Fukushima Floating Offshore Wind Farm Demonstration Project (FORWARD)

Current state and prospective

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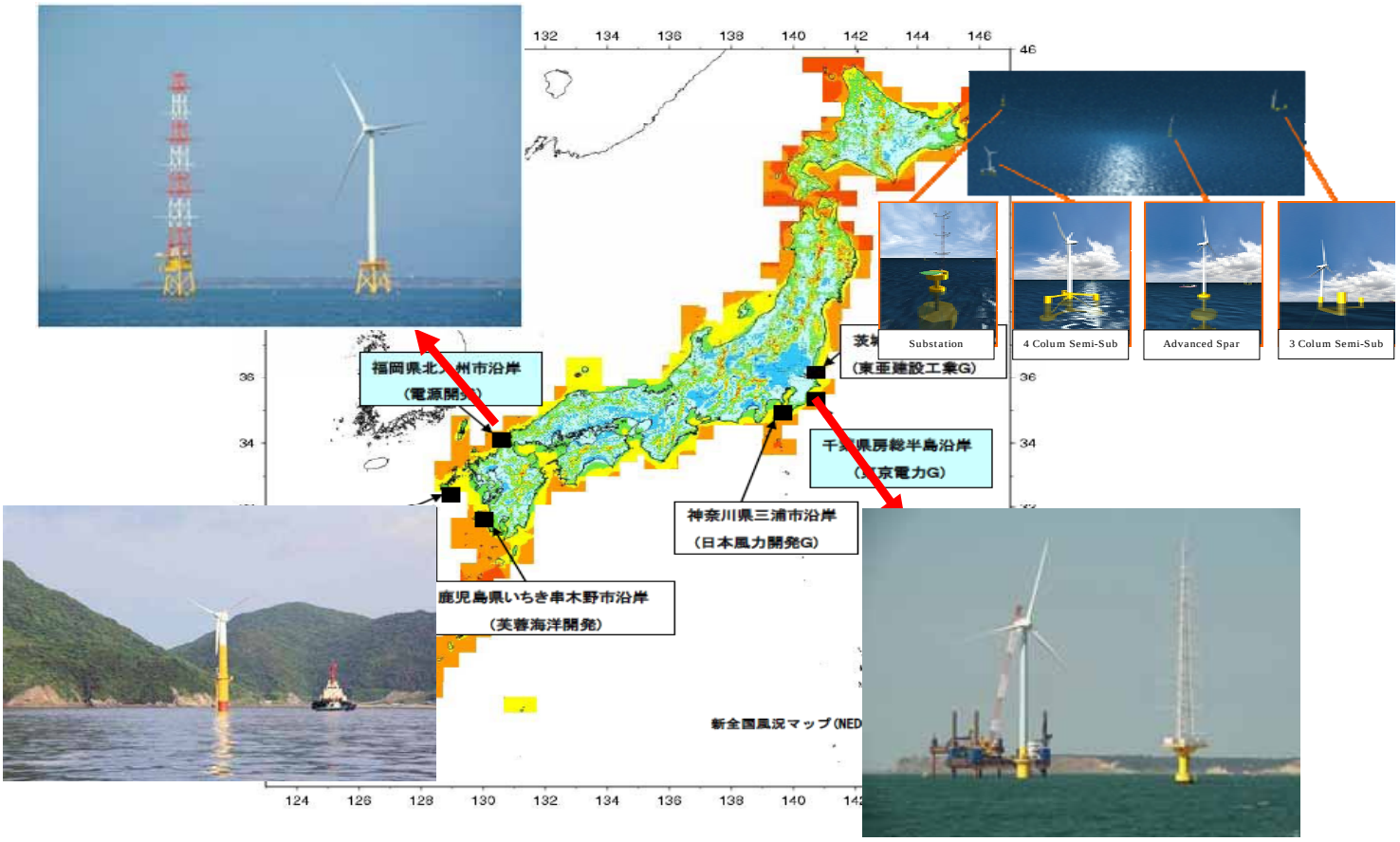
Current state of offshore wind power in Japan

