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Response to 23-ERDD-01 RFI

Additional submitted attachment is included below.

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California Energy Commission
715 P Street
Sacramento, CA 95814-5512

SUBJECT: Response to "Request for Information Entangled Debris Monitoring for Floating Offshore Wind Infrastructure" 23-ERDD-01

To Whom It May Concern:

Stress Engineering Services, Inc. (SES) appreciates the opportunity to assist the California Energy Commission with by responding to the Request for Information regarding entangled fishing gear in floating offshore wind infrastructure. At Stress Engineering Services, we have worked in the Energy sector for 50 years, much of which has served the offshore oil & gas industry. Through our history we have pioneered technologies to advance the offshore oil & gas industry through the development of engineering software, testing services, condition monitoring solutions and digital twins and most of SES's core competency is centered around floating systems.

As the world embraces renewable energy, SES stands ready to provide our decades of experience in support of these emerging markets. SES sees the tremendous opportunity floating wind poses for the United States. Similarly, we understand the challenges of building and operating energy facilities in the harsh marine environment.

We look forward to responding to any future funding opportunities regarding floating wind anchoring and mooring that may arise from this Request for Information.

Please contact me if you have any questions.

Regards,

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1. Response to Numbered Questions

1.1 Question 1

"What technologies, equipment, and types of inspection could detect entanglement on FOSW infrastructure?

Machine vision, contact detection, and autonomous underwater vehicles hold promise for detection of entangled fishing gear and may also provide data that can be useful in other ways. Additionally, structural health monitoring systems measuring mooring line tension, inclination and acceleration may be able to also detect the presence of entanglement.

Additionally, it may be useful to perform a study to understand the types of fishing gear that are expected to become entangled and where (e.g., near surface, 50 m below surface, near seabed, etc.). This will aid in the assessment of which detection methods are viable. For example, machine vision may be ideal for near-surface gear by using hull-mounted cameras, but this is not viable below a certain depth.

"What research is needed to advance these technologies? Please provide details on sensor accuracy, potential cost of the technology, and any additional hazards or conditions that can be detected/monitored."

This could start with a survey of existing work regarding each method, as applied to entangled debris detection or elsewhere.

For each type of detection, research could be performed to determine if a commercially available sensor exists for this application. For detection strategies that rely on measuring dynamic response, analysis or testing could be performed to determine the defining characteristics of that response and the required sensitivity, sampling rate, etc. For strategies that would rely on contact detection, realistic entanglement scenarios will produce contact force, contact area, etc. The cost of such technologies would vary depending on the system specifications required.

1.2 Question 2

"What types of structural integrity or environmental monitoring technologies would be practical and cost effective to couple with detecting entanglement? What research is needed to advance these technologies? For example, continuous condition monitoring of electrical array cables, export cables, or mooring line integrity. Please provide as much detail as possible on the accuracy and cost of each technology and specify which parameters or conditions can be detected/monitored."

Methods that measure cable or mooring line tension and/or response could conceivably also provide information about line integrity.

Current profile data (current speed and direction as a function of depth and time) might be useful for defining metocean data that could be useful for design of additional floating facilities, oceanographic research, or marine biology research.

Some methods that detect ensnared debris might also detect

- other marine debris that passes by even if it is not entangled
- marine life
- vessels that pass by the facility, either with authorization or not.

The cost of such technologies would vary depending on the system specifications required.

1.3 Question 5

"To what extent are permanent FOSW infrastructure-mounted sensors more cost effective than deploying specialized vessels or equipment such as ROVs and AUVs? Please take into consideration the differences in sensor accuracy and the travel time of vessels from port to the FOSW farm."

The cost of mobilizing vessels and crew to the site can be quite high through the lifetime of the wind farm. Thus it seems likely that permanently installed equipment would be far less expensive to operate than methods that require a vessel to mobilize to the site. Permanent systems can provide continuous monitoring, whereas methods that require mobilization cannot. While continuous monitoring systems may go down or be subject to maintenance, mobilizations for a well-designed system should be minimal (e.g., annual basis, every 5 years). It is likely that the continuous monitoring systems can be designed such that their maintenance could be performed during regular turbine maintenance mobilizations.

1.4 Question 6

"Please describe the FOSW farm structural integrity and/or environmental inspections that must be conducted by ROVs and AUVs. Are there additional technologies that could supplement the use of ROVs and AUVs to minimize deploying specialized vehicles?"

ROVs or AUVs enable visual inspection of the hull, mooring lines, and anchors to inspect the structural integrity of those systems. Visual inspection is also likely to detect entangled fishing gear. However, it is possible that fishing gear could become entangled and then be freed between inspections, meaning such gear would not be detected and detection of damage to the mooring line would not be easily measured through ROV and AUV inspections. It may also be feasible to design some sort of device such as a robotic crawler that travels along the line, to provide close visual inspection of the lines and stops if it hits resistance as would be produced by entangled gear.

1.5 Question 7

"What are the biggest challenges in integrating permanently mounted sensors for structural integrity monitoring or environmental monitoring onto FOSW infrastructure? Please describe any current limitations with regards to sensor placement on platforms, mooring lines, electrical cables, or anchors."

The biggest challenges in integrating permanently mounted monitoring systems lie in installation of these systems, design life requirements and power.

Monitoring systems need to be designed such that they can either be installed offshore after the mooring line has been installed or installed beforehand onshore. The latter installation requires that the monitoring equipment withstand transportation and installation of the mooring line. The design would also need to accommodate retensioning of the lines.

Permanently mounted monitoring systems will need to operate for the design life of the wind farm, which is typically 25-30 years. Since this system is located on unmanned platforms offshore, maintenance can be costly and the requirement for maintenance should be minimized in design.

The last major challenge is powering the system. A system that requires electrical power would need to get its power from batteries or through an umbilical to the turbine. For monitoring systems that require sensing mounted on a mooring line, this routing and installing a power cable in-situ can be very challenging. On the other hand, battery power solutions may limit the amount of data that can be collected since data collection and transmission may require substantial storage and/or bandwidth.