Operations II

Case Study of DP Vessels Performing SIMOPS

Xiaobing Shi

Diego Martinez

Doug Phillips

American Global Maritime, Inc

Return to Session Directory

Case Study of DP Vessels Performing SIMOPS

Xiaobing Shi, Diego Martinez, Doug Phillips

American Global Maritime Inc., Houston

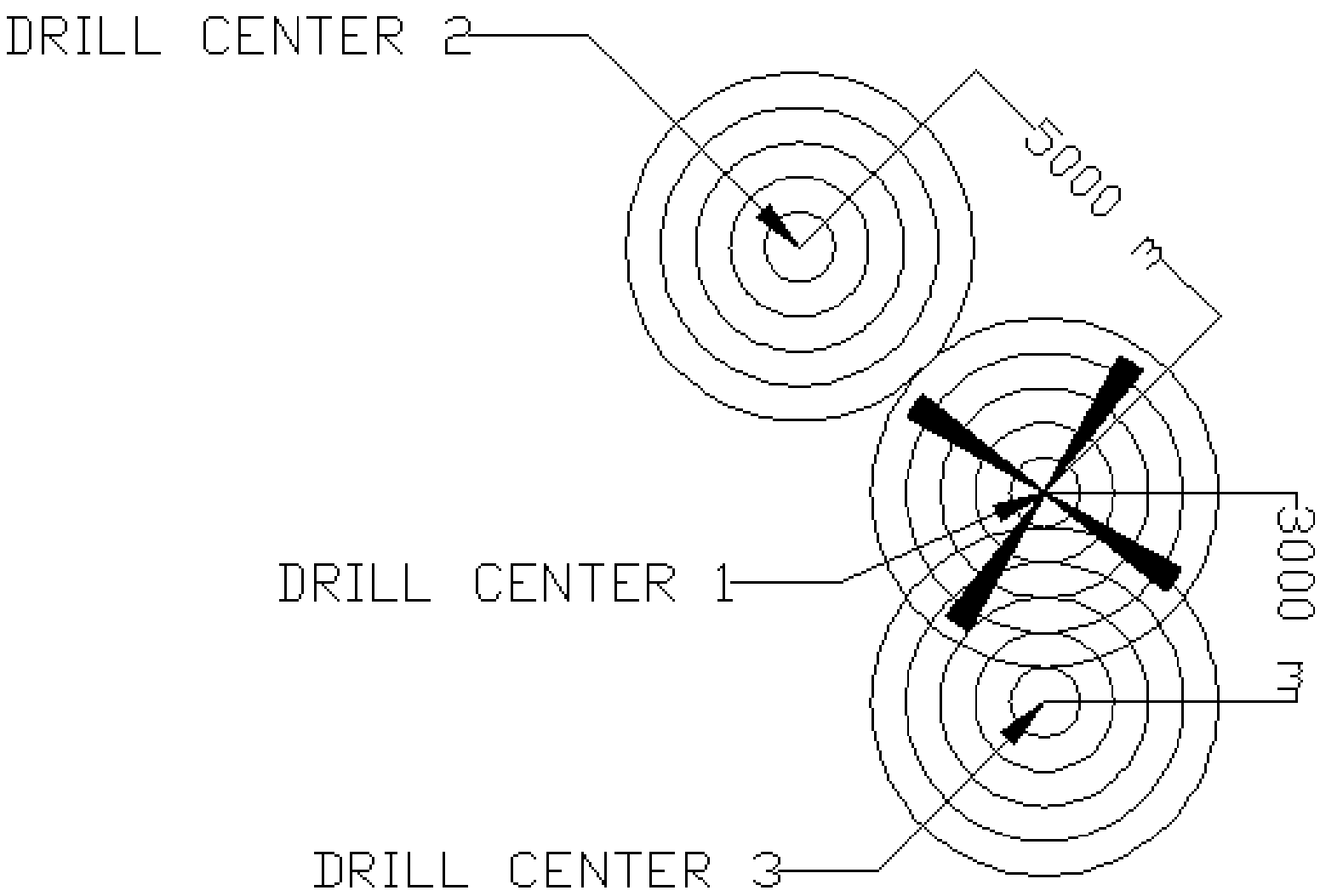
Objectives

- Focus on the collision risks associated with SIMOPS.
- Classify the risk of collision.
- Identify areas that should be improved.
- Provide mitigation and contingency plans if the collision risk level is not acceptable.

