ENERGY

Certification of Marine Renewables

12. FZK Kolloquium 2017

Kimon Argyriadis

22 February 2017

About DNV GL

On 12th September 2013, Det Norske Veritas (DNV) and Germanischer Lloyd (GL) merged to form **DNV GL**

We are today…

- the **world's largest** ship and offshore classification society
- the **leading technical advisor** to the global oil and gas industry
- a **leading expert** of the energy value chain, including renewables and energy efficiency
- one of the world's **top three** certification bodies

Renewables certification

Accredited certification of equipment (products), services and projects in renewable energy

- Component certification
- Prototype certification
- Type certification
- Project certification

- Onshore wind
- Offshore wind
- Wave and tidal
- Solar/PV

Certification is based upon:

- Internationally accepted standards
- Various national certification systems
- DNV GL standards and guidelines

Commercialisation of the marine renewables ...Solving the energy trilemma

Ungraded

Reliability

Sustainability

What is Certification?

Photo: Voith

Do they match???

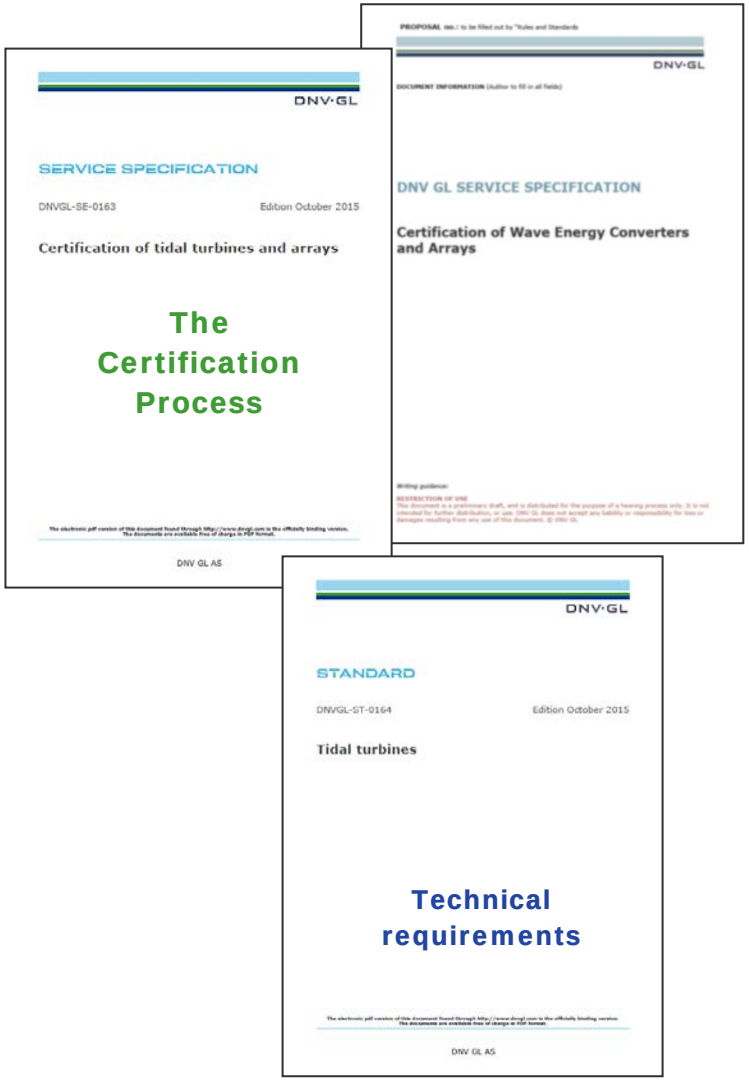


Photo: Tocardo

Ungraded

Basic marine renewables certification elements

Design Assessment

- Plausibility of the design
- Protection and safety
- Loading
- Structural analysis
- Mechanical & electrical installation
- Examination of drawings
- Examination of components

Image: Atlantis

Test

- Model tests
- Component tests
- Test of the prototype
- Comparison of test results with assumptions

