

MARITIME

# Air gap in operating condition

Ptil Webinar

**Alf Henry Aker / Hans J. Berg**

28 January 2021

## Contents

---

- Rule requirements for air gap in operating draught
  - DNVGL-OS-C103, July 2020 edition
- Status of the DNV GL work for existing fleet
- Risk evaluation of an observed sea state
- Operating limitations
  - Hull
  - Drilling system

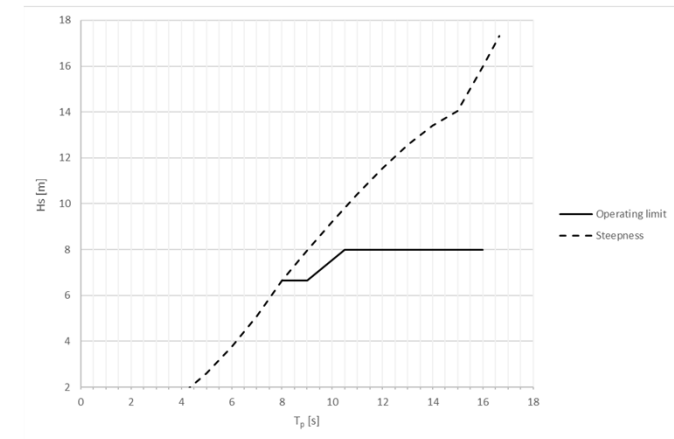
## Rule requirements wrt. air gap in operating condition.

---

- DNVGL-OS-C103, July 2020 edition
  - Zero air gap at edge of deck box and in vicinity of moon pool (In case of flush columns/upper hull outer shell: negative air gap above columns, extent of negative air gap to be less than in survival)

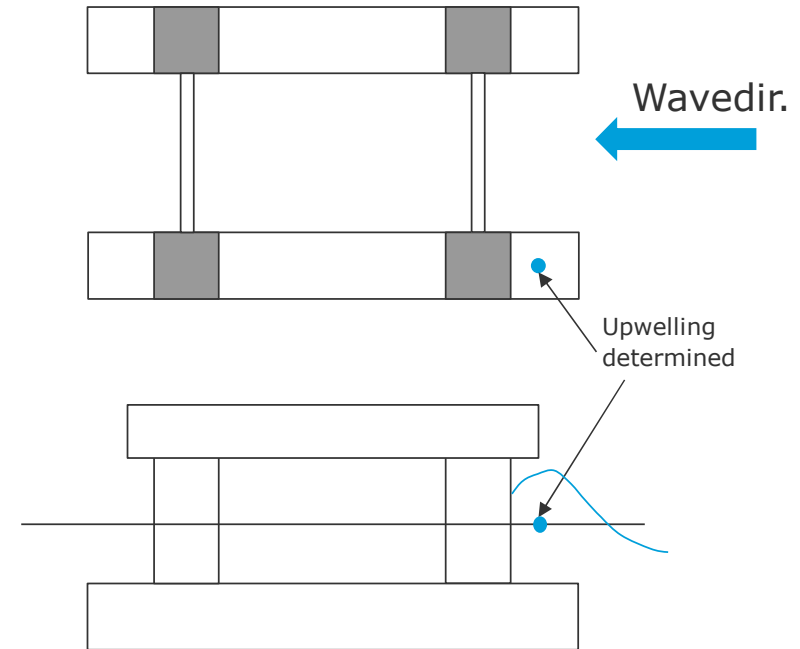
## Status DNV GL work related to air gap in operating condition.

- Review of documentation of operating draught
  - After adjustment of the operation limit all reviewed rigs fulfil the requirements for zero air gap at deck box edge according to DNVGL-OS-C103, July 2020
- Issuing summary letters to owner for each unit (Ongoing work).
  - Letters cover survival and operating condition.
- Updating the Appendix to Class with new limiting operating curves and general text.



