 75% pre-Hurricane Ivan production rates on 15 March after being shut-in for 175 days

23 /49

Ivan Pipelines – mud slides Damage to pipelines



Ivan Mudslide damage

- Info from an MMS communication

- MMS estimates that 150 platforms and 10,000 miles of pipelines were in the direct path of Hurricane Ivan.
- Pipelines are buried by as much as 20 to 30 feet of mud.
- Overall, twelve large diameter pipelines (10" or larger) were damaged in Federal waters.
- The most pipeline movement Northcutt said he had encountered previously was a few hundred feet. After Ivan, however, one pipeline was found to have moved two miles.
- The combination of Ivan and mudslide movement is also thought to have toppled the Taylor Energy fixed platform in Mississippi Canyon block 20. The eight-pile unit was located in 479ft of water in a notorious mudslide area.

Mudslides

- Underwater landslides are called turbidity currents
- Turbidity currents consist of a flow of water saturated sediments flowing downslope.
- Can travel a long way – 1000km and more
- We know where they have happened and damaged assets
- "couldn't happen on the continental slope as it's too steep for the mud to build up"
- BUT …

Turbidity Currents

- On 18 November 1929 an earthquake struck the continental slope off the coast of Newfoundland
- Twelve transatlantic telephone cables were snapped in a total of 28 places.
- Exact times and locations were recorded for each break suggesting current speeds of 50 to 70kph
- Covered an area larger than Maine and Connecticut
- Moved up to 200 cubic kilometres of ocean floor sediments on the continental slope.
- Eventually travelled over 1,200 km from its source out across the Sohm Abyssal Plain.

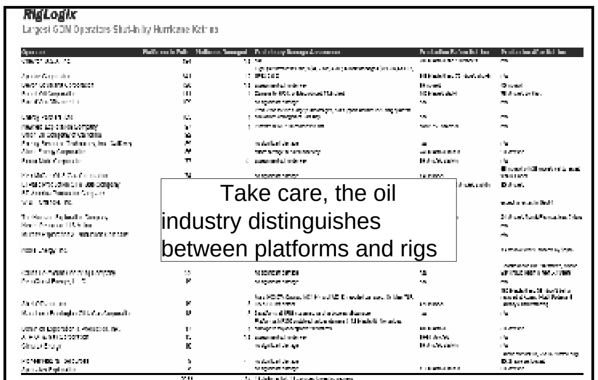
- Implications for energy assets……

Katrina

Majority of platforms damaged were end of life.

Semi sub Chemul under construction for Pemex

TLP with Helmerich & Payne drill package



Take care, the oil industry distinguishes between platforms and rigs

▪http://www.rigzone.com/data/riglogix/Hurricane_Katrina_Report-OperatorPlatformDamage.pdf

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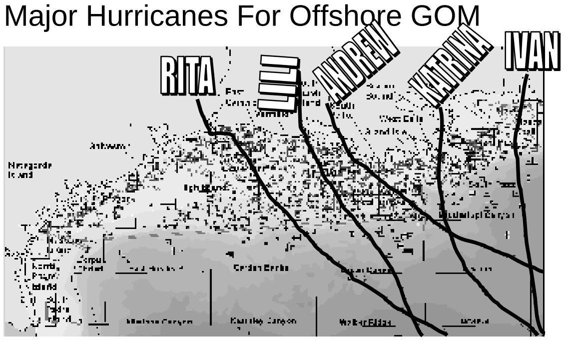
Major Hurricanes For Offshore GOM

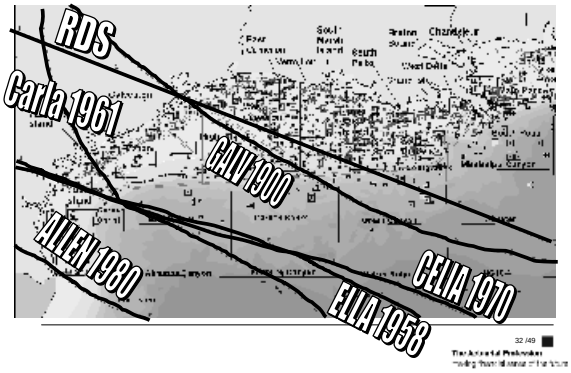


Storm tracks taken from Eras

Lloyd's RDS

- Storm Track – West North West
- Intensity – not explicit
- Loss Calculation
  - Loss factor by distance from centre of storm
  - Factors different for each coverage
- Historic Precedent ?
  - Never say never….

Historic Storms Similar to Lloyd's RDS



Aggregation Systems

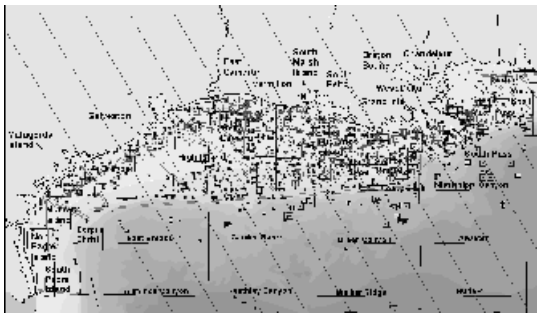
- Eras – Room Solutions
- Exact – Room Solutions
- Open Exposure – Intech Solutions
- Bespoke systems
- Others?

