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Lessons learned towards safe and efficient wind turbine installations

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BACKGROUND

In a study funded by NOWRDC, MARIN studied the differences in the operability characteristics of various feeder concepts.

Saint James Marine provided project coordination and interface management with a large pool of stakeholders who provided input to the study and reviewed the results

OBJECTIVE

Develop consensus-based best practice from collective knowledge, expertise & experience, to address a operability of feeder vessels

Identify the required minimum specification of feeder vessels to achieve acceptable availability.

METHODS

A combination of time domain and frequency domain simulations provided a comparative operability for different feeder solutions.

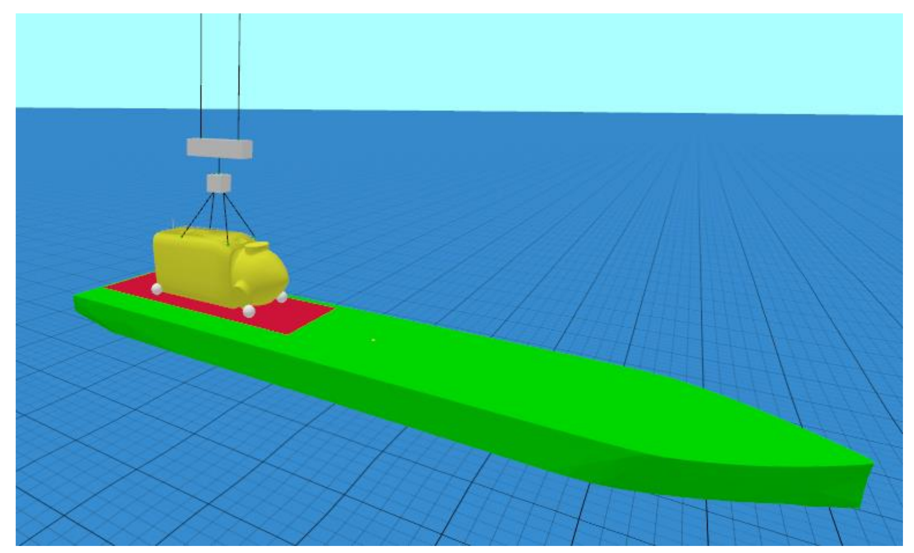
Time domain simulations can handle changing draft/roll period, re-hits, winch speeds and details of non-linear hoist wire stiffness. The success rate was compared to the heave motions at the component foundations.

A frequency domain analysis quickly evaluates a range of feeder sizes, compensation systems, rails, roll mitigation to identify their impact on the driving vertical motions of the components during lift

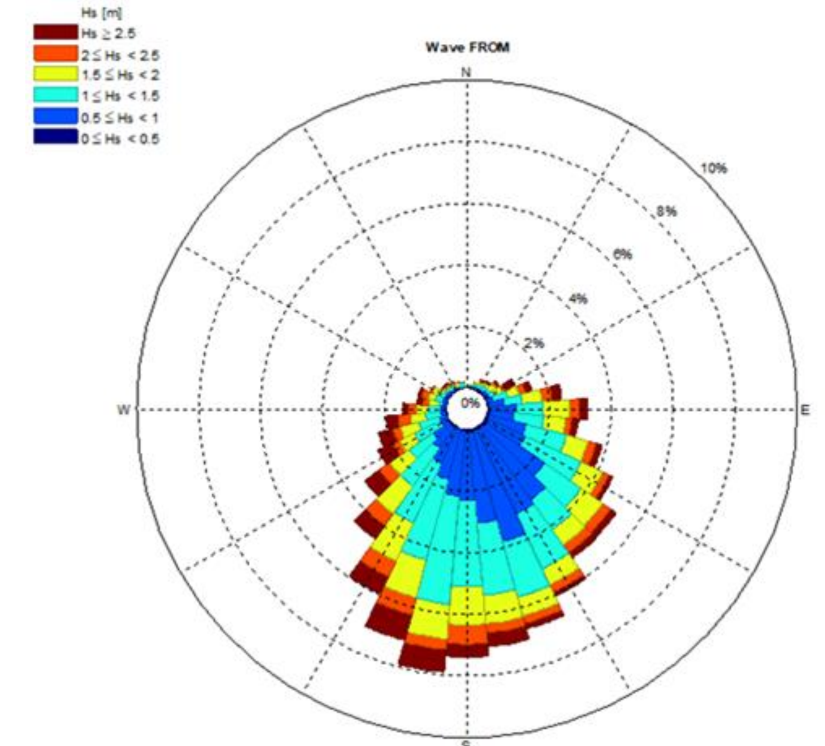
RESULTS

Feeder vessel with tower sections, blade rack and nacelle components to be lifted to Wind turbine Installation Vessel (WIV)

Simulations with time domain solver considering wave forces, hoist speed, component weight and hoist wire stiffness. These simulations were carried out with and without crane based heave compensation



Waves considered for operability are somewhat directional and mostly around 6 to 10 seconds peak period, predominantly between 1 and 2 meters