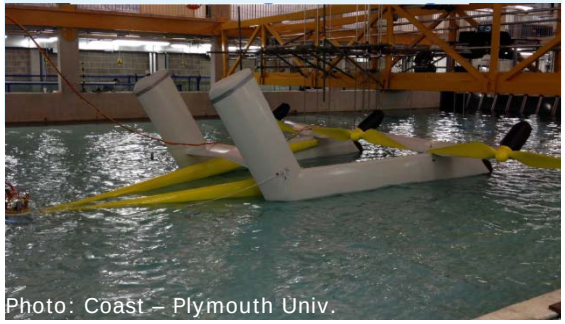


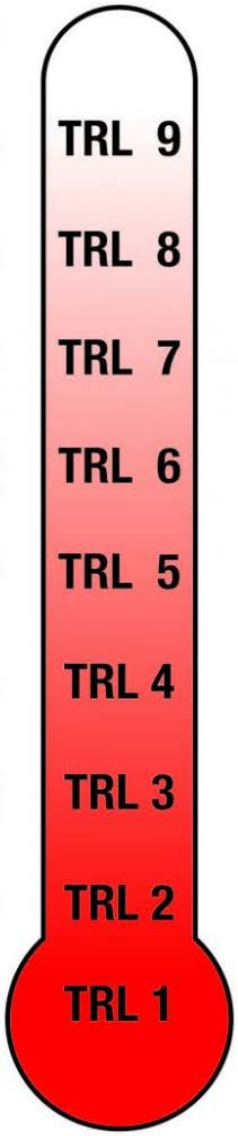
Photo: Coast – Plymouth Univ.

Survey and Quality Control

- Examination of fabrication quality
- Witnessing of installation
- Witnessing of commissioning

Photo: Scotrenewables

Certification and Technology Readiness Levels



- **TRL 9** — actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)
- **TRL 8** — system complete and qualified
- **TRL 7** — system prototype demonstration in operational environment
- **TRL 6** — technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- **TRL 5** — technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- **TRL 4** — technology validated in lab
- **TRL 3** — experimental proof of concept
- **TRL 2** — technology concept formulated
- **TRL 1** — basic principles observed

Type / Project

Prototype

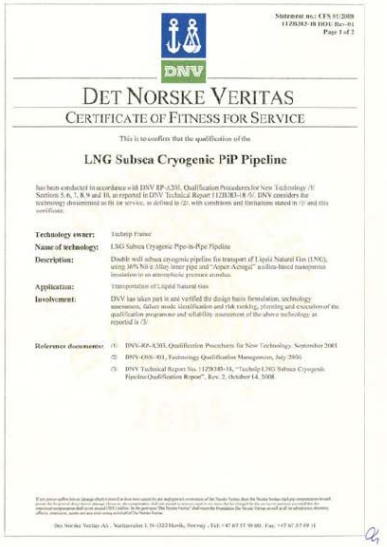
Concept

Ungraded

Technology qualification, examples from Oil&Gas

Technip

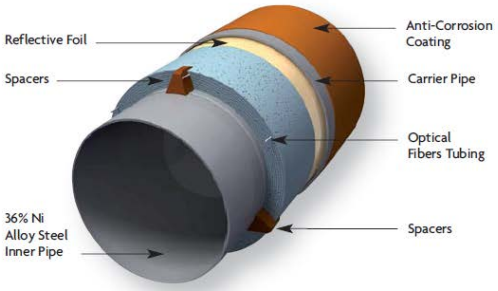
Cryogenic Pipe-in-Pipe



DET NORSKE VERITAS

CERTIFICATE OF FITNESS FOR SERVICE

LNG Subsea Cryogenic PiP Pipeline



ABS

APPROVAL IN PRINCIPLE STATEMENT

QUALIFICATION OF TECHNIP LNG SUBSEA PIPE-IN-PIPE PIPELINE CONCEPT

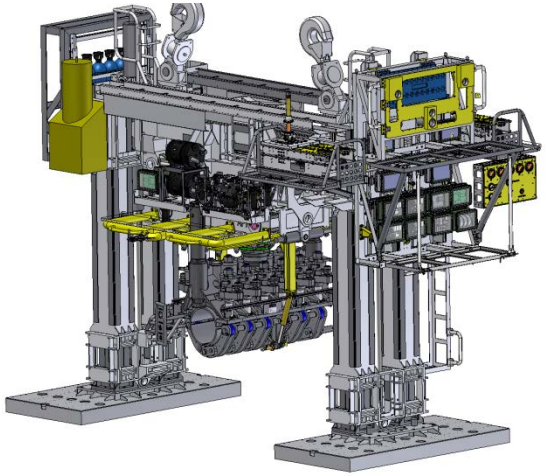
Contact: Afzal Hussain

afzal.hussain@dnvgl.com

+47 911 24 024

SOURCE:

http://www.technip.com/sites/default/files/technip/publications/attachments/Marine%20LNG%20transfer%20%26%20facilities_November%202013_Web.pdf



Statoil Remote Pipeline Repair System

Statoil Pipeline Repair Systems is developing remote operated repair tools and equipment for pipeline repair beyond diving depth, including replacement of pipeline sections by welded connection, clamp repair and hot tapping.

