DNV·GL

ENERGY

Certification

Foundation Ex Conference

D Butterworth

1st October 2019

SAFER, SMARTER, GREENER

DNV GL service documents

Complete certification system for the renewables industry

- DNV GL Certification Scheme
- IEC Certification Scheme

RENEWABLES CERTIFICATION
DNV·GL
Certificate no.
TC-DNVGL-SE-0441-01234-0

- Onshore Wind
- Offshore Wind
- Offshore Substations
- Floating Offshore Wind
- Solar Power Plants
- Energy Storage Systems
- Tidal & Wave devices and arrays

- Design Ass.
- Manufacture
- Survey
- In service
- Lifetime
- Component certification
- GCC
- Shop approvals
- Training
- Fire protection
- Markings

Concept → Prototype → Type → Project → In place → Lifetime extension

>30 DNV GL service documents

Certificate no. TC-DNVGL-SE-0441-01234-0

DNV GL service documents (39No.)

Service specifications

DNVGL-SE-0441 Type and component certification of wind turbines
DNVGL-SE-0190 Project certification of wind power plants
DNVGL-SE-0074 Type and component certification of wind turbines according to IEC 61400-22
DNVGL-SE-0073 Project certification of wind farms according to IEC 61400-22
DNVGL-SE-0436 Shop approval in renewable energy
DNVGL-SE-0439 Certification of condition monitoring
DNVGL-SE-0077 Certification of fire protection systems for wind turbines
DNVGL-SE-0263 Certification of lifetime extension of wind turbines
DNVGL-SE-0448 Certification of service and maintenance activities in the wind energy industry
DNVGL-SE-0176 Certification of navigation and aviation aids of offshore wind farms
DNVGL-SE-0420 Certification of meteorological masts
DNVGL-SE-0422 Certification of floating wind turbines
DNVGL-SE-0078 Project certification of photovoltaic power plants
DNVGL-SE-0163 Certification of tidal turbines and arrays
DNVGL-SE-0120 Certification of wave energy devices and arrays
ISI Development of third party services for energy storage systems

Standards

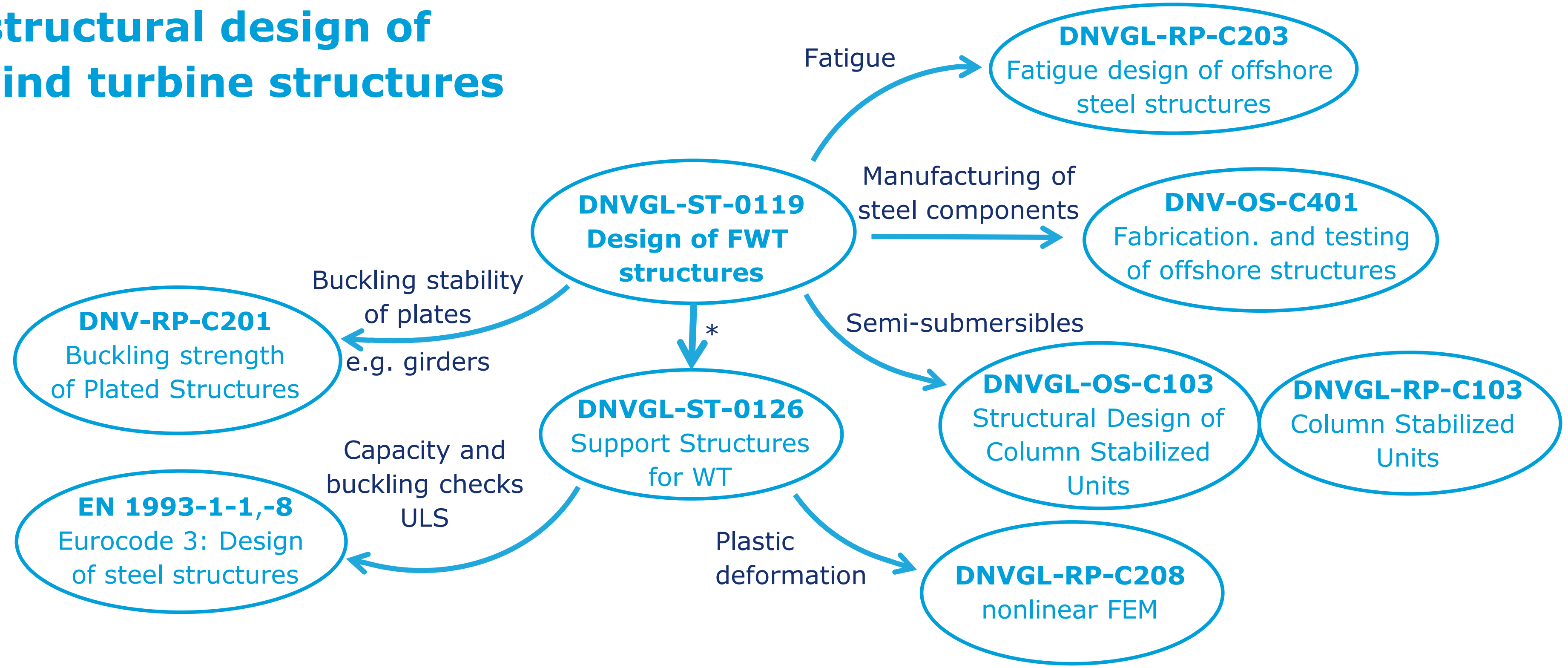
DNVGL-ST-0376 Rotor blades for wind turbines
DNVGL-ST-0437 Loads and site conditions for wind turbines
DNVGL-ST-0438 Control and protection systems for wind turbines
DNVGL-ST-0126 Support structures for wind turbines
DNVGL-ST-0361 Machinery for wind turbines
DNVGL-ST-0054 Transport and installation of wind power plants
DNVGL-ST-0262 Lifetime extension of wind turbines
DNVGL-ST-0119 Floating structures for wind turbines
DNVGL-ST-0145 Offshore substations
DNVGL-SE-0124 Certification of grid code compliance
DNVGL-ST-0125 Grid Code Compliance
DNVGL-ST-0076 Electrical installations for wind turbines
DNVGL-ST-0359 Subsea power cables
DNVGL-ST-0164 Tidal turbines

