DYNAMIC POSITIONING CONFERENCE
October 11-12, 2016

COMPETENCY/DESIGN

DNV GL DP Capability - A New Standard for Assessment of the Station Keeping Capability of DP Vessels

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MARITIME

DNV GL DP Capability - A New Standard for Assessment of the Station-Keeping Capability of DP Vessels

MTS DP Conference 2016

Aleks Karlsen and Luca Pivano

12 October 2016

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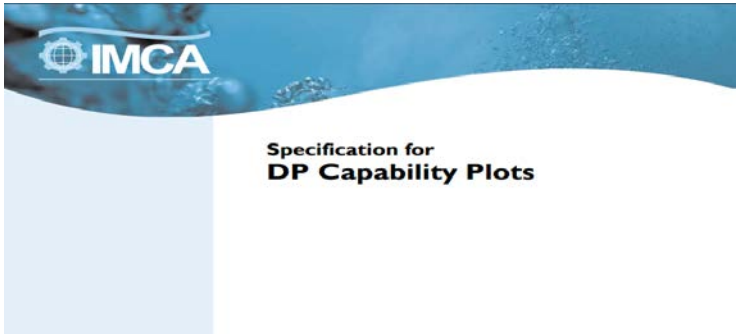
Agenda

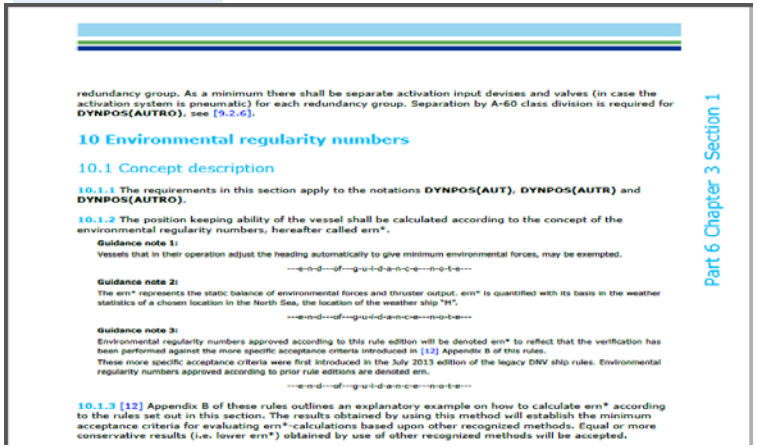
1. Why a new standard
2. Project goal and objectives
3. The DP Capability concept
4. The development project
5. My DNV GL web application

Ungraded

Challenges with the existing standards and concepts

- E.g. IMCA and DNV GL ERN
- **Specification** of **input parameters** (e.g. actuators)
- Lack of clear **method requirements** (e.g. actuator capacity and environmental forces).
- **ERN** has become an important parameter in the **charter specifications**. Lack of unified standards has been argued to result in **unfair competition** (e.g. by yards and designers).
- Calculation reports **can not be used to compare** vessels when input data and methods differ between reports, even when they refer to the same standard.
- **Hard to verify results** (e.g. why the results differ between vessels/designs).




redundancy group. As a minimum there shall be separate activation input devises and valves (in case the activation system is pneumatic) for each redundancy group. Separation by A-60 class division is required for **DYNPOS(AUTRO)**, see [9.2.6].

10 Environmental regularity numbers

10.1 Concept description

10.1.1 The requirements in this section apply to the notations **DYNPOS(AUT)**, **DYNPOS(AUTR)** and **DYNPOS(AUTRO)**.

10.1.2 The position keeping ability of the vessel shall be calculated according to the concept of the environmental regularity numbers, hereafter called ern*.