Field Layout Main Items

- A permanently Moored Semi-submersible
- 3 DP Vessels.
  - Vessel A: Class 3 >100,000 tons
  - Vessel B: Class 2 >100,000 tons
  - Vessel C: Class 3 >10,000 tons
- 3 Drill Centers
- Subsea Structures
- Sloping Seabed

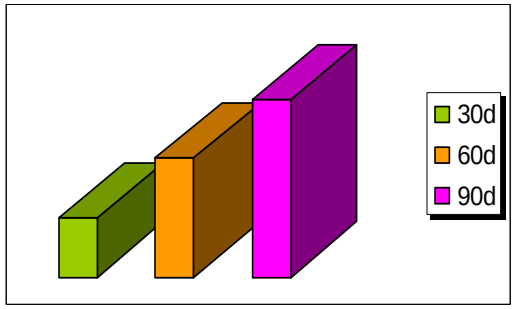
Field Layout Map



Types of Disconnect Incidents

- Drift off
  - Total Blackout
  - Partial Blackout resulting in Insufficient Thrust
  - Incorrect Thrust Commands
- Drive off
  - Operator Error
  - DP Control Failure
  - Position Reference “Freeze” or Poor Information Accepted

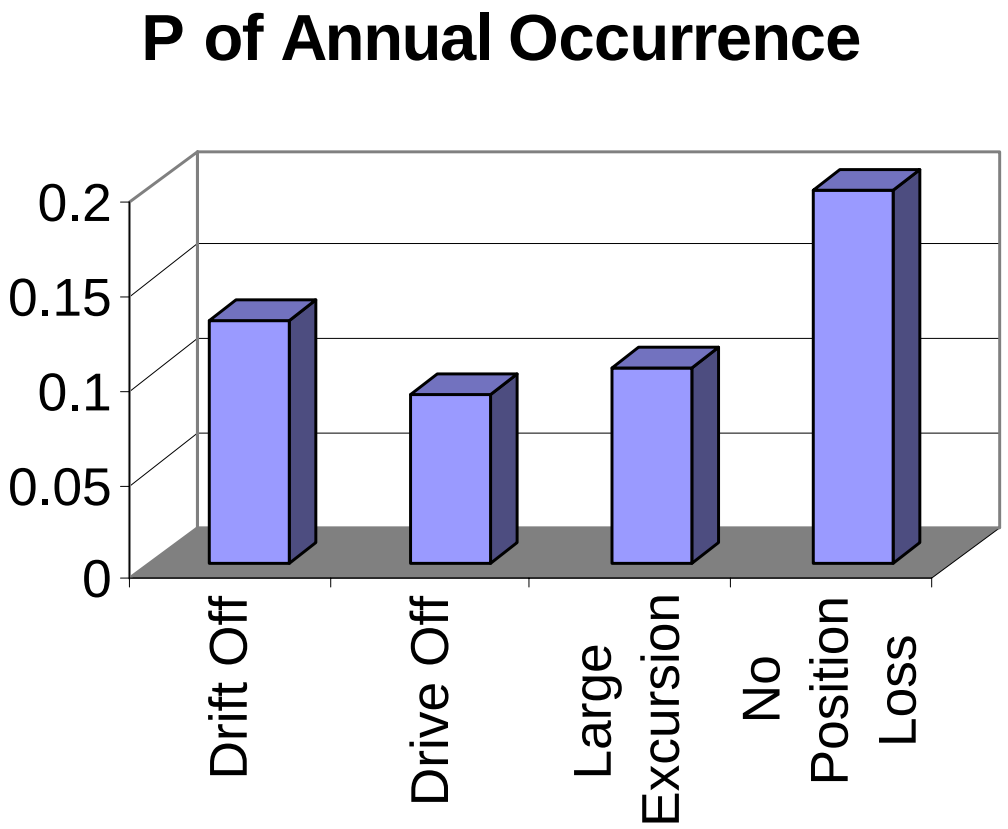
Scenarios for Vessel Collisions



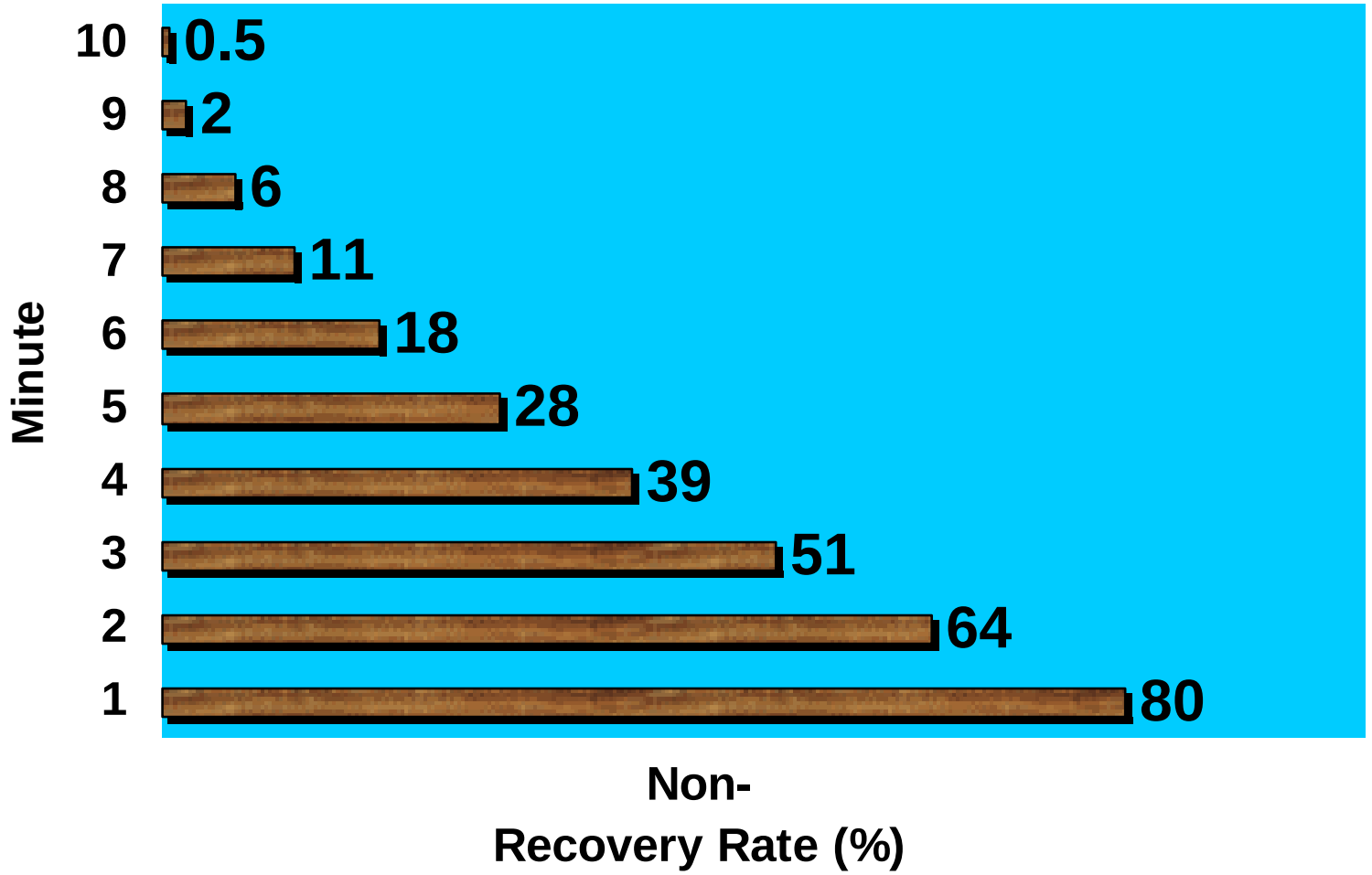
Scenarios for Vessel and Subsea Structure Collisions

