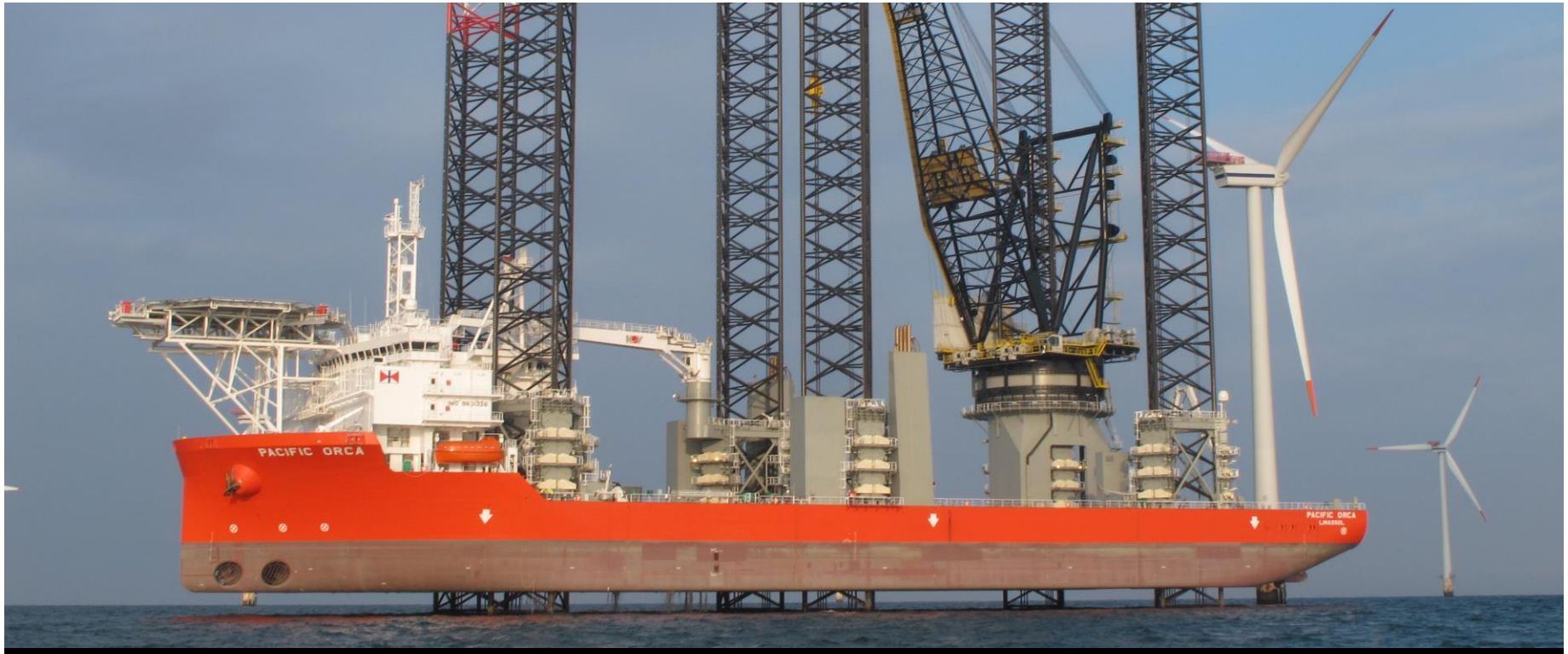

2016-05-27, Taipei, Windfarm Development Seminar, Kokkit Lee

ABB – a strong business partner

Jacking Drive System

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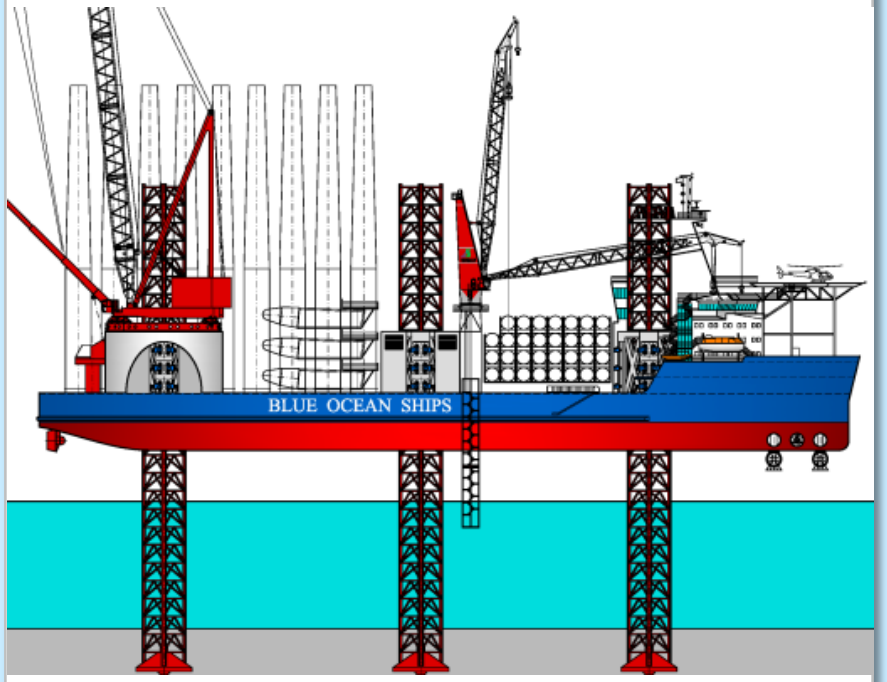
Power and productivity for a better world™

ABB Marine & Ports
General

ABB Marine and Ports