Guidance note 1:
Vessels that in their operation adjust the heading automatically to give minimum environmental forces, may be exempted.
---end---of---guidance---note---

Guidance note 2:
The ern* represents the static balance of environmental forces and thruster output. ern* is quantified with its basis in the weather statistics of a chosen location in the North Sea, the location of the weather ship "M".
---end---of---guidance---note---

Guidance note 3:
Environmental regularity numbers approved according to this rule edition will be denoted ern* to reflect that the verification has been performed against the more specific acceptance criteria introduced in [12] Appendix B of this rules.
These more specific acceptance criteria were first introduced in the July 2013 edition of the legacy DNV ship rules. Environmental regularity numbers approved according to prior rule editions are denoted ern.
---end---of---guidance---note---

10.1.3 [12] Appendix B of these rules outlines an explanatory example on how to calculate ern* according to the rules set out in this section. The results obtained by using this method will establish the minimum acceptance criteria for evaluating ern*-calculations based upon other recognized methods. Equal or more conservative results (i.e. lower ern*) obtained by use of other recognized methods will be accepted.

Part 6 Chapter 3 Section 1

Goal and objectives

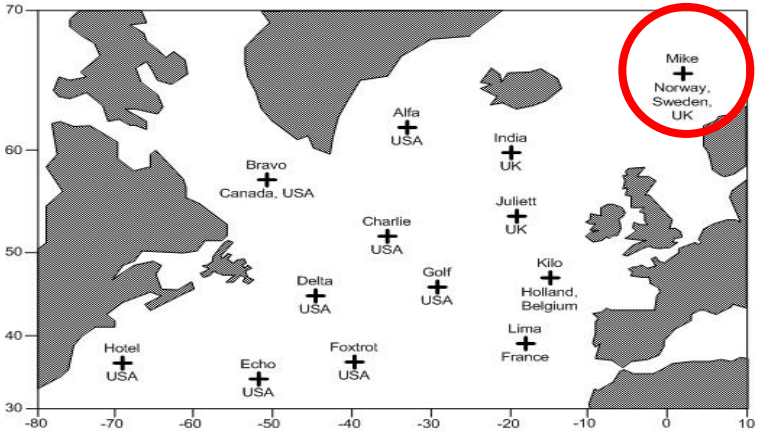
"Create a new industry standard for position keeping capability assessment"

- **Improved standard**, tailor for better risk control
- Capabilities should be **clearly understood**:
  - **intact vessel condition**
  - **after worst case failure conditions**
- Set requirements to:
  - **Methods**
  - **Documentation**
  - **Verification**

- **Solve the issue with lack of unified standards** which could result in **unfair competition** (this was a specific request from the industry)

The DNV GL Environmental Regularity Numbers (ERN) concept

- Weather statistics from "***MS Polarfront"*** which was known as the weather station M ("Mike"), and was located at 66°N, 02°E.
- **Environmental forces:**
  - Average wind speed V1 (0-21.51 m/s)
  - Significant wave height H1 (0-6.1 m)
  - Current 0.75 m/s
- Required **recognized calculation methods** (i.e. no specified parameters or specific methods required).
- Environment **direction on the beam** (worst case).
- **Static balance** of environment and forces



DP Capability numbers

The **DP Capability Level 1, Level 2 and Level 3** numbers are correlating with the Beaufort scale:

Beaufort Number	DP Capability number (Position keeping ability maintained in the corresponding BF number conditions, but not in the conditions specified for the next BF number.)	Beaufort description	Wind speed [m/s]	Significant wave height [m]	Tp [s]	Current [m/s]
0	**0**	Calm	0	0	NA	0
1	**1**	Light air	1.5	0.1	3.5	0.25
2	**2**	Light breeze	3.4	0.4	4.5	0.50
3	**3**	Gentle breeze	5.4	0.8	5.5	0.75
4	**4**	Moderate Breeze	7.9	1.3	6.5	0.75
5	**5**	Fresh breeze	10.7	2.1	7.5	0.75
6	**6**	Strong breeze	13.8	3.1	8.5	0.75
7	**7**	Moderate gale	17.1	4.2	9.0	0.75
8	**8**	Gale	20.7	5.7	10.0	0.75
9	**9**	Strong gale	24.4	7.4	10.5	0.75
10	**10**	Storm	28.4	9.5	11.5	0.75
11	**11**	Violent Storm	32.6	12.1	12.0	0.75
12	NA	Hurricane force	NA	NA	NA	0.75

- The wind speed is 10 min average 10 m above sea level.
- The given Tp represent a 95% confidence interval in the world wide scatter diagram.