Recommended practices

DNVGL-RP-0175 Icing of Wind Turbines
DNVGL-RP-0363 Extreme temperature conditions for wind turbines
DNVGL-RP-0416 Corrosion protection for wind turbines
DNVGL-RP-0440 Electromagnetic compatibility of wind turbines
DNVGL-RP-0423 Manufacturing and commissioning of offshore substations
DNVGL-RP-0419 Analysis of grouted connections
DNVGL-RP-0360 Subsea power cables in shallow water
DNVGL-RP-0171 Testing of rotor blade erosion protection systems
DNVGL-RP-0286 Coupled analysis of floating wind turbines

DNV GL system of interlinked standards

Example structural design of floating wind turbine structures



* The requirements for the structural design given in DNVGL-ST-0126 apply to FWT structures, except the deviations and additional requirements given in DNVGL-ST-0119 Section 7

Service document maintenance

Maintenance 2019

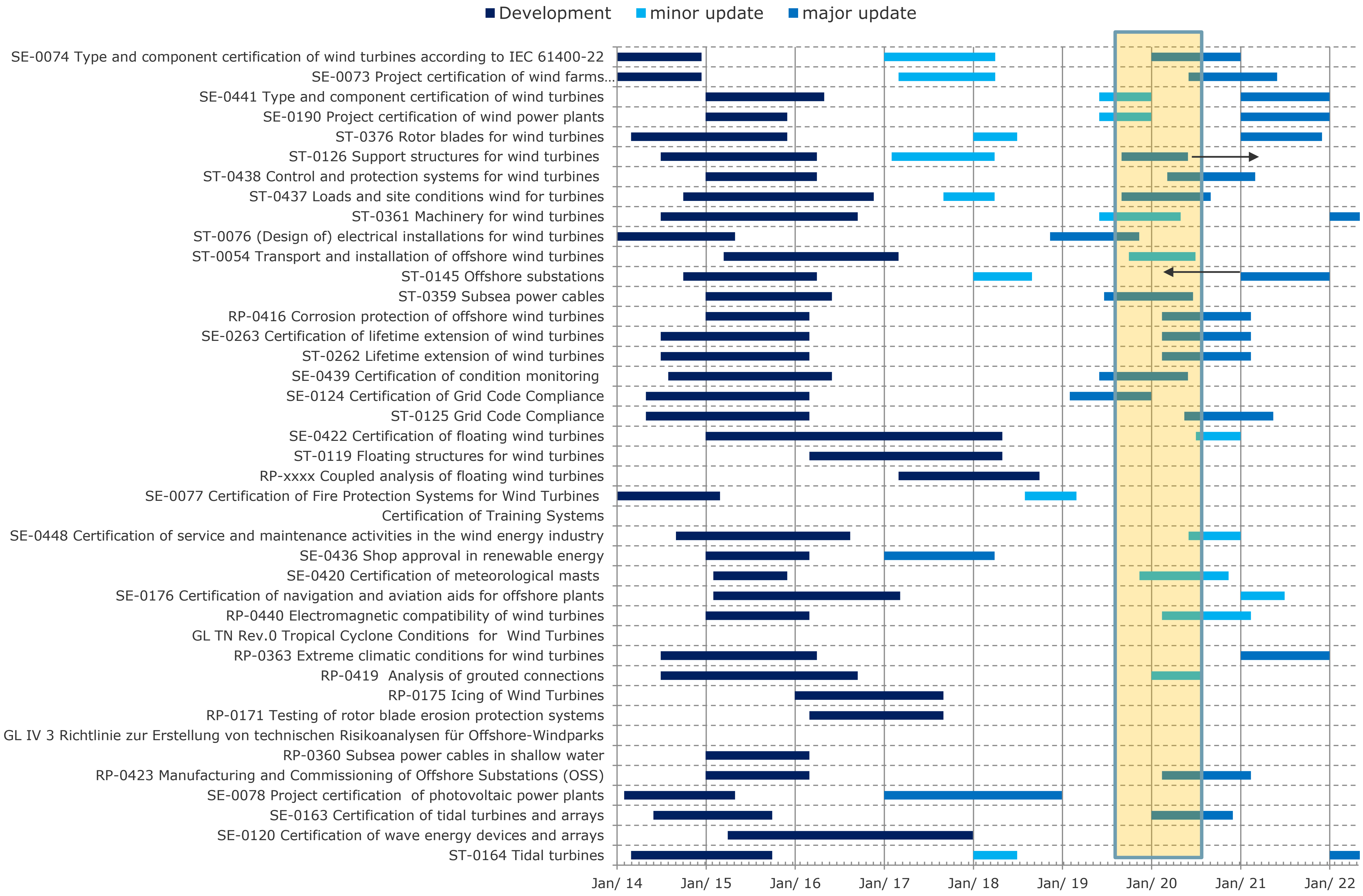
ST-0145 Offshore Substations

SE-0439 Certification of condition monitoring

SE-0190 Project certification

Planned maintenance in 2020

- Grid code compliance requirements
- Machinery components for wind turbines
- Type certification
- Corrosion Protection


Development
minor update
major update
SE-0074 Type and component certification of wind turbines according to IEC 61400-22
SE-0073 Project certification of wind farms…
SE-0441 Type and component certification of wind turbines
SE-0190 Project certification of wind power plants
ST-0376 Rotor blades for wind turbines
ST-0126 Support structures for wind turbines
ST-0438 Control and protection systems for wind turbines
ST-0437 Loads and site conditions wind for turbines
ST-0361 Machinery for wind turbines
ST-0076 (Design of) electrical installations for wind turbines
ST-0054 Transport and installation of offshore wind turbines
ST-0145 Offshore substations
ST-0359 Subsea power cables
RP-0416 Corrosion protection of offshore wind turbines
SE-0263 Certification of lifetime extension of wind turbines
