

# 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

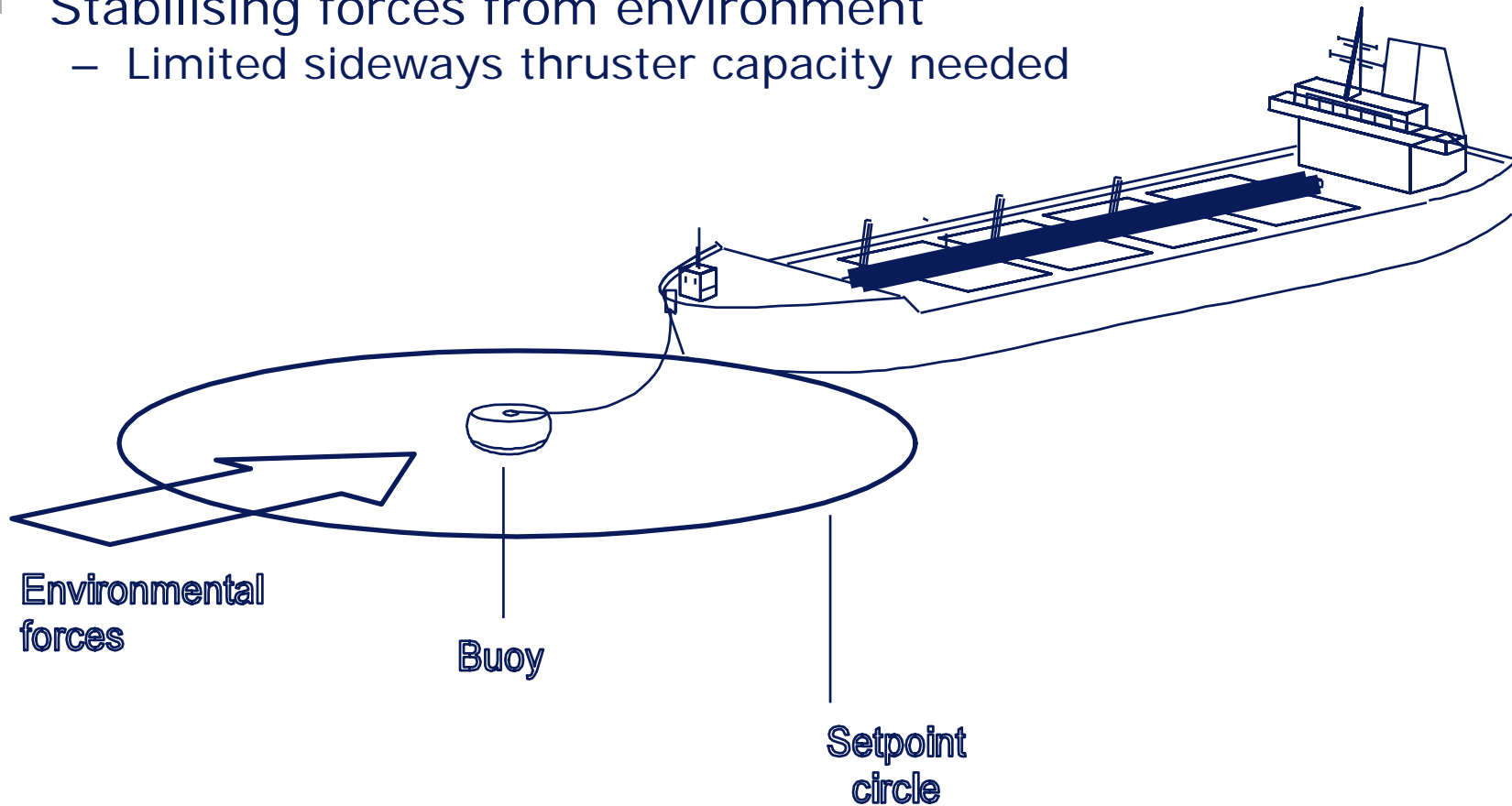




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# Weather Vane Principle

- Stabilising forces from environment
  - Limited sideways thruster capacity needed