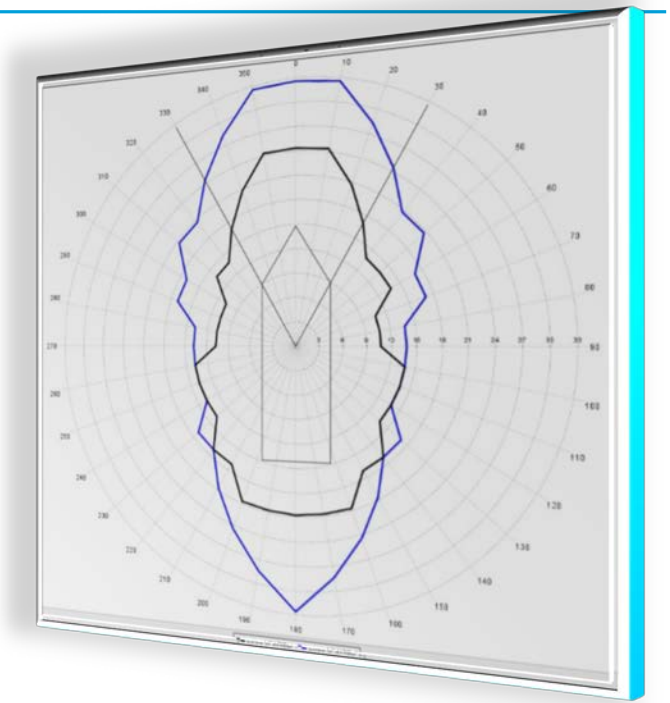
Three levels + site specific calculations

DP Capability level	Description
1	Describes a prescriptive method for documenting ship-shaped mono-hull vessels based on a **fixed set of prescriptive formulas**. The calculations are based on a static balance of environmental forces and thrust output. Beaufort scale based environmental conditions shall be used. **The rigidness of the method ensures that the DP-CAP numbers calculated according to the method will be comparable between different vessels.**
2	A more comprehensive quasi static method. This level **allows for project specific adjustments** to the calculations and is applicable for all vessel shapes. Any project specific data shall be documented and justified. Beaufort scale based environmental conditions shall be used.
2-Site	Same as Level 2 and in addition the method **allows for site specific environmental data** to be used, and for inclusion of external forces.
3	The purpose of DPCAP Level 3 is to **get more insight on the vessel DP capability performance by use of time domain simulations**. By performing time-domain simulations and including the relevant dynamics, DPCAP Level 3 can provide more information of the station-keeping performance than the other DPCAP Levels such as statistics of the vessel position and heading, thruster and power utilization, and of other relevant vessel states.
3-Site	Same as Level 3 and in addition the method allows for **site specific environmental data** to be used, and for inclusion of external forces.

DP Capability numbers format for Level 1 and Level 2

- **DP Capability-LX(A, B, C, D)**
  - **X** = 1 or 2 describing the DPCAP level
  - **A** = Intact condition, heading 0-±30°
  - **B** = Intact condition, heading 0-360°
  - **C** = Worst Case Single Failure condition, heading 0-±30°
  - **D** = Worst Case Single Failure condition, heading 0-360°

  - Example: **DP Capability-L1(9, 7, 6, 4)**



- **DP Capability–LX-Site** calculations shall be documented by wind envelope plots only

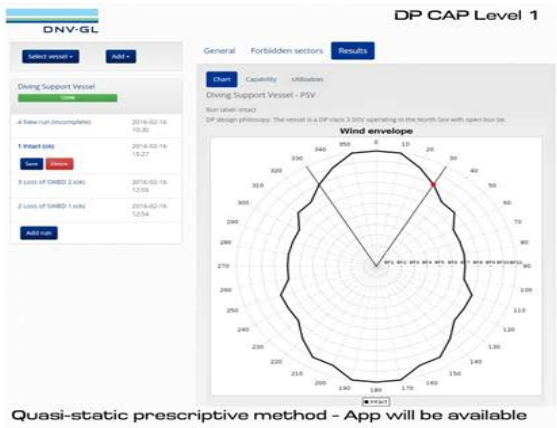
Industry participation (Almost 20 companies, Norway, Netherlands, UK)