Vessel	Structure	Failure Type	Distance (m)	Direction	Duration (d)
A	Test Flowline	Drift Off	150	E	60
A	Umbilicals	Drift Off	150	S	60
A	Sea Bed	Drift Off	500	N	60
A	Mooring Line	Drift Off	4000	SE	60
A	Mooring Line Center	Drift Off	5000	SE	60
A	Export pipeline	Drift off	2500	E	60

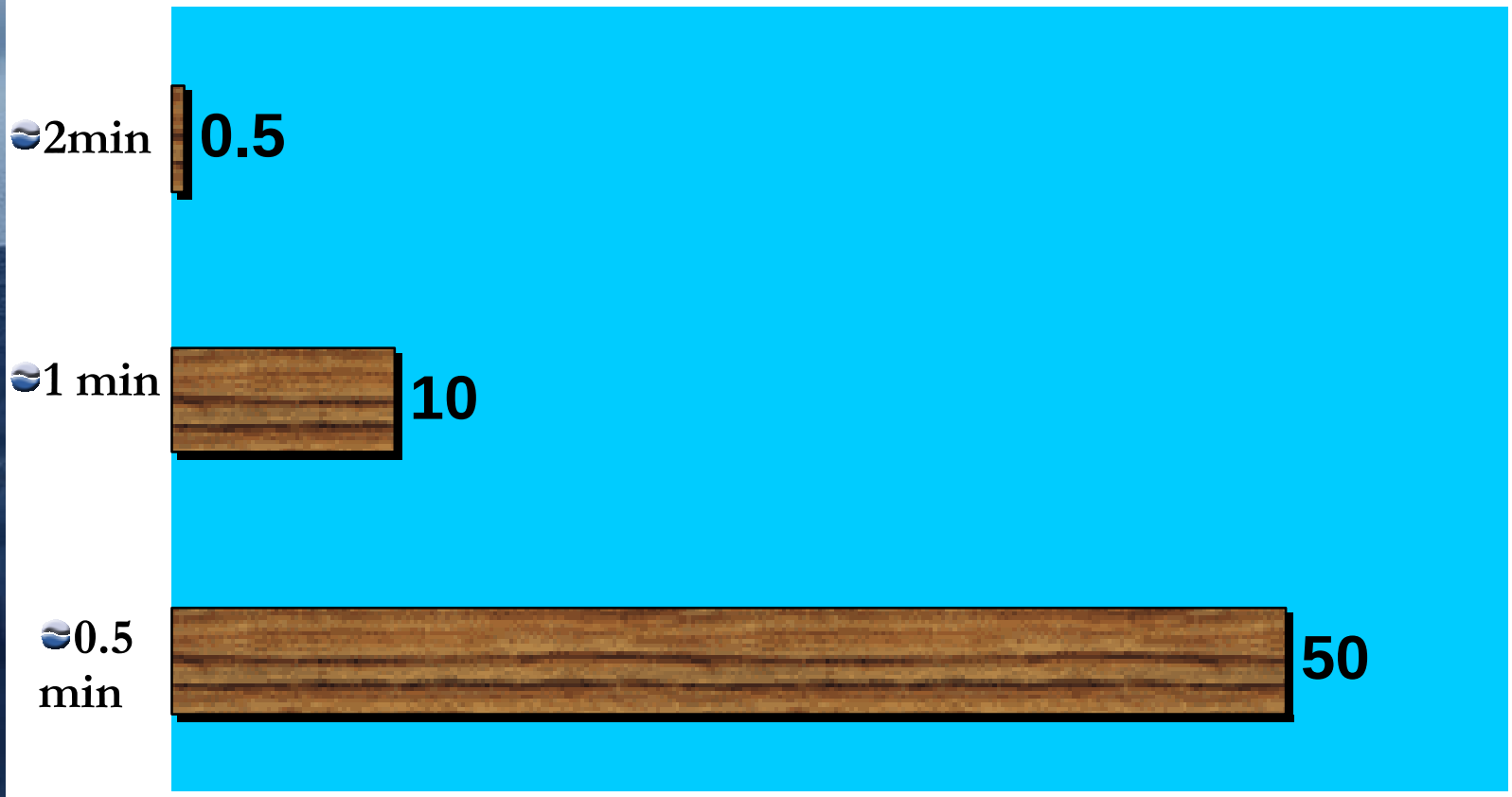
DP Incident Probabilities



Probability of Non-Recovery (Drift-Off)



