Dynamic Positioning as Enabler of Offshore Wind Projects

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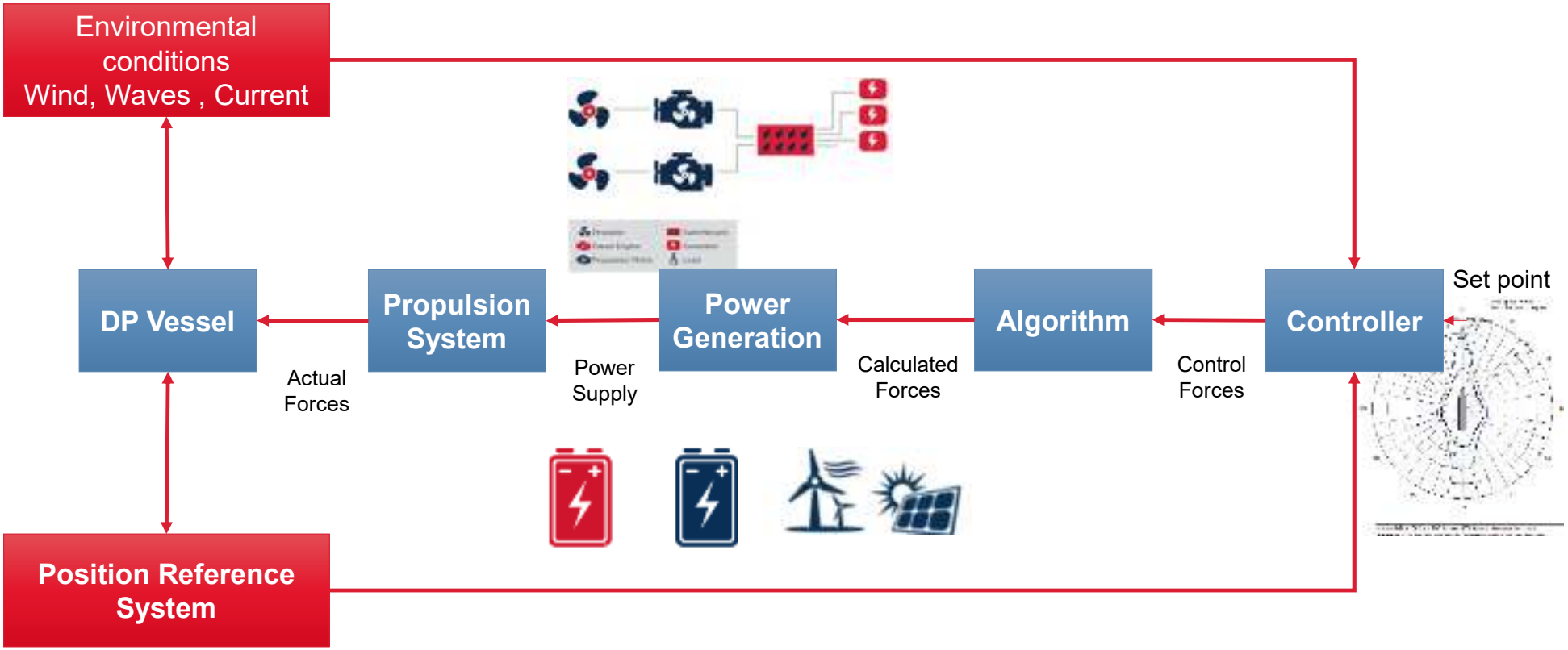
Basic DP Principles: Diagram of DP System



Operational Significance and Benefits of DP systems in Offshore Wind Projects

Precise Positioning

- Enable vessels to accurately position themselves during critical operations
- Ensure accurate equipment deployment and optimizing the overall efficiency.

Enhanced Flexibility

- Allowing vessels to maintain position and heading in challenging environmental conditions.
- Improves project timelines and reduces weather-related downtime
- Support the growth of offshore wind farms into areas with deeper waters.

Improved Safety

- The safety of personnel and equipment
- Reduce the risk of collisions, damage to the equipment
- Support emergency response capabilities

***Figure**: Wind farm Offshore, construction, maintenance on wind turbine*

Technological Advancements in DP Systems

Advances in DP Control Algorithms

- Significant advancements in control algorithms.
- Improving system performance, responsiveness, and accuracy
- Employ sophisticated mathematical models to optimize vessel positioning and minimize positioning errors.