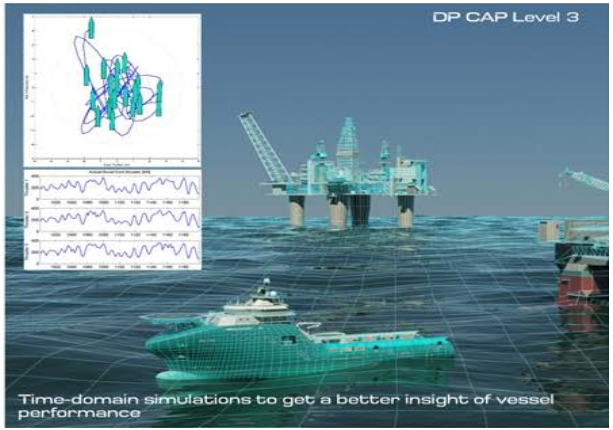
- Internal project kick-off: **January 2013**
- First DP CAP meeting with industry: January 2013
- Update ERN to ERN*: **July 2013**
- Key DNVGL stakeholder meeting: January 2014
- TEKNA conference presentation: February 2014
- Workshop 1: April 2014
- Workshop 2: June 2014
- Workshop 3: November 2014
- Workshop 4: November 2015
- Workshop 5: January 2016
- Proposal sent on industry wide external hearing: Spring 2016
- Release of DP Capability standard: **July 2016**
- Release of DP Capability Level 1 software App: **August 2016**