Vessels with Jacking System

Wind Farm Installation Vessel



Self Elevated Mobile Offshore Vessel

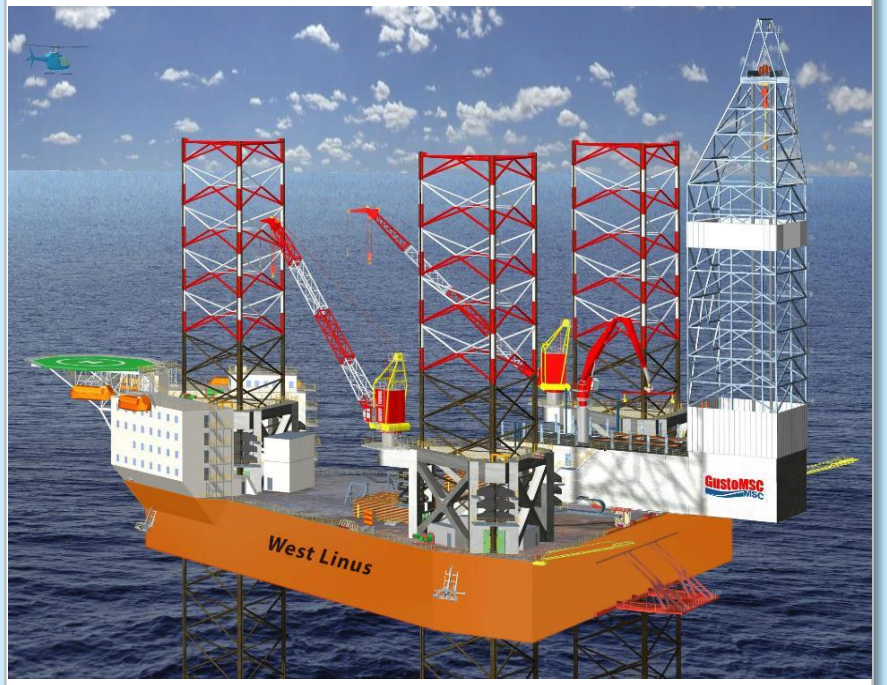


ABB Marine and Ports
Jacking drive system

Focus

Increase integrity by integrating with the PMS reducing risk of blackout during starting

High performance jacking control software with individual inverter for each motor