ST-0262 Lifetime extension of wind turbines
SE-0439 Certification of condition monitoring
SE-0124 Certification of Grid Code Compliance
ST-0125 Grid Code Compliance
SE-0422 Certification of floating wind turbines
ST-0119 Floating structures for wind turbines
RP-xxxx Coupled analysis of floating wind turbines
SE-0077 Certification of Fire Protection Systems for Wind Turbines
Certification of Training Systems
SE-0448 Certification of service and maintenance activities in the wind energy industry
SE-0436 Shop approval in renewable energy
SE-0420 Certification of meteorological masts
SE-0176 Certification of navigation and aviation aids for offshore plants
RP-0440 Electromagnetic compatibility of wind turbines
GL TN Rev.0 Tropical Cyclone Conditions for Wind Turbines
RP-0363 Extreme climatic conditions for wind turbines
RP-0419 Analysis of grouted connections
RP-0175 Icing of Wind Turbines
RP-0171 Testing of rotor blade erosion protection systems
GL IV 3 Richtlinie zur Erstellung von technischen Risikoanalysen für Offshore-Windparks
RP-0360 Subsea power cables in shallow water
RP-0423 Manufacturing and Commissioning of Offshore Substations (OSS)
SE-0078 Project certification of photovoltaic power plants
SE-0163 Certification of tidal turbines and arrays
SE-0120 Certification of wave energy devices and arrays
ST-0164 Tidal turbines
Jan/ 14
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Jan/ 16
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Jan/ 18
Jan/ 19
Jan/ 20
Jan/ 21
Jan/ 22

WTG Foundation Design DNVGL-ST-0126 & associated standards

- Bolted Connection Design – (new RP in progress)
- Early Age Cycling – (Reviewing options for possible JIP)
- Earthquake – (ACE JIP due to commence)
- ALS for projects with SOV
- Damping improved guidance for jackets
- Multiaxial stresses and fatigue
- SN Curves and automated welding
- Probabilistic Design Methods
- Inspection & Reliability Guidance
- Steel Material Tables – alignment with EN 1993 and 10225