# Tandem Loading



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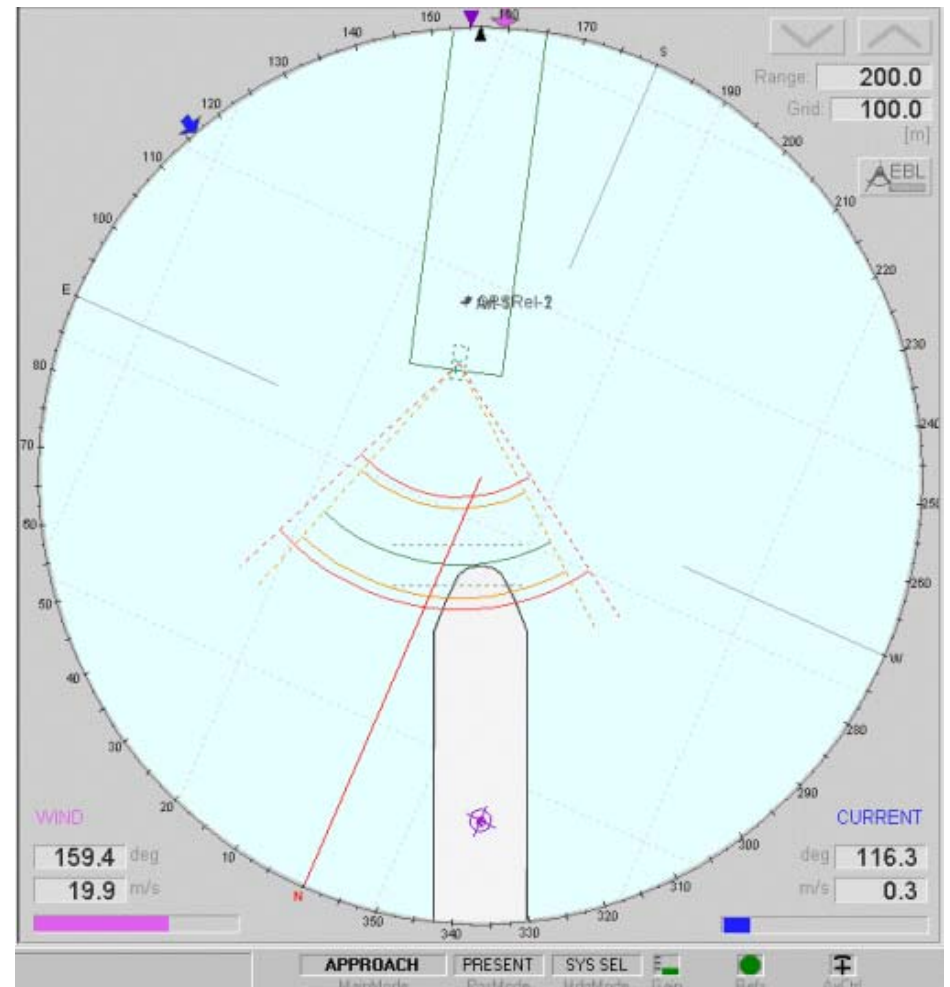
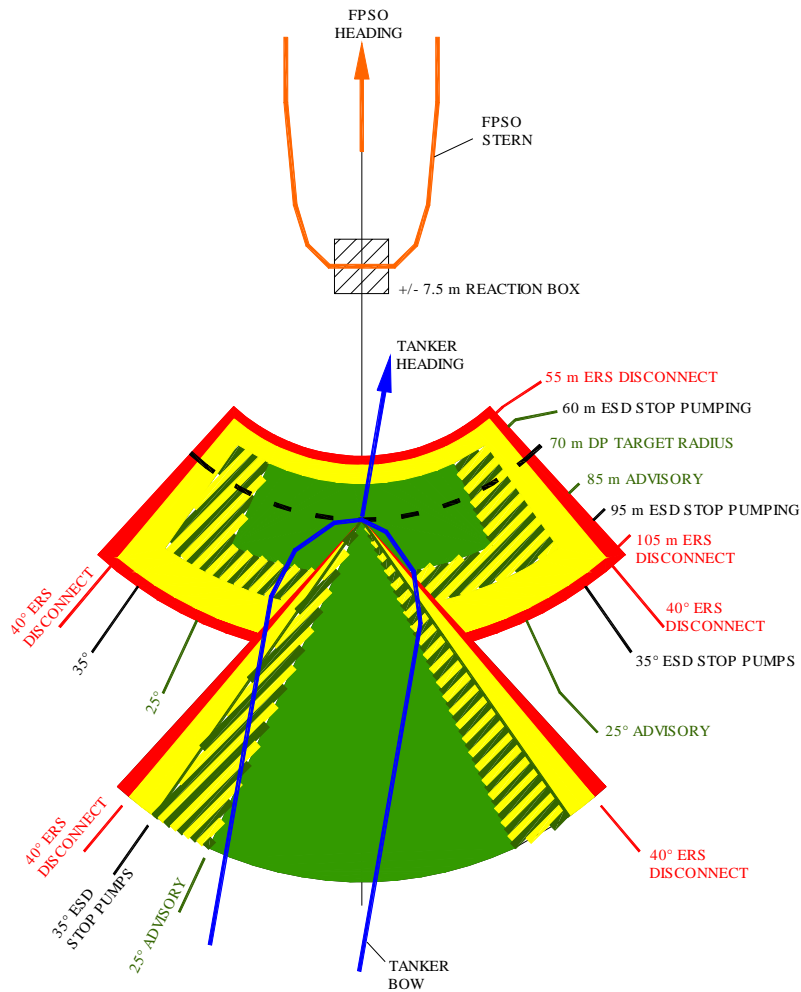
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**THE FULL PICTURE**



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# Tandem Loading; Operational Limits / Alarms





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# Tandem Loading; FPSO movement

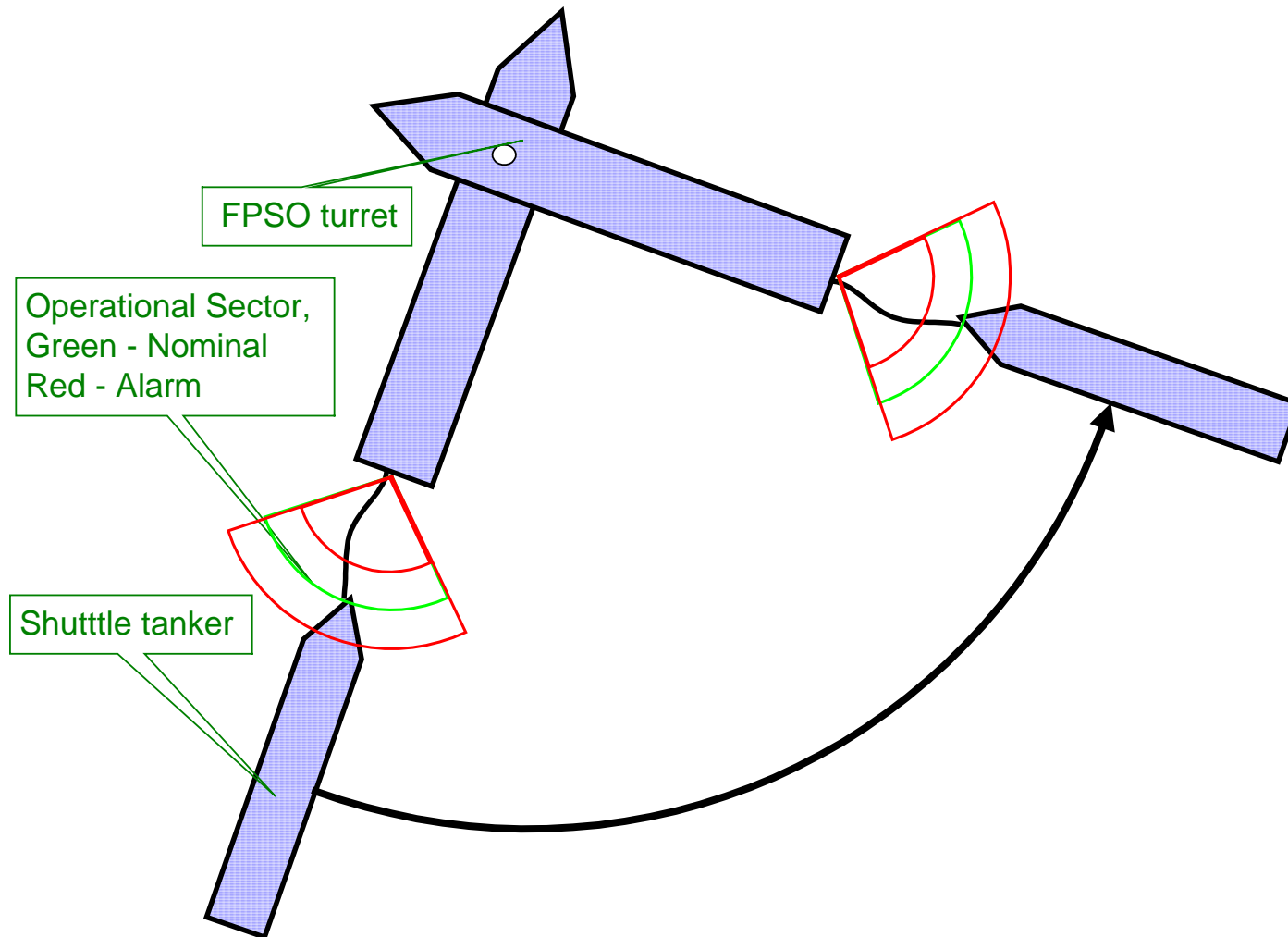
- Minimum 2 absolute systems
- Minimum 3 relative systems
- Must not be treated as similar
  - Different purpose
  - Separate error handling