Simplicity interface with the other system suppliers

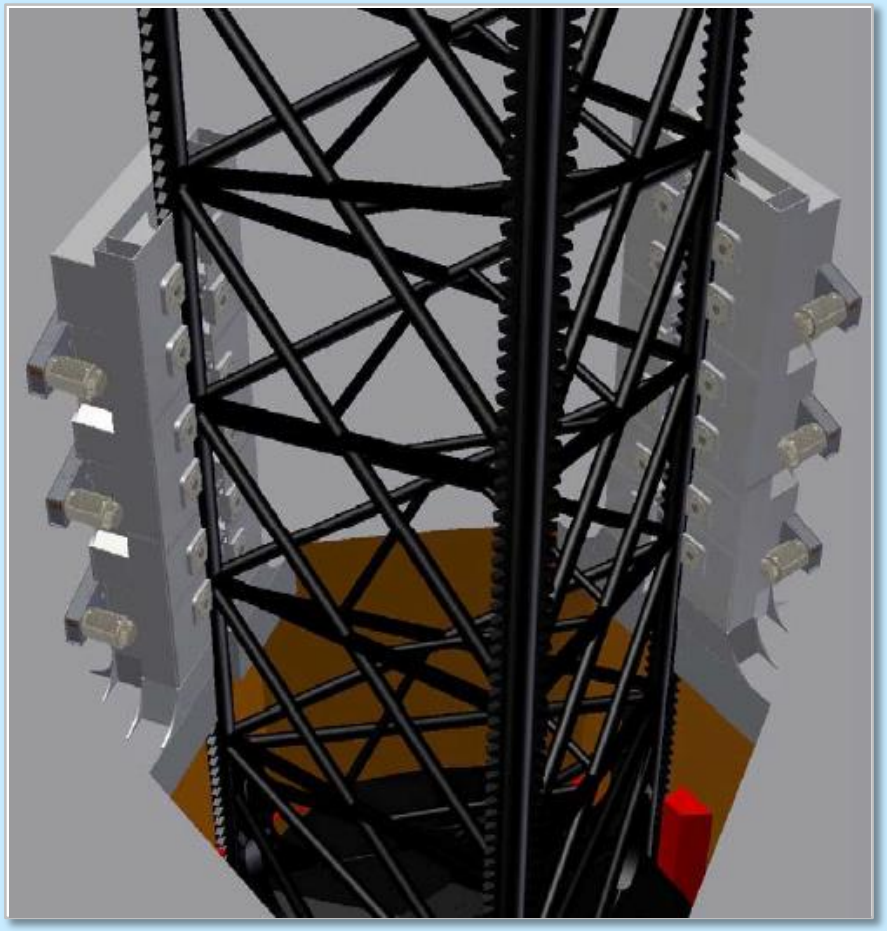
Flexible solution with multi drive system, 6-24 pulse, active rectifier solutions, air or liquid cooled drive

Increase reliability with redundant control network between Control Unit and Workstation

Remote diagnostic support (option)

Proven solution

Better comfort with liquid cooled drive due to reduced vibration and noise



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Jacking drive system
Why use VFD for jacking?