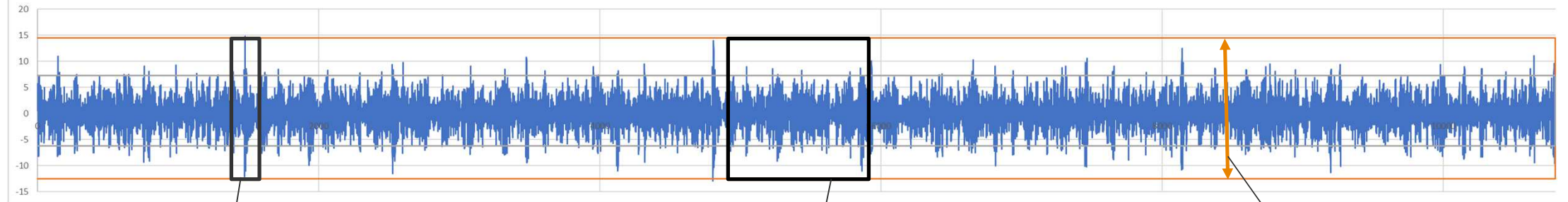
## Example of time series of the wave upwelling in a 3 hour storm

- Wave upwelling in front of the column
- Typical limiting sea state in operating condition giving zero air gap (i.e. 90 percentile upwelling is 13.5m which equals the static air gap)
- $H_s=6.65\text{m}$ ,  $T_p=9\text{s}$ , Jonswap, Gamma=5.
- No run-up or jets (linear calculations)