Workshop-3 participants November 2014

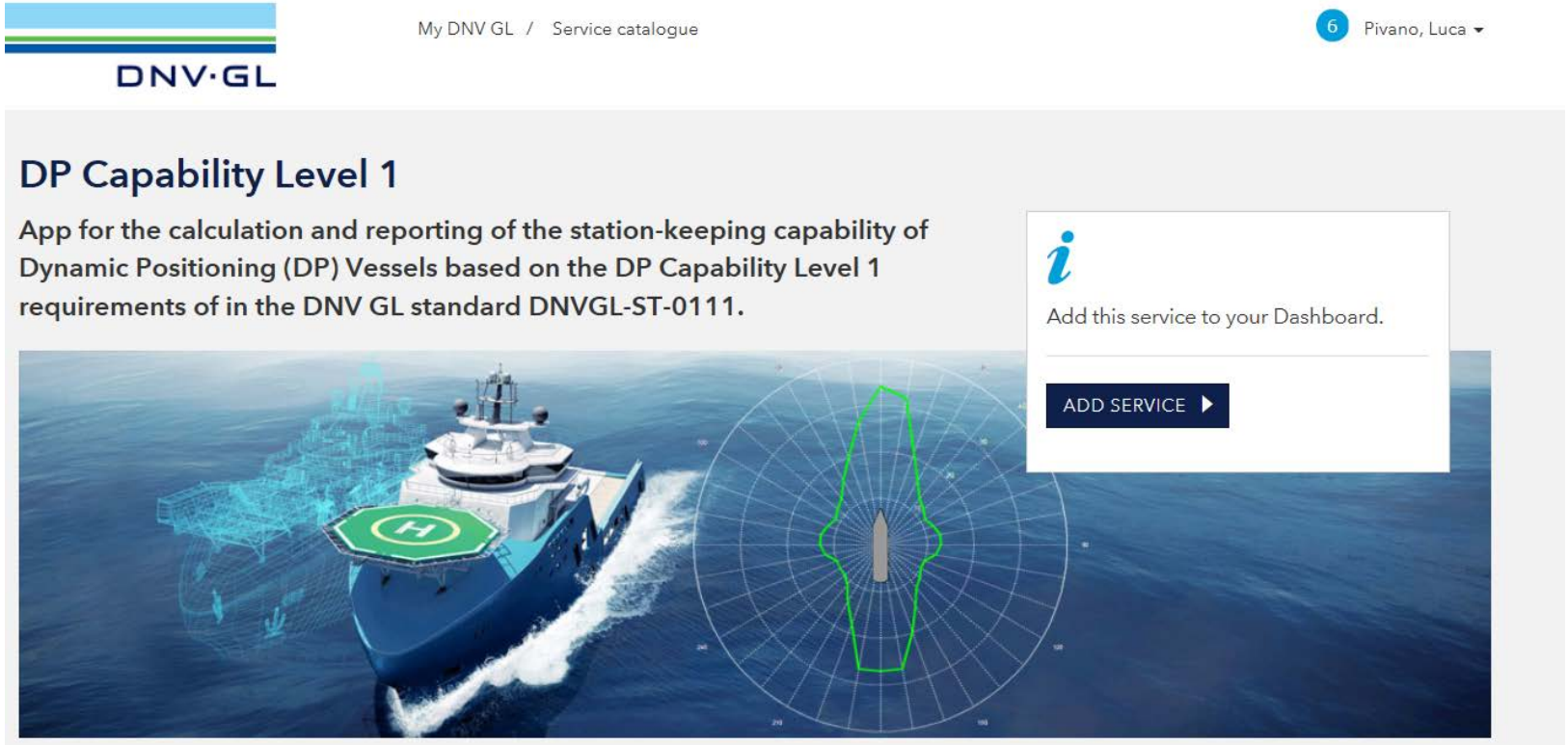
DP Capability status

- **Standard** with three assessment levels published June 2016
- **WEB App** for level 1 published August 2016
- **Rule proposal** where ern* is replaced by DP Capability numbers is on hearing (proposed to be required for new vessels, but can also be assigned to sailing vessels)





DP Capability Level 1 – My DNV GL web application



Ungraded

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DIVING SUPPORT VESSEL

SAVE * DELETE ✖ EXPORT

Run 1 Intact case ✔	2016-09-08 19:39
Run 2 Loss of SWBD 1 ✔	2016-08-19 12:00
Run 3 Loss of SWBD 2 ✔	2016-08-19 12:00

ADD RUN

General | Hull | Thrusters and rudders | Power | Results | Report | Additional services

Created: Unknown

Updated: 2016-09-18 19:10

Vessel name: Diving Support Vessel

Vessel type: Diving Support Vessel

DNV GL vessel ID:

IMO number:

Yard name:

Yard vessel number:

# of thrusters: 5

# of generators: 4

# of prime movers: 4

# of switchboards: 2

DP design philosophy description

This is the default vessel included in the DP Capability App.

General arrangement ADD IMAGE REMOVE ✖

Single line diagram ADD IMAGE REMOVE ✖

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SAVE * DELETE ✖ EXPORT

Run 1 Intact case ✔	2016-09-08 19:39
Run 2 Loss of SWBD 1 ✔	2016-08-19 12:00
Run 3 Loss of SWBD 2 ✔	2016-08-19 12:00

ADD RUN

General | Hull | Thrusters and rudders | Power | Results | Report | Additional services

Loa [m] 87	Lpp [m] 80	B [m] 20
xlos [m] -2	Los [m] 85	awlaft [m2] 800
Summer load line draught [m] 6		Bow angle [deg] 32
Number of skegs 1		
xskeg1 [m] -30		yskeg1 [m] 0

AF wind [m2] 300		
AL wind [m2] 700		AL current [m2] 500
xL wind [m] 5		xL current [m] 1

Front view picture ADD IMAGE REMOVE ✖

Side view picture ADD IMAGE REMOVE ✖

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SAVE DELETE EXPORT

Run 1 Intact case ✔ 2016-09-08 19:39

Run 2 Loss of SWBD 1 ✔ 2016-08-19 12:00

Run 3 Loss of SWBD 2 ✔ 2016-08-19 12:00

ADD RUN

General Hull Thrusters and rudders Power Results Report Additional services

Thruster 1 Thruster 2 Thruster 3 Thruster 4 Thruster 5

Thruster maker

Thruster Maker

Maker's identification

Tunnel AAA

Diameter [m]

2

Max. power consumption [kW]

1800

Nominal thrust [kN]

197

Thruster x-position [m]

52

Thruster y-position [m]

0

Thruster z-position [m]

2.6

(Not selected)
Tunnel
Azimuth
Pod
Shaft line
Cycloid

Other shapes

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SAVE DELETE EXPORT

Run 1 Intact case ✔	2016-09-08 19:39
Run 2 Loss of SWBD 1 ✔	2016-08-19 12:00
Run 3 Loss of SWBD 2 ✔	2016-08-19 12:00

