The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Remember Where the Offshore Rigs Are and What They Can Take?

Posted by Prof. Goose on August 26, 2006 - 11:42am
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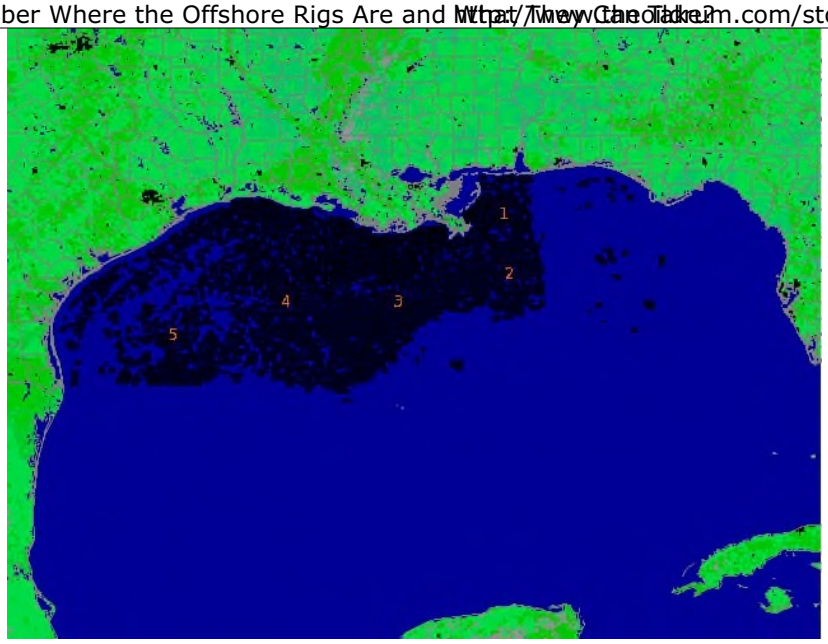
This is the GSF High Island III, damaged last year.

Under the fold is a discussion we had last year with our friends at KAC/UCF (a site we'll probably be seeing a lot of if trends continue--and here is a link to their "Hurricane Impacts on Gulf of Mexico Oil Production" (.pdf warning)). The discussion was regarding the structural standards to which offshore rigs are built and their wind tolerances...interesting stuff.

Remember where the oil fields and the rigs are? They are here:



From one of our insiders, here's a couple of pictures of damaged rigs here (GSF Adriatic VII) and here (GSF High Island III). The insider reminded us that:

> You might also point out that in order to beach one of these rigs, ALL THREE of their 150' legs must be broken off by the storm. So to fix these rigs, they would require 3 new legs, a new derrick, a new block and draworks, repair of everything broken....it is most likely that they will be scrapped or at a minimum, stripped to the hull and rebuilt. Rebuild will take longer than building a new rig because of inspections and removal of damaged stuff, but with material costs high, it may be viable.

From our KAC/UCF friends:

> Thought I could shed a little light on design criteria for the offshore facilities.
>
> As you pointed out you have to balance the design life of the structure, the raw replacement cost of the structure, and the cost of not having the production from the structure. Lets look at five sites in the GOMEX (map attached here).
>
> All wind speeds are in knots, two minute average at 10meters above the surface, and are based on an analysis of hurricane activity since 1851 (see Watson and Johnson, "Hurricane Loss Models, an opportunity to improve the state of the art", Bulletin of the American Meteorological Society, Nov. 2004). Assuming a 10 year design life, what conditions should we expect? Here are the 10 year, 95% prediction limit values (in other words, in any given 10 year period there is only a 5% chance this value will be exceeded) for these sites:
>
> 10 Year
>
> Site 1
>
> 70
>
> Site 2

79

Site 3

80

Site 4

75

Site 5

70

Most engineers use a 100 year design criteria for major structures even if the design life is substantially less than that. Our comparable 100 year values are:

100 Year

Site 1

117

Site 2

139

Site 3

140

Site 4

131

Site 5

118

The 100 year values used in the GOMEX are a bit lower than this because most ocean engineering firms base their analyses on data since 1900, and missed the period of intense activity in the late 1800's.

It is important to keep in mind that very few sites actually exceeded a 100 year design event for Katrina or Rita. However, even if a structure is a 100 year design on commissioning day, after a couple years bathing

in warm salt air and the normal wear and tear of use it probably isn't anywhere near that level in reality, even with a PM program.

So how hard is it to build a better structure? Harder than you might think. This table shows the relative wind load and relative stress (which includes vibration modes) between the minimum wind speed for each Saffir Simpson Category:

Category

Min Wind

Wind Load

Stress

1

64

1.00

1.00

2

84

1.72

2.26

3

97

2.30

3.48

4

114

3.17

5.65

5

135

4.45

9.39

In Saffir/Simpson terms, most designs are for a Cat 3. If you wanted to build something to withstand a Cat 5, you would have to build it roughly three times stronger - a pretty tough thing to do without totally blowing out the economics of the structures. These are wind loads - designing for wave loads for an anchored structure get to be nightmarish for extreme events. A big air gap for waves means a big surface area for wind loads. The uplift forces, differential stress from waves coming from different directions (which happens inside hurricanes), combined with wind loads, makes designs above Cat 3 problematic.

The ultimate question is, do you pay some large amount up front in your design, or do you roll the dice and hope your less well designed structure is lucky? Most engineers try to split the difference and protect against most events, and hope the big ones don't show up during their watch.

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