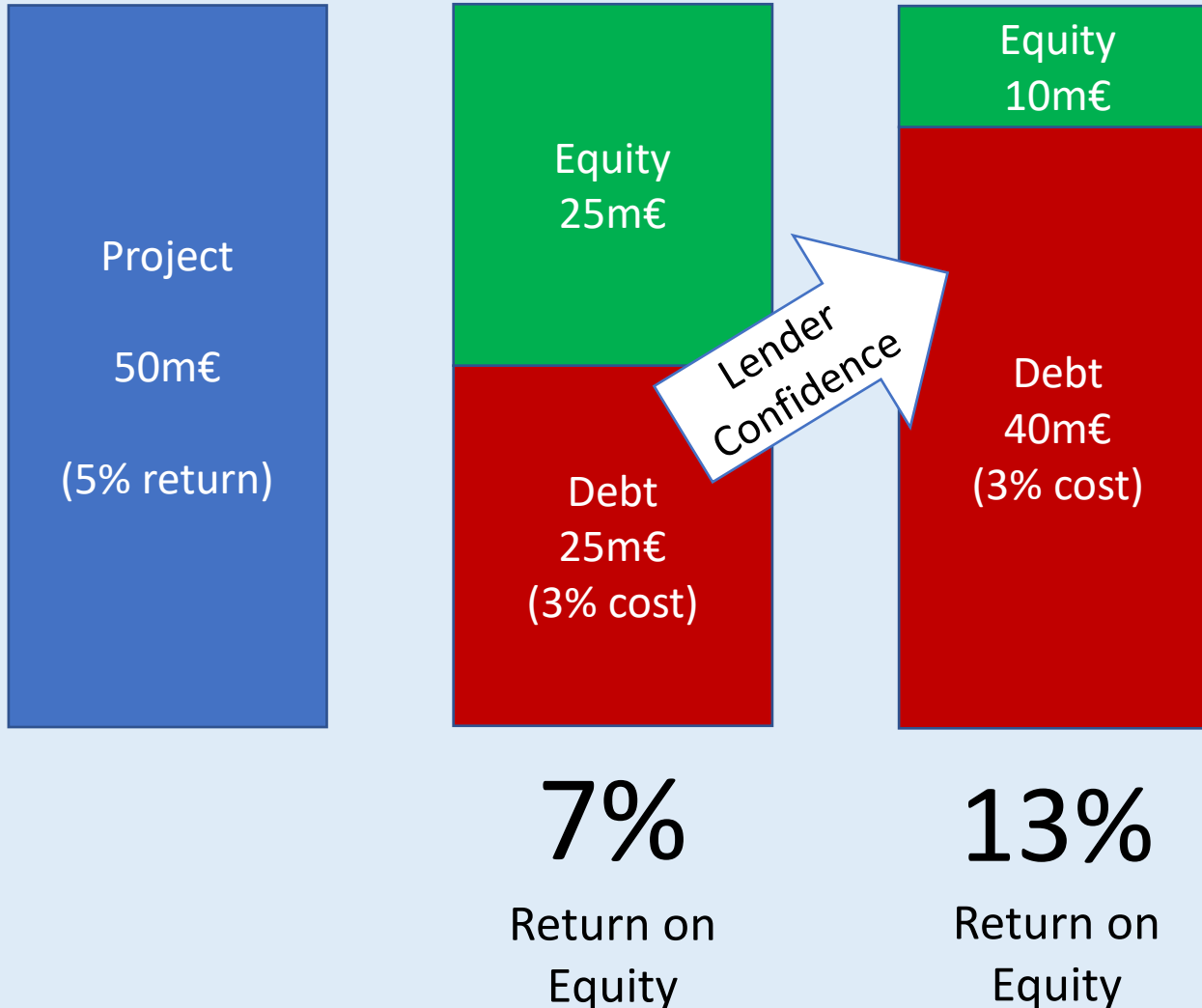


ETIP Ocean Certification of WaveRoller

Christopher Ridgewell / CEO AW-Energy Oy
18 February 2021



Why Certify Technology





Why did we seek certification?

- Customers' requirement
- Transparency
- Process structure
- Repeatability

Which standards did we use?