DNVGL-ST-0145 Update 2019

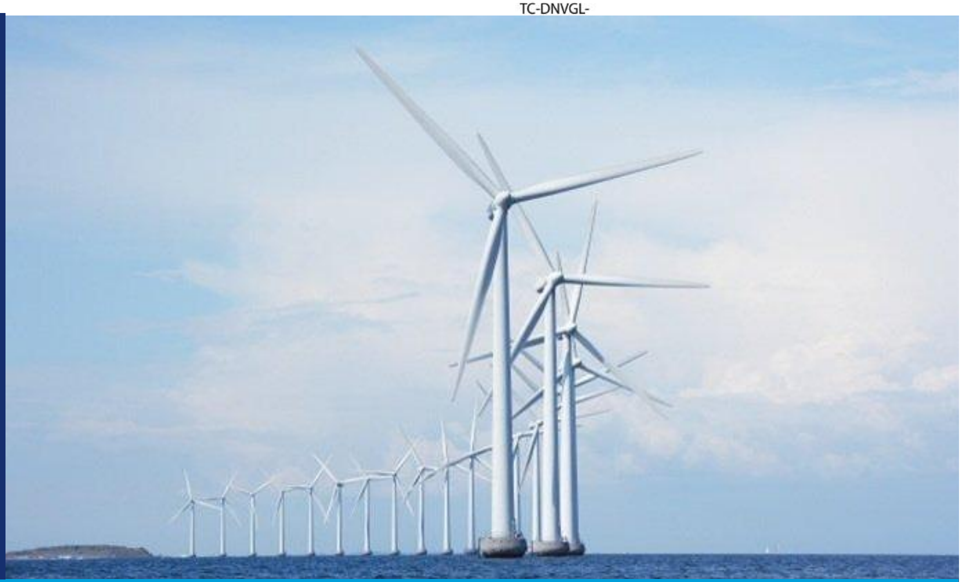
Formal Safety Assessment	Clarifications on requirements. Overall safety will be achieved is prescriptive requirements are met. If not then a Risk Based Assessment is required
Arrangement Principles	Removal or requirement for 2 Transformers, focus on availability, N-1 criteria must be met
Structural Design	Air gap to apply to 100year wave 1m or 20% Hs100. ALS to 10k wave crest. Steel Table updated to reflect new 10225 update
Electrical Design	Islanded condition clarifications, Not automatically an emergency, emergency services must remain available for seven days, For Manned – Aux power autonomous, for unmanned external source acceptable
Fire and Explosion Protection	More details on materials and requirements for both passive and active systems
Emergency Response	Clarifications on provisions for Manned & Unmanned facilities and requirements

DNV GL service documents to come

Certificate no.
TC-DNVGL-

Development of new services and standards via JIP's or collaborative projects with industry partners and academia

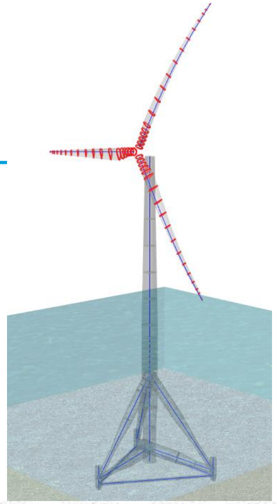
- Meet customers/market expectations
- Use best technology available
- Drive improvements in design approach and lower costs



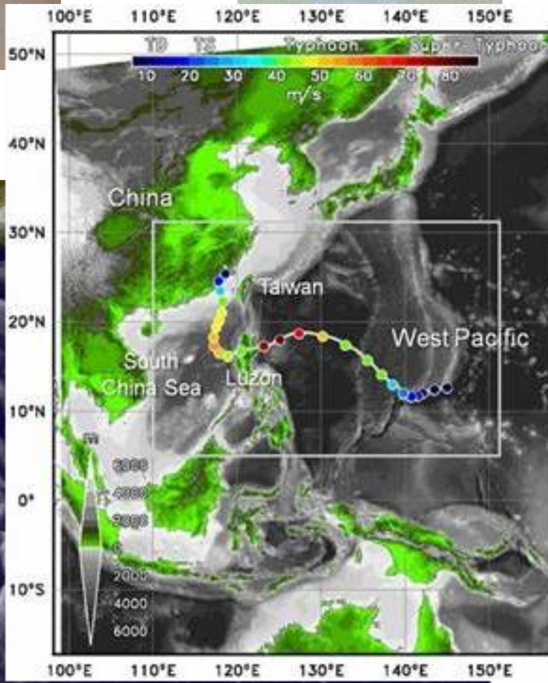
DNVGL-RP-xxxx Design requirements for wind turbines in seismic and cyclone areas – ACE JIP
DNVGL-RP-xxxx LIDAR based turbulence intensity measurement – LIDAR-TI JIP

DNVGL-RP-xxxx Comprehensive model for rain erosion analysis - JIP COBRA
DNVGL RP-xxxx Superconducting drivetrains of wind turbines – EcoSwing (EU H2020 project)
DNVGL-RP-xxxx Scour protection – HaSPro JIP
DNVGL-RP-xxxx Energy storage system safety - tbd
DNVGL-RP-xxxx Bolted Connections

Backgrounds and pains –
design of offshore wind turbines in new markets



- Earthquakes
  - Uncertainty in design conditions: geotechnical conditions, combination of wind and earthquake loads.
  - Inconsistency in approaches used to design for Earthquakes.
  - International/Local codes & standards not sufficiently detailed/harmonized
- Cyclones
  - Uncertainty in extreme wind speed.
  - Uncertainty in transferring local building code requirements to large offshore turbines
  - Detailed modelling is expensive and uncertain.
  - Lack of measurements available for calibration/verification of detailed models.
  - Statistical treatment is difficult.