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# Tandem Loading; FPSO movement

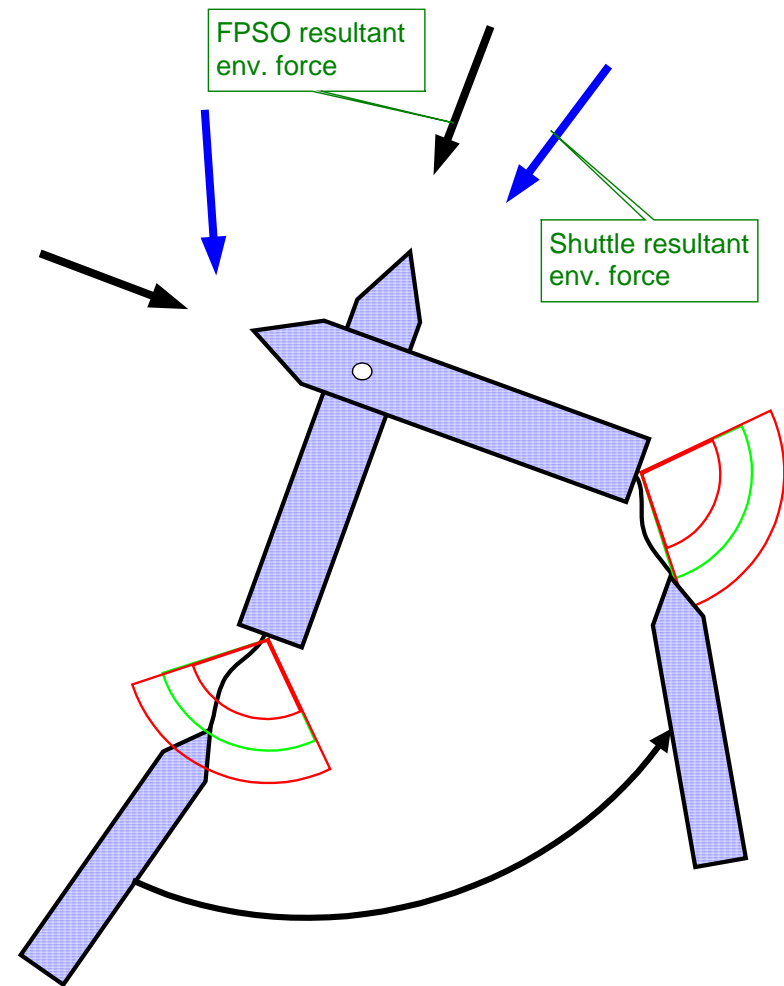




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## Tandem Loading; FPSO movement