Probability of Non-Recovery (Drive-Off)



Metocean Criteria

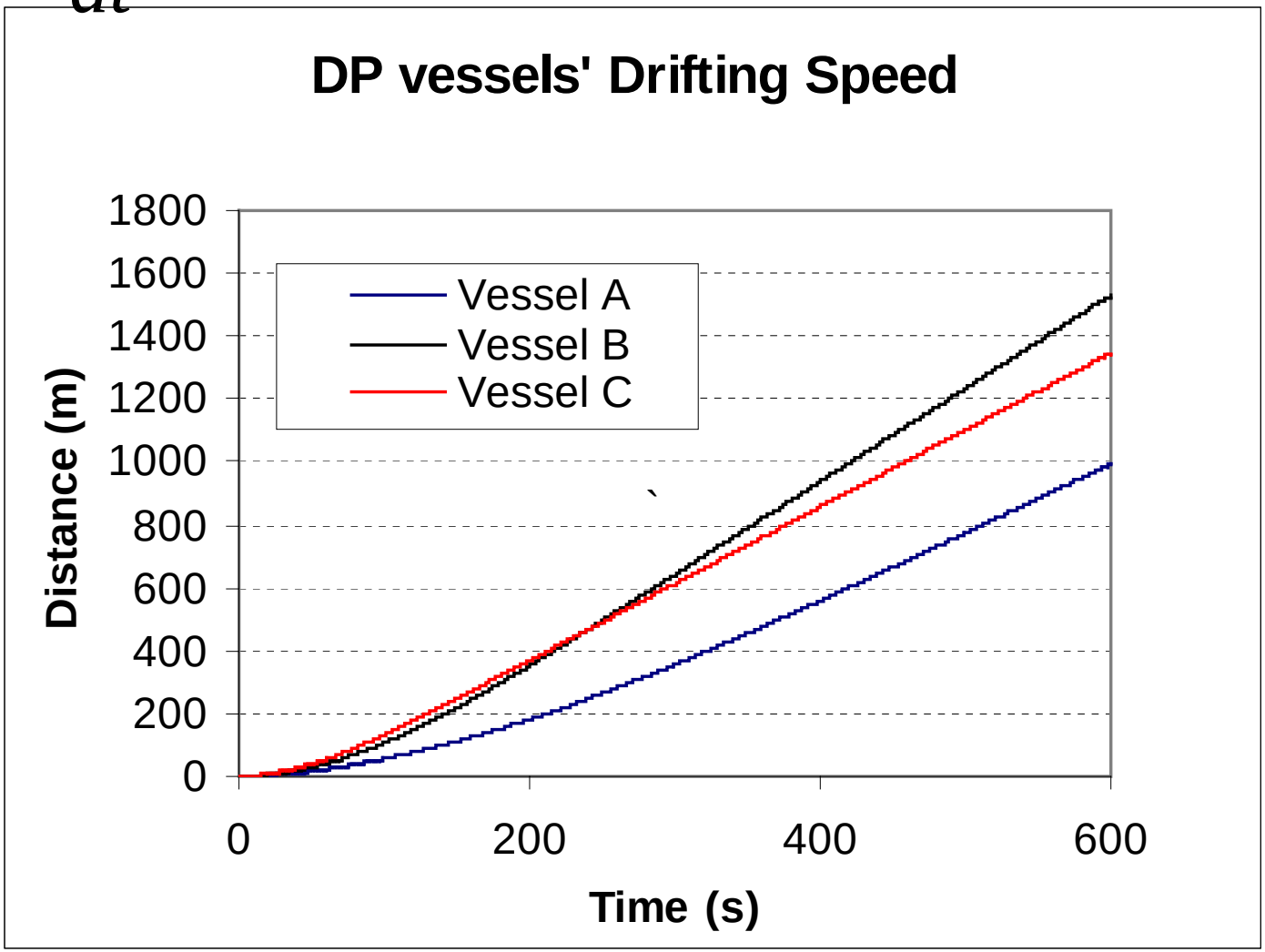
- Typically 1-yr Normal Operating Storm Condition for GoM