Interested? Please contact us!
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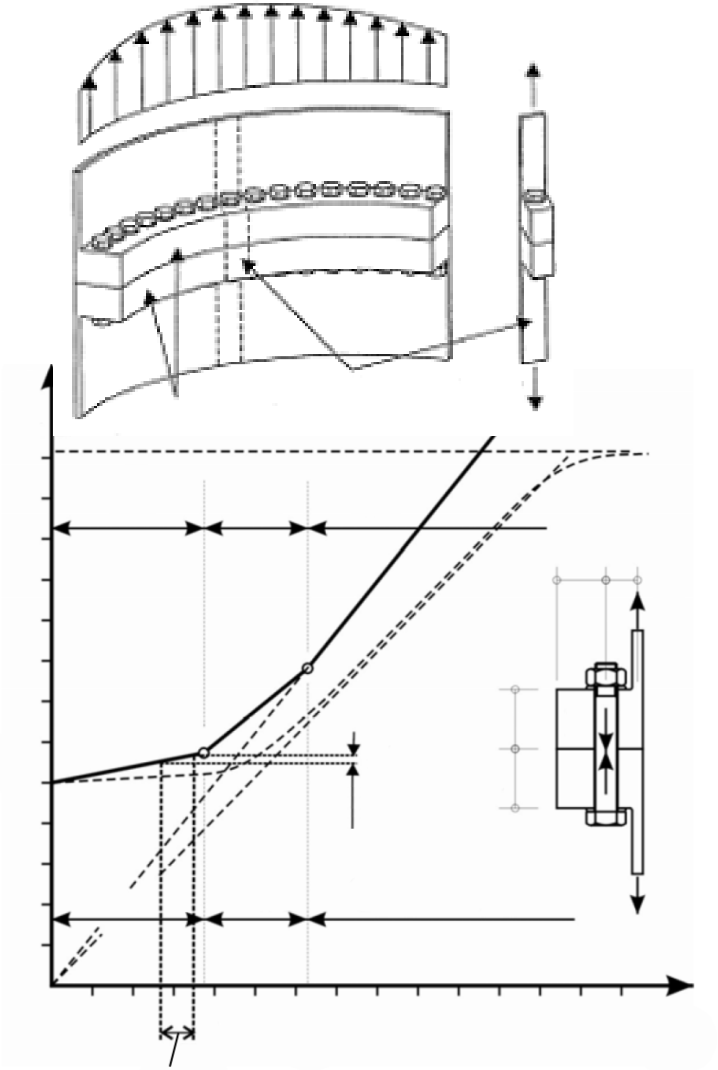
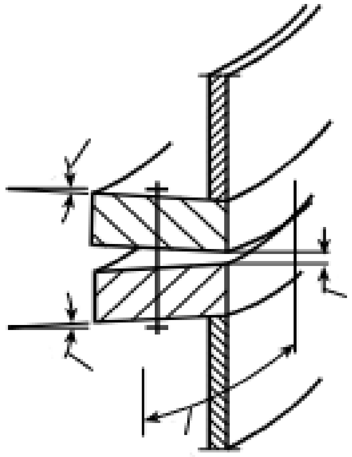
Tower Bolts

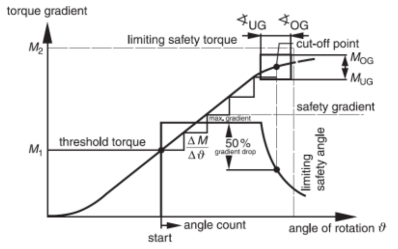




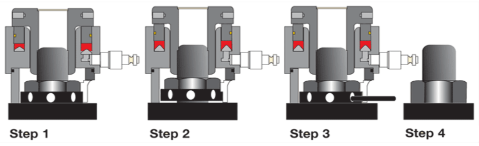
Design Assumptions vs Execution

Short term preload losses

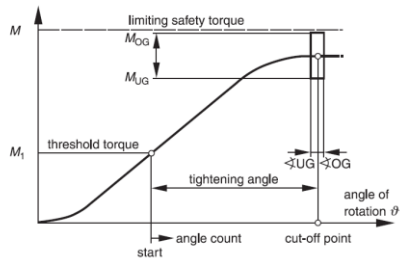
Preload loss, 12 hours(Yield Controlled tightening)	
Average bolt preload loss μ	0%
Worst case bolt preload loss (97.7% value)	-15%



