

Tandem Loading and drilling operations under changing environmental conditions



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Presentation topics

- Weather Vane principle
- Tandem Loading
 - Alarm limits
 - FPSO heading changes
 - Online Capability plot
- Drilling Operations
 - Strong sea current

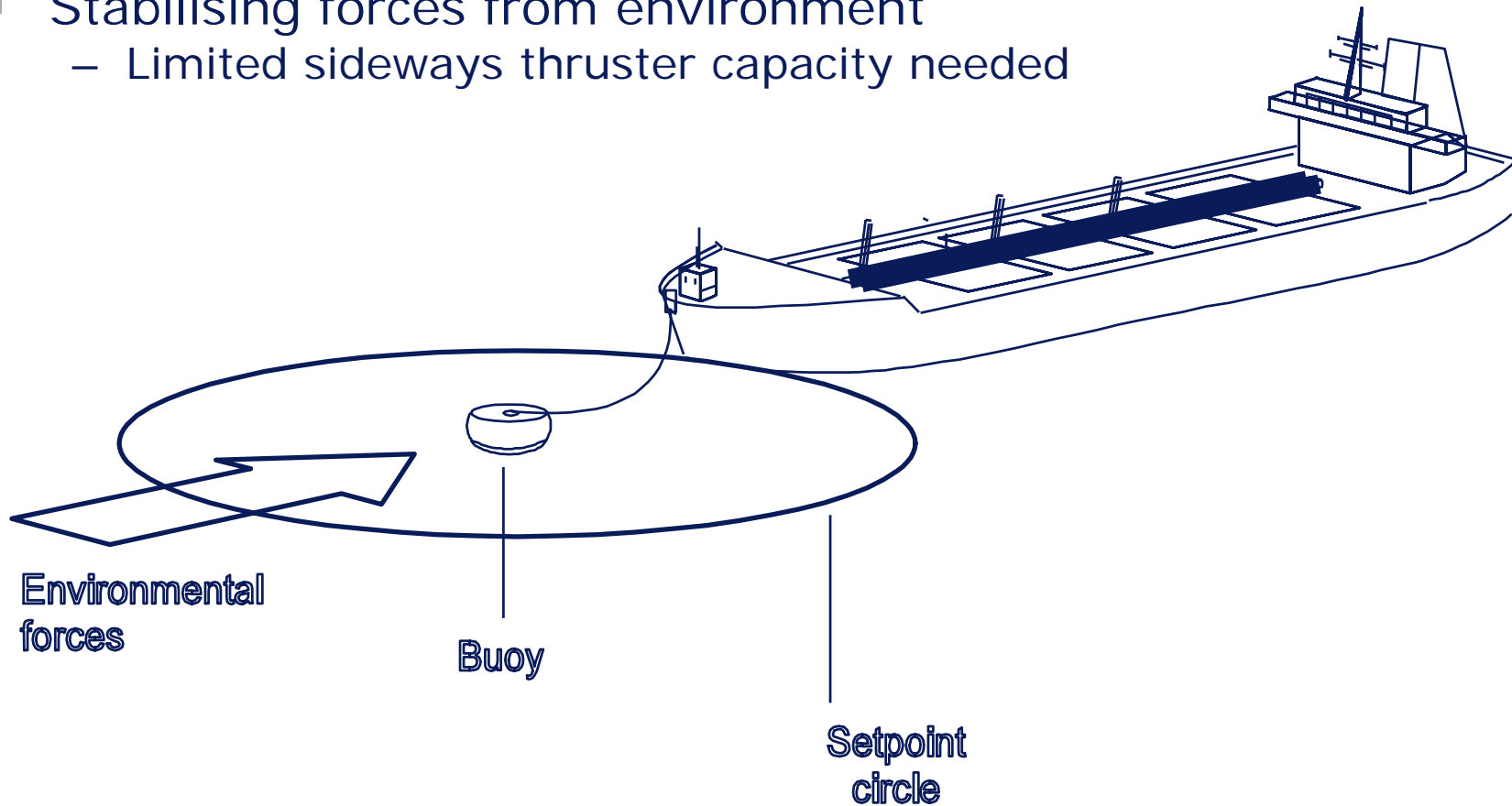




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Weather Vane Principle

- Stabilising forces from environment
 - Limited sideways thruster capacity needed



