Agenda

• Background and overview of Offshore Energy insurance

• Evolution of market pricing methods

• Developments to windstorm pricing (asset dispersion)?

• Future market environment – post Deepwater Horizon
Science and Technology
- Oil and gas formation

- Cooking
- Pressure
- Migration
- Trapping

Impermeable rock

Permeable reservoir rock

Oil & gas
Science and Technology - Drilling

**Schematic**

- Cement Casing
- Drill string
- Drill bit

**Multiple wells**

Blowout Preventer (BOP)
Science and Technology
- Drilling units

Mobile drills (semi-submersibles, jack-ups, etc.)
Science and Technology - Production

- Platforms / complexes
- Subsea
- Pipelines
Global Offshore Energy insurance market

Total reported: 2.95 USD billion

Source: IUMI Global marine insurance report 2009
Offshore Energy Insurance Gross Loss Ratios - as at 31 December 2009

Source: Lloyd’s (incurred losses)
Evolution of market pricing methods
Overview
Assureds, Perils and Insurance Coverage

Main coverages:
• Property Damage (and removal of wreck)
• Control of well (and re-drill, pollution clean-up)
• Liability
• Loss of Production Income / Loss of Hire

Main perils:
• Blowout
• Windstorm
• Collision
• Fire
# Rating overview - Pre Ike

<table>
<thead>
<tr>
<th>Property Damage</th>
<th>Control of Well</th>
<th>LOPI / LOH</th>
<th>Liability</th>
<th>Clash (ex-wind)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sum insured</td>
<td>Well length</td>
<td>Maximum period x Maximum unit value</td>
<td>Revenue Sum insured No. of wells</td>
<td>Total complex value plus CoW limit, etc</td>
</tr>
<tr>
<td>Asset type</td>
<td>Well depth</td>
<td>Oil price Day rates Asset type</td>
<td>Operator Loss record Location Contract</td>
<td>See PD/CoW</td>
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<tr>
<td>Area</td>
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<tr>
<td>Operator</td>
<td>Well type</td>
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<tr>
<td>Water Depth</td>
<td>Horizontal wells?</td>
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<tr>
<td>Air gap (hurricane)</td>
<td>Contractor</td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td>Waiting period</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XS defined for 100% interest</td>
<td>Re-drill? Clean-up? UGBO? Contract terms Limit/XS</td>
<td>Waiting period</td>
<td>Limits DIC/DIL</td>
<td>Combined single limit</td>
</tr>
<tr>
<td>Separate hurricane limit/XS</td>
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</tbody>
</table>

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Rating Overview
- Pre Ike

• Control of Well coverages triggered without loss of well control
  – Re-drill
  – Re-drill without re-drill
  – Seepage & pollution clean-up

• BUT coverages rated on well length
  – Not directly related to hurricane risk
  – Difficult to monitor aggregate exposure

• Post Katrina
  – Gulf of Mexico footage rates tripled

• Post Ike
  – windstorm pricing re-structured
Rating Overview - Post Ike

- Explicit windstorm and non-windstorm pricing

- Additional Control
  - Scheduled sum insured per well
  - Rate applied to total well sum insured

- Per windstorm retention and annual windstorm limit
  - Based on proportion of total asset value
  - Total asset value includes well sum insureds

- Notional rates increased (~ +25%)
  - 15-20% rate on line
  - Put the Cat back into Cat Mad Men?
Rating using Cat models

Windstorm events with probabilities

Asset details

Damage calculation

Damage with probabilities

Insurance losses with probabilities

Coverage details

Expected loss + Loadings = Premium
Two different worlds

**Status Quo**
- Simple rating structure (rate x exposure)
- Consistency between accounts
- Quick
- Cross-subsidies between accounts?
- Commercial influences easily mixed up with technical influences

**Catastrophe model**
- Considers the details
- Commercial influences are explicit
- Complexity reduces transparency and results are difficult to sense check
- Mostly calibrated at the micro-level
- Modelling the impossible? (eg non-PD coverages)
- Cat models have not always been right
Developments to windstorm pricing
- Asset dispersion
The rating process