ADD RUN

Generators

#	Power (kW)	Connected to SWBD	Connected to SWBD	Feed from prime mover
Generator 1	2500	1	Not connected	1
Generator 2	2500	1	Not connected	2
Generator 3	2500	2	Not connected	3
Generator 4	2500	2	Not connected	4

Prime movers

#	Power (kW)
Prime mover 1	2500
Prime mover 2	2500
Prime mover 3	2500
Prime mover 4	2500

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Run 1 Intact case ✔ 2016-09-08 19:39

SAVE DELETE ✖

Run 2 Loss of SWBD 1 ✔ 2016-08-19 12:00

Run 3 Loss of SWBD 2 ✔ 2016-08-19 12:00

ADD RUN

General | Forbidden zones | Results

Run label: Intact case

DP mode: DP Model label

Run description: Run description

Include power limits in the calculation: ☑

Dynamic factor: 1.25

Thruster power configuration - % of max thruster power from each source

	Switchboards		Prime movers	
#	SWBD 1 [%]	SWBD 2 [%]	Prime mover connected	[%]
Thruster 1	80	0	Not connected	
Thruster 2	0	80	Not connected	
Thruster 3	100	0	Not connected	
Thruster 4	0	100	Not connected	
Thruster 5	100	0	Not connected	

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Run 1 Intact case ✔ 2016-09-08 19:39

SAVE DELETE ✖

Run 2 Loss of SWBD 1 ✔ 2016-08-19 12:00

Run 3 Loss of SWBD 2 ✔ 2016-08-19 12:00

ADD RUN

General | Forbidden zones | Results

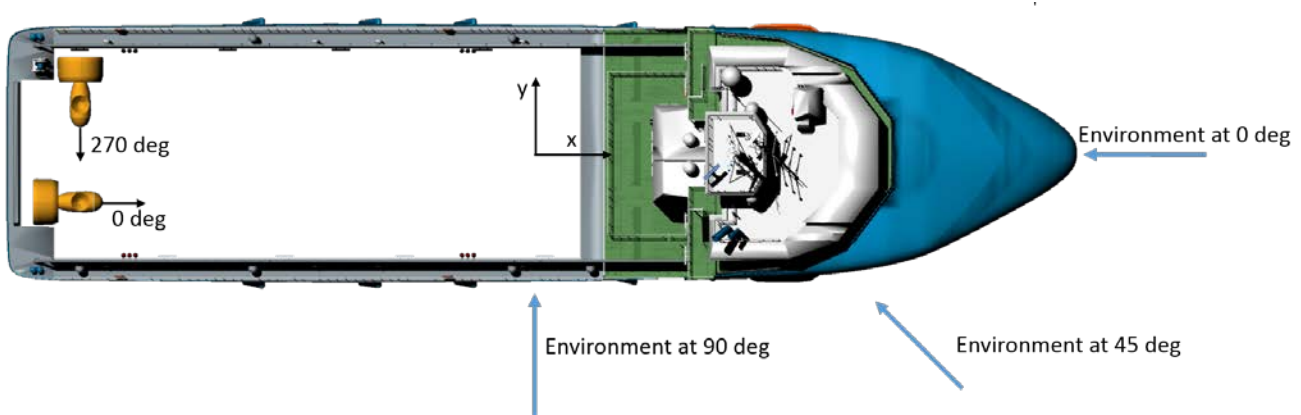
Default forbidden zones

#	Min angle [deg]	Max angle [deg]
Thruster 4	73.3	106.7
Thruster 5	-106.7	-73.3

Additional forbidden zones

ADD SECTOR

#	Min angle [deg]	Max angle [deg]



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DIVING SUPPORT VESSEL

Run 1 Intact case ✔ 2016-09-27 17:34
SAVE DELETE ✖
Run 2 Loss of SWBD 1 ✔ 2016-08-19 12:00
Run 3 Loss of SWBD 2 ✔ 2016-08-19 12:00
ADD RUN