- 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



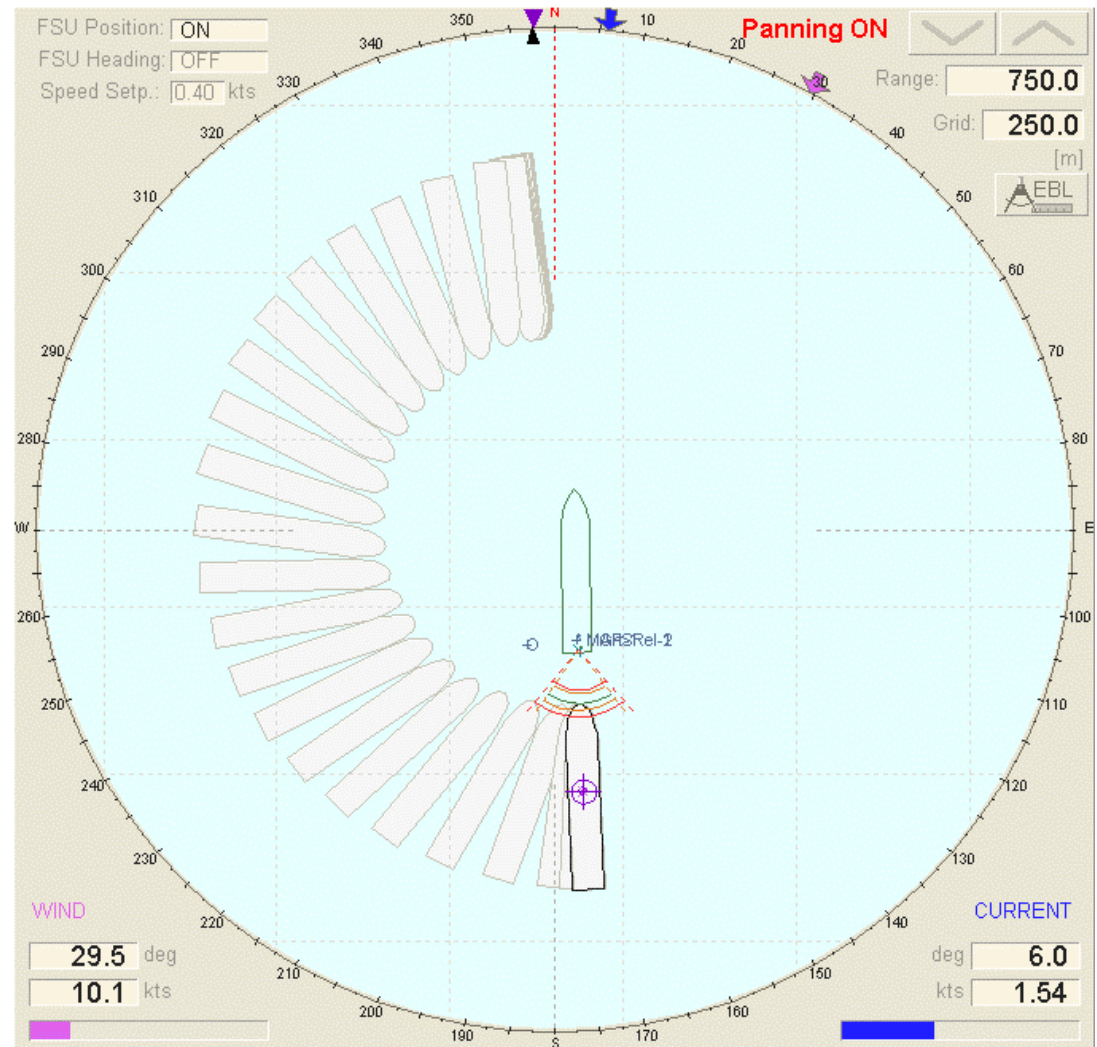




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## Tandem loading; Tidal change

