Dynamic Positioning Committee

Marine Technology Society

Risk Management

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

Doug Phillips
American Global Maritime

Global Maritime

Return to Session Directory

DP Risk Analysis
Up Weather DP Dive Vessel

Global Maritime

Return to Session Directory

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

Global Maritime

Return to Session Directory

The Problem

Global Maritime

Return to Session Directory

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

Global Maritime

Return to Session Directory

The Vessel

Global Maritime

Return to Session Directory

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

Global Maritime

Return to Session Directory

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

Global Maritime

Return to Session Directory

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

Global Maritime

Return to Session Directory

DP Audit

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

Global Maritime

Return to Session Directory

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

Global Maritime

Return to Session Directory

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 concident
- Tested on vessel – new analysis correct

Global Maritime

Return to Session Directory

Risk Picture

Global Maritime

Return to Session Directory

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

Global Maritime

Return to Session Directory

Risk Profile

• Frequency	Likely hood
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

•

Global Maritime

Return to Session Directory

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

Global Maritime

Return to Session Directory

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)

Global Maritime

Return to Session Directory

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.

Global Maritime

Return to Session Directory

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

Global Maritime

Return to Session Directory

IMPACT ENERGIES (consequences)

Global Maritime

Return to Session Directory

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)

Global Maritime

Return to Session Directory

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

Global Maritime

Return to Session Directory

What is a Mega Joule?

- 5800 lb SUV with 800 lb pay load (3 Tonne) at 30 mph
- 0.25 MJ

Global Maritime

Return to Session Directory

¼ of a Mega Joule?

Global Maritime

Return to Session Directory

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 5.81MJ (30m drive off)

- **Consequences ---------**
- Jack Up 1 – 14 MJ – Minor to Moderate
- Jack Up 2 – 5 MJ – Minor to Extreme

Quantifying the Risk

Global Maritime

Return to Session Directory

Return t Session Directory

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

Global Maritime

Return to Session Directory

Risk Profile

	Consequences						
		Factor	1	3	10	30	100
	Likelihood	Factor	Low	Minor	Moderate	Major	Extreme
<1yr	Almost Certain	100	High 100	High 300	Extreme 1000	Extreme 3000	Extreme 10000
1 to 10 yrs	Likely	30	Moderate 30	High 90	High 300	Extreme 900	Extreme 3000
10 to 100 yrs	Possible	10	Low 10	Moderate 30	High 100	Extreme 300	Extreme 1000
100 to 1000	Unlikely	3	Low 3	Low 9	Moderate 30	High 90	Extreme 300
1000 to 10000	Rare	1	Low 1	Low 3	Moderate 10	High 30	High 100

Global Maritime

Return to Session Directory

Risk Profile

Consequences _ Likelihood	Jack Up 1 (minor to moderate)	Jack Up 2 (minor to extreme)
Possible – IMCA 93 – 10 days exposure	30 to 100	30 to 1000
Unlikely (IMCA 2001)	9 to 30	9 to 300
Rare (IMCA (93 and 12 hour exposure	3 to 10	3 to 100

Global Maritime

Return to Session Directory

Threats - Problems

- Unknown DP system faults
- Operator Error
- Systematic Faults
- Unexpected change in the weather
- Fast change in the current

Global Maritime

Return to Session Directory

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

Global Maritime

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

Global Maritime

Return to Session Directory

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

Global Maritime

Return to Session Directory

CONCLUSIONS

Global Maritime

Return to Session Directory

CONCLUSIONS

- 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.

Global Maritime

Return to Session Directory

DP Risk Analysis
Up Weather DP Dive Vessel

Global Maritime

Return to Session Directory