Tandem Loading



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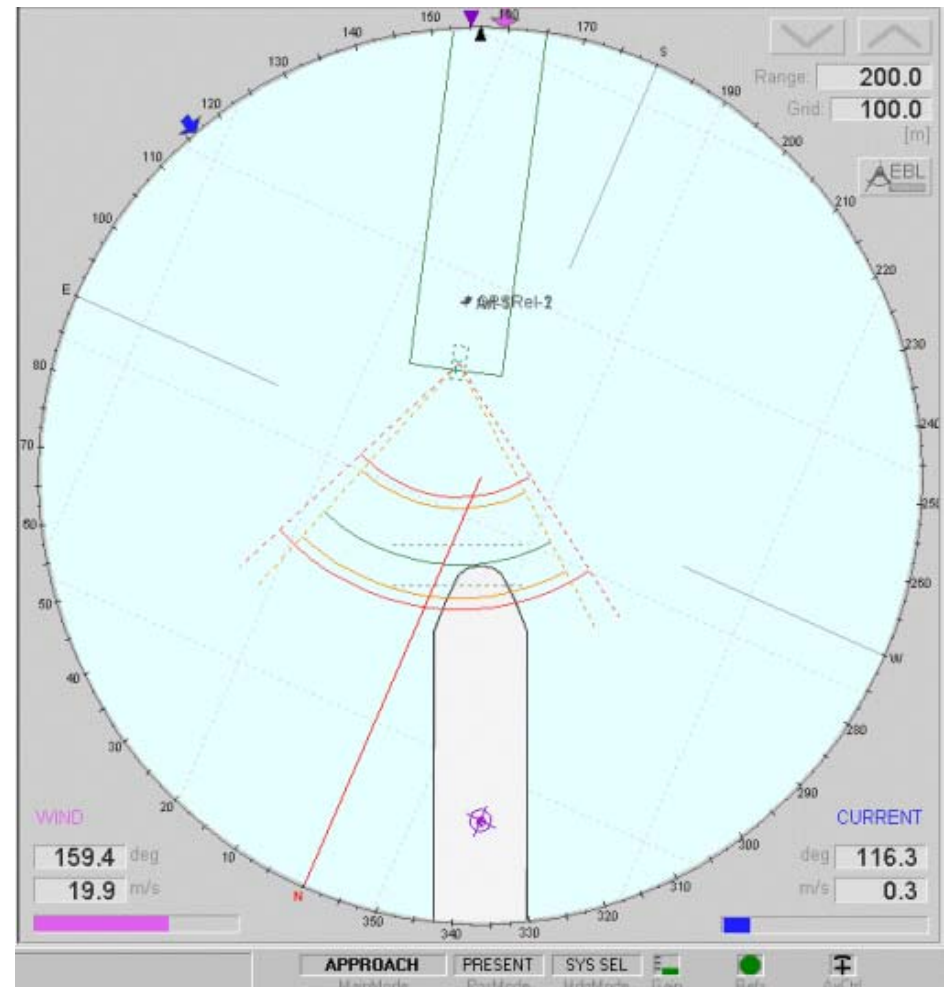
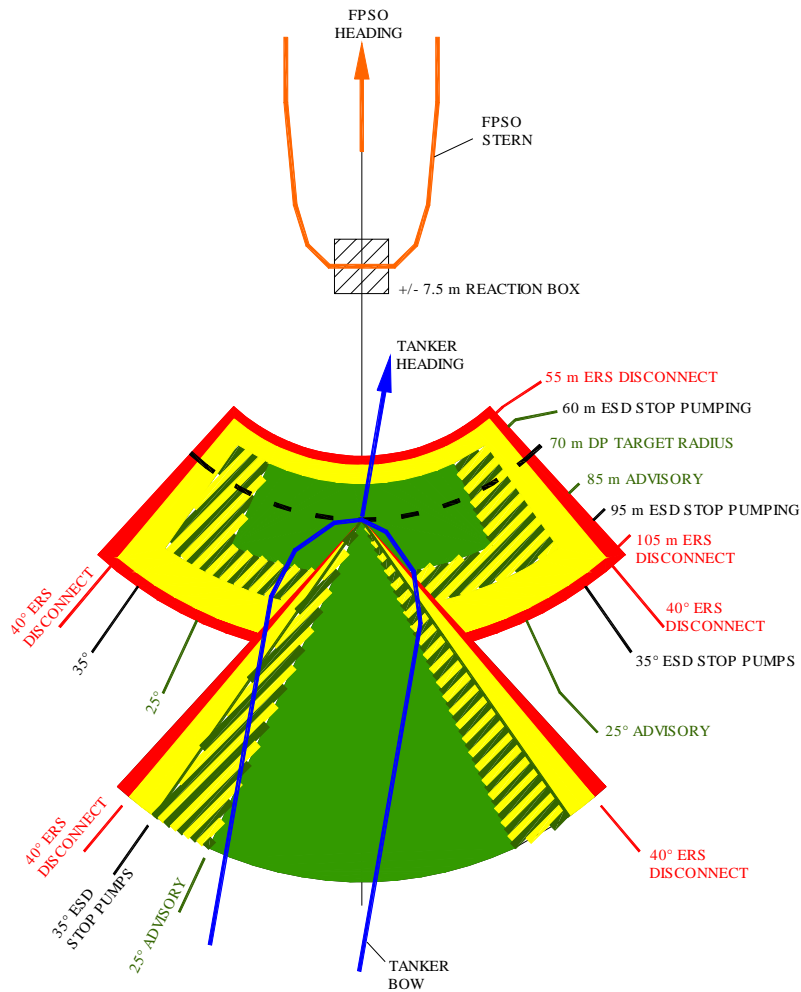
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THE FULL PICTURE



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Tandem Loading; Operational Limits / Alarms





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Tandem Loading; FPSO movement

- Minimum 2 absolute systems
- Minimum 3 relative systems
- Must not be treated as similar
 - Different purpose
 - Separate error handling