Technology qualification

Application Area	Technology Status		
	Proven	Limited Field History	Unproven
Known	1	2	3
New	2	3	4

Technology Class	Definition
1	No new technical uncertainties
2	New technical uncertainties
3	New technical challenges
4	Demanding new technical challenges

Class	Name	Description	Indicative annual failure rate (up to)	Reference
1	Very Low	Negligible event frequency	1.0E-04	Accidental (event not failure)
2	Low	Event unlikely to occur	1.0E-03	Strength / ULS
3	Mediu m	Event rarely expected to occur	1.0E-02	Fatigue / FLS
4	High	One or several events expected to occur during the lifetime	1.0E-01	Operation low frequency
5	Very high	One or several events expected to occur each year	1.0E+00	Operation high frequency

Class	Description of consequences (impact on)				
	Safet y	Environ ment	Operation	Ass ets	Co st (€)
1	...	...	Negligible effect on production (hours)		
2	...	...	Partial loss of performance (retrieval not required outside maintenance interval)		
3	...	...	Loss of performance requiring retrieval outside maintenance interval		
			Total loss of production up to 1 m (€)		
			f production greater an 1 m (€)		

Consequence					
Probability	1	2	3	4	5
5	Low	Med	High	High	High
4	Low	Med	Med	High	High
3	Low	Low	Med	Med	High
2	Low	Low	Low	Med	Med
1	Low	Low	Low	Low	Med

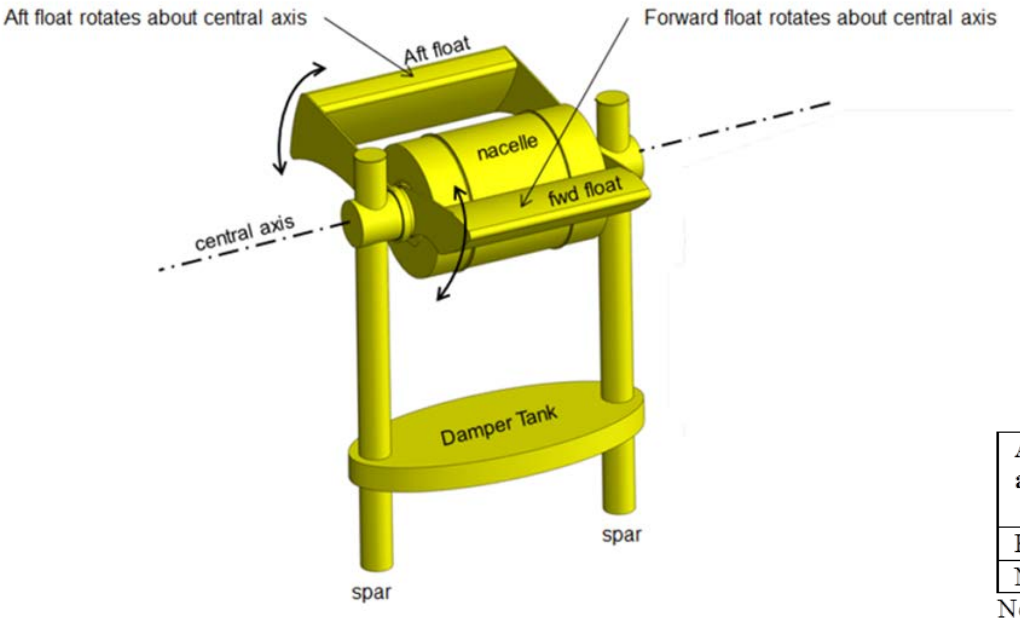
Notes:

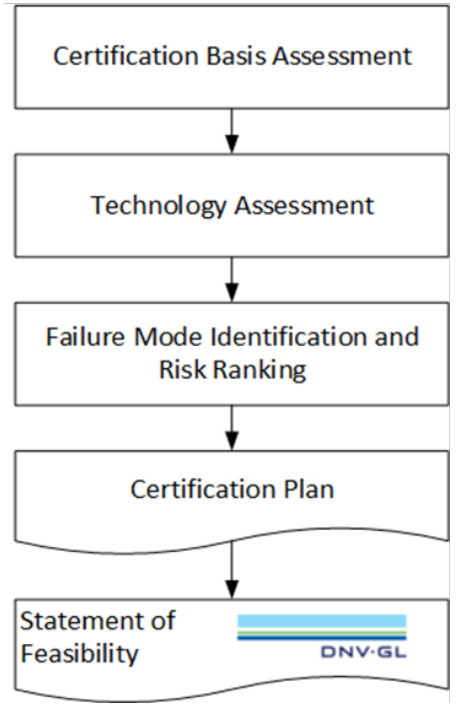
Low	Tolerable, no action required
Medium	Mitigation and improvement required to reduce risk to Low
High	Not acceptable: mitigation and improvement required to reduce risk to Low (ALARP)

Ungraded

Risk Based Certification for Marine Renewables

- No mature technology yet
- Diversity of technologies and strategies
- How to achieve success varies from technology to technology



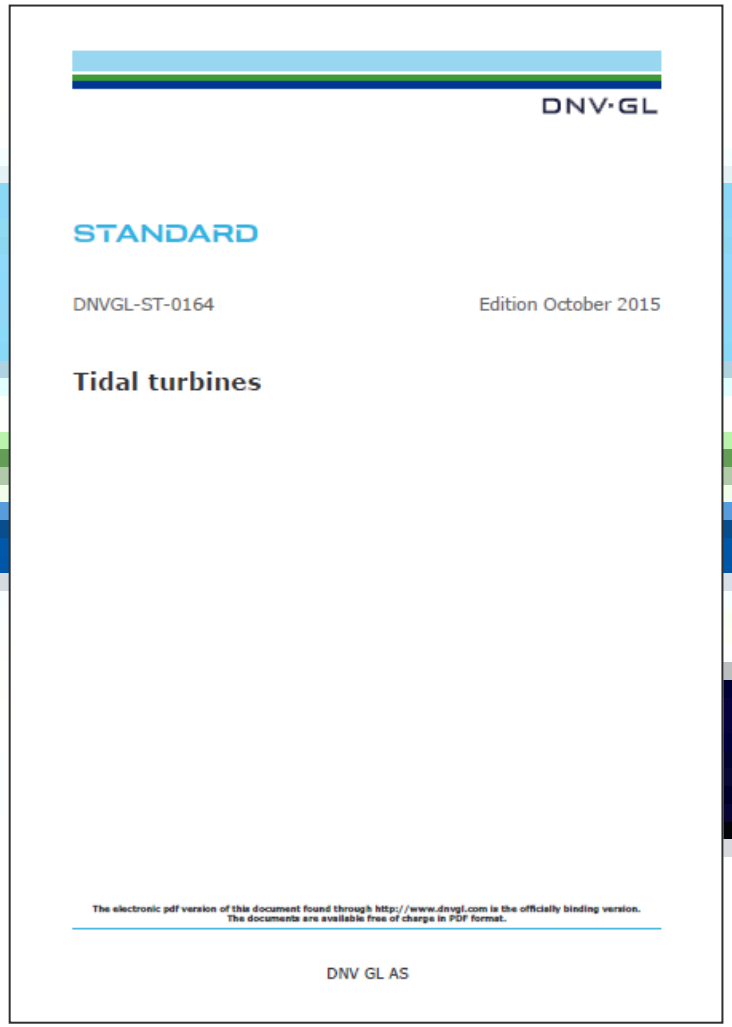


Application area	Technology status		
	Proven	Limited field history	New or unproven
Known	1	2	3
New	2	3	4

Notes:
1: No new technical challenges 2: New technical uncertainties
3: New technical challenges 4: Demanding new challenges