DNV-OSS-312: Certification of Tidal and Wave Energy Converter

DNV-DSS-401 Technology Qualification Management

DNV RP-A203
Technology
qualification

Codes and Standards

Results of TQ
Plan

DNV-OS-C101

DNV-OS-C401

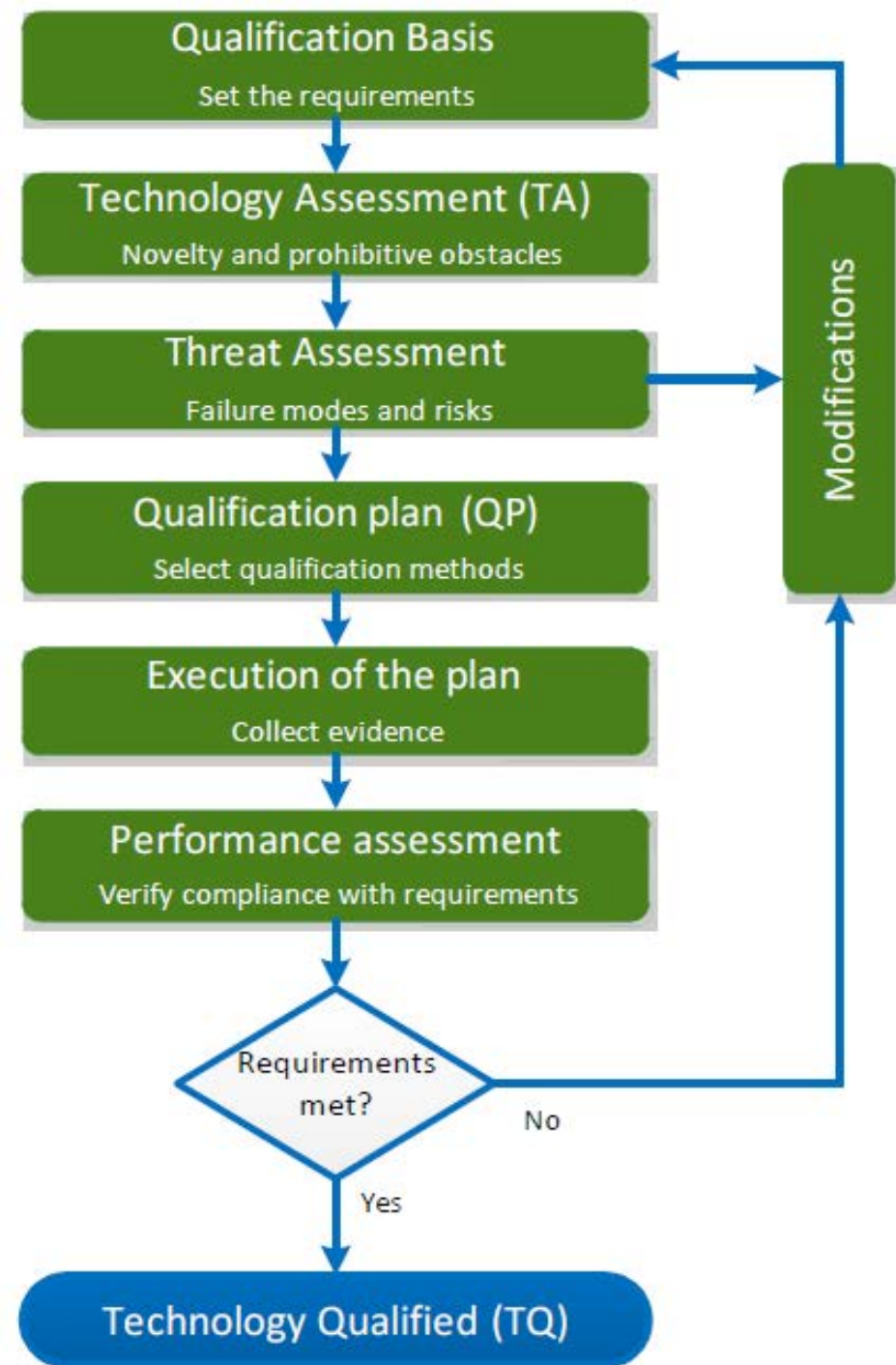
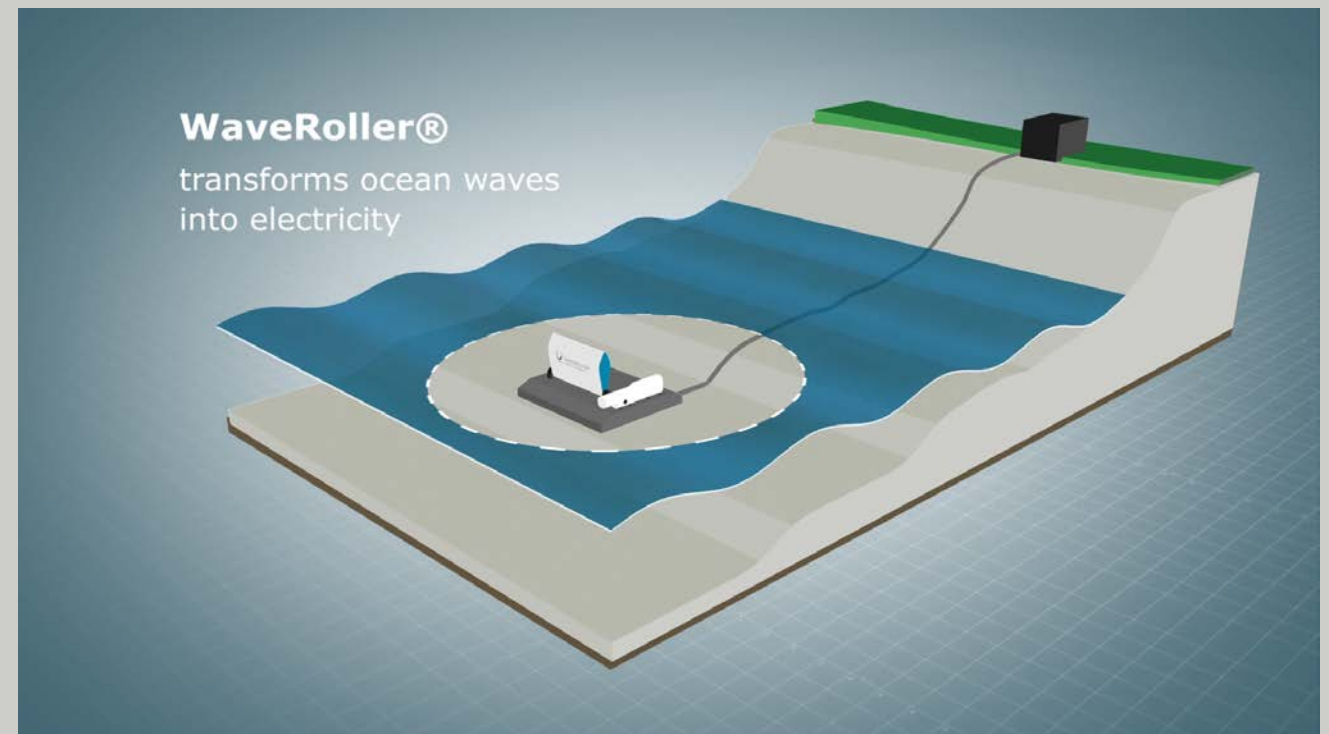
DNV-OS-C502