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

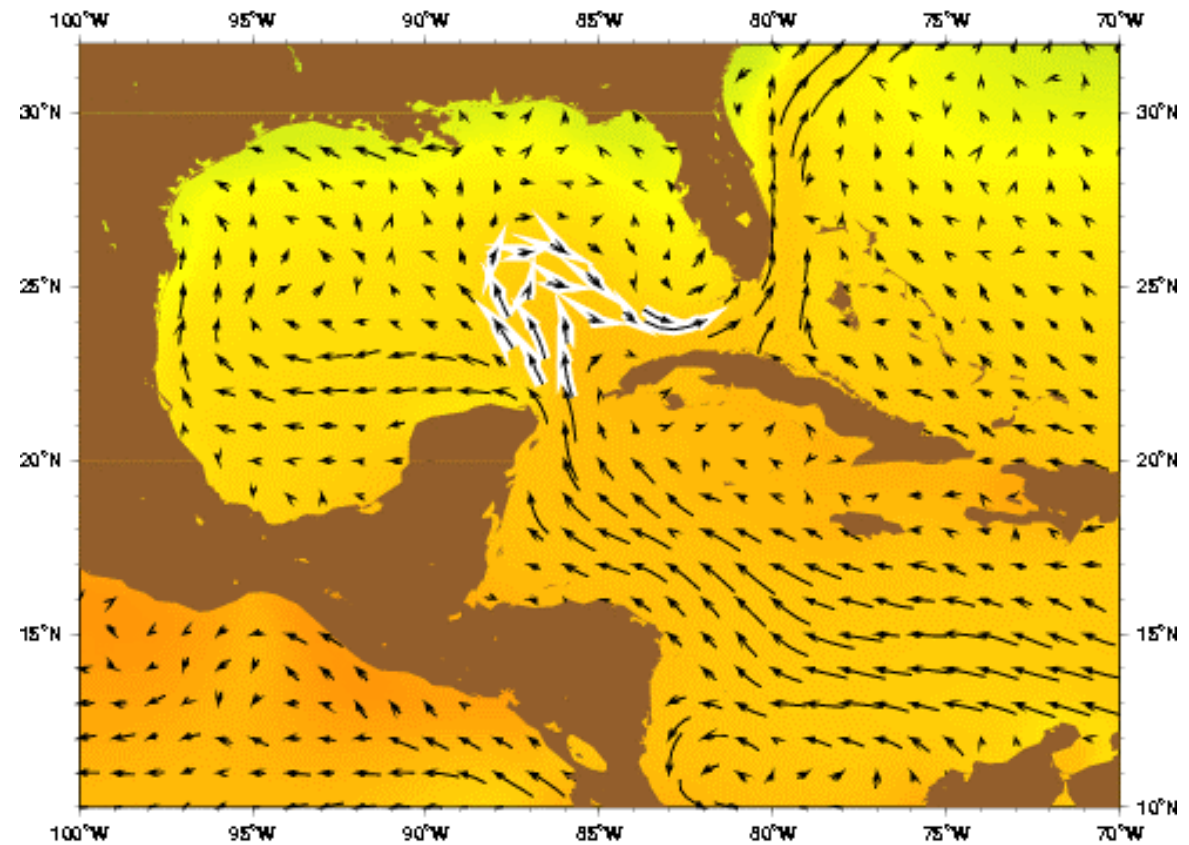


# Loop current



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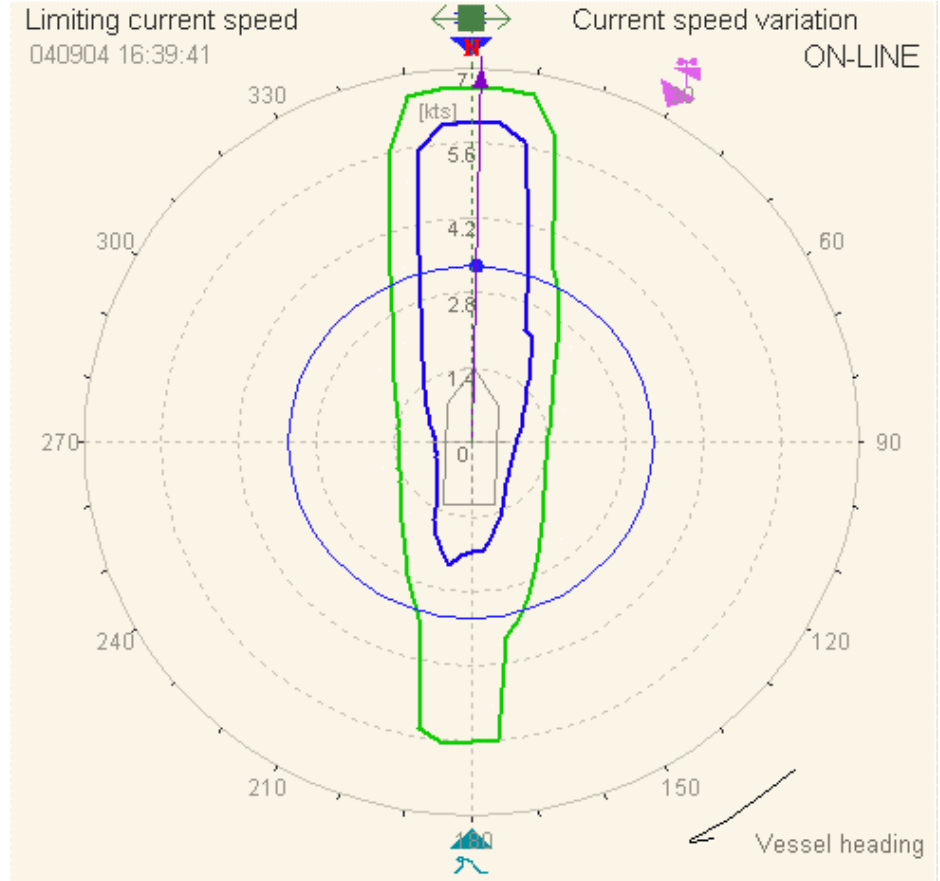
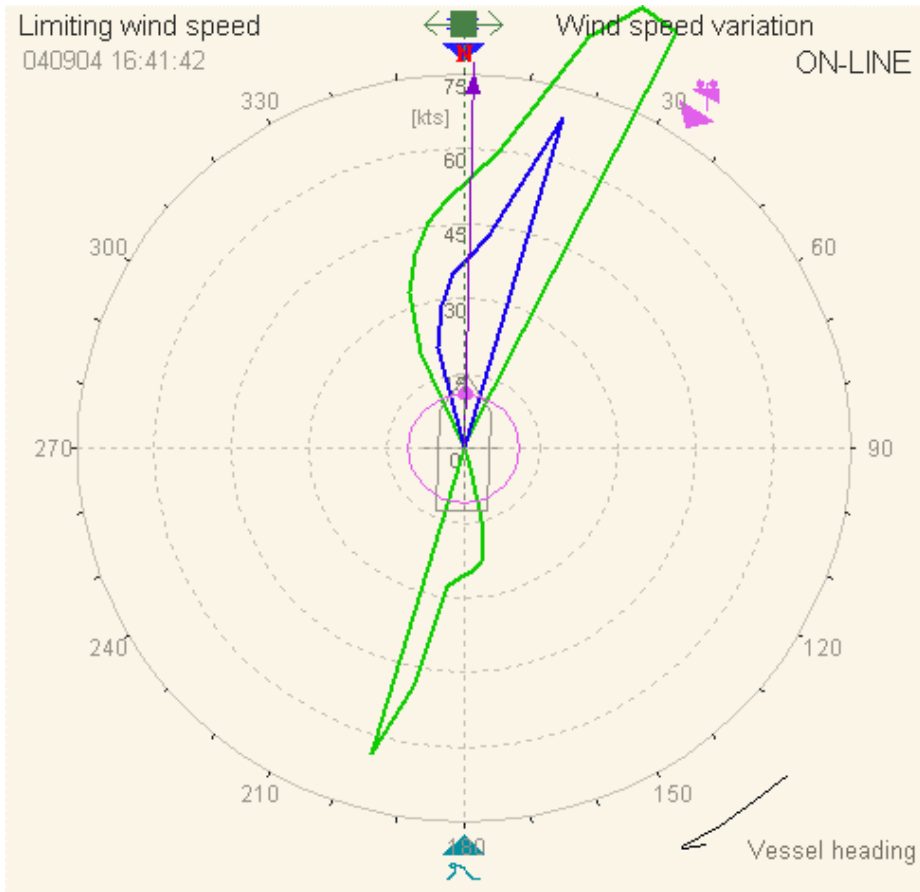
- Loop current eddies
- Current up to 4 knots
- Forecasting services available