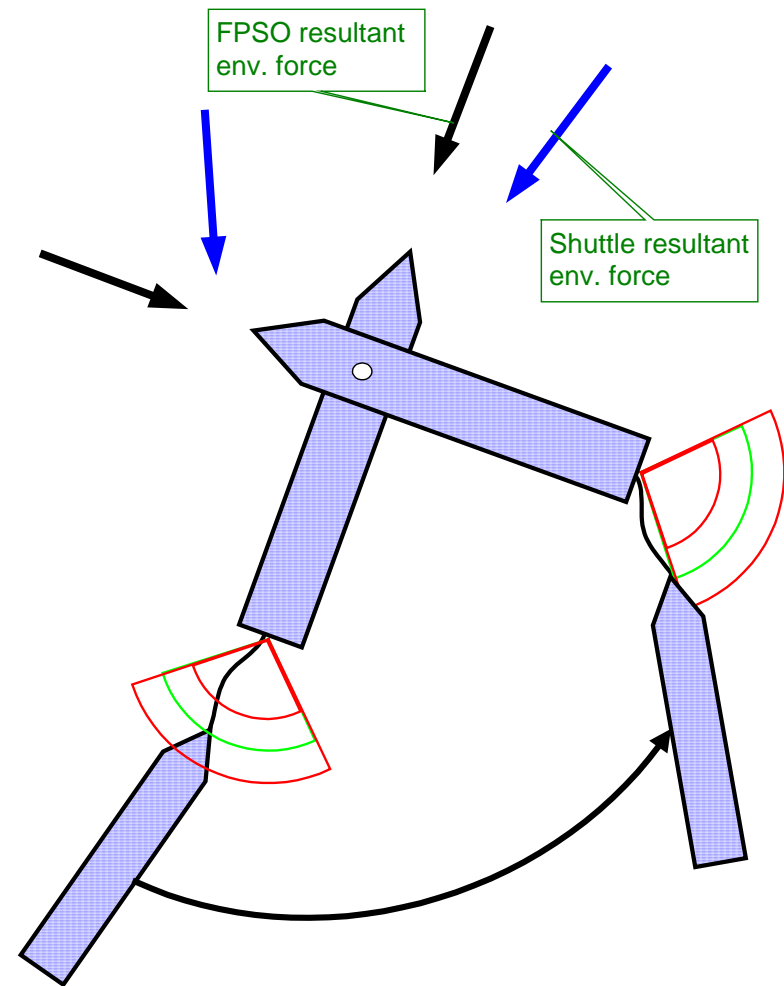




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Tandem Loading; FPSO movement

- FPSO without heading control
 - Different dominant force
 - High speed rotation
 - Shuttle tanker must adapt to FPSO
- FPSO with heading control
 - FPSO can adapt to shuttle tanker
 - FPSO can control speed of rotation
- Sideways thrust needed on shuttle

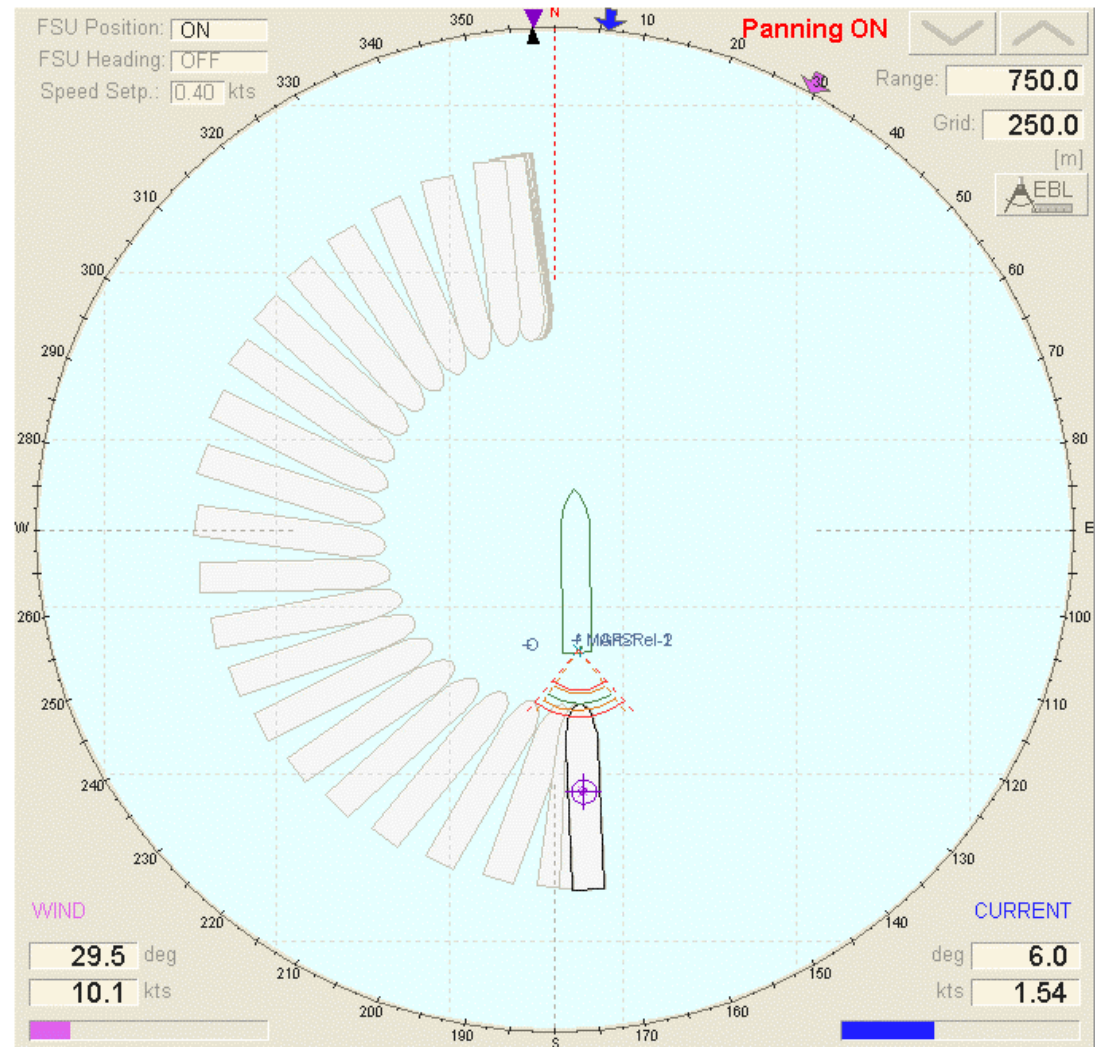




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Tandem loading; Tidal change

