#### DNV·GL



# The Subsidy Free World: The age of flexible and dynamic renewables operation

Keir Harman, Director - Renewables Operations IWEA Autumn Conference 2018, Galway

SAFER, SMARTER, GREENER

### Broad and deep knowledge gives us the bigger picture







www.dnvgl.com/eto





#### www.dnvgl.com/eto

# **Global Electricity Supply**

# DRAMATIC RISE IN SOLAR PV AND WIND



www.dnvgl.com/eto

### **Renewables in GB right now and forecast for next 7 days**



#### www.dnvgl.com/forecaster

# ...and All Island for today



http://smartgriddashboard.eirgrid.com/#all/wind

**Smarter operation is needed now!** 

# ~€75<sub>/MWh</sub> ⇒ <<€50<sub>/MWh</sub> ?

Maximize Energy Production

Minimize cost

Boost revenue

# Many untapped opportunities to reduce cost of energy

# **Asset optimization route map**



# Management Life Assessment

# An operating lifetime of 30 years or more? 40

## Life Assessment: An integrated approach



# **Life Assessment: Principles**

- 1. Estimate the loading
- 2. Estimate the strength
- 3. Estimate the uncertainties in loading and strength
- 4. Calculate the probability of failure or reliability index (inverse probability of failure)
- 5. Estimate "operating life" as the year in which site specific reliability = target reliability (per 20 year design life)



# Life Assessment: Principles

# Major structural components

- Safety critical
- non replaceable
- high consequence of failure

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Foundation
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Tower

Nacelle bedplate

Hub

System components may come into this category due to prohibitive replacement cost



# Replaceable system components

- Non safety critical
- Replaceable
- lower consequence of failure
- Form majority of O&M cost

Pitch system Yaw system Braking system Blades Generator Power converter Gearbox Bearings Main shaft

Simpler failure modes - **load models** able to estimate fatigue life

Complex failure modes – data-based statistical models best suited

# Life Assessment: The demand

• Lifetime assessment of over 20GW of operating wind farms for owners across the globe.



DNV GL standard on Life Extension of Wind Turbines (ST-0262): www.dnvgl.com/rules

# Whole wind farm control

A move away from the 'selfish turbine' approach



# "The whole is greater than the sum of its parts"

Aristotle

# Whole wind farm control



increased loading!

Switch this turbine off?

Or reduce the power set-point of this one?

Or maybe yaw the turbine slightly to steer its wake away from the next turbine?

## Whole wind farm control: the challenge



# Whole wind farm control: example dynamic simulation



# Whole wind farm control: Benefits



# Whole wind farm control: Horizon 2020 and other projects







http://www.clwindcon.eu/





#### http://www.totalcontrolproject.eu/

- DTU
- DNV GL
- Siemens Gamesa
- Offshore Renewable Energy Catapult (ORE)
- SINTEF
- Equinor
- University of Leuven (KUL)
- Vattenfall
- DNV GL is working on other owner/operator and OEM led initiatives

# Be prepared to operate in the subsidy free era!

 The energy transition demands renewable energy assets to operate in a very different way to before, more;

> Visible Predictable Controllable

- State of the art communications and forecasting with real-time performance management infrastructure is essential
- Plan to operate and manage the asset more dynamically; optimise lifetime and adopt whole wind farm control to minimise LCoE

# Thank you



#### Keir.harman@dnvgl.com