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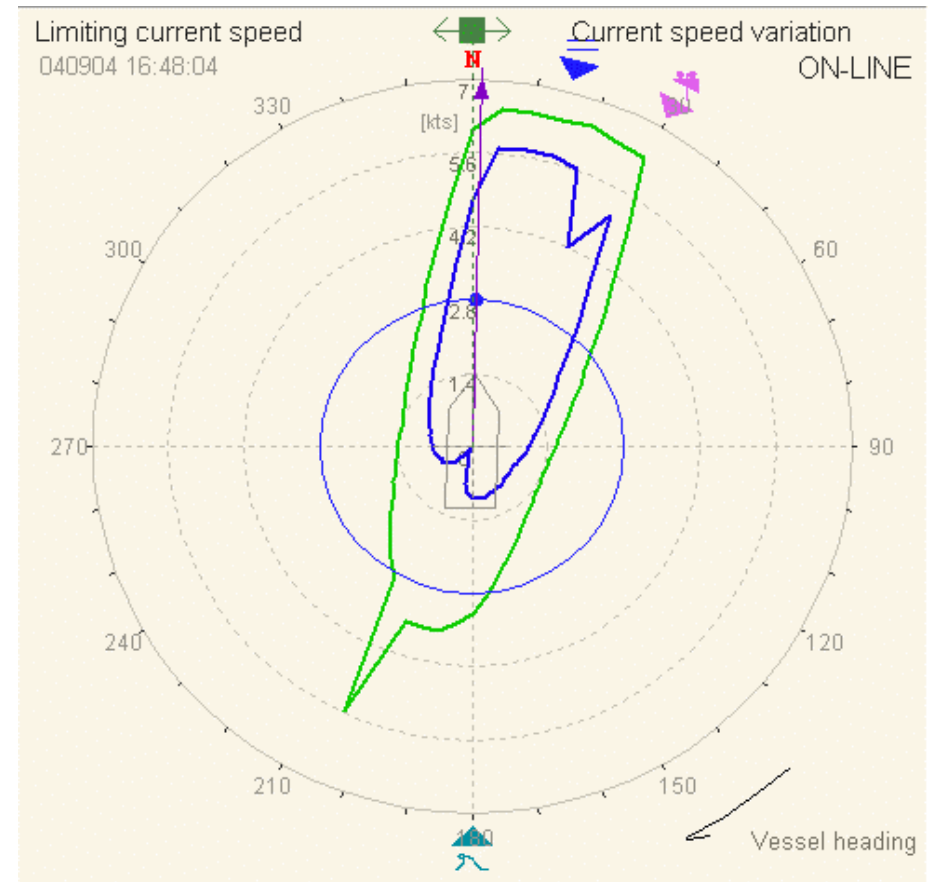
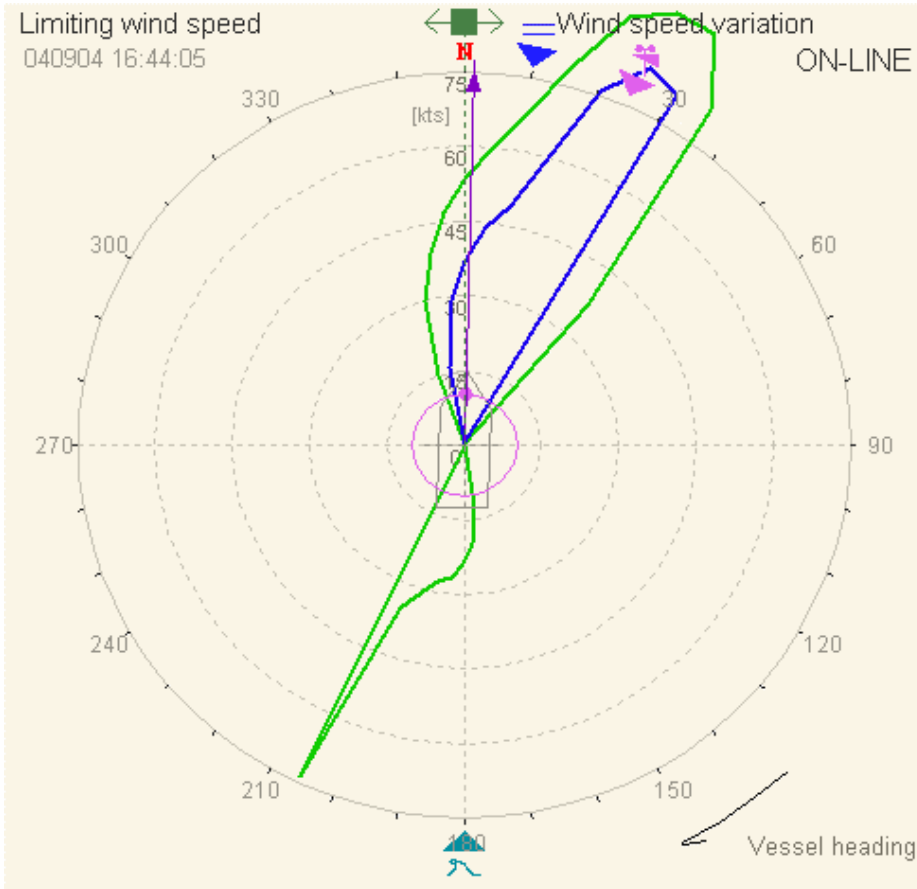
# Online DP Capability plot





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# Online DP Capability Plot; Wrong Sea current