- Tidal current 1.4 knots
- Moderate wind
- FPSO heading change 170° in 40 minutes
- Shuttle tanker apply sideways thrust

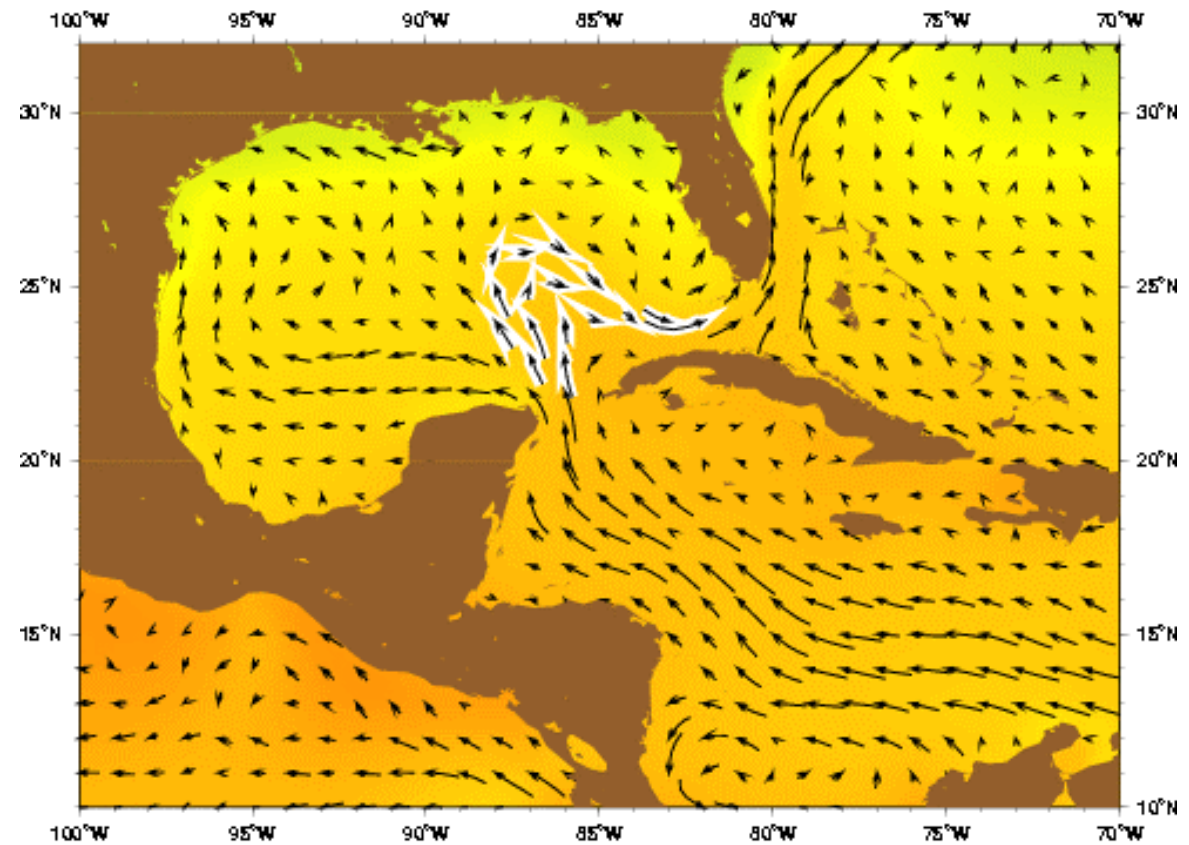


Loop current



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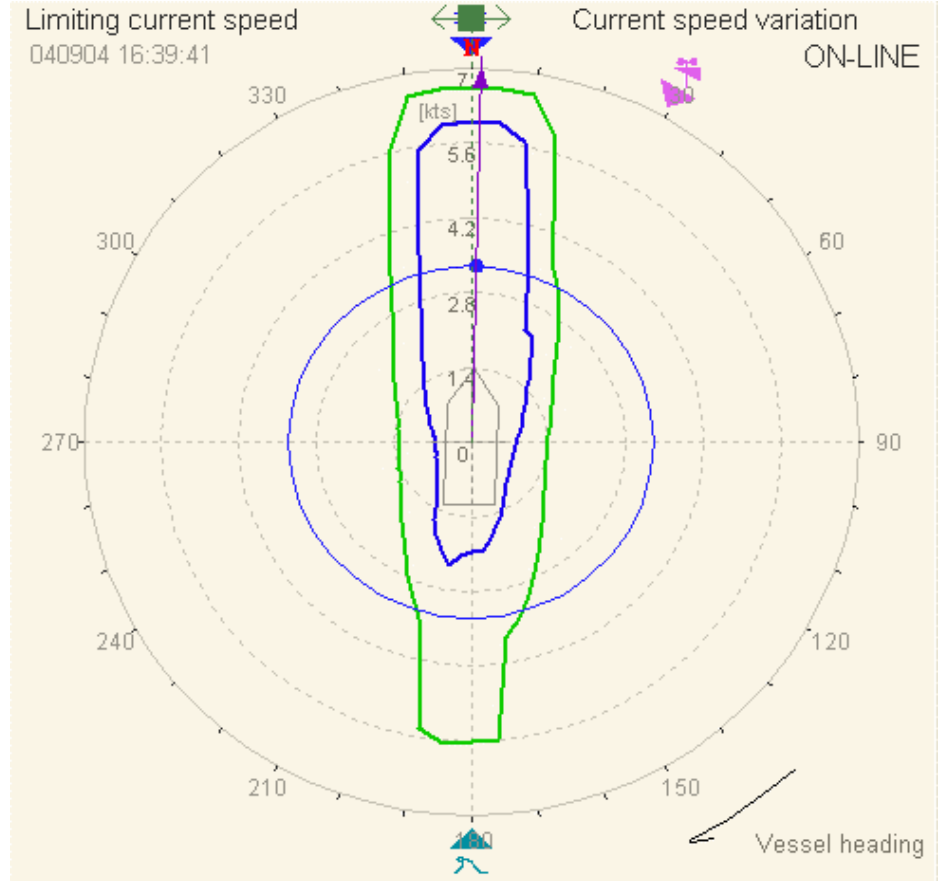
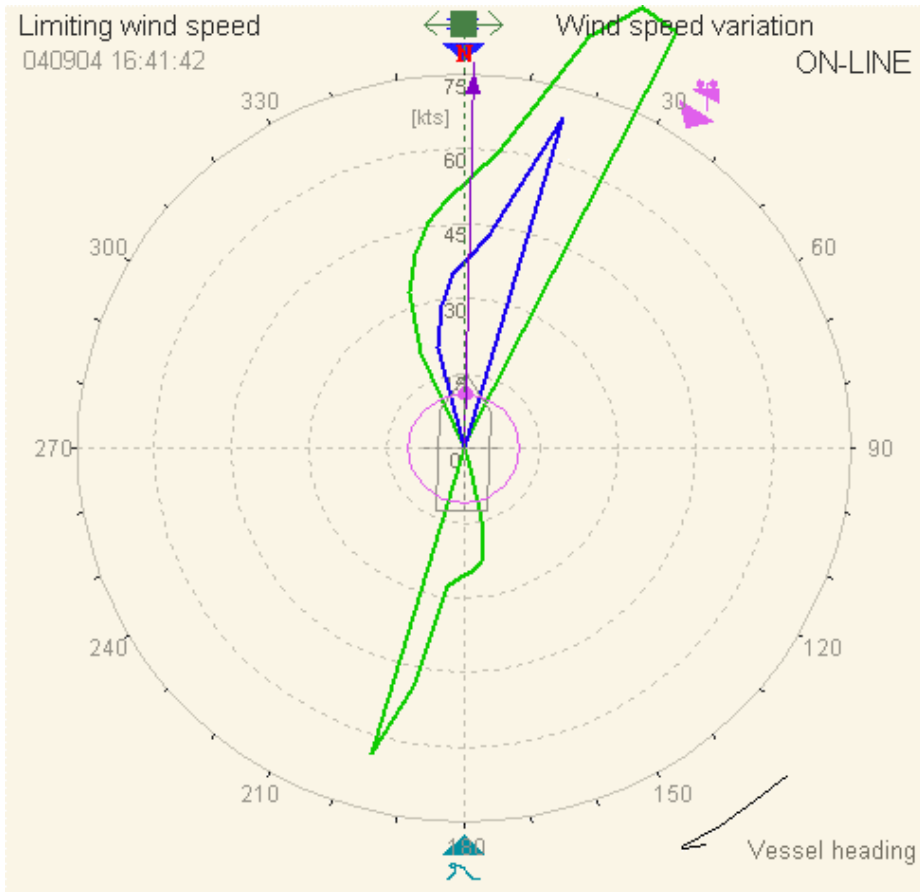
- Loop current eddies
- Current up to 4 knots
- Forecasting services available