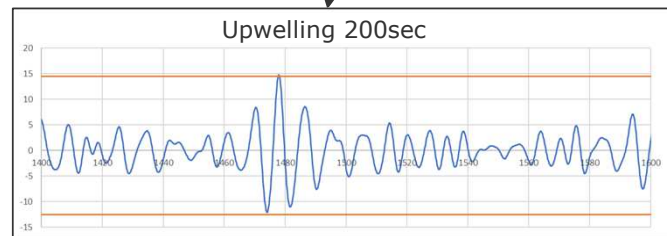


# Results

3hours = 10800sec

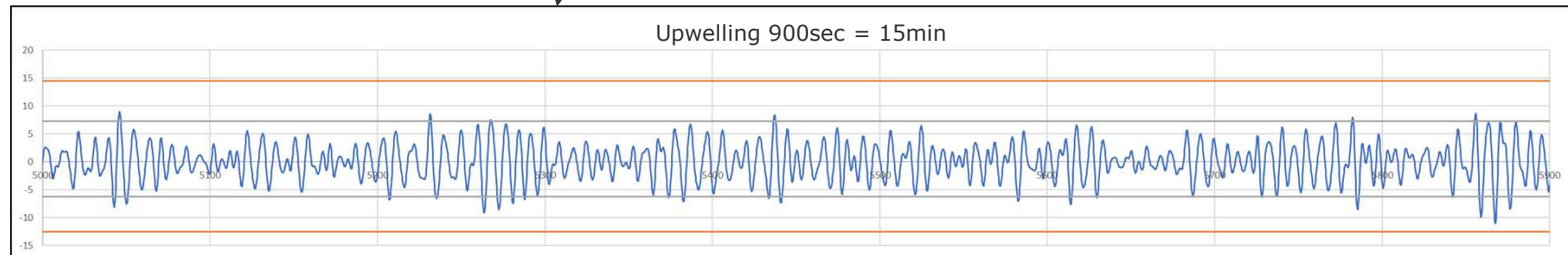


Upwelling 200sec



Zero air gap=90 percentile upwelling

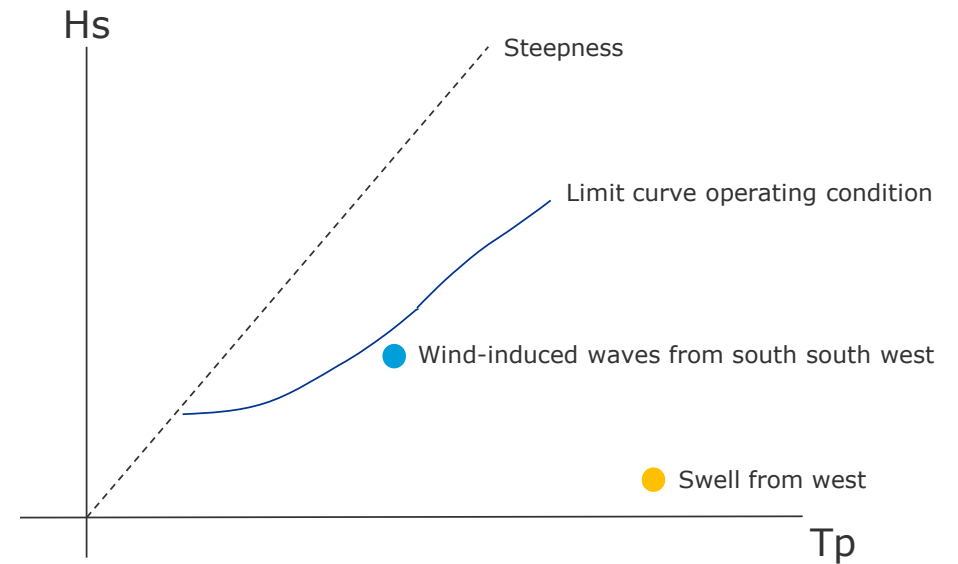
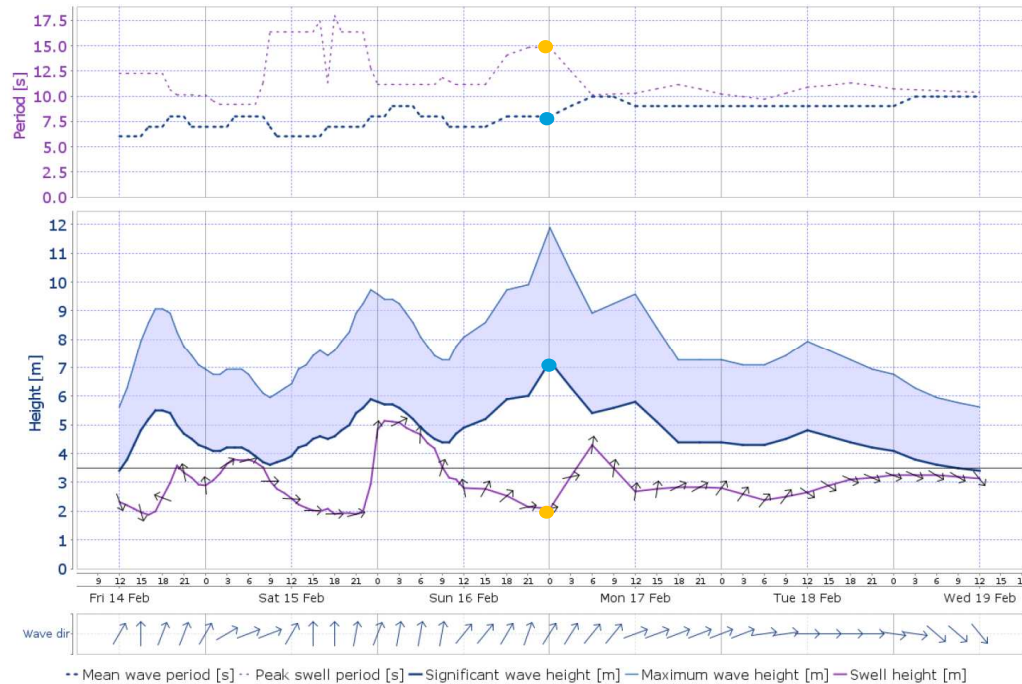
Upwelling 900sec = 15min



Long periods with upwelling less than 50% of air gap!

## Forecast wave conditions vs airgap limit curves

- The real sea and weather forecast can contain a number of stated  $H_s$  and periods:  $H_s$ ,  $T_z$  and  $T_p$  for each wind, swell and overall sea + different directions
- Easy to accurately apply on the "Airgap limit curve"?