Hs (m)	4
Tp (sec)	9
Wind (kts)	47
Current (m/s)	0.9

- Wave scatter diagram

Drifting Rates

$$\frac{d^2\mathbf{S}}{dt^2}\mathbf{M} = \mathbf{F}_{wave} + \mathbf{F}_{wind} + \mathbf{F}_{drag} + \mathbf{F}_{Thrust}$$



Event Sequence Probabilities

- Apply DP incident probability, e.g. P(drift off) of 0.1283/yr.
- Combine this with the appropriate weather conditions acting in an appropriate sector P (Weather Direction).
- Derive probability of non-recovery within time it takes the vessel to cover distance to collision P(non-recovery)
- Combine the derived probabilities to give an estimate of the collision risk for a particular scenario.

Absorbed Kinetic Energy

$$KE_a = 0.5 \frac{M_1 M_2}{M_1 + M_2} V_2^2$$

- M_1 is the mass of the static vessel. M_2 and V_2 are the mass and impact velocity of the rogue vessel

Risk Criteria

Category	Probability /Frequency	Consequence
Low	Return period > 10,000 yr	Cost< $100,000 Energy < 15 MJ
Medium	Return period> 1,000 yr.	Cost< $2 million Energy<100 MJ.
High	Return period <1,000 yr	Cost>$2 million Energy > 100 MJ

Risk Definition Matrix

Frequency	X Consequence	=Risk
L	L	L
L	M	L
L	H	M
M	L	L
M	M	M
M	H	H
H	L	M
H	M	H
H	H	H

Proximity Risk for Vessel Collisions

Rank	Vessels		Failure	Dis-tance (m)	Proba-bility	Impact Energy (MJ)	Risk
	Rogue	Static	Type				
1	A	Semi	Drift Off	30	6.61E-03	20.47	H
2	C	Semi	Drift Off	30	8.14E-03	12.83	M
3	C	B	Drift Off	30	8.14E-03	12.54	M
4	B	C	Drift Off	30	6.72E-03	9.96	M
5	B	Semi	Drift Off	3000	2.01E-05	353.12	M
6	A	B	Drift Off	3000	1.34E-05	159.62	M
7	B	A	Drift Off	3000	1.32E-05	314.07	M
8	C	Semi	Drive Off	30	7.29E-04	13.87	L
9	C	B	Drive Off	30	7.29E-04	13.55	L
10	C	Semi	Drift Off	5000	1.10E-05	49.78	L

Vessel and Subsea Structure Collision Risks

Vessel	Structure	Failure Type	Distance (m)	Probability Of Collision (P)	Return period in years (1/P)
A	Test Flowline	Drift Off	150	1.2E-03	8E+02
A	Umbilicals	Drift Off	150	9.1E-04	1E+03
A	Sea Bed	Drift Off	500	6.1E-05	2E+04
A	Mooring Line	Drift Off	4000	2.2E-05	5E+04
A	Mooring Line Center	Drift Off	5000	2.2E-05	5E+04
A	Export pipeline	Drift off	2500	1.8E-05	6E+04

Mitigation Plans

Mitigation	Notes
Safety Anchor	May make DP unstable and may present a hazard in itself.
Safety Boat	Have a quick connect system. Could be another collision hazard and connecting in an emergency can be fraught
Drift Off Analysis	Predict the trajectory for existing or forecast conditions
Consequence Analysis	Warns the operator of the worst case failure