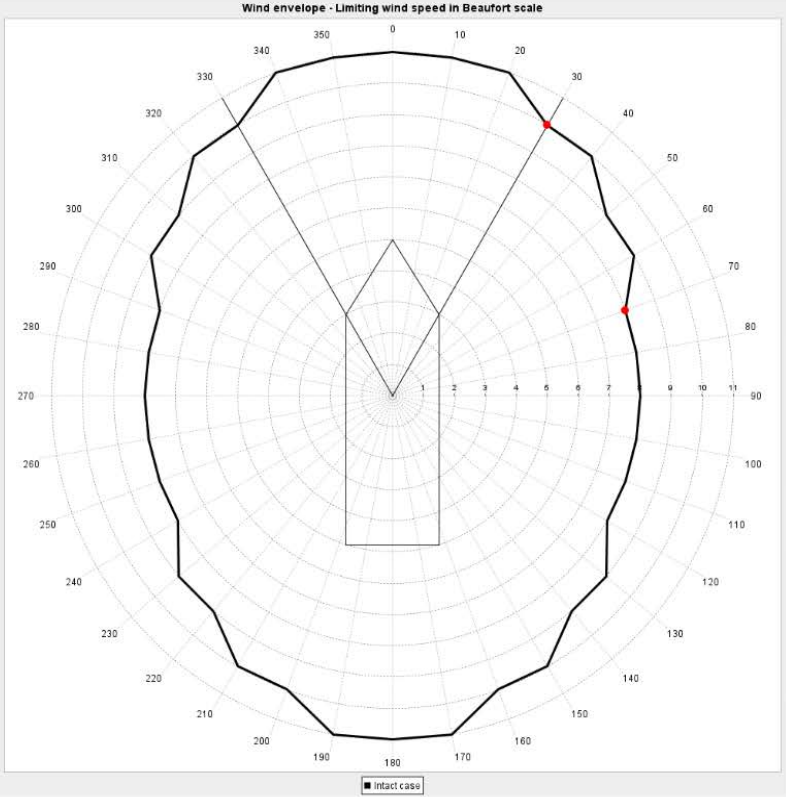
General Forbidden zones Results

Capability plot Capability table Thruster utilization table Switchboard power table Thruster power table

Diving Support Vessel - Diving Support Vessel

DYNAMIC FACTOR: 1.25

RUN LABEL: INTACT CASE



Select run for results

Diving Support Vessel - Diving Support Vessel

Results: DP Capability L1 (10, 8, 7, 5)

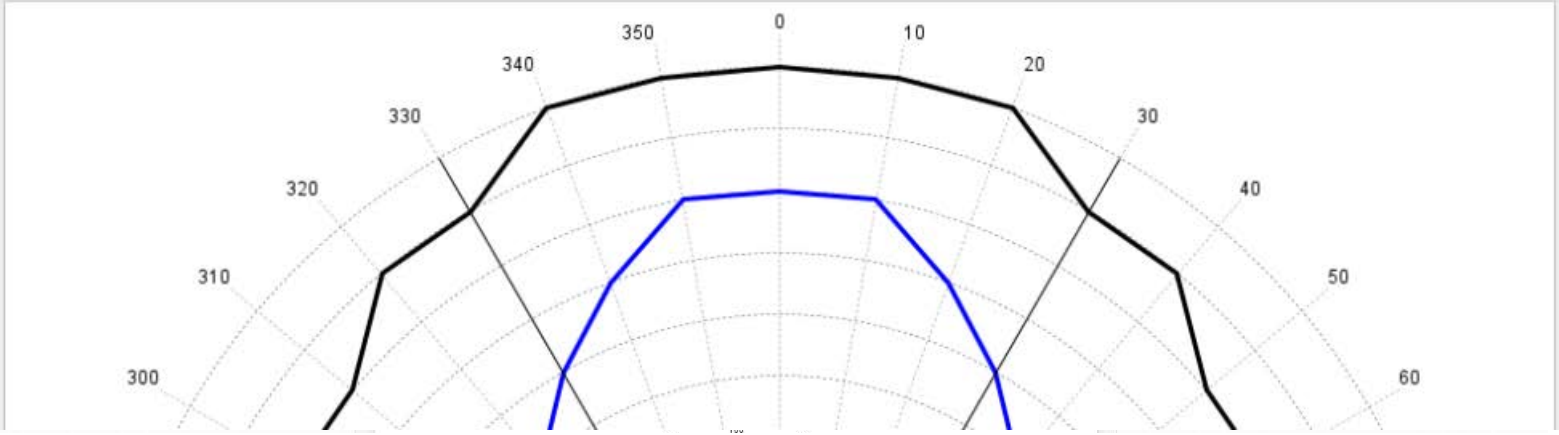
Intact and worst case single failure results