## Improvement of the limit curve considerations

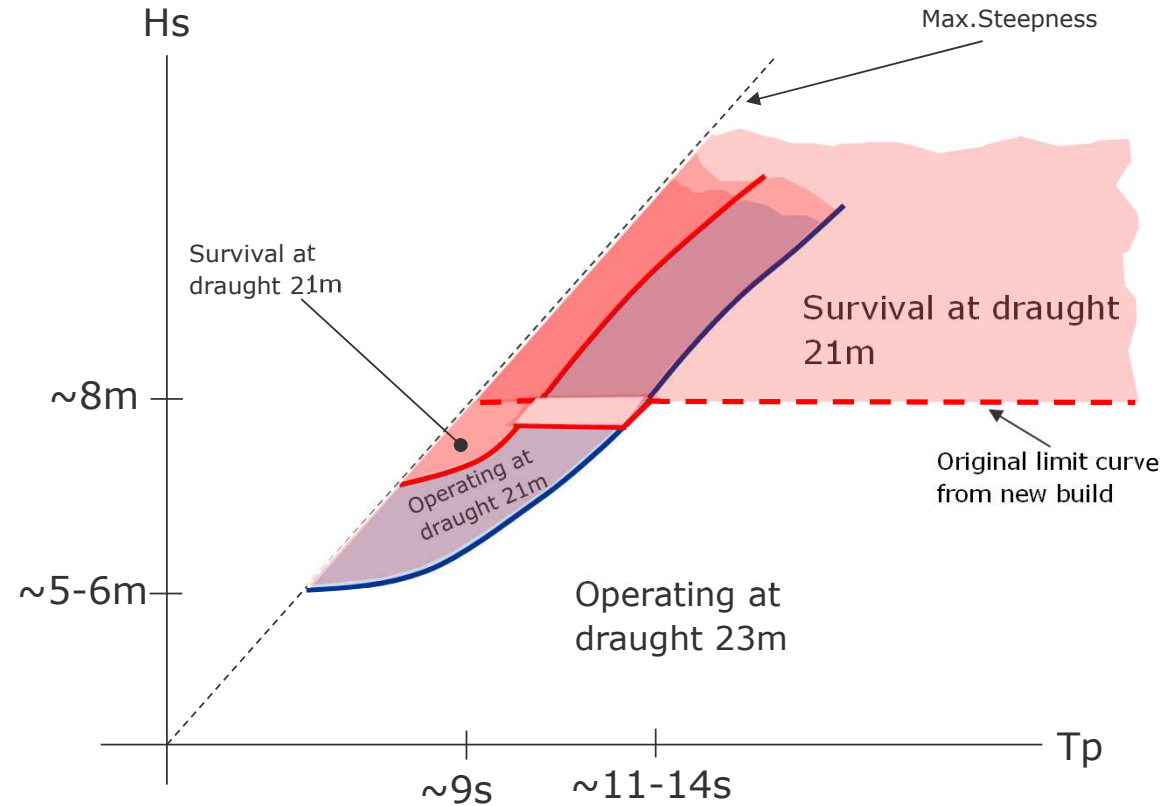
---

- Measure the upwelling and wave height from the unit.
  - Based on models identify critical sea states wrt. horizontal wave impact.
- Prediction models as forecast.
  - Based on weather forecast estimate upwelling.
- Evaluate the use of 2D-spectre
- To be further investigated