Re-hit is main driver of operability for component transfer

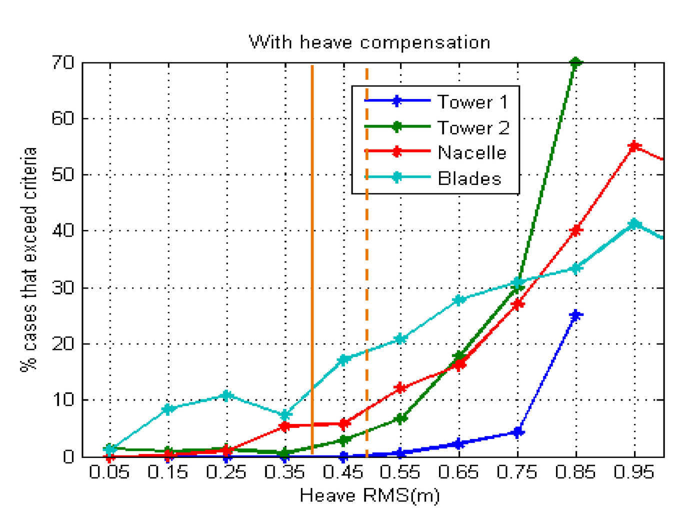
2 feet significant wave height for dominant wave periods

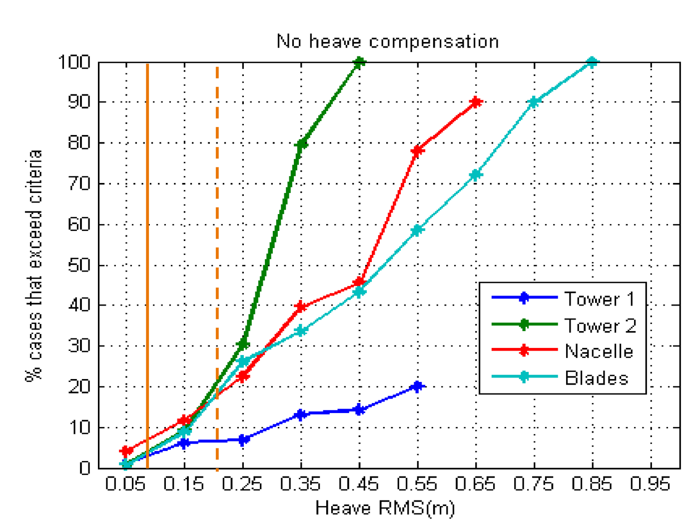
Crane based heave compensation helps

Deck based motion compensation also improves rigging

Advanced systems can increase wave height to 8 feet

Vessel	100m SS feeder				Barge feeder				165m SS feeder			
Rails	No		Yes		No		Yes		No		Yes	
Roll	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Jan	39.8	45.2	46.2	48.4	48.4	48.4	52.7	54.8	68.8	75.3	80.6	81.7
Feb	43.5	45.9	48.2	49.4	42.4	43.5	44.7	47.1	80.0	84.7	85.9	87.1
Mar	48.4	49.5	52.7	57.0	50.5	52.7	57.0	57.0	79.6	81.7	84.9	87.1
Apr	37.8	45.6	47.8	52.2	42.2	47.8	56.7	57.8	67.8	73.3	80.0	82.2
May	59.1	66.7	74.2	77.4	63.4	66.7	71.0	75.3	77.4	80.6	88.2	89.2
Jun	87.8	94.4	95.6	96.7	87.8	92.2	95.6	95.6	100.0	100.0	100.0	100.0
Jul	86.5	91.9	93.2	94.6	83.8	91.9	91.9	91.9	97.3	97.3	97.3	97.3
Aug	83.9	85.5	88.7	88.7	87.1	87.1	88.7	90.3	93.5	93.5	95.2	96.8
Sep	53.3	63.3	63.3	66.7	56.7	60.0	63.3	63.3	71.7	78.3	80.0	80.0
Oct	32.3	35.5	48.4	50.0	35.5	40.3	46.8	51.6	66.1	67.7	67.7	71.0
Nov	51.7	56.7	60.0	60.0	58.3	63.3	66.7	66.7	78.3	83.3	85.0	86.7
Dec	43.5	50.0	50.0	56.5	48.4	50.0	53.2	56.5	66.1	69.4	77.4	79.0
Total	55.5	60.7	63.9	66.3	58.5	61.8	65.6	67.2	79.1	82.4	85.6	86.9





Operability is strongly seasonal in the U.S. northeast Atlantic coast.

Larger feeders vessels (>500ft) moored into the waves move less than feeder vessels of 300 ft length resulting in larger availability

Skidding and anti-roll systems improve operability somewhat in beam wave conditions

CONCLUSIONS

This study revealed the need for workforce development, modification to existing barges and new build vessels to match the demand and ensure an efficient and safe development. Installation contractors, designers and developers will participate to highlight the lessons learned from earlier installation projects

ACKNOWLEDGEMENTS

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