Integration of Sensor Systems for Precise Positioning

- A wide range of sensor systems. These systems include:
  - Global Navigation Satellite Systems (GNSS)
  - Inertial Navigation Systems (INS) and Doppler Velocity Logs (DVL)
  - Integration of multiple sensor systems

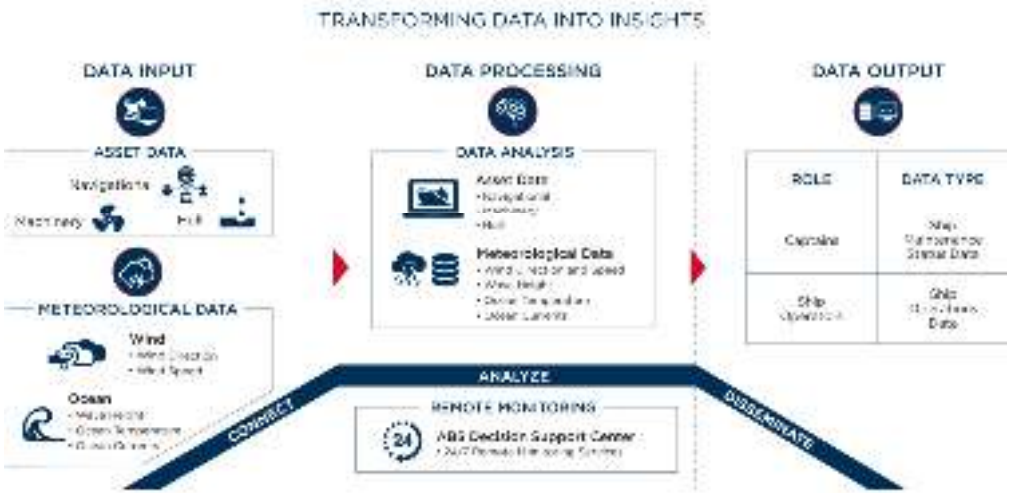
Technological Advancements in DP Systems

Enhanced Redundancy and Fault Tolerance Mechanisms

- Enhanced redundancy and fault tolerance mechanisms achieved by:
  - multiple independent sensors, computers, and control equipment.
  - fault tolerance mechanisms to detect and isolate faults
  - advanced fault detection algorithms, self-testing capabilities, and automated failover mechanisms

Utilization of Data Analytics and Machine Learning

- Analysis of real-time data to identify patterns, correlations, and anomalies.
- Make predictions about vessel behavior, environmental conditions, and system performance
- Resulting in better positioning accuracy, improved fuel efficiency, and enhanced decision-making capabilities
- Enable predictive maintenance and continuous monitoring.



Technological Advancements in DP Systems

Advances in Power Management Systems

- Improve the efficiency of the DP system by optimizing the use of power
- Monitor the power consumption of the vessel and adjust the power output of the generators
- Reduce fuel consumption and emissions, while also improving the reliability of the system
- Incorporation of renewable energy sources such as solar panels and wind turbines to further reduce fuel consumption and emissions.

DP System Design Complexity for Offshore Wind Farms

Integration of DP systems with other onboard systems

- Challenging sub-systems integration with power management, navigation, communication and other onboard systems.
- Seamless communication, synchronization and coordination are essential to ensure efficient and safe operations

Environmental conditions

- Significant impact of environmental factors such as wind, waves and currents on DP system design complexity
- Advanced calculations based on accurate wind speed/load, wave height, wave period and current speed as input
- Many combinations for the analysis of input data in a specific location.

***Figure**: Walk to work vessel Northsea windfarm*

Regulatory Requirements for DP in Offshore Wind Projects

International Regulations and Standards Governing DP Operations for Offshore Wind Industries

- **International Maritime Organization (IMO) Guidelines** : **IMO MSC/Circ.1580** - *Guidelines for Vessels and Units with Dynamic Positioning (DP) Systems*
- **International Standards and Guidelines**
  - **International Marine Contractors Association (IMCA)**: **IMCA M 103**, *Guidelines for Design and Operation of Dynamically Positioned Vessels*
  - **International Electrotechnical Commission (IEC): IEC 60812,** *Analysis techniques for system reliability - Procedure for Failure Mode and Effects Analysis (FMEA)*

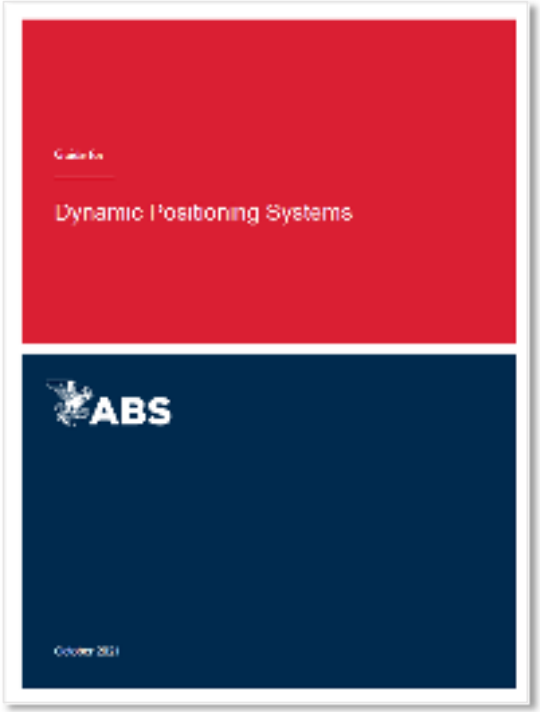
Regulatory Requirements for DP in Offshore Wind Projects