Intact run label: Intact case

Worst case single failure (Loss of SWBD 1, Loss of SWBD 2)

Dynamic factor: 1.25

Wind envelope - Limiting wind speed in Beaufort scale



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SAVE DELETE EXPORT

Run 1 Intact case ✔ 2016-09-27 17:34

Run 2 Loss of SWBD 1 ✔ 2016-08-19 12:00

Run 3 Loss of SWBD 2 ✔ 2016-08-19 12:00

ADD RUN

Request approval Export to PDF

Diving Support Vessel - Diving Support Vessel

Project ID

Project ID

Prepared by

Author

Company

Company Name

E-mail

nume.surname@email.com

Report date

18.09.2016

Executive summary

This is the executive summary which can be edited directly in the app.

ADD ABBREVIATION

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Run 1 Intact case ✔ 2016-09-27 17:34

SAVE DELETE ✖

Run 2 Loss of SWBD 1 ✔ 2016-08-19 12:00

General Forbidden zones Results

Capability plot Capability table Thruster utilization table Switchboard power table Thruster power table

Diving Support Vessel - Diving Support Vessel

DYNAMIC FACTOR: 1.25

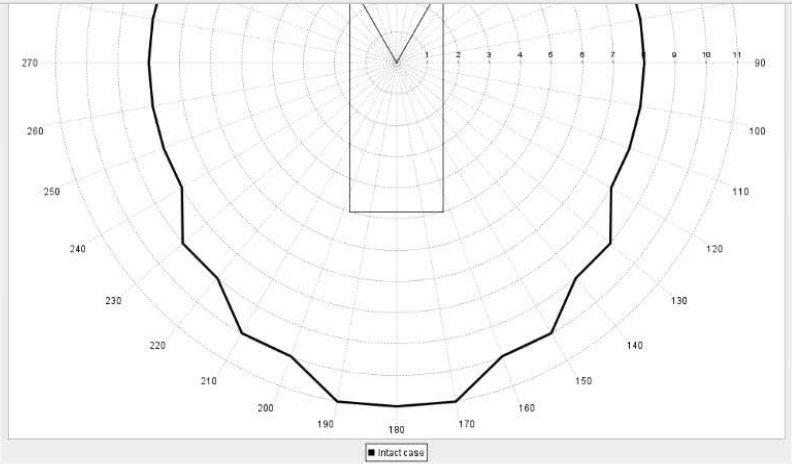
Capability plot | Capability table | Thruster utilization table | Switchboard power table | Thruster power table

Diving Support Vessel - Diving Support Vessel

DYNAMIC FACTOR: 1.25

RUN LABEL: INTACT CASE

Wind envelope - Limiting wind speed in Beaufort scale



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Run 1 Intact case ✔ 2016-09-27 17:34

SAVE DELETE ✖

Run 2 Loss of SWBD 1 ✔ 2016-08-19 12:00

Run 3 Loss of SWBD 2 ✔ 2016-08-19 12:00

ADD RUN

General Forbidden zones Results

Capability plot Capability table Thruster utilization table Switchboard power table Thruster power table

Diving Support Vessel - Diving Support Vessel

DYNAMIC FACTOR: 1.25

RUN LABEL: INTACT CASE

Capability result table

Heading [deg]	Beaufort #	Wind force [kN]	Wave force [kN]	Current force [kN]	Wind moment [kNm]	Wave moment [kNm]	Current moment [kNm]	Wind limit [m/s]
0	11	137	197	2	0	0	0	32.6
10	11	152	245	15	1877	241	316	32.6
20	11	190	352	30	3322	277	622	32.6
30	10	180	327	43	3271	81	909	28.4
40	10	215	407	56	3671	-154	1045	28.4
50	9	183	372	66	2759	-383	1009	24.4
60	9	203	416	75	2589	-703	875	24.4

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