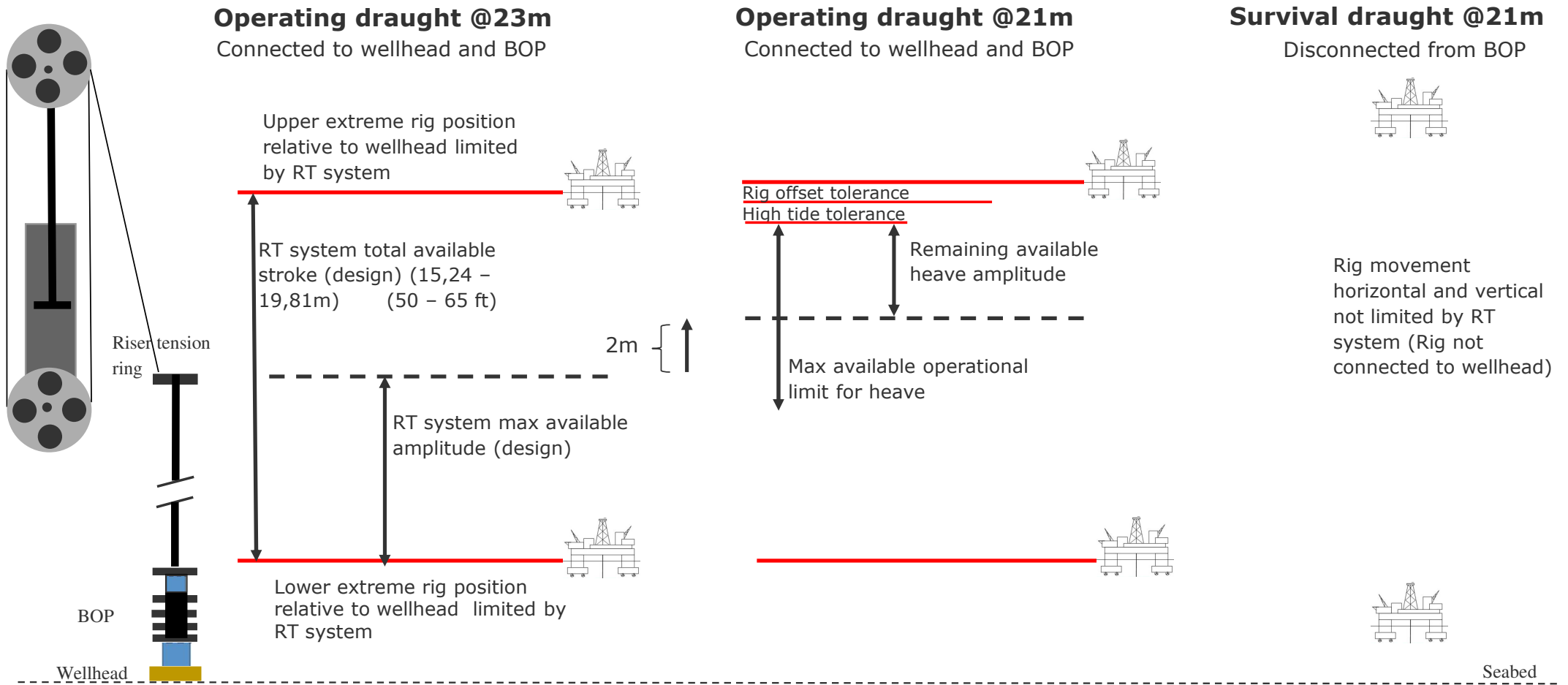


## Operating draught(s) limitations

- For existing units
  - Limitations due to air gap, DNVGL-OTG-13
    - Limiting curve for operating at draught 23m
    - Limiting curve for operating at draught 21m
  - Limitations original design
    - Air gap, accelerations with operating loads, equipment restrictions
  - Limitation curve for operating draught at 21m due to increased accelerations compared to operating at 23m draught.

