Risk Management

Risk Analysis of a Dynamic Positioning Diving Vessel Up Weather of a Platform and Jack Up

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DP Risk Analysis
Up Weather DP Dive Vessel
Presentation Content

• The ‘problem’ identified
• Vessel – DP System, Capability, DPOs and Audit
• Risk Picture – frequency (industry and vessel), exposure time, Drift of Drive off (industry and vessel), Impact Energy ROMs
• Threats, Controls and Mitigation
• Conclusions
The Problem
The Problem

- Three fixed platforms
- Two Jack Up rigs
- Up weather DP diving vessel < 30 m
- Strong prevailing currents up to 2 knots
- HAZID identified the collision risk
- Needed to quantify the risk
The Vessel
Vessel’s DP System

• Class 3
• 3 bow tunnels – 1100 kW – 18.75 tonnes
• Auto c’over - manual start bow thruster
• 2 stern azimuths – 1300 kW – 21.87 tonnes
• 1 small skeg tunnel 380 kW – 6.25 tonnes
• 6 Diesel Gens (4x1100kw, 2x 1300kW)
• Split 660V
• Split and third 440V
DP Control System

- Triple voting (Simrad)
- Back up (Simrad)
- Two taut wires (Alstom)
- Two acoustics (Simrad & Sonardyne)
- Two DGPS (Racal Multifix, SatA, B, spot beam)
- Three Gyros, VRS and Wind Sensors
- Four UPSs
DP Operators & DPQA

- Four DPOs plus Captain (UK, Ireland, Poland, Italy, American)
- One may be contract or from another vessel
- 12 hour on 12 hour of overlap 6 hours
- Senior & Junior together
- Six week rotation
- Three week crew change (problem?)
- DPQA – IMCA/IMO best industry practice
DP Audit

- Failure Mode and Effect Analysis (FMEA) and proving trials.
- Annual Trials.
- DP Mobilization Trials.
- DP Operator Training, Qualifications, Familiarization and Experience.
- Capability Study.
- DP Watch keeping check lists.
- DP log books – DP Certificates.
DP Worse Case Failures

• Loss of 660V swbd (short circuit) – 1 Azimuth and one bow thruster
• Loss of one engine room (governor 24V, fuel, cooling etc.) - same
• Note transfers load to remaining side – doubles it.
• Loss of UPS – Stbd taut wire, DGPS 1 and both acoustics?
• Perfect position reference
DP Weather Capability

- Vessel had standard IMCA 1.5 knot current set and worse case failure
- Performed new analysis on for 2 to 2.5 knot beam current and 20 knot head or stern wind
- As ran a test set to compare to 1.5 knot set – large discrepancy – 20 rather than 40 knots coincident
- Tested on vessel – new analysis correct
Risk Picture
Risk Picture

- IMCA Platform Collision 93 – 7.13 DP yrs
- LOP 1 - 7.69 months
- IMCA Shuttle Collision – 29 DP yrs
- DeepStar Emergency Disconnect – 11.6 yrs
- GM 1990 to 1998 LOP1 – 2 yrs
- GM add 99 to 2001 – 2 + yrs
- IMCA 2001 – 8 well run LOP 1 – 2.8 years
- Drift/Drive off – 40:60 to 1993
- Drift/Drive off – 60:40 since
# Risk Profile

- **Frequency**
  - One or more times a year: Almost certain
  - Once every 1 to 10: Likely
  - Once every 10 to 100: Possible
  - Once every 100 to 1000: Unlikely
  - Once every 1000 to 10000: Rare

- **Likelihood**
Vessel DP incidents – 5+yrs

- Four incidents since beginning of 1999
- Two were taut wire perfect reference
- One was black out operator error
- One was thrusters left in fixed azimuth mode – operator error
- Nos of DP hours recorded – 16,920
- Equivalent to nearly two years DP in (about 40% of time)
- No collisions – No drive offs
Vessel DP Incidents

• Four incidents in 16,920 DP hours over 5 years
• One every 4,230 hours = 5.875 months
• No collisions
• IMCA 93 that assumed 50% on DP here about 40% - (2 years)
DP Incident Causes IMCA 2001

- Position References – 20 to 23%
- Computer – 20 to 23%
- Thrusters – 17%
- Operator – 17% (down from 25%)
- Environment – 8% (up from 2%)
- Rest – generators, electrical, other
- Looked at 90 to 2001, 90 to 95 and 95 to 2001.
DP incident Causes

• Two ‘perfect’ position refs – refs or computer or human error?
• Two operator error – avoidable
• One would not have happened with divers down
IMPACT ENERGIES (consequences)
STANDARDS