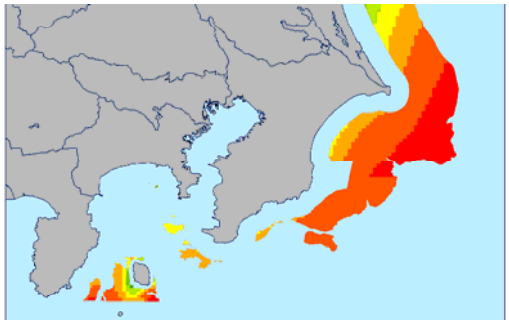
Offshore wind demonstration projects in Japan



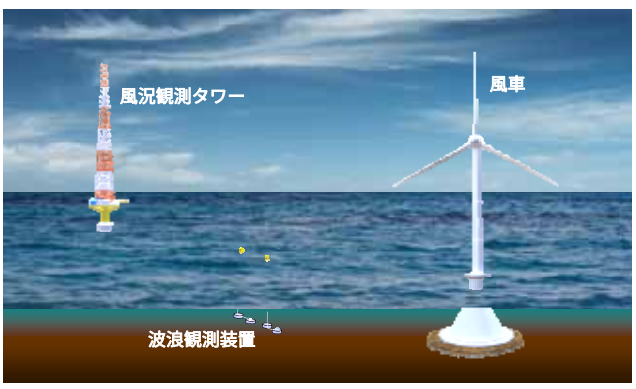
Background of NEDO project

Natural environmental conditions in Japan, such as strong winds during typhoon, high waves, and earthquakes are severer than Europe.

Wind and marine conditions



Design and construction



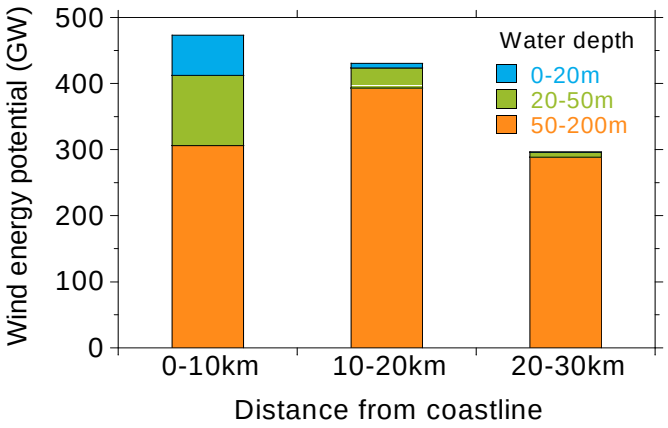
Environmental issue

Background of Fukushima project

Benefits

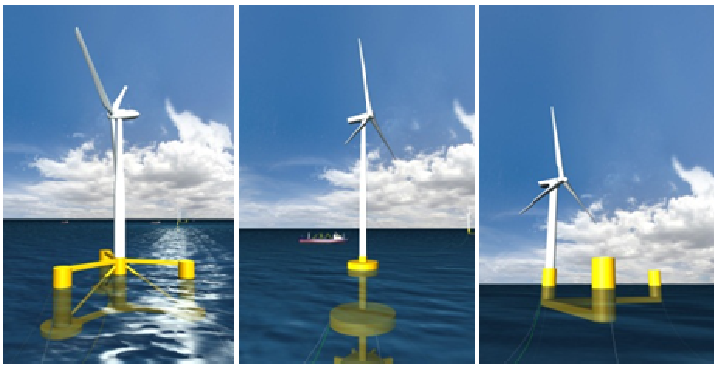
- Offshore wind energy potential along Japan is 1.6TW
- More than 80% of the offshore wind energy potential in Japan are located at deep water.
- The accumulation of wind energy industry will help the restoration of Fukushima

Offshore wind energy potential in Japan



Challenges

- Floating offshore wind technology
- Measurement and Prediction technology
- Floating substation
- Cost efficiency