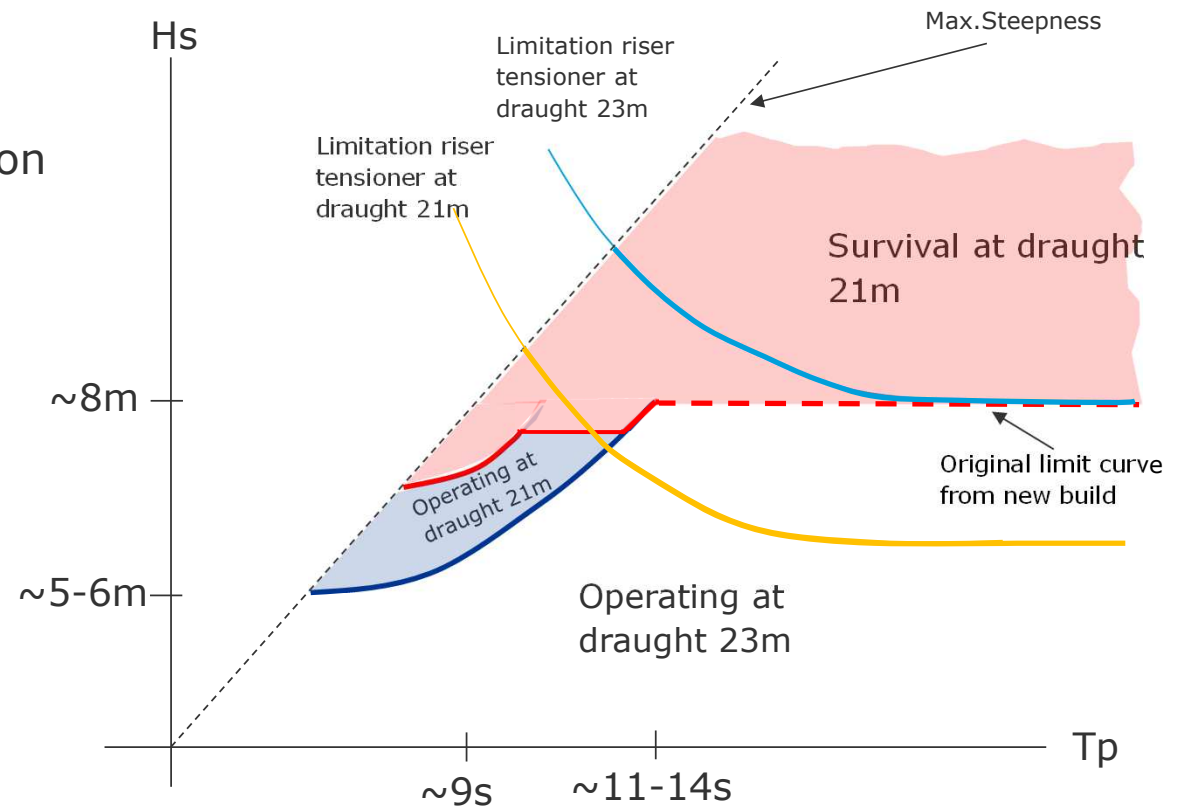


# Change of operating draught - effect on riser & riser tensioning system

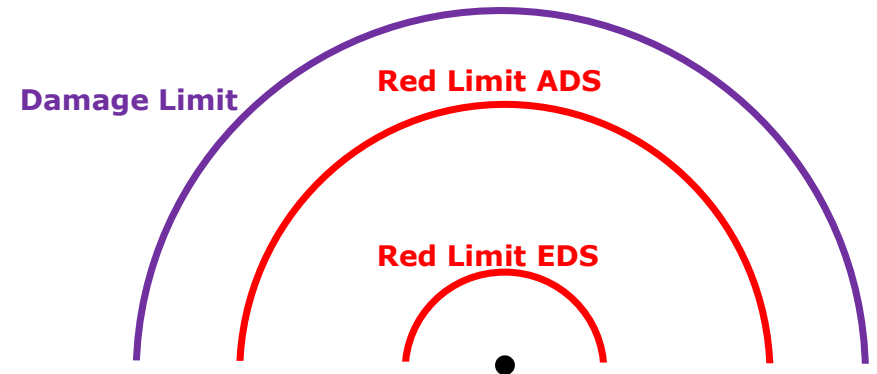
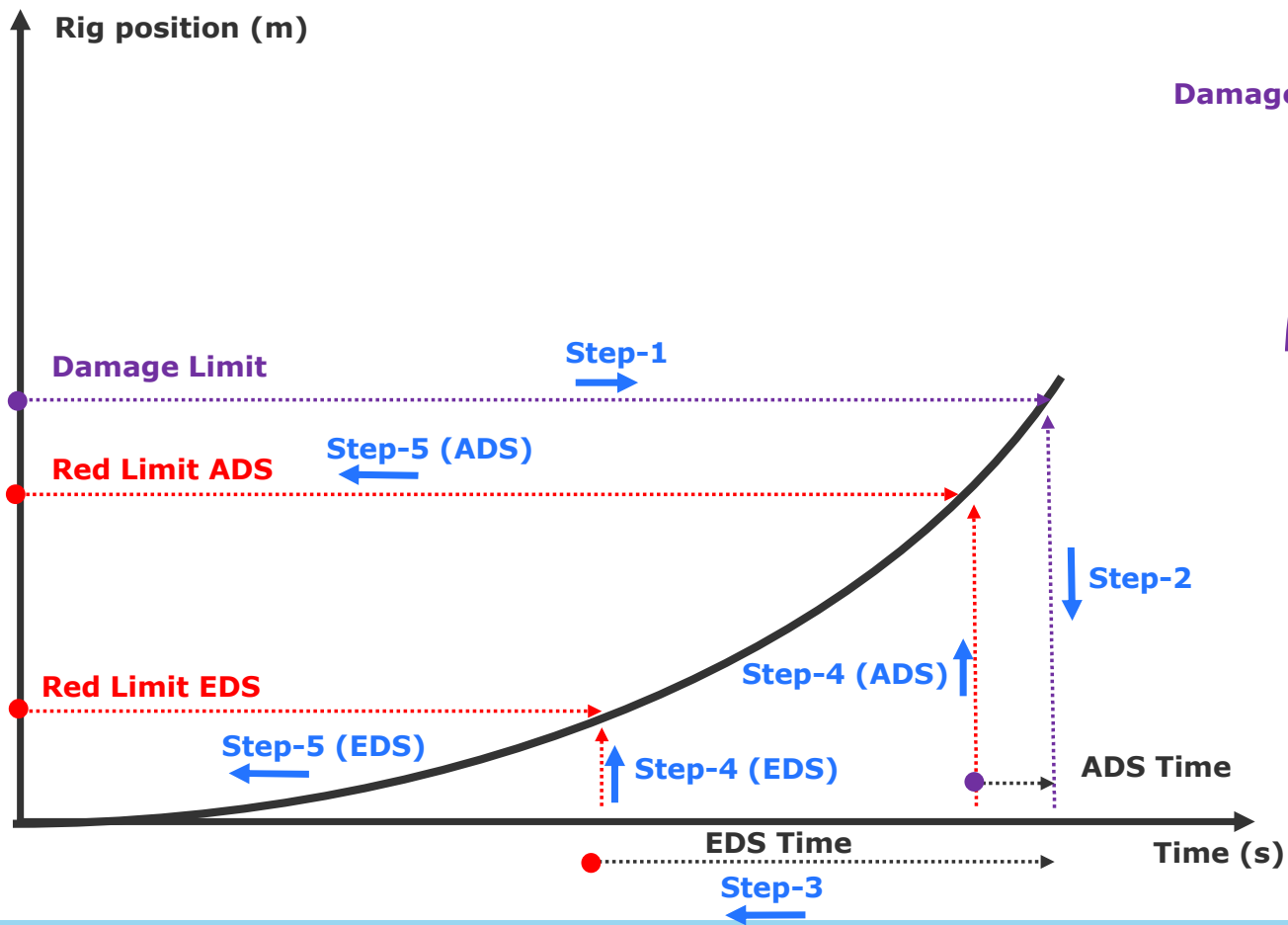