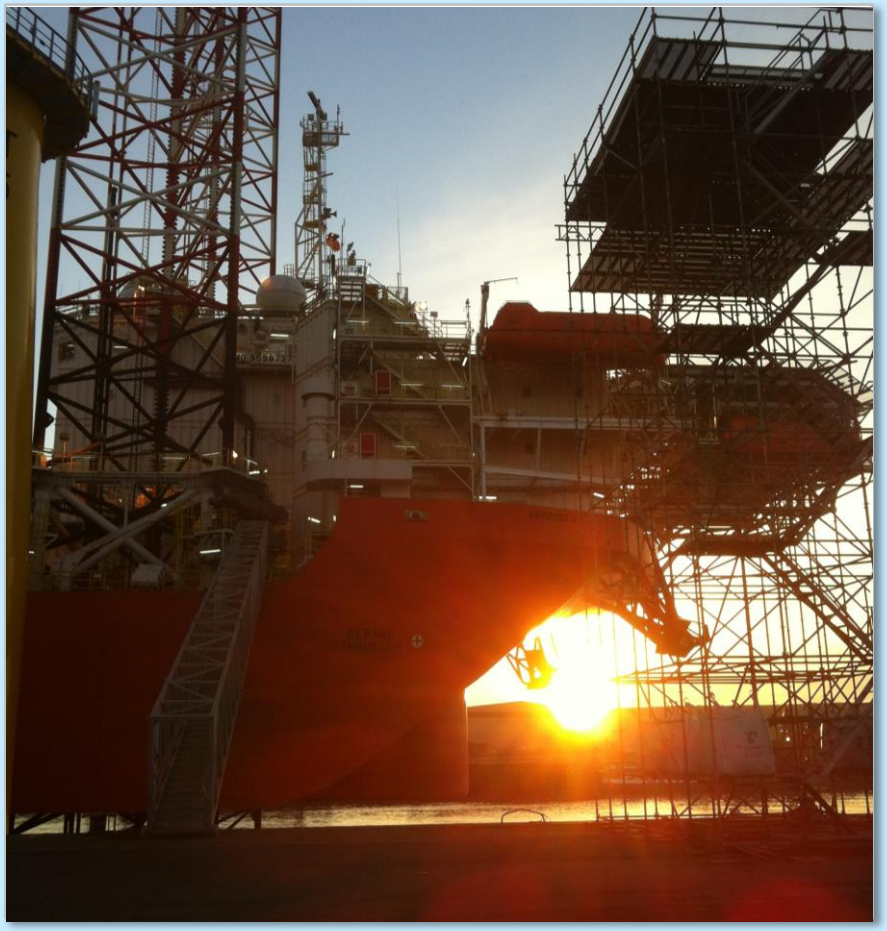
Problems to be solved with old design

Electrical jacking systems are typically powered by special high-slip motors which are DOL started.

Starting currents are very high with DOL starting

Mechanical stresses are very high during starting and stopping.

For jackup vessels with DP, the transition from DP to jacking may be dangerous due to risk of blackout when starting the jacking system



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Jacking drive system
Benefits

Features

Standard VFD motors can replace high-slip jacking motors.

Safe, controlled starting is possible with full torque and low current.

Integration with the power system and PMS means that the risk of blackout during starting is minimized.

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Jacking drive system
System setup

Power

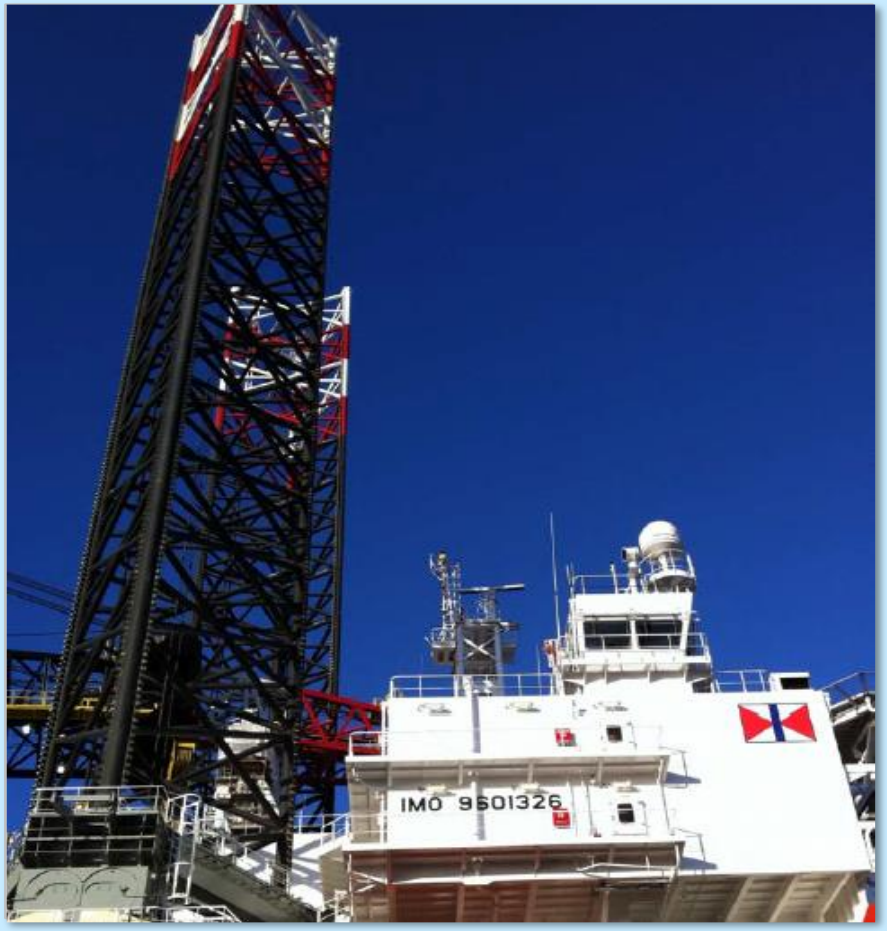
Variable speed drives in a multidrive configuration, replacing MCCs.

