Demonstrations of Floating Technology

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Freeport McMoRan, Inc.
Houston
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WHO IS IDEOL ?

FULLY DEDICATED TO FLOATING WIND

Founded in 2010

Privately held

Fully integrated staff of 50+

REASONS FOR DEMONSTRATION

Technical validation

- Experience in the oil and gas industry (but also nuclear) shows that catastrophic failures occur more often than per design
- Floating wind turbines are multiple in wind farms, increasing the consequences and probability of undesired events
- Prototype testing captures weak points and strengths
- Power curve can be truly validated by full-scale experiments

Soft matters

- Operation procedures and occupational safety
- Environmental impact assessment
- Proof testing of contractual interface with all parties
- Feedback on actual availability of materials and contractors / builders capacity
- Proof testing of logistics
- Identification/validation of sensitive quality control points

ONE-OFF UNITS ARE NOT ALL SUCCESSFUL

Mars drilling rig collapse
(GoM in hurricane Katrina, 2005)

Typhoon Tension Leg Platform
capsizing in hurricane Rita

Caused by simultenaeous failure
of two tendons in storm

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CONDITIONS OF BANKABILITY

Build demonstrators representative of all design options:

- Choice of hull and mooring materials
- Test different certification framework

Challenge collected data:

- Use certified monitoring equipment when existing to get approvable data
- Rigourous commissioning and testing process to allow simulation models validation
- Third party validation of tests data

And above all : Keep next projects close enough to demonstrators to make feedback relevant

THE HIBIKI-NADA DEMONSTRATOR

- Design, build, install a 3MW floating wind turbine
- 2-blade machine
- Offshore Japan, Japan sea, North of Kyushu
- Steel hull (45m x 45m x 7.5m draft)
- All-chain mooring lines
- Financed by the NEDO
- Typhoon-prone location

THE FLOATGEN DEMONSTRATOR

- Design, build, install a 2MW floating wind turbine
- Offshore France, N-E Atlantic Ocean
- SEM-REV test site in shallow water, operated by ECN
- Concrete hull (36m x 36m x 7m draft)
- Synthetic mooring lines
- Financed by EU and France

- Partnership with

CENTRALE NANTES

BOUYGUES TRAVAUX PUBLICS

Fraunhofer IWES

University of Stuttgart

LESSONS LEARNT

- Seakeeping performance as planned
- Power curve of Floatgen as / better than expected
- Mooring performance better than design
- No need for retensioning lines after several storms
- The Hibiki-nada floater survived to 3 typhoons

- Regulatory frame-work impacts heavily on design
- Split of offshore installation contracting key to reducing costs
- Local content can be maximized by concrete fabrication

- Lessons will be relevant for very large turbines even in very severe environments

- Wind turbine manufacturer’s momentum is key to the success of the project

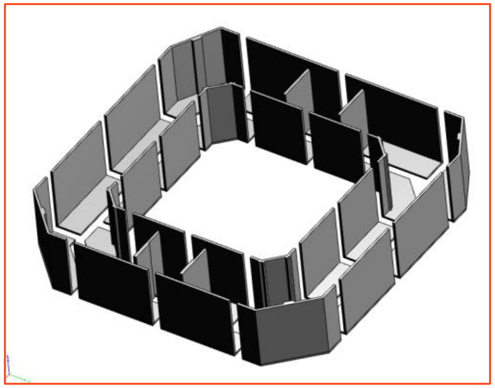
NEXT STEPS: SERIAL PRODUCTION

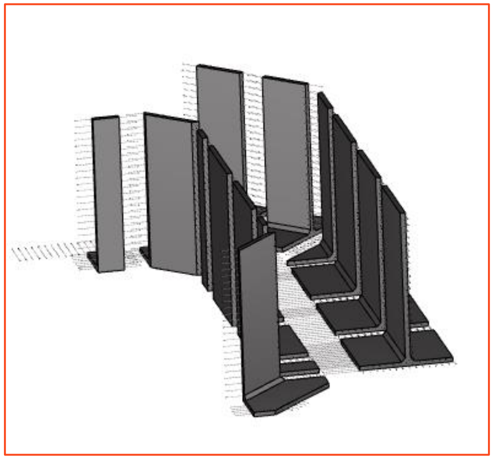
The 12MW version is ready and still comparable to the 2MW demonstrator