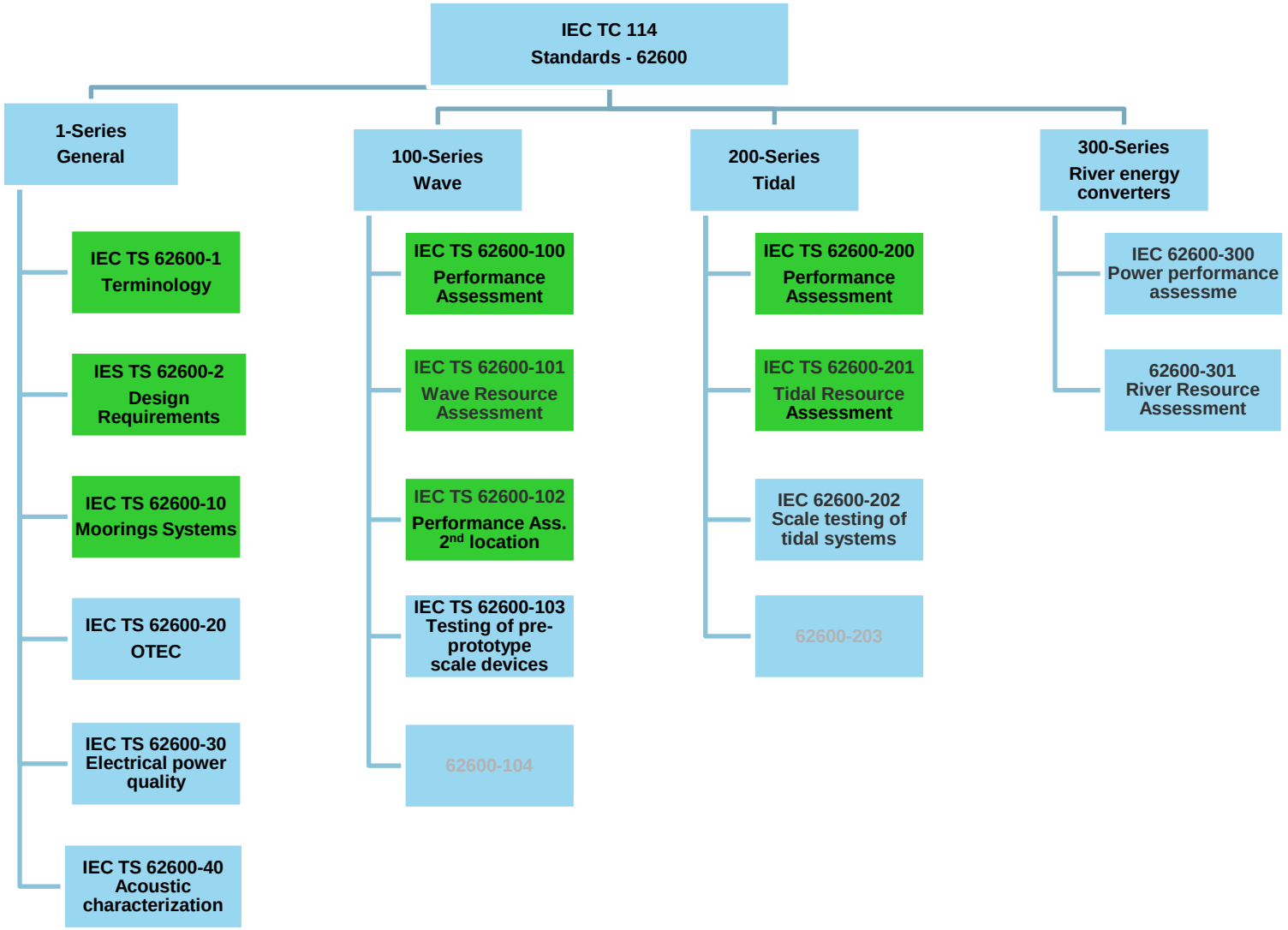
Ungraded

DNV GL – ST-0164 Tidal Turbines



- Design principles
- Manuals for onshore and offshore works
- Site conditions and characterization
- Loads and load effects
- Safety factors
- Materials for structures and blades
- Floating stability
- Steel structures
- Foundation and mooring system design
- Blades, machinery, electrical systems
- Protection and safeguarding
- Corrosion protection
- Marine operations
- Tests and measurements