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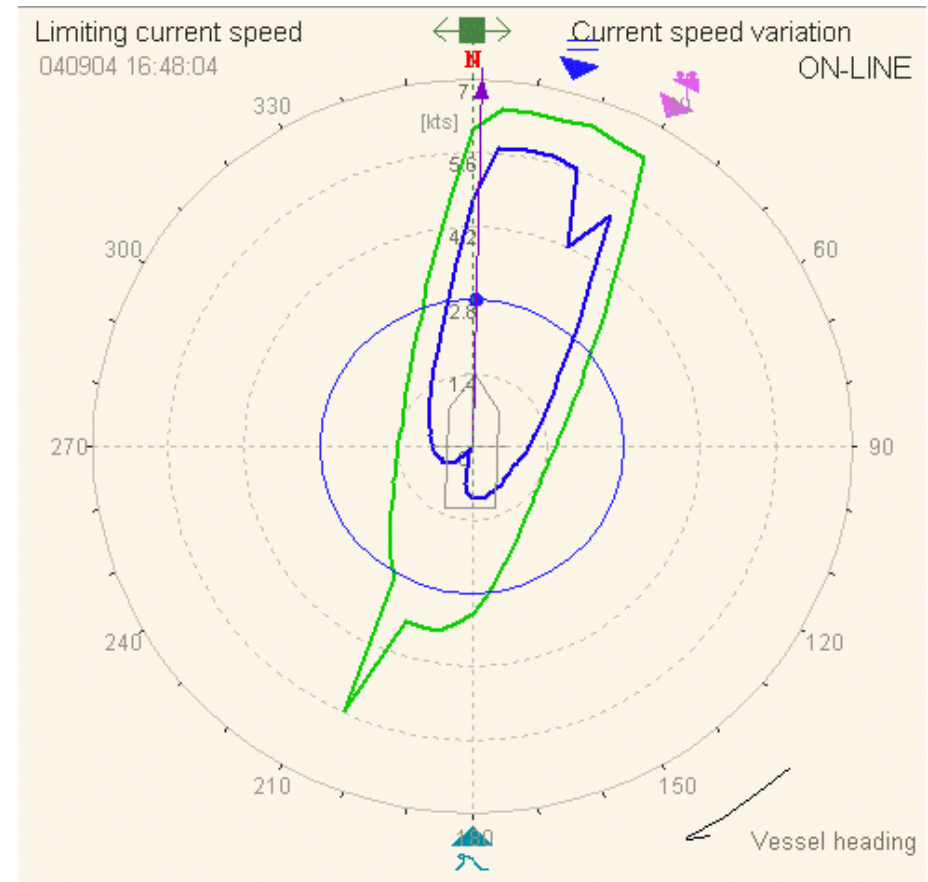
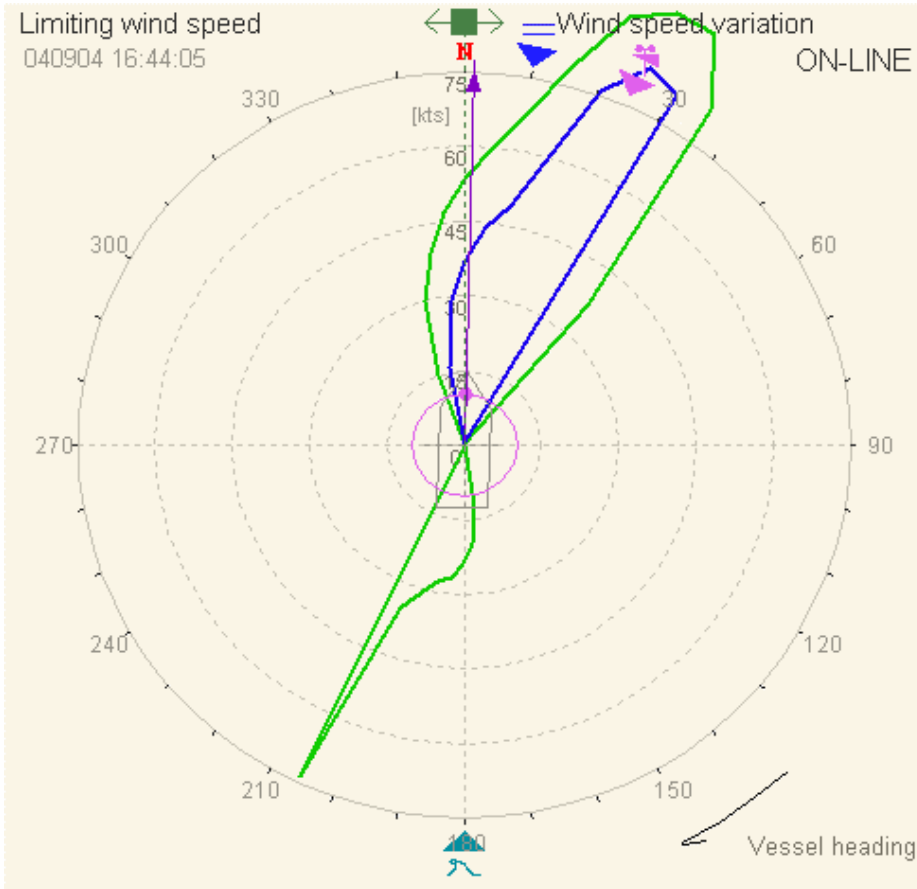
Online DP Capability plot





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Online DP Capability Plot; Wrong Sea current