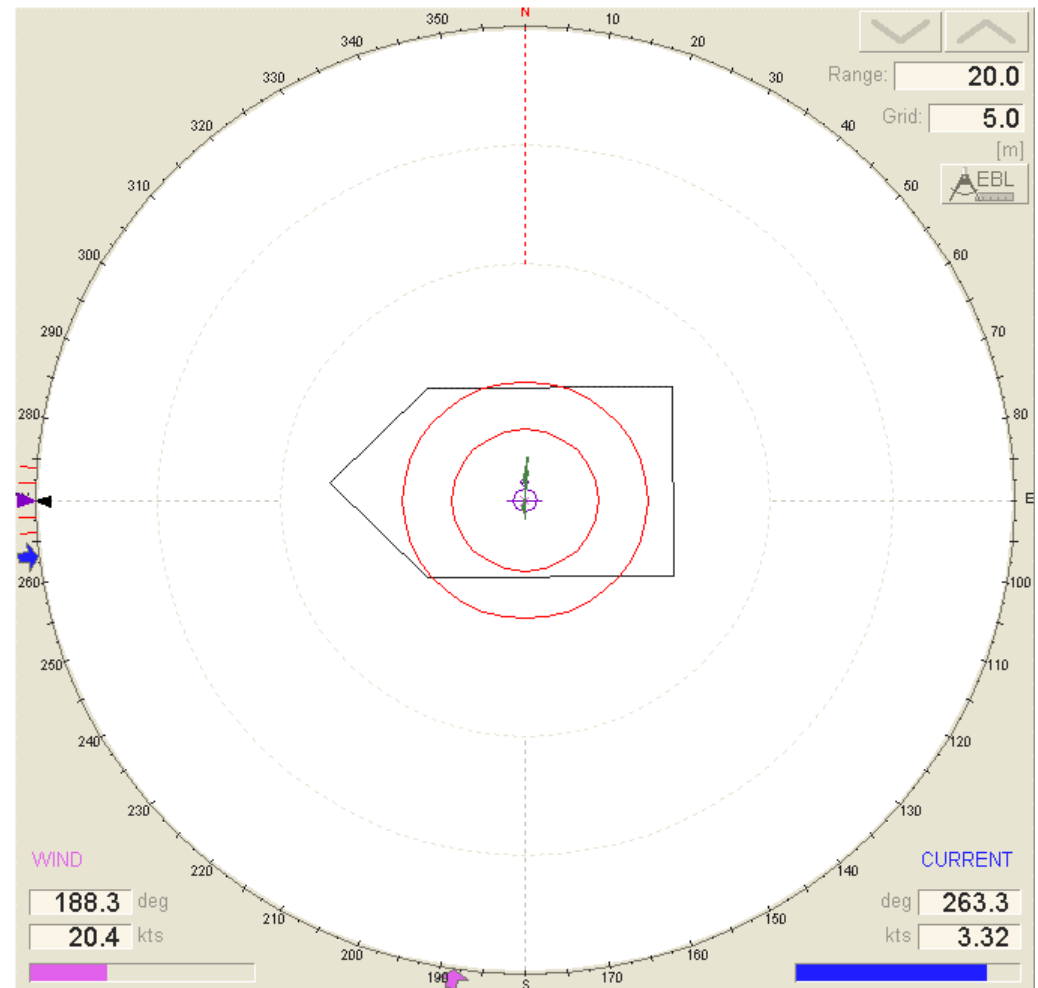




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# Drilling Operation

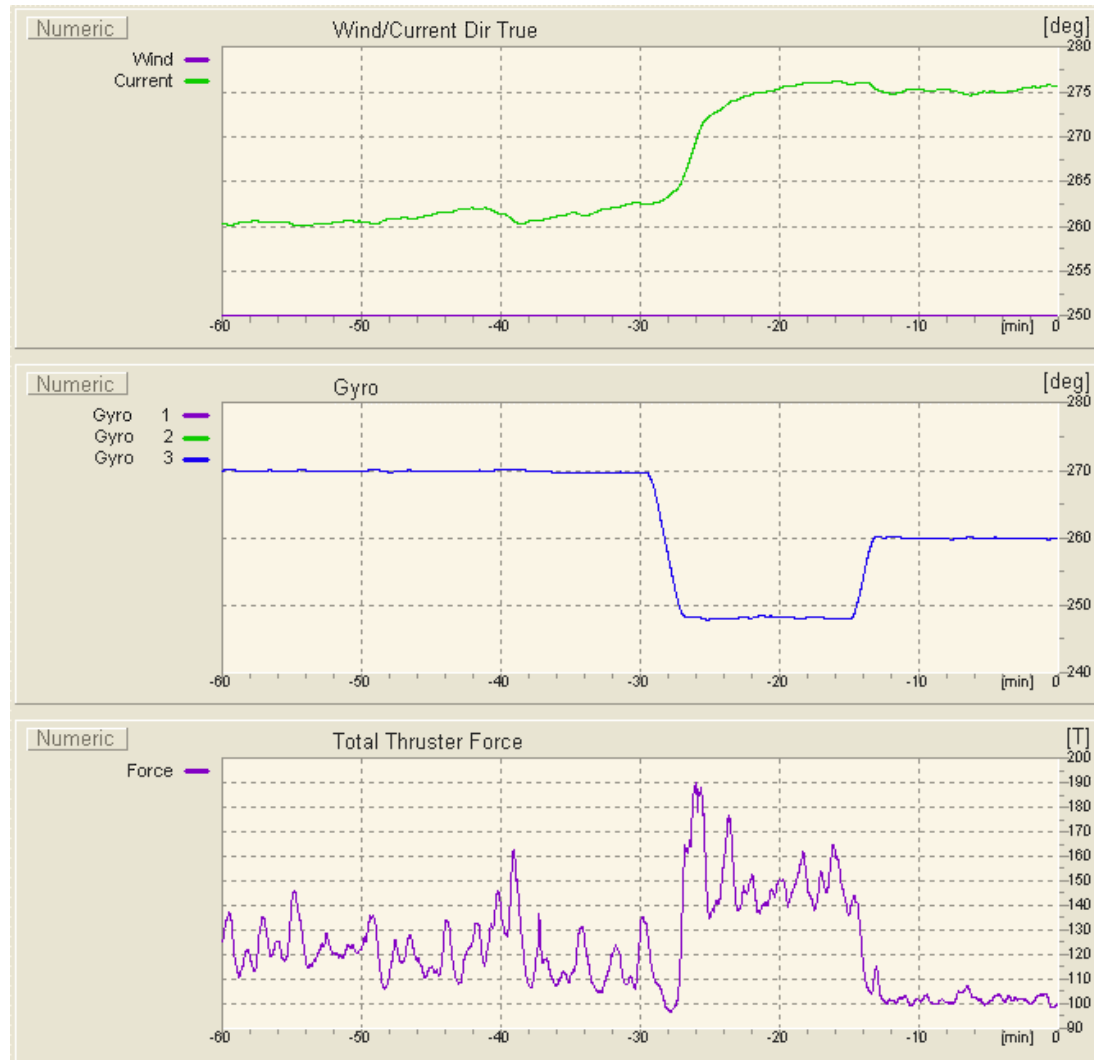
- Wind: 23 knots from 190°
- Current: 3.3 knots from 280°
- Waves: 2.0 meter with period 6 seconds from 180°
  