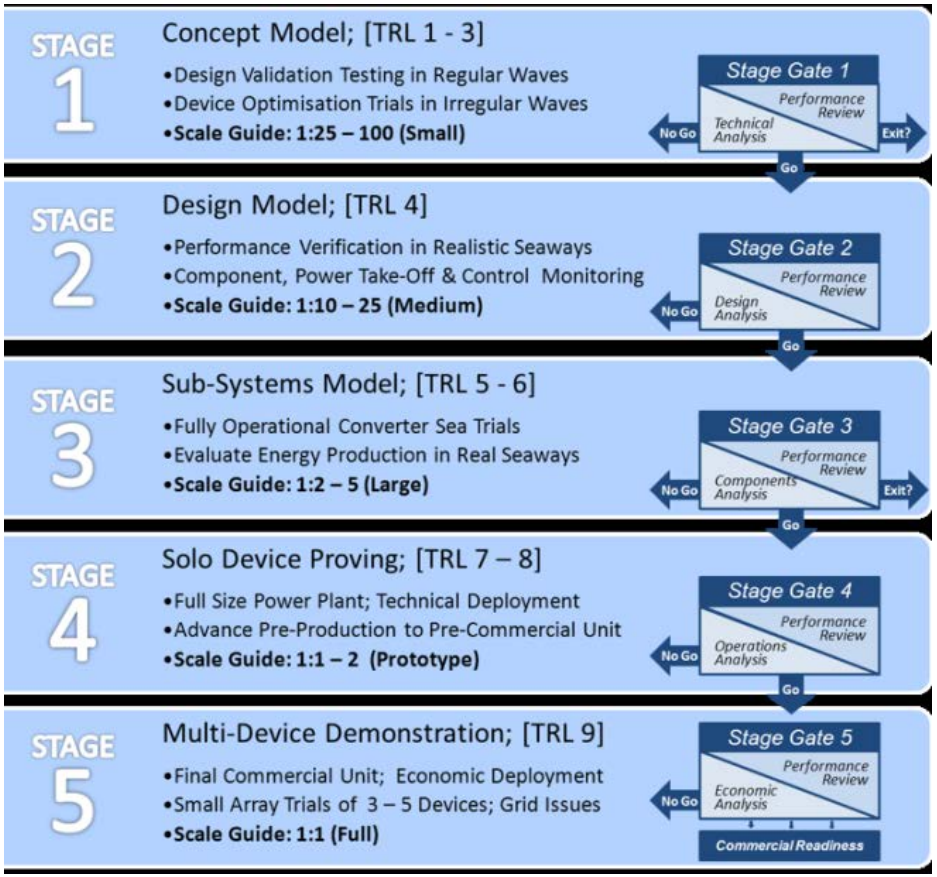
IEC TC114, Marine Renewables work programme



Ungraded

Tank testing

- Model tests / pre-prototype
  - IEC TS 62600-103, -202 (under development)

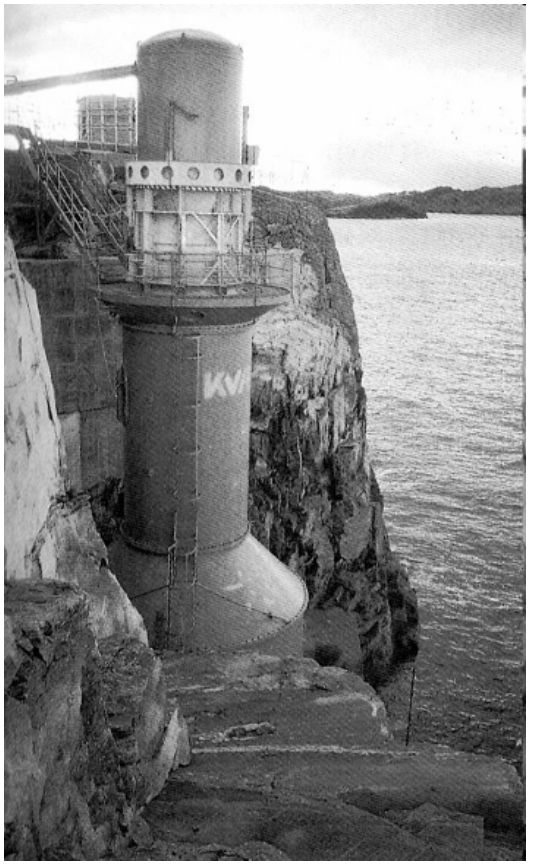


Marin

Ungraded

Prototype and tank testing

- Power performance measurement
  - IEC TS 62600-100, -200
- Load measurement to be developed



Conclusion

- Certification provides additional confidence to stakeholders
  - Compliance with existing standards is assured
  - Risks are reviewed through a structured process with third party oversight
- The Marine Renewables sector requires a special approach regarding certification
  - Risk based approach based on Technology Qualification process
  - Handling of uncertainties, novelty, safety, environment and functional requirements
  - Use of existing technology that is compatible with marine renewables
- Significant effort on standardization is needed
  - Design standards
  - Test standards

Scotrenewables

Tocardo

Forschungszentrum Küste

Thank You!

Certification of Marine Renewables
FZK Kolloquium 2017

Kimon Argyriadis
Kimon.argyriadis@dnvgl.com
+49 40 36149 138

www.dnvgl.com

SAFER, SMARTER, GREENER