## Operational limitations due to riser tensioners

- Riser tensioner limit at draught 23m
- Riser tensioner limit at draught 21m
  - Limit will depend on heave motion and on period for limit



# Drive-off: Relationship between physical limit (damage limit) and red limit



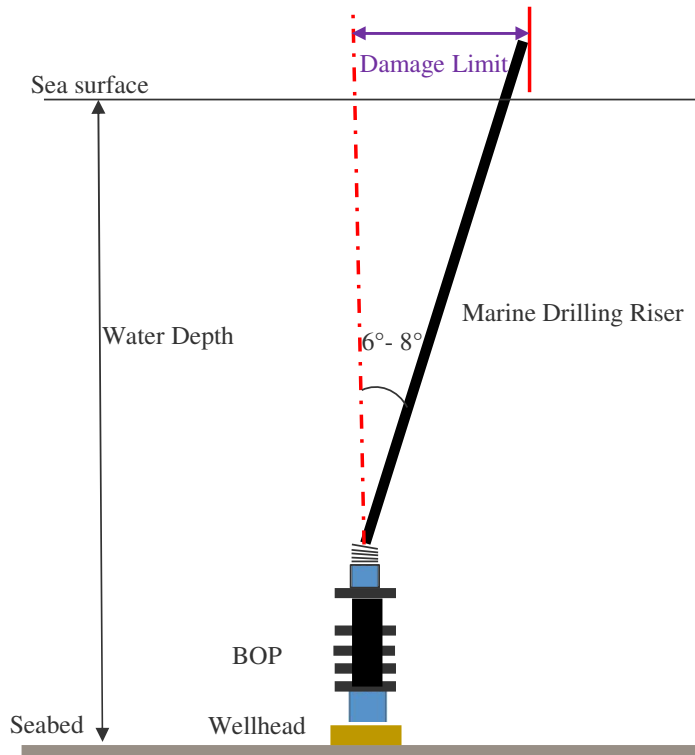
ADS: (mechanical activation subsea)

- Riser Connector unlatch
- Autoshear activation

EDS: (signal from surface)