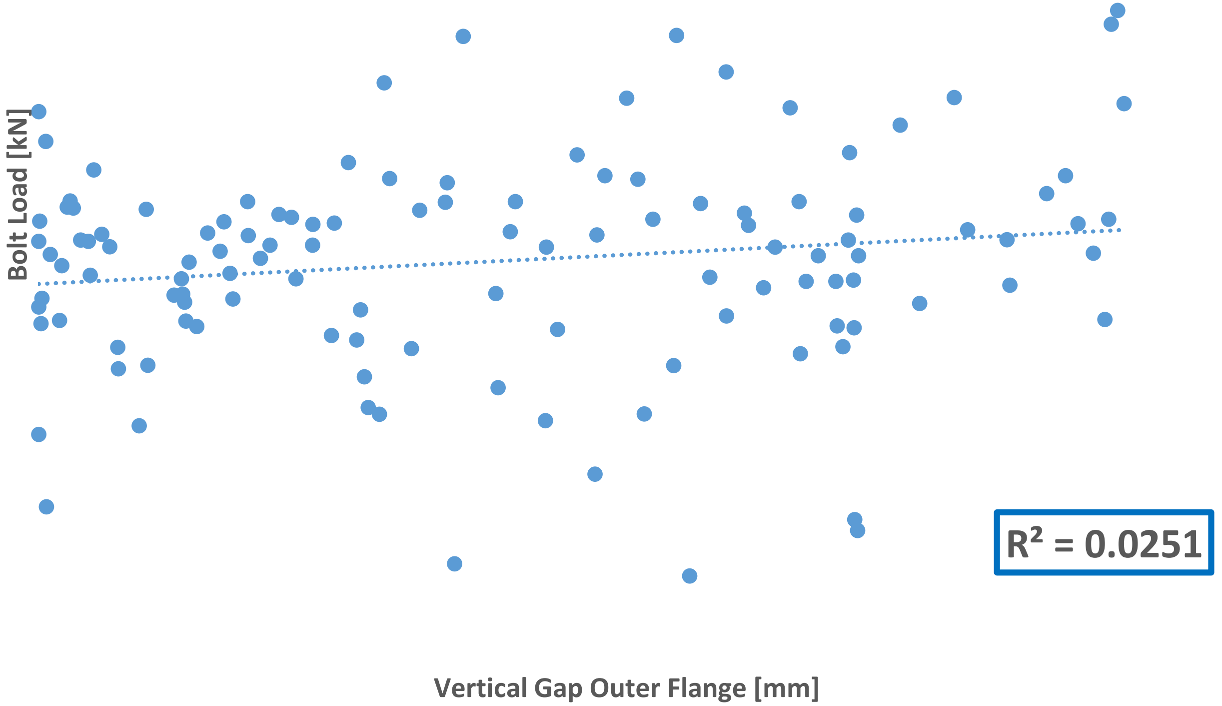
Preload loss, 12 hours (Hydraulic tensioning)	
Average bolt preload loss μ	-1%
Worst case bolt preload loss (97.7% value)	-23%