Compact semi-sub | Advanced spar | V-shape semi-sub

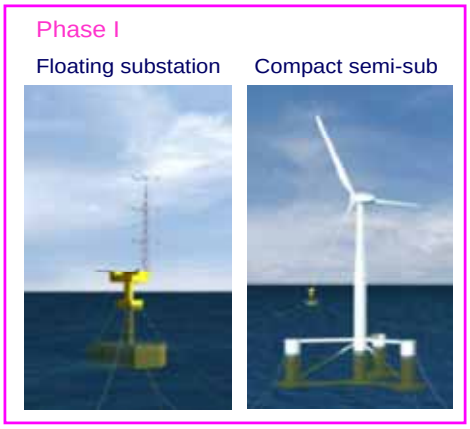
Development phases and key success factors

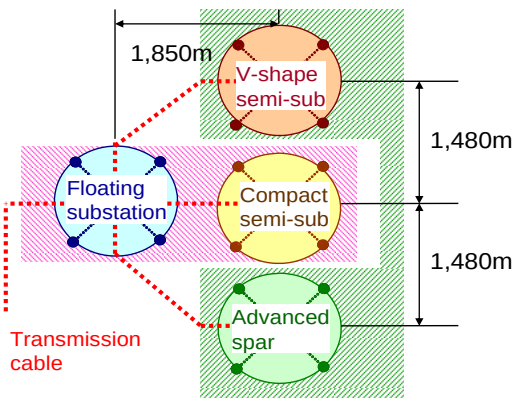
2 Phases:

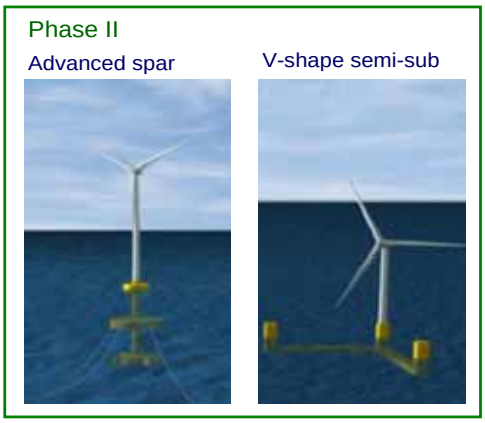
Phase I (2011~2013) → **Phase II (2014~2015)**

Floating substation
Compact semi-sub (2MW)

V-shape semi-sub (7MW)
Advanced spar (7MW)







3 key success factors:

- Design / Test / Improvement
- Cost efficiency / industrialization
- Technology maturity / Social acceptance

Presentation of consortium members

Consortium Member	Main Role
Marubeni Corporation (Project Integrator)	Pre-Studies, Approval and Licensing, Operation and Maintenance, Collaboration with Fishery Industry
The University of Tokyo (Technical Advisor)	Measurement and Prediction Technology, Navigation Safety, Public relation
Mitsubishi Corporation	Pre-Studies, Approval and Licensing, Environmental Assessment
Mitsubishi Heavy Industries, Ltd.	V-Shape Semi-Sub Type Floater
Japan Marine United Inc.	Advanced Spar Type Floater and Floating Substation
Mitsui Engineering & Shipbuilding Co., Ltd.	Compact Semi-Sub Type Floater
Nippon Steel & Sumitomo Metal Corporation	Advanced Steel
Hitachi, Ltd.	Floating Electric Power Substation
Furukawa Electric Co., Ltd.	Undersea and Dynamic Cables
Shimizu Corporation	Pre-Studies, Construction and Installation Technology
Mizuho Information & Research Institute, Inc.	Documentation, Committee Operations

FORWARD vision and challenges

Green growth in Fukushima
- Industry accumulation
- Employment
- Restoration

Fukushima FORWARD

Technical challenge
- Floater concepts
- Measurement and prediction
- Floating substation
- Cost efficiency
- Advanced material

Social acceptance
- Navigation safety
- Environmental assessment
- Collaboration with fishery
- Public relation