- Model errors introduced





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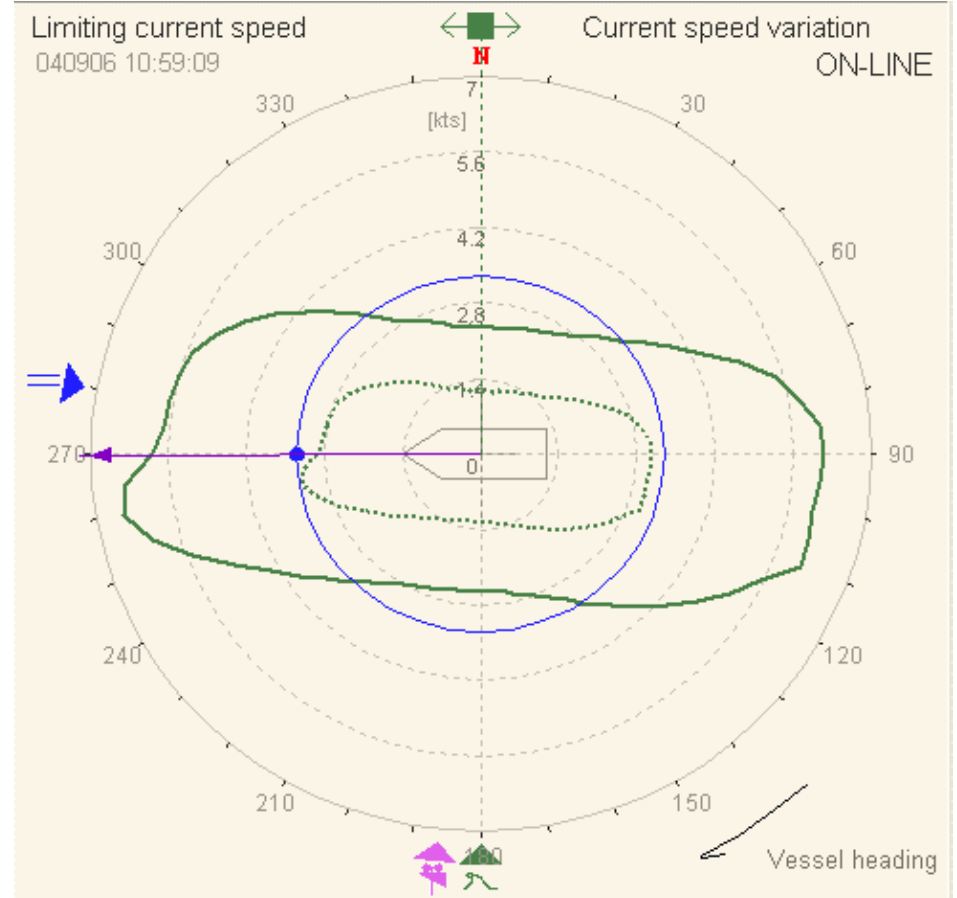
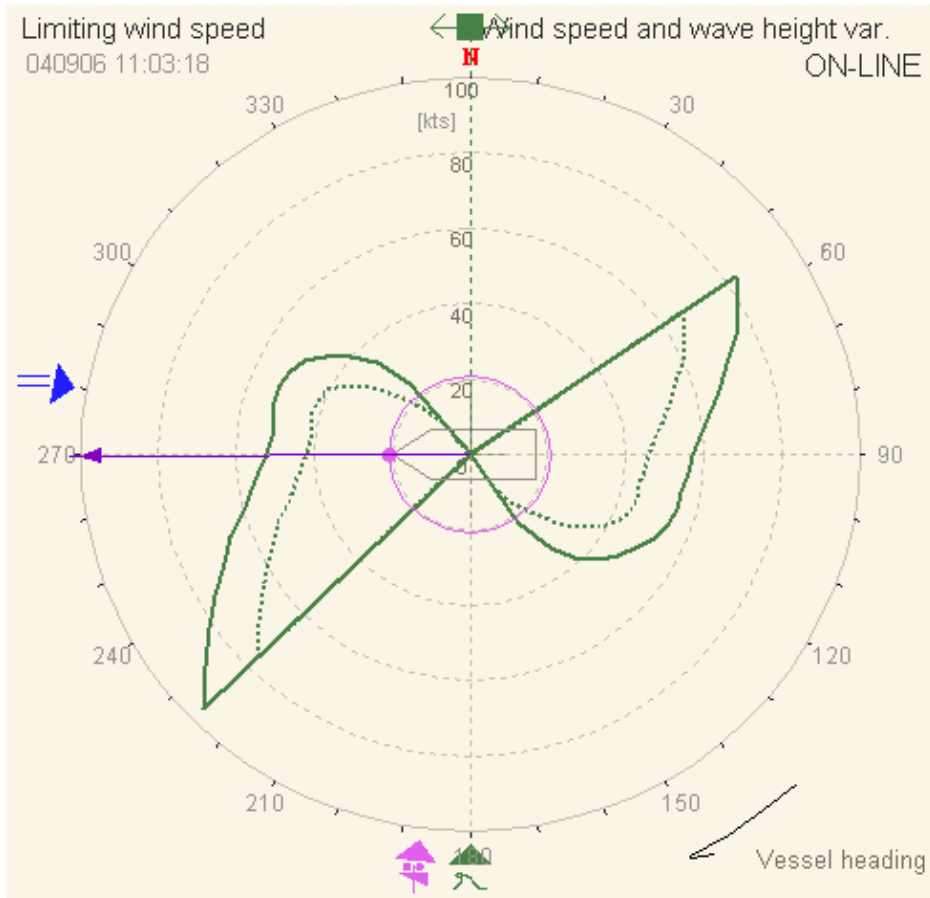
# Drilling Operation; Wrong operator interaction



# 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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