1. Identify new risk factor – better differentiator
2. Measurable values of this factor – rating factor levels
3. Calibrate rate relativities – data and models

Windstorm example using Cat models
1. Asset spread
2. Spatial dispersion measure
3. Use Cat model to generate losses and calibrate premium adjustment factor
Asset dispersion
- Example account
Asset dispersion
- Another example account
Measures of asset dispersion

- Variance in two dimensions
  \[
  \tilde{A} = \begin{bmatrix}
  \text{Var}(X) & \text{Cov}(X,Y) \\
  \text{Cov}(X,Y) & \text{Var}(Y)
  \end{bmatrix}
  \]

- Trace is the sum of squared distance from the centroid

- Each point can be weighted (e.g., asset value)

- Other measures
  - Determinant, largest eigenvalue, nearest neighbour distance, …
Improvements to rating
- Sample portfolio

• 27 fictional accounts
  - Asset values scaled such that all accounts have the same total insured value
  - All asset types set as equal
  - Asset locations are real
  - ie. A one-way analysis

• All the accounts would notionally be charged the same premium

• All the accounts would have the same windstorm retention and windstorm limit
Improvements to rating - findings

Cat loss standard deviation vs asset dispersion
(27 accounts)

Ground up loss variation ($\sigma_{GU\ loss}/\mu_{GU\ loss}$)

Spatial variation ($\sigma_x^2 + \sigma_y^2$)

$R^2 = 0.4486$
Improvements to rating - findings

Insured layer burn vs asset dispersion (27 accounts)

Burn ratio ($\mu_{layer\ loss} / \mu_{GU\ loss}$)

Spatial variation ($\sigma_x^2 + \sigma_y^2$)

$R^2 = 0.3478$
Conclusions - Sample portfolio

- Both variance and average burn (negatively) correlated with the asset dispersion

- Dispersion statistic can be used to adjust mean windstorm risk premium if Cat model not used in underwriting process

- Further extend the idea to adjust cost of capital based on portfolio dispersion:
  - Monitor aggregate exposures
  - Manage risk appetite, increase line sizes or price more aggressively
Current to future market situation – Deepwater Horizon
Deepwater Horizon – Background

• Where?
  – Macondo prospect
  – Mississippi Canyon
  – 60km from shore

• Who?
  – Operator: BP
  – Joint Venture Partners:
    Anadarko
    MOEX (Mitsui)
  – Drilling Contractor: Transocean
  – Drilling Rig: Deepwater Horizon
  – Products:
    Halliburton (cement)
    Cameron (BOP)
Deepwater Horizon – Background

• What and when?

22 April
Deepwater Horizon sinks

30 April
Oil spill reaches US shores

8 May
1st attempt to cap the well fails

28 May
“Top kill” fails

4 June
Cap successfully placed over leak

20 April
Blowout ignites - killing 11 rig workers

26 April
RoVs detect oil leak from riser and drill pipe.

Failure to activate BOP

19 September
Transocean successfully complete relief well and plug leak
Deepwater Horizon – The cost

- $1.5bn - $3bn insured loss
  - PD (Deepwater Horizon insured value = $600m)
  - Control of Well, clean-up
  - Liabilities
  - Contingent liabilities?
  - D&O?

- $20bn+ total cost
  - BP self-insured
  - Oil Pollution Act (OPA) 1990 - Exxon Valdez
  - BP elected not to stand behind $75m liability limit
Deepwater Horizon – The fallout

- Long lasting environmental damage?
- Tony Hayward leaves BP
- Deepwater drilling moratorium
- Increased regulation of the oil industry
- Legal challenges to “knock-for-knock” provisions
- Amendments to OPA 1990
  - Increased or unlimited liability?
- Increased demand for Liability and Control of Well limits
  - Rate increases (including RI)
  - New capacity entering the market?
  - New rating for offshore liabs?
Questions or comments?

Expressions of individual views by members of The Actuarial Profession and its staff are encouraged.

The views expressed in this presentation are those of the presenter(s).