EN 1992-1-1
(Eurocode 2)

Etc..

Step 1. TA & QP

Application Area	Degree of Novelty technology		
	Proven	Limited Field History	New or Unproven
Known	1	2	3
Limited Knowledge	2	3	4
New	3	4	4



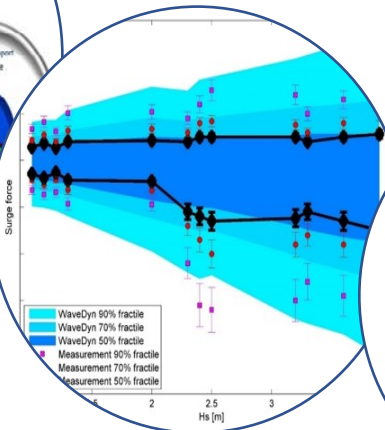
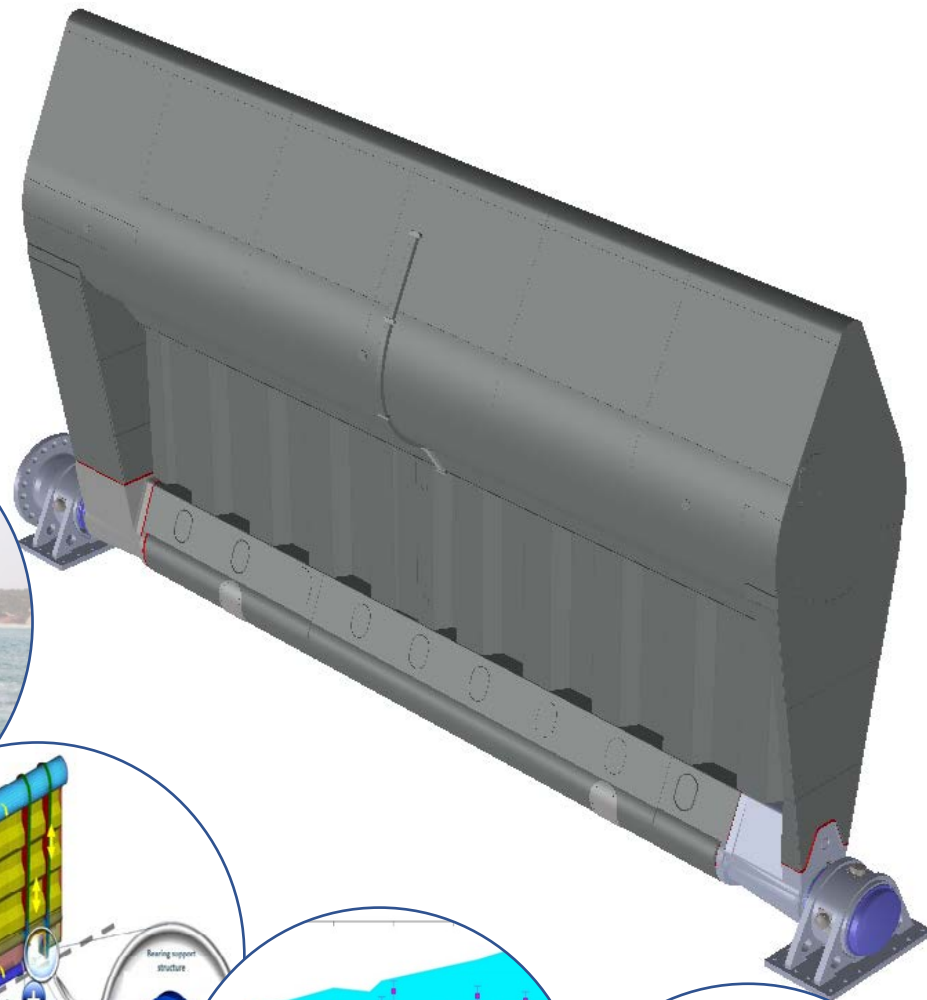
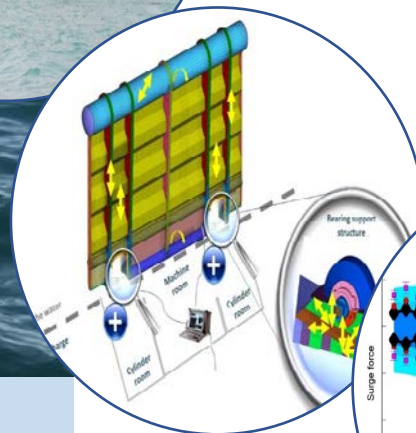
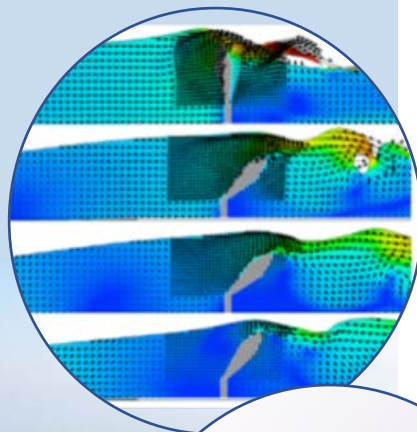