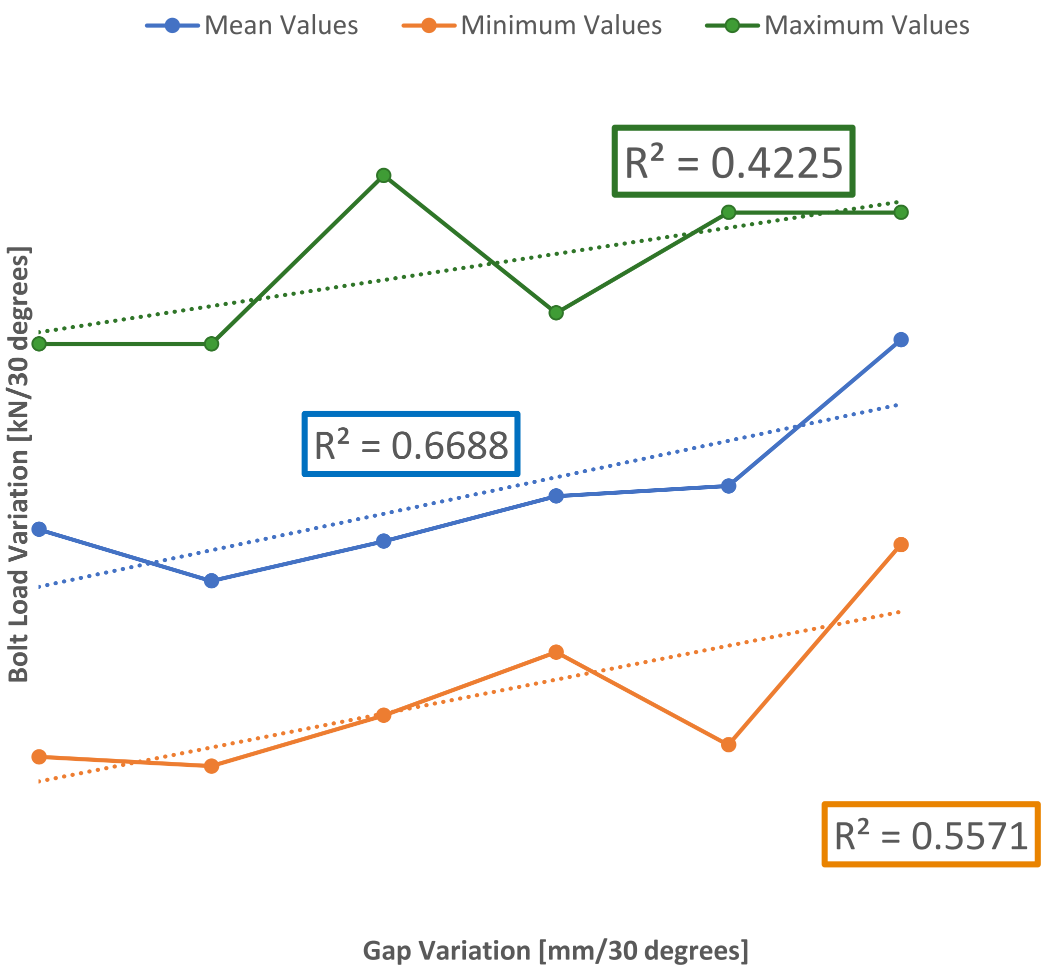


Preload loss, 12 hours (Torque/Angle tightening)	
Average bolt preload loss μ	-0.1%
Worst case bolt preload loss (97.7% value)	-21%



Scatter diagram preload vs gap





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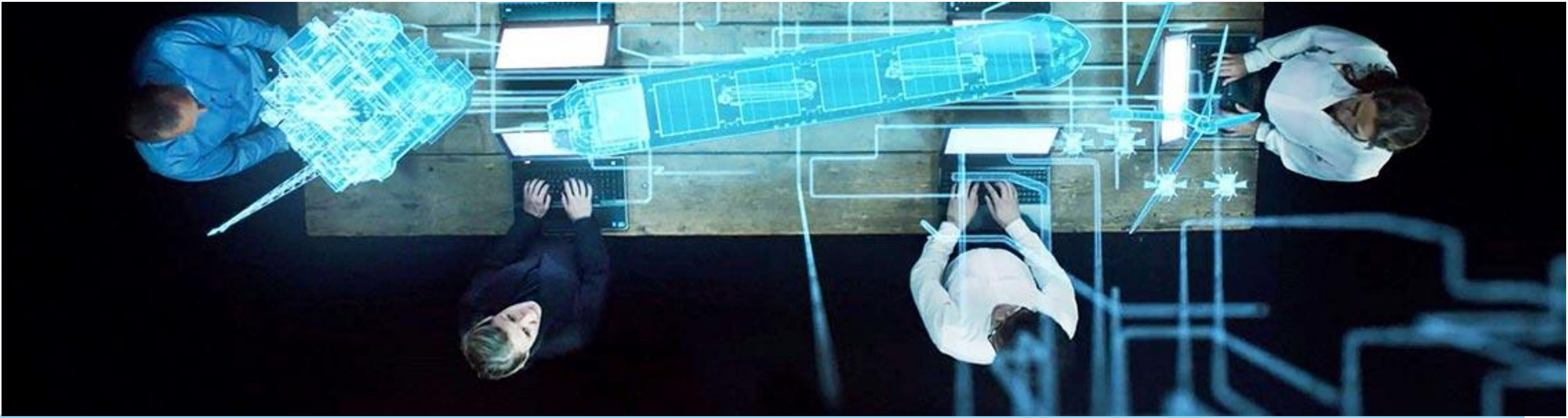
Veracity - an Open Industry Platform

- Marketplace for digital services, data and analytics
- Functionality to securely share your data container
- Functionality to create a data container for your data



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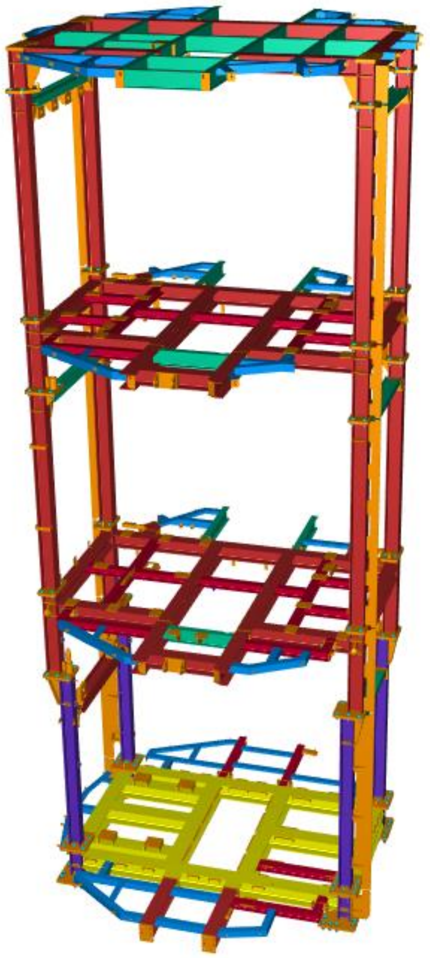
MyCertificate