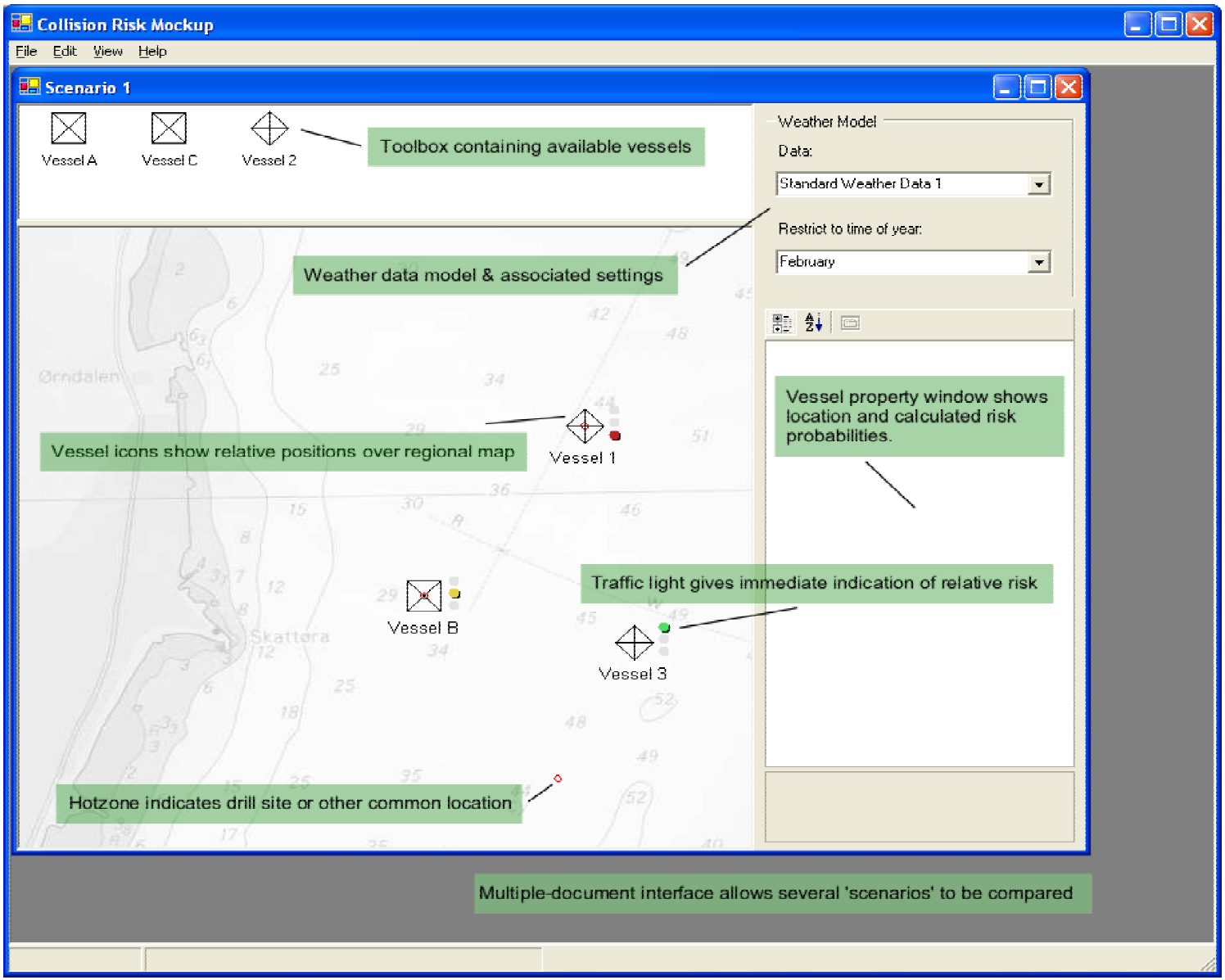
Mitigation Plans (Cont'd)

Well-Specific Operational Guidelines for Planning	Specific for each location with contingency plans
Riser height	Develop means of raising riser when it disconnects
Collision avoidance Radar	Possibly over lay of field and obstructions-should be on a UPS
Inter Vessel Communication	Set up independent command channel. Test regularly
Minimize exposure time	Run riser in safe position then move over location, use of dual derricks