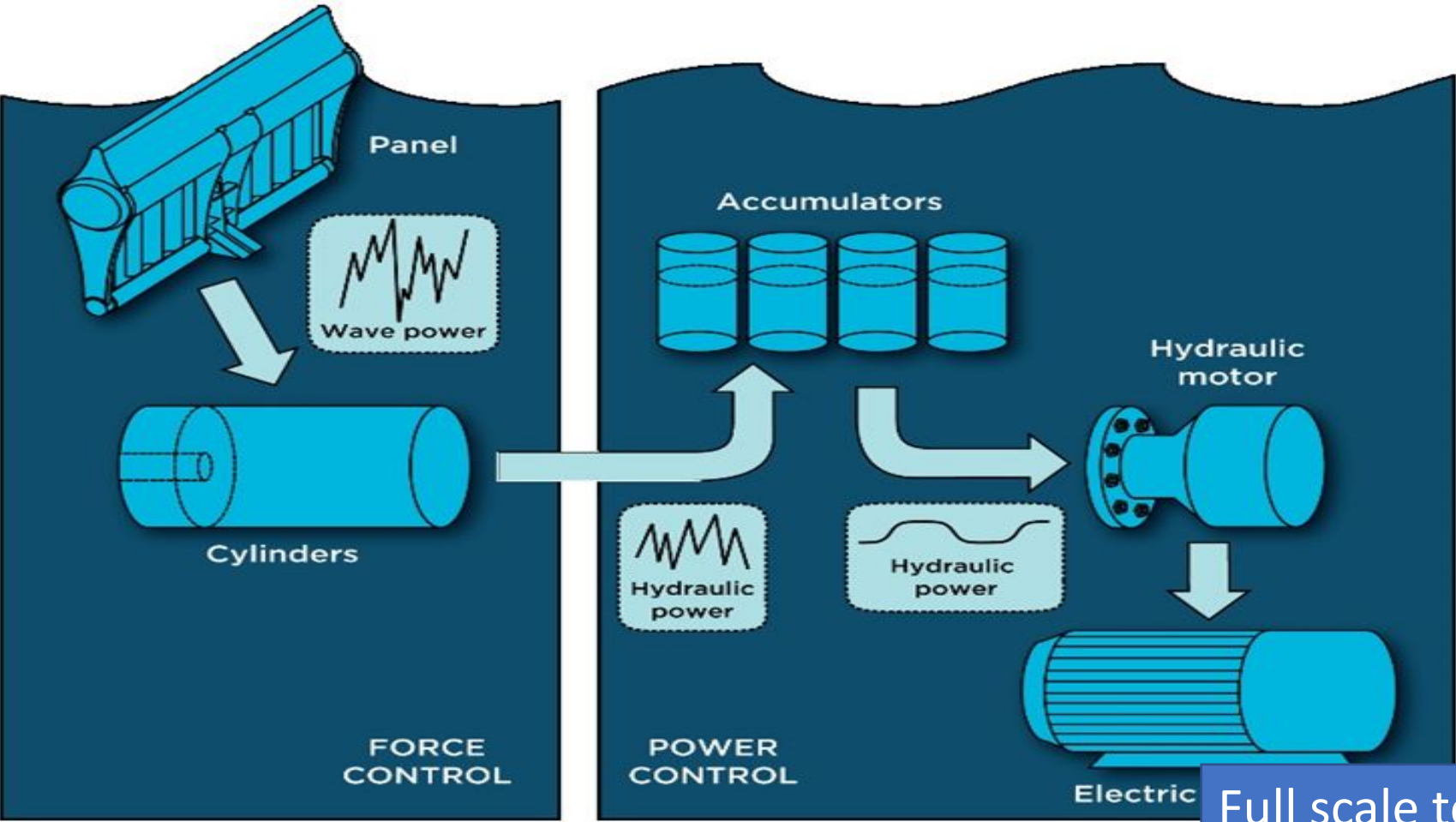
Table D1 Load factors γ_f for ULS

Combination of design loads	Load categories			
	G	Q	E	D
a)	1.3	1.3	0.7	1.0
b)	1.0	1.0	1.3	1.0

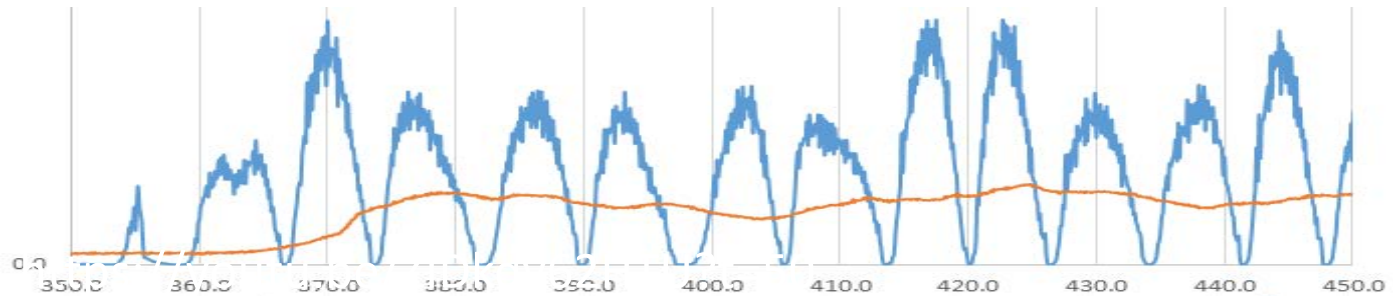
Load categories are:
 G = permanent load
 Q = variable functional load
 E = environmental load
 D = deformation load
 For description of load categories see Sec 3.