- RAM BOP function(s)
- Riser Connector unlatch

# Riser Disconnect Criteria



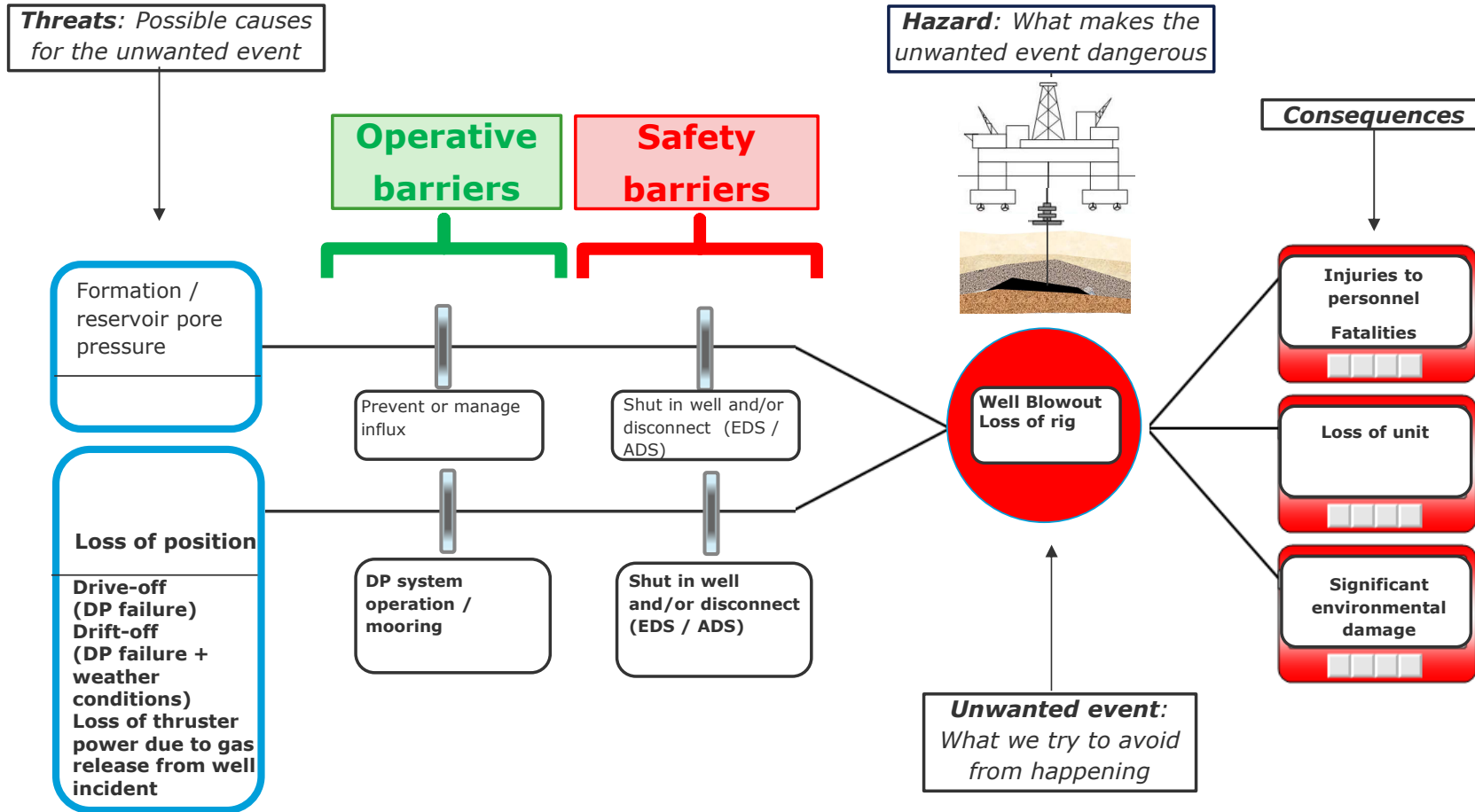
Note: The figure is for illustration and not to scale.

Water Depth	Offset Angle	RT/TJ Stroke-out	Rig Offset	Disconnect criteria	Disconnect initiation
350m	5°	1,3m	30m	Rig offset	ADS
500m	5°	1,9m	43,7m	Rig offset	ADS
1000m	5°	3,8m	87,5m	RT stroke limit	EDS

Disconnect criteria influenced by:

- Riser Tensioning System and Telescopic Joint capability
- $H_s$  / Wave period
- Heave
- Wind
- Water depth
- Operating condition (draught)
- Tide
- Riser Tensioning System and Telescopic Joint Space-out

# Drift-off/Drive-off scenario shown in a Bow-Tie diagram



## Operating draught @ 21m - considerations

---

Change of operating draught due to air gap restrictions (DNVGL-OS-C103, DNVGL-OTG-13)

- Well Specific Operating Guidelines (WSOG)
  - Riser tensioning system and telescopic joint available stroke at new draught
  - Riser space-out
  - Systems necessary for performing safe disconnect;
    - Emergency Disconnect System EDS
    - Automatic Disconnect System ADS
    - Emergency Hang-off Tool
    - Pull out drill string alt. position drill string for hang-off and shearing
    - Continued circulation
  - Topside drilling systems not evaluated for operation outside design operating draught;
- Hull integrity/HSE
  - Air gap for operating draught(s)
  - Accelerations for new introduced operating draught(s)
  - Stability for new introduced operating draughts
  - Operating manual
  - Manned areas and walkways to be evaluated for safe access for new operating conditions



[www.dnvgl.com](http://www.dnvgl.com)

**SAFER, SMARTER, GREENER**

The trademarks DNV GL®, DNV®, the Horizon Graphic and Det Norske Veritas® are the properties of companies in the Det Norske Veritas group. All rights reserved.