Work packages

1 Preliminary study
- site assessment
- preliminary design

2 Measurement / prediction
- metocean
- floater motion
- substation / power cable

3 Floating wind turbines
- wind turbine
- floater / mooring
- advanced material

4 Grid integration
- floating substation
- dynamic cables

Phase I

Phase II

5 Operation & Maintenance
- floater / mooring
- wind turbine
- substation / power cable

6 Environment issue
- environmental assessment
- marine navigation safety
- collaboration with fishery

7 Documentation
- technical review
- manual
- project report

8 Public relation
- communication centre
- seminar and symposium

Floater concepts

	Compact semi-sub	Advanced Spar	V-shape semi-sub
			
Control	Passive control with ballast water	Hydro-dynamic control	Passive control with motion suppression board
Motion	Good	Good	Challenge
Installation	Good	Challenge	Good
Cost	Challenge	Good	Good

Construction of compact semi-sub floater

MES 三井造船株式会社

A view of compact semi-sub floater

MES 三井造船株式会社

Floating metocean measurement technology

Meteorological observation by lidar equipped on floater

Motion

RTK-GPS

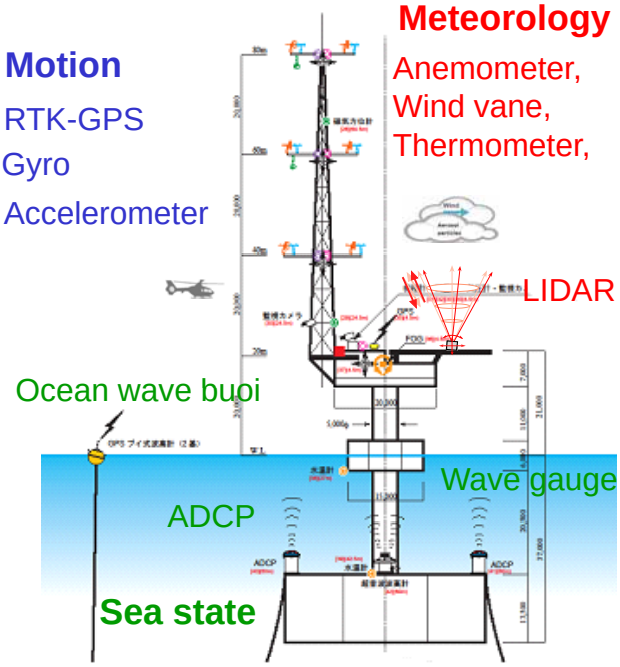
Gyro

Accelerometer

Meteorology

Anemometer,
Wind vane,
Thermometer,

Meteorological measurement by tower equipped on floater



The correction of floater motion by accelerometer and GPS

Sea state measurement by wave gauge and ADCP

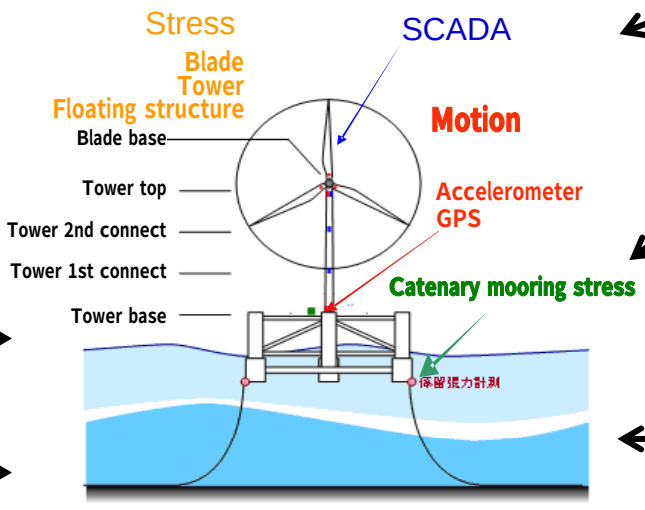
Develop metocean measurement technology considering floater motion