• Impact Energy – DnV, LR, NORSOK, UKOOA UK, - 5000 Tonnes at 2 m/s (10MJ)
• API – 1000T at 0.5 m/s (0.125 MJ)
Vessel Impact Energy ROMs

- 10000, displ, 4000 added mass, environment – bows at 33%, azis 50%, no drag
- Drift off 10 m 40 T environment – 3.77 MJ
- Drift off 20 m 40 T environment < 6.52 MJ
- Drift off 30 m 40 T environment < 8.56 MJ
- Drive off 10 m 80 T (40:40) < 7.51 MJ
- Drive off 20 m 80 T (40:40) < 13.09 MJ
- Drive off 30 m 80 T (40:40) < 17.45 MJ
- Further off greater the energy
- Better chance of recovery or miss
What is a Mega Joule?

- 5800 lb SUV with 800 lb pay load (3 Tonne) at 30 mph
- 0.25 MJ
¼ of a Mega Joule?
Impact Energy?

- DNV – 66% vessel and 33% rig
- HSE – 65% vessel and 35% rig (14 to 4 ratio)

- 1.25 MJ (10m drift off)
- to 5.81 MJ (30m drive off)

Consequences

- Jack Up 1 – 14 MJ – Minor to Moderate
- Jack Up 2 – 5 MJ – Minor to Extreme
Quantifying the Risk
Exposure Time

- 9 days in position of critical exposure time, assumed 10 days
- 2 days two and 5 days at the other
- Of that 10 hours with heading totally restricted and beam to current – assumed 12 hours
# Risk Profile

<table>
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<th>Consequences</th>
<th>Factor</th>
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<th>3</th>
<th>10</th>
<th>30</th>
<th>100</th>
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<td>Almost Certain</td>
<td>100</td>
<td>High 100</td>
<td>High 300</td>
<td>Extreme 1000</td>
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<tr>
<td>1 to 10 yrs</td>
<td>Likely</td>
<td>30</td>
<td>Moderate 30</td>
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<td>100 to 1000</td>
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<td>3</td>
<td>Low 3</td>
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<td>Low 1</td>
<td>Low 3</td>
<td>Moderate 10</td>
<td>High 30</td>
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Return to Session Directory
## Risk Profile

<table>
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<tr>
<th>Consequences</th>
<th>Jack Up 1 (minor to moderate)</th>
<th>Jack Up 2 (minor to extreme)</th>
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<tbody>
<tr>
<td>Possible – IMCA 93</td>
<td>30 to 100</td>
<td>30 to 1000</td>
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<tr>
<td>- 10 days exposure</td>
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<tr>
<td>Unlikely (IMCA 2001)</td>
<td>9 to 30</td>
<td>9 to 300</td>
</tr>
<tr>
<td>Rare (IMCA (93 and 12 hour exposure)</td>
<td>3 to 10</td>
<td>3 to 100</td>
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</tbody>
</table>

Consequences: Jack Up 2 (minor to moderate)
Threats - Problems

• Unknown DP system faults
• Operator Error
• Systematic Faults
• Unexpected change in the weather
• Fast change in the current
Mitigation/Controls

- Op Class 3 - 660V, fuel, cooling, 440V split
- DP Control System limitations known, researched and DPOs trained
- Capability Checked
- Manned ECR
- Main pumps on correct side of board
- Back ups check at mobilization
- Attend Annual Trials and UKOOA Audit
- Test loss of swbd and transfer of load

Return to Session Directory
Mitigation/Controls

• Test all DGs and thrusters to full load
• Power Limits – 33% thrust Bow, 50% azis, 50% each swbd – 40 T pull off
• Independent measurement and alarm of distance to closest point (fan beam)
• Control of DP shift after crew change
• Accurate weather forecasts
• Weather fronts watched for
• Accurate current information
Mitigation/Controls

• Worse heading – got choice of most favorable conditions
• Consequence analysis selected
• Fast Current update
• Back up tests – pumps, batteries, diodes
• Survey to show vessel, rig and platform at DP position
CONCLUSIONS
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• Initial assessment was ‘likely’ but given the exposure time this was reassessed as ‘unlikely’ and for the critical work as ‘rare’

• Vessel capable of operating in the prevailing conditions (2 knots beam and head wind – 20 knots)

• Vessel well operated and limitations known

• Risk ALARP provided all risk reduction measures identified were implemented prior to the start of the operation.
DP Risk Analysis
Up Weather DP Dive Vessel