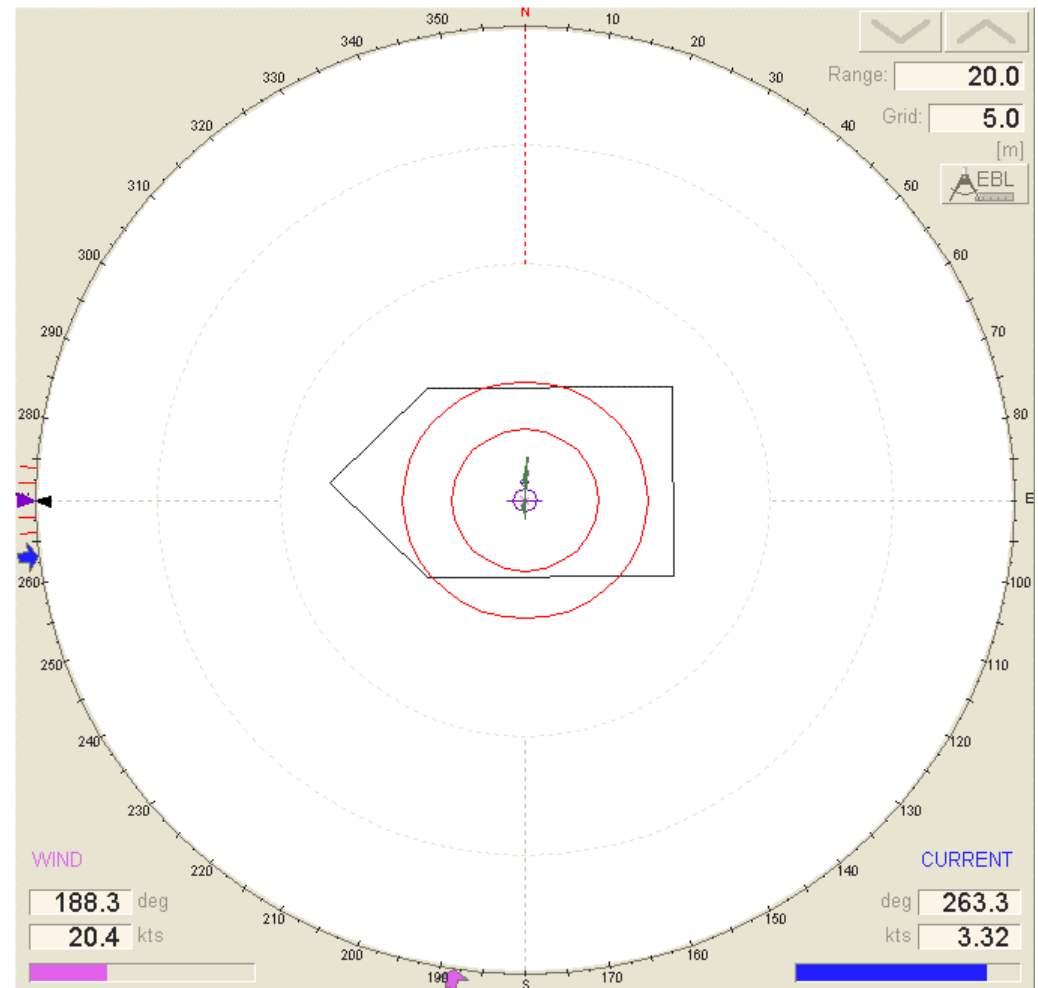


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Drilling Operation

- Wind: 23 knots from 190°
- Current: 3.3 knots from 280°
- Waves: 2.0 meter with period 6 seconds from 180°