Ex. of Technology Qualification Actions

Ex. of Technology Qualification Actions



Full scale testing using real site data to test operation modes autonomous control and component/system reliability



Functional FMEA with VTT

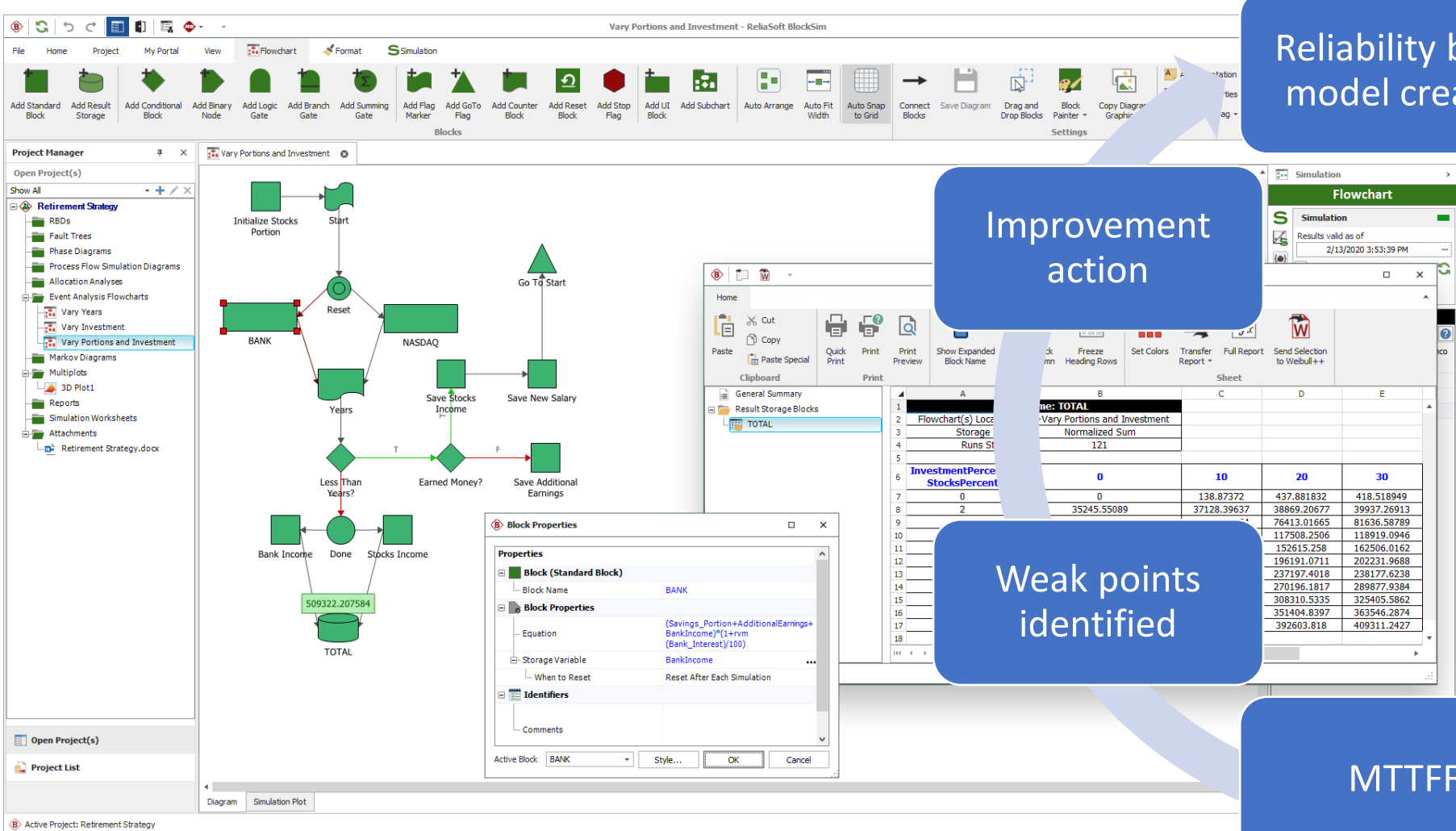
(Failure Mode Effect Analysis)

Subsystem, function, item number	Failure mode	Effects of failure	Cause(s) of failure	Means for detection	Current preventive measures	Improvement actions, additional information, remarks	Severity	Occurrence	Detection	RPN
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FMEA to improve:

- Measurement system
- Operational modes
- Automation & control

Reliability Simulations with VTT using Reliasoft BlockSim (Reliability, Availability, Maintainability)



Reliability block model created

Improvement action

Component reliability

Weak points identified

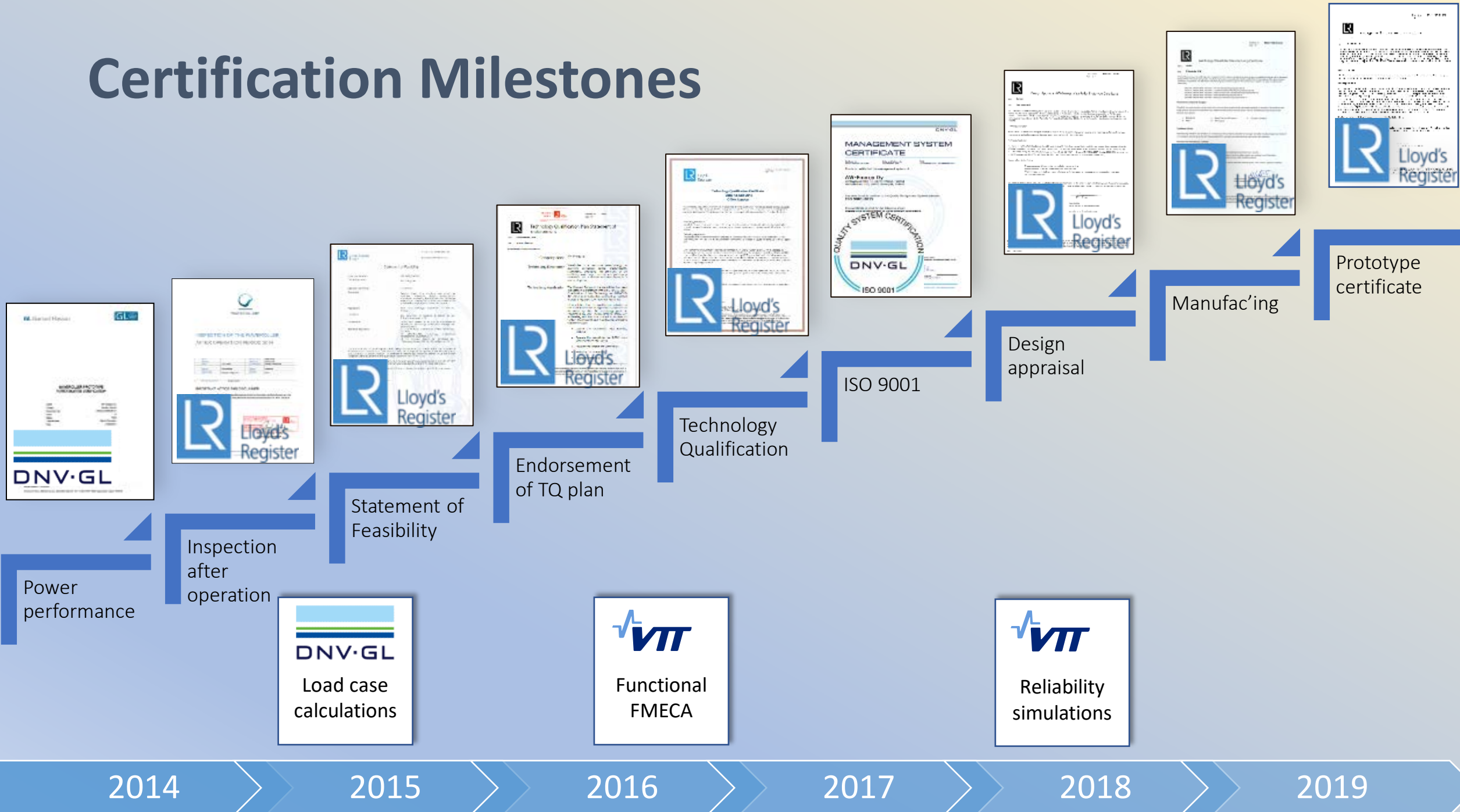
Test facility operational data

MTTFF

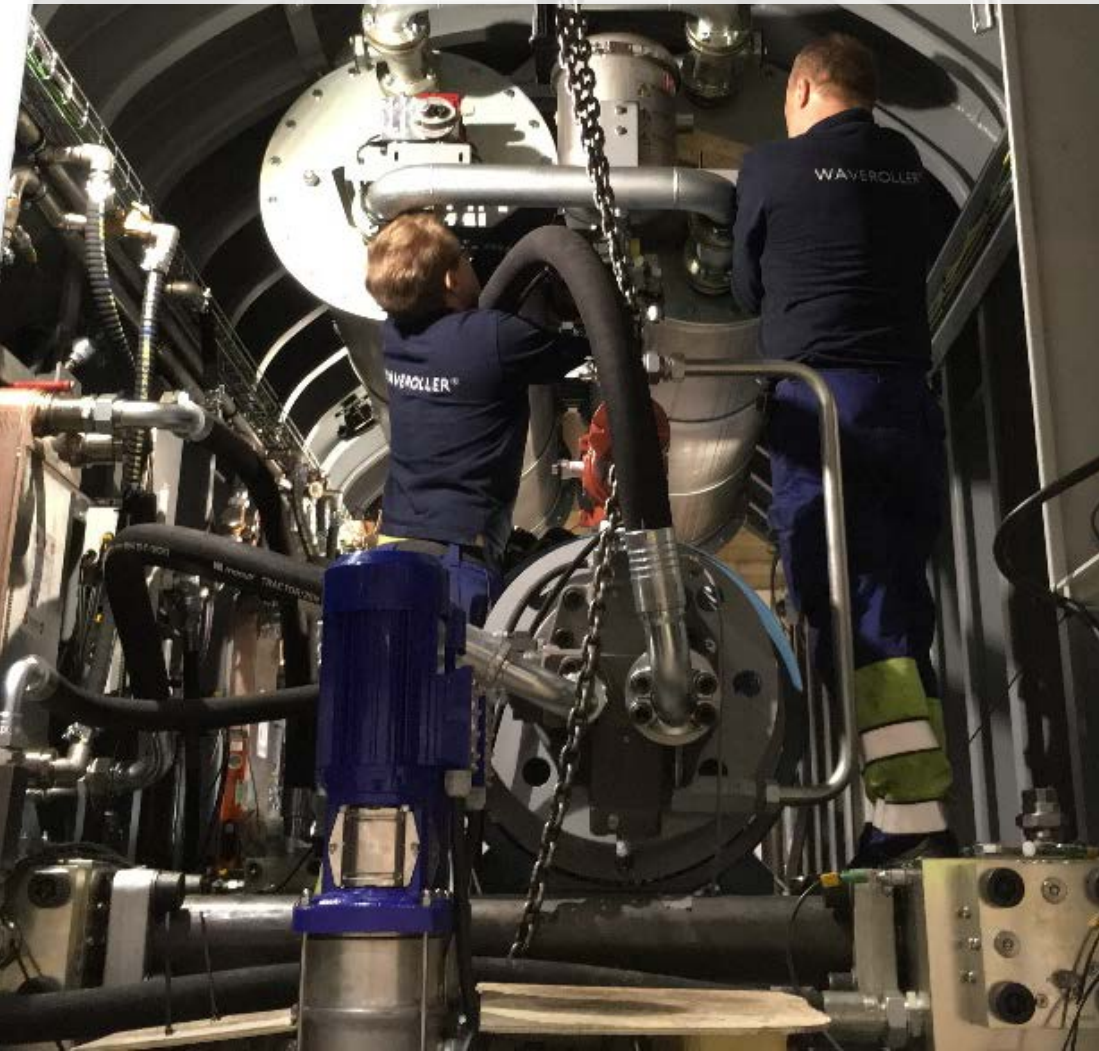
Certification alongside design, procurement, manufacturing & assembly



Certification Milestones



The rigor of certification has other benefits



**Global Patents
Granted/Pending**

63/19

Total

82 over 26 families

Global Trademarks

WaveRoller®

Global Patent Coverage



Structure to Company Progress

2014

2015

2016

2016

2018

2019

2020



Grid
connected
sea trials

Performance
verified by
DNV GL

TRL 5

Full scale
PTO test
facility

Technology
qualified

Company
ISO 9001

TRL 6

EiB financing
through
InnovFin
programme

Lloyd's
Register
certified
design and
manufacture

WaveRoller
assembled
and
deployed

Bankable
insurance
criteria met

TRL 7

Project
proposal
accepted and
financing
earmarked
for
commercial a
project

Next Steps:

- H2020 MegaRoller test facility
- EMFF WaveFarm industrialized package
- Commercial project developments