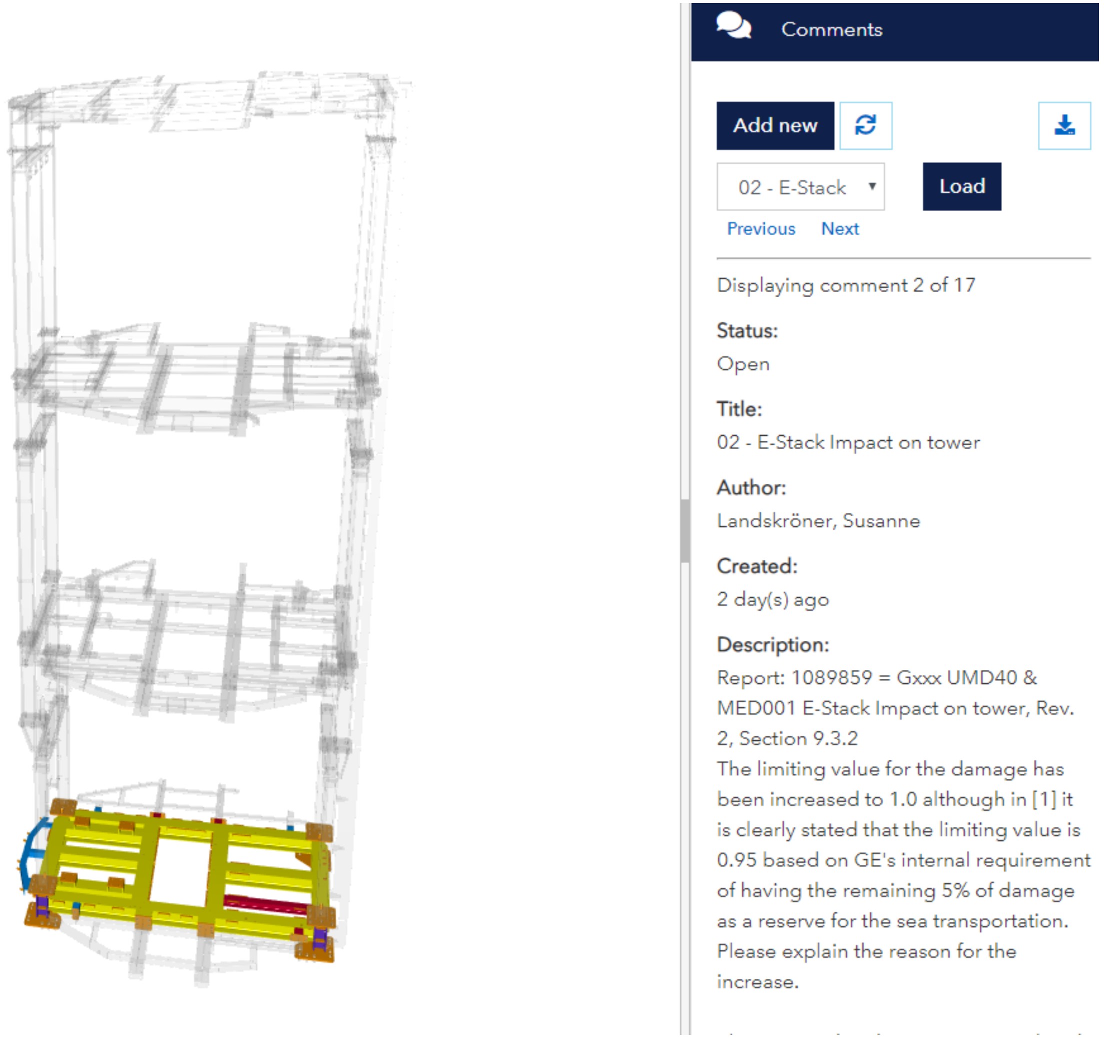
- See at a glance what has been certified and what hasn’t
- Instantly check certification status of all components in a new configuration
- Self-generated certificate includes QR codes for verifying their authenticity

Assessment of secondary steel components for wind turbines by stp-files



Development of an online visualization and communication tool for the exchange of certification comments

Change in the internal certification process from technical drawings to the use of stp- or gnx-files for basis of parallel calculation



Thanks for Listening – any ideas for future improvements and/or feedback please get in touch

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www.dnvgl.com

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