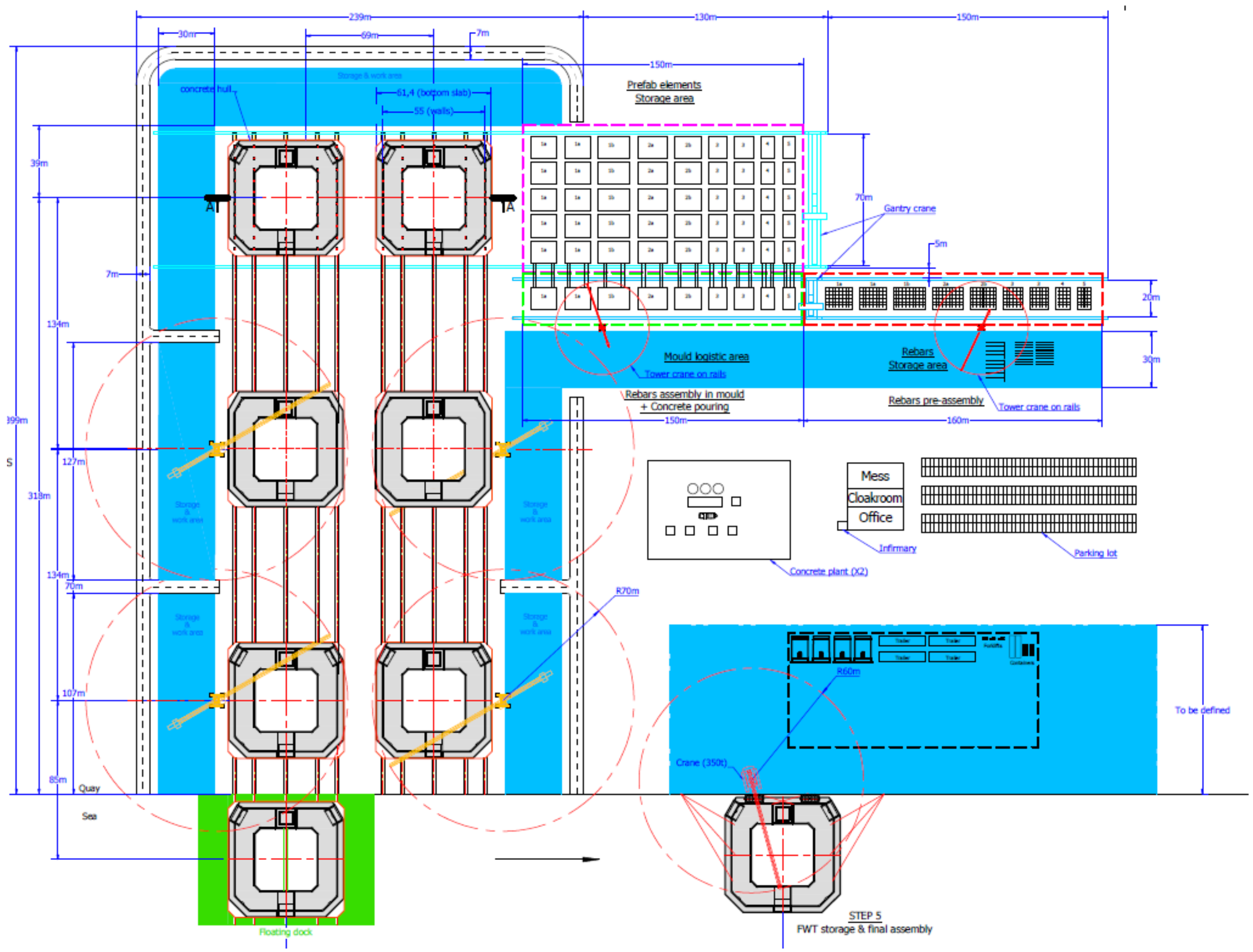
For this next step:

- only manufacturing is changed
- to build on demonstrators' track record
- And take no risks with materials

EXAMPLE SERIAL PRODUCTION







1 floater every 2 weeks

With two assembly lines and prefabrication

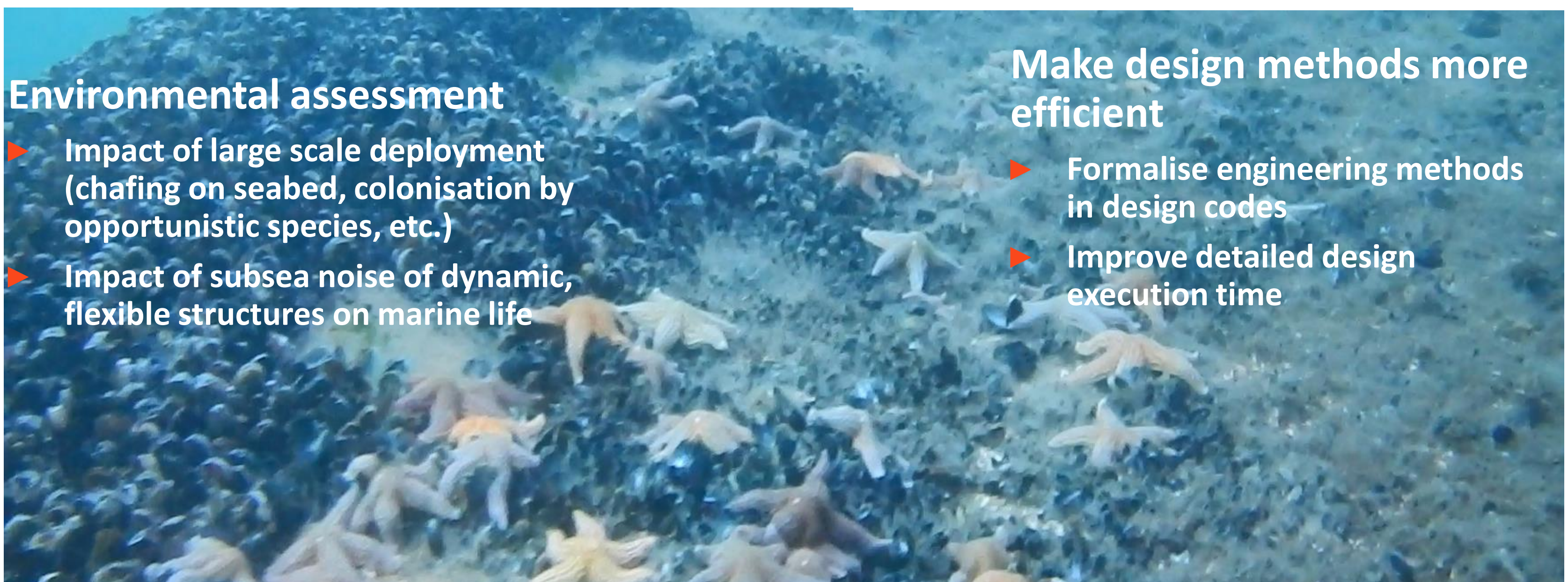
FLOATING WIND NEXT R&D PRIORITIES

Simplify hull construction and industrial production

- Prepare scenarios for 500MW farms construction and manage logistic flows
- Develop alternate simplifying materials and associated processes
- Mooring components reliability

Develop last bricks missing before commercial farms

- Floating substation and related equipment
- Dynamic export cable systems



Environmental assessment

- Impact of large scale deployment (chafing on seabed, colonisation by opportunistic species, etc.)
- Impact of subsea noise of dynamic, flexible structures on marine life

Make design methods more efficient

- Formalise engineering methods in design codes
- Improve detailed design execution time


THANK YOU
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