Flag State Regulations

- For example, USCG Guide "*Introduction to Dynamic positioning DP systems*"

Classification Society Guidelines

- *ABS Guide for Dynamic Positioning Systems*



Classification Society Guidelines: Insight into the Certification Process

- Design Review
- Type Approval and Equipment Certification
- Installation and Commissioning
- Performance DP Testing
- Periodic Survey

ABS Class Equivalent Notation

IMO	Class 1	Class 2	Class 3
ABS	DPS-1	DPS-2	DPS-3
ABS Enhanced System notations		EHS-E EHS-P EHS-C EHS-F	EHS-E EHS-P EHS-C
ABS Station keeping performance (SKP) notations	SKP SKP(a,b,c,d,e,f)		

Safety Considerations and Design Requirements for DP Operations

- Operational and weather limits
  Establishing operational limits based on:
  - the vessel's capabilities,
  - weather conditions,
  - the project's specific requirements.

- Collision avoidance
  Implementing collision avoidance measures.

- Subsea hazard avoidance
  Identifying and avoiding subsea hazards such as pipelines, subsea cables and other underwater structures.

- Safe access and egress
  Ensuring the safe transfer of personnel and equipment

- Emergency Response Planning and Procedures

- Risk Assessment and Mitigation Strategies

Figure: Block Island Wind Farm

Vessels Support Offshore Wind Farm Life Cycle

Survey and Dredging	• Survey Vessel • Dredgers
Foundation Installation	• Monopiles and Jackets installed by a Jackup Vessel or Self-Propelled Wind Turbine Installation Vessel (WTIV) • Crane Barge
Turbine Installation	• Wind Turbine Installation Vessel (WTIV) and Jackup Vessel • Crane Barge and Heavy-Lift Vessels
Transportation/Feeder	• Supply Vessel and Heavy Transport Vessel • Liftboat, Feeder Jackup • Feeder Barge • Crew Transfer Vessel (CTV) and W2W Vessel
Cable Laying	• Cable Laying Vessel • Cable Laying Barge
Operation and Maintenance	• Heavy Maintenance Vessel (Jackup heavy lift vessel) • Service Operation Vessel (SOV) • Crew Transfer Vessel (CTV)

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Strategies to Manage System Complexity

Modular and scalable designs
- Enable flexibility in accommodating future expansions
- Cost efficiency
- Simplify maintenance and enhance serviceability
- Seamless integration

Integration of advanced automation and control systems
- Optimize performance,
- Maintain stability and reduce human intervention

Simulation and modeling tools
- Evaluate performance under various conditions
  Identify potential design improvement
- Reducing real-world risks

Effective communication

Data communication and Cyber Security

***Figure**: Wind float Atlantic*

Case Study: Self-Elevating Wind Turbine Installation Vessel (WTIV)

- The first ever Jones Act compliant WTIV "Charybdis" will be built to ABS Class.
- Now under construction by Keppel AmFELS for Dominion Energy.
- The 472-foot vessel is designed to handle turbine sizes of 12 MW or larger.
- The vessel will have accommodation for up to 119 crew and wind farm technicians.

***Figure**: First Jones Act compliant WTIV, Dominion Energy's Charybdis, will be built to ABS Class*

Case Study: Self-Elevating Wind Turbine Installation Vessel (WTIV)

- Charybdis will be equipped with DP system of
  - a seven thruster' system
  - dual DP controller (DPC)
  - independent joystick
  - the DPC has dual power supplies with two UPSs
  - position reference system : DGPS, transponder, laser-based relative PRS, (Gyro and MRU) and wind sensors.

- The DP capability analysis is based on simulation using Kongsberg Maritime AS computer software.

- The vessel is supposed to receive a notation **DPS-2**
  - **SKP(a, b, c, d, e, f)**

***Figure**: First Jones Act compliant WTIV, Dominion Energy's Charybdis, will be built to ABS Class*

ABS Mission

To serve the public interest as well as the needs of our members and clients by promoting the security of life and property, and preserving the natural environment.

"Where technology enables, people achieve. It is the dedicated people of ABS who take firm hold of the latest technologies and bring them to bear in the spirit of our mission and in the service of safety."

CHRISTOPHER J. WIERNICKI
Chairman, President and CEO ABS

Thank You

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