ERAS Aggregation Modelling Data

- Aggregation by area & block gives a misleading picture
- At GEIS we run 11 storm aggregations
- Plus the Lloyd's RDS Track
- Parallel tracks about 50 miles apart
- We use a 50 mile radius
- PML factors – selection made in Eras

PKZIP File

GEIS Aggregation Storm Tracks



Storm Track Aggregates

- Expressed as a % of the Lloyd's RDS aggregate

Storm 1	1%
Storm 2	4%
Storm 3	17%
Storm 4	33%
Storm 5	45%
Storm 6	88%
Storm 7	98%
Storm 8	59%
Storm 9	84%
Storm 10	66%
Storm 11	54%
Lloyds RDS	100%

Old GEIS data

The Actuary's Problem

- How to estimate the loss cost for offshore GOM hurricanes?
- Can we do better?
  - At gathering data
  - At modelling
  - At communicating the results
  - Especially the uncertainty
- Not just a problem for actuaries…underwriters, risk managers and senior managers too

Historic Data Requirement

- Historically we used the largest platform exposures
  - Sometimes by coverage
  - With no policy level information
- This precluded all but the simplest approaches
  - No Coverage Limits or Excess points
  - Or Policy Limits

Offshore GOM Loss Cost Estimation

- How do we estimate Loss Cost?
  - 4000+ structures
  - Numbers damaged by storm as % of total–
    - Andrew 87 - 2.2%
    - Ivan 79 – 2.0%
    - Rita 104 – 2.6%
  - Return period
  - 10 years?
  - Twice a year?
- Burning Cost ?
  - Hit and miss – some have zero cost, others are badly hit
  - Should cedants be penalised or rewarded for chance?
- Rate on exposed aggregates?
- ROL Load?
- Ignore it ?

Loss Cost Estimation – Data Required

- Need to get rigs & exposures electronically
- Platforms by policy
  - Exposures for every platform
  - With coverage limits & excess points
  - And policy limits

Aggregation Data Needed for Modelling

- Policy Identifier
- Platform Name
- Area
- Block
- type - mobile, shallow water, deep water, pipeline
- signed line (or written if signed not known)
- Policy Hurricane Sub-limit
- Policy CSL Physical damage
- Policy CSL Business Interruption
- Policy CSL Combined PD, BI
- Underlying deductible eg OIL

- Then [Limit , Excess and exposure by coverage]

- Control of well
  - Limit
  - Excess
- Physical damage
  - Total Insured Value
  - Limit
  - Excess
- Removal of Wreck
  - Limit
  - Excess
- Business interruption
  - Limit
  - Excess
  - Average Daily Value
- etc, etc for all coverages

Modelling Tools

- Only for GOM at present
- Room Solutions Eras / Exact ……
- RMS Risk Link
- Eqecat have been talking about developing a tool
- Others?

RMS Platform matching

- Need to match exposed platform names to the RMS naming convention
- RMS has a complete list of offshore structues
- With construction details & water depth
- Can match by county (named Area)
  Block and platform

RMS Model – claim calculation

- Stochastic Event Module
  - Simulates the physical parameters - a set of stochastic hurricanes.
- Hazard Module
  - Peak wind speed for each storm and analyzed location.
- Vulnerability Module
  - Impact of the hazard on the built environment
- Financial Analysis Module
  - Calculates losses considering the insurance and reinsurance conditions.

Wind modelling

- Water roughness of 4
- Platform roughness of 5
- designed to simulate the open water sparse construction environment

- Platform damage caused by waves
- RMS models peak wind speed

- Impact of very large seas having a higher roughness factor?
- Impact of Water depth, Wind duration and Fetch?
- Rogue waves

Vulnerability Module

- Construction classes
  - Shallow water structures
  - Fixed Structures
  - Deep water structures
- Occupancy class
  - Offshore Platform
- Year built
  - Pre or post 1971
- Building inventory data
  - Coverage 1 - Buildings
  - Coverage 2 - Contents
  - Coverage 3 – Business Interruption (time element)
  - *Removal of Wreck – manual calc using damage factors*

- Physical damage split between CV1 & CV2
- Rationale ?

RMS Benchmarking

- Benchmarked against limited claims data
- BI data especially thin
- 2005 will add a lot to the benchmarking data set

RMS Risk Link

- 4.32 first to include offshore energy…….
- 4.5
- 5.0 Latest version

- Check that you are getting sensible answers from each of the three coverages modelled

All pictures and much information have been taken with thanks from the following websites

- http://www.answers.com/topic/oil-platform
- http://www.civl.port.ac.uk/comp_prog/offshore_platforms/
- http://galveston.ssp.nmfs.gov/platforms/index.html
- http://www.rigjobs.co.uk/oil/oilrigs.shtml
- http://www.rigzone.com/data/riglogix/Hurricane_Katrina_Report-OperatorPlatformDamage.pdf
- http://www.gomr.mms.gov/homepg/pubinfo/freeasci/platform/freeplat.html
- http://www.freerepublic.com/focus/f-news/1473113/posts
- http://news.bbc.co.uk/onthisday/hi/witness/july/6/newsid_3036000/3036510.stm
- http://www.oilonline.com/news/features/oe/20050805.3D_laser.18751.asp
- http://www.oilonline.com/news/features/oe/20041101.Ivan_-_t.16269.asp
- http://www.toolpusher.co.uk/Rigpics/fpso-floaters.htm
- http://www.tos.org/oceanography/issues/issue_archive/issue_pdfs/18_3/18.3_muller_et_al.pdf
- http://www.offshore-technology.com/projects/northamerica_gallery.html