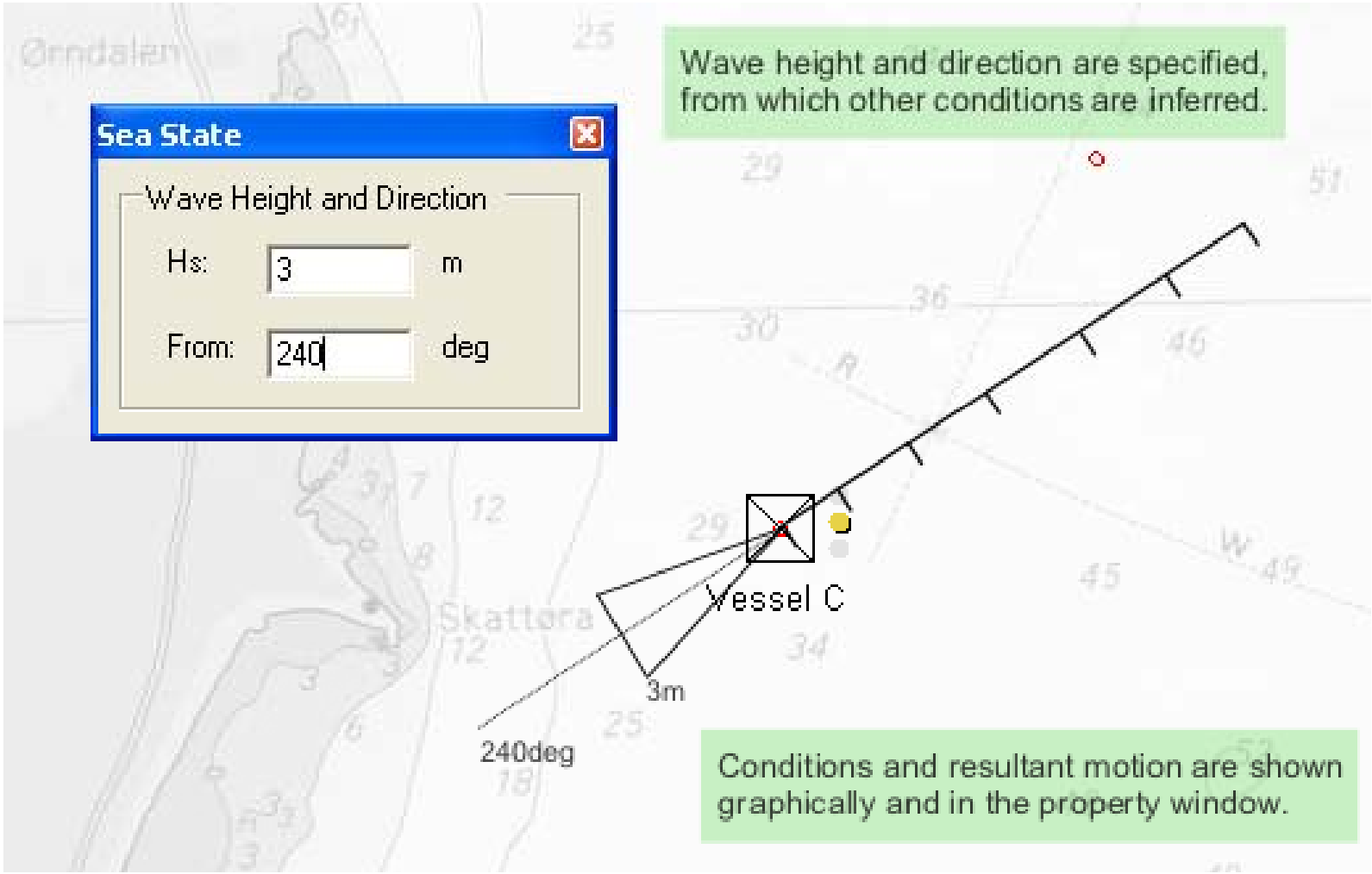
SIMOPS Risk Simulator

- The software solution of the simulator is a program targeted at a modern desktop PC running Microsoft Windows operating system.
- The near real time risk simulator can carry out risk calculation in an interactive manner.
- This tool will be of most use of vessels performing SIMOPS in close proximity e.g. within 300m.
- It can work as a mitigation tool, and it is also suitable for training and demonstration purposes.

Example of Interface Layout



Example of Drift Time Display



Conclusions

- The close proximity SIMOPS, account for the highest risks.
- Most of SIMOPS occur at large distance, which will reduces the probability of collision, but when the DP vessels are massive the resulting impacting energies are very large and the consequences shouldn’t be overlooked.
- Generally, risk level caused by DP vessel drive off is low, since the drive-off vessel can be recovered within two minutes.

Case Study of DP Vessels Performing SIMOPS

Xiaobing Shi, Diego Martinez, Doug Phillips

American Global Maritime Inc., Houston