Verification of design and prediction technology

Typhoon

Wave, current Tsunami

Earthquake



Blade and tower measurement system

Floating structure measurement system

Catenary mooring measurement system

The advanced design and prediction technology for floating offshore wind farm

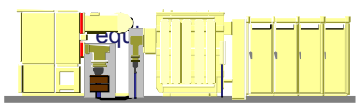
Water tank test

Grid integration system

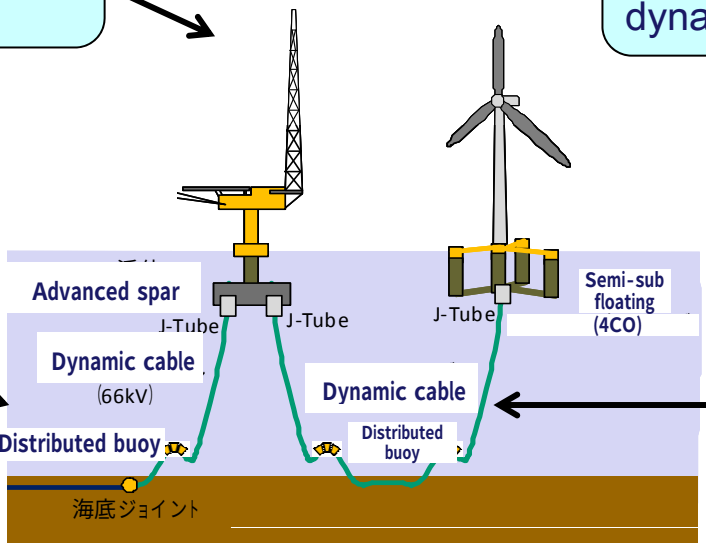
Durable substation equipment against motion and declination

Long life, water shield and high voltage dynamic cables

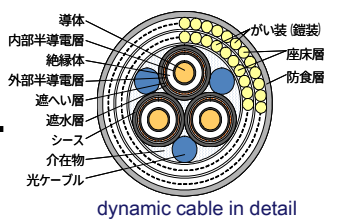
Offshore substation



Joint device for different cables and anchor



Development of Long Life water shield layer for high voltage

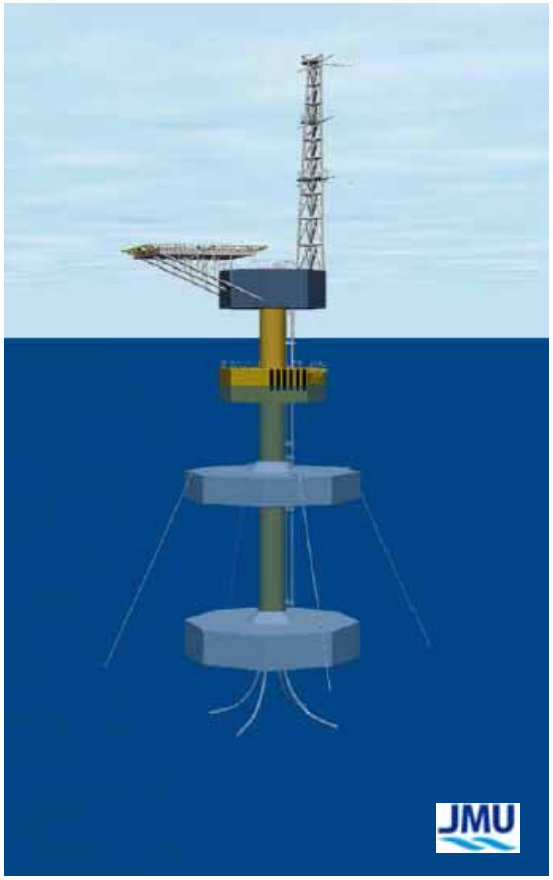


dynamic cable in detail

World first floating offshore transformer with 66kV dynamic cable

Test for dynamic cable and transformer

Construction of substation



Public relation

- Exhibition of Fukushima project
- Model display

- Briefing session
- Web page
- Symposium

- Social acceptance
- Publication
- Communication

Establish the good communication route and relationship with people in local area.

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