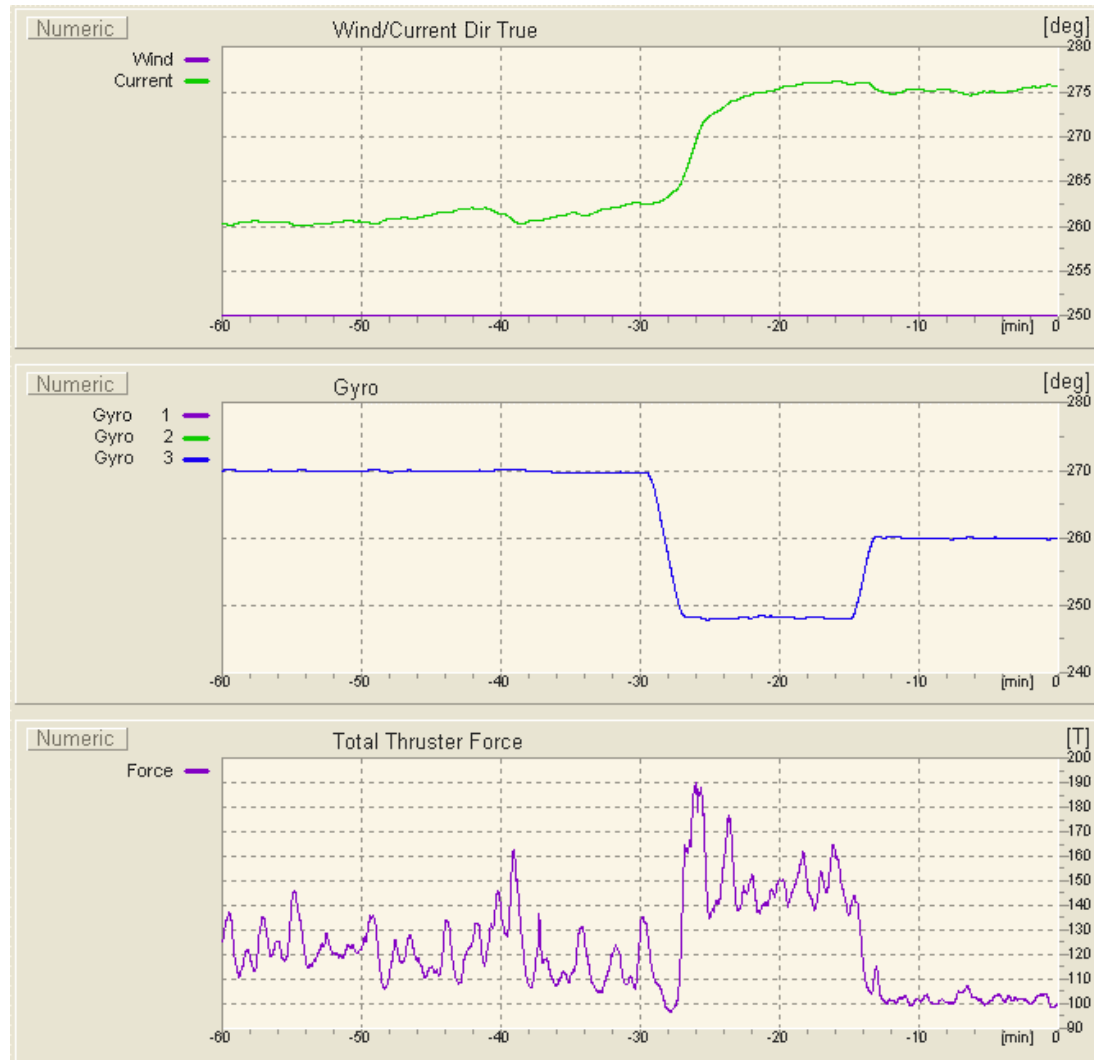
- Model errors introduced





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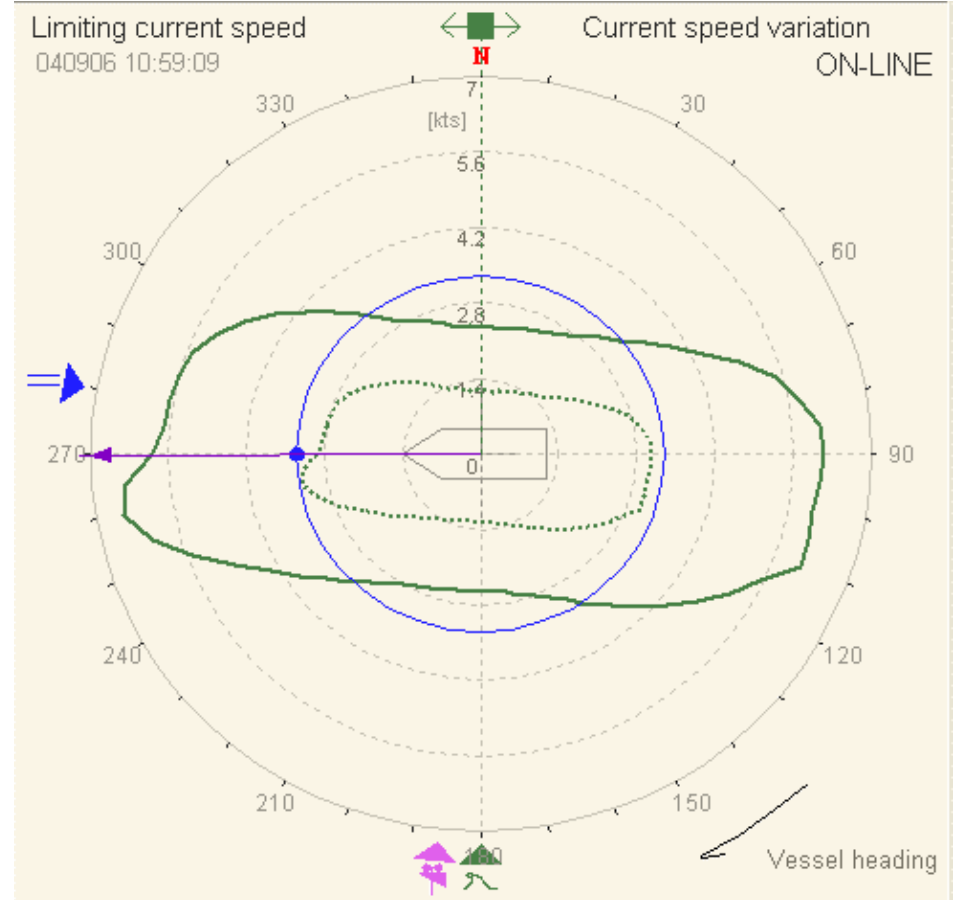
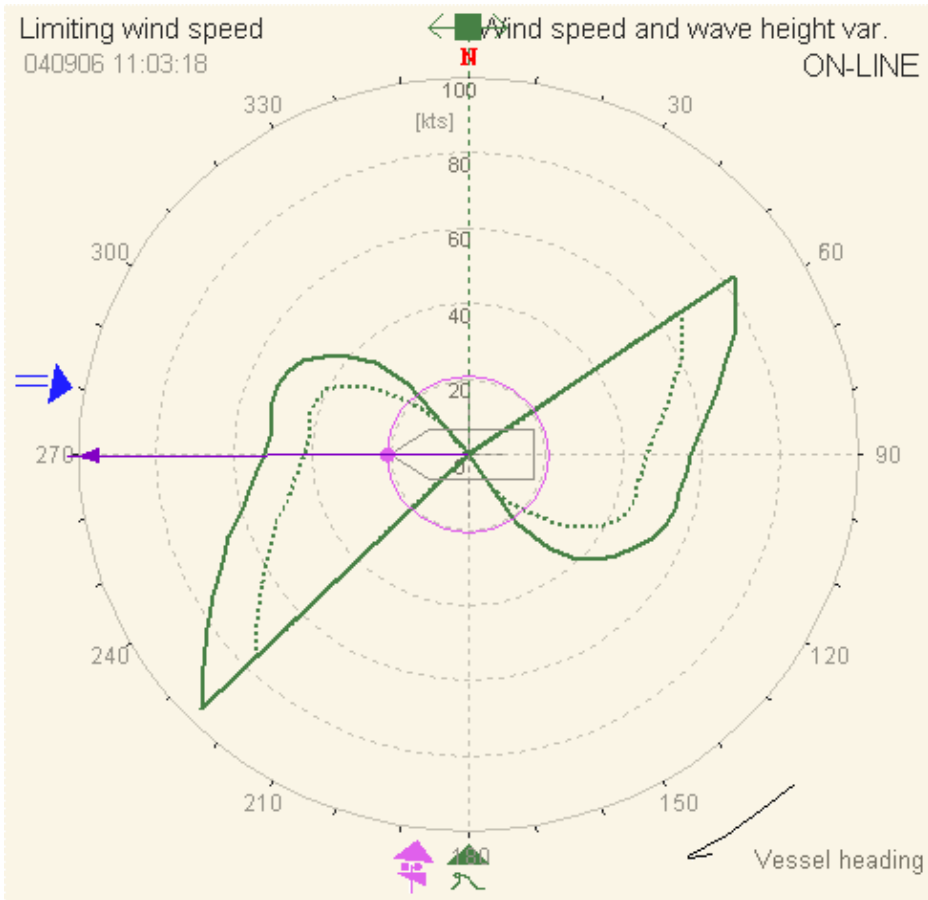
Drilling Operation; Wrong operator interaction



Online DP Capability Plot



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Summary



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- Change in environmental condition is a challenge
- Tandem Loading safer with FPSO with active heading control
- Operator guidance tools benefits from accurate sea current input
- Stepwise heading changes under marginal conditions





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