One inverter per jacking motor.

Inverters are arranged into multidrives by leg or by layer.

Water-cooled drives are supplied as standard for the most compact solution. Air cooled drive is also available

Braking units (chopper) and resistors are provided to dissipate energy while jacking down



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Jacking drive system
VFD setup

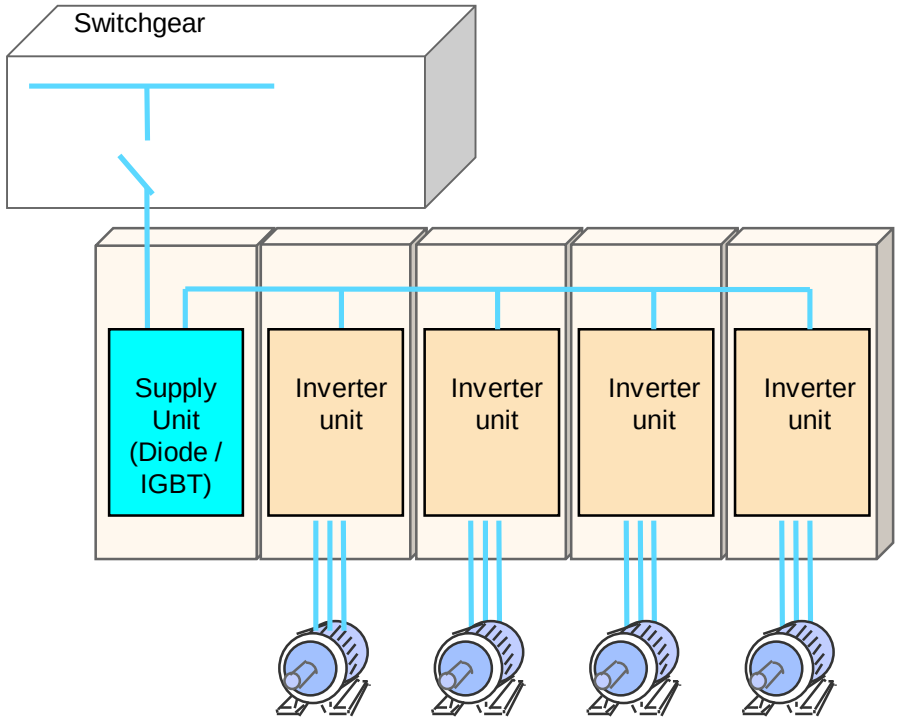
Multidrive

Common Diode supply unit for several Inverter Units

Inverters unit connected to common DC bus

One common supply from switchgear or transformer

THD <8% (for 12/24 pulse system with diode supply unit connected from phase shift transformers) or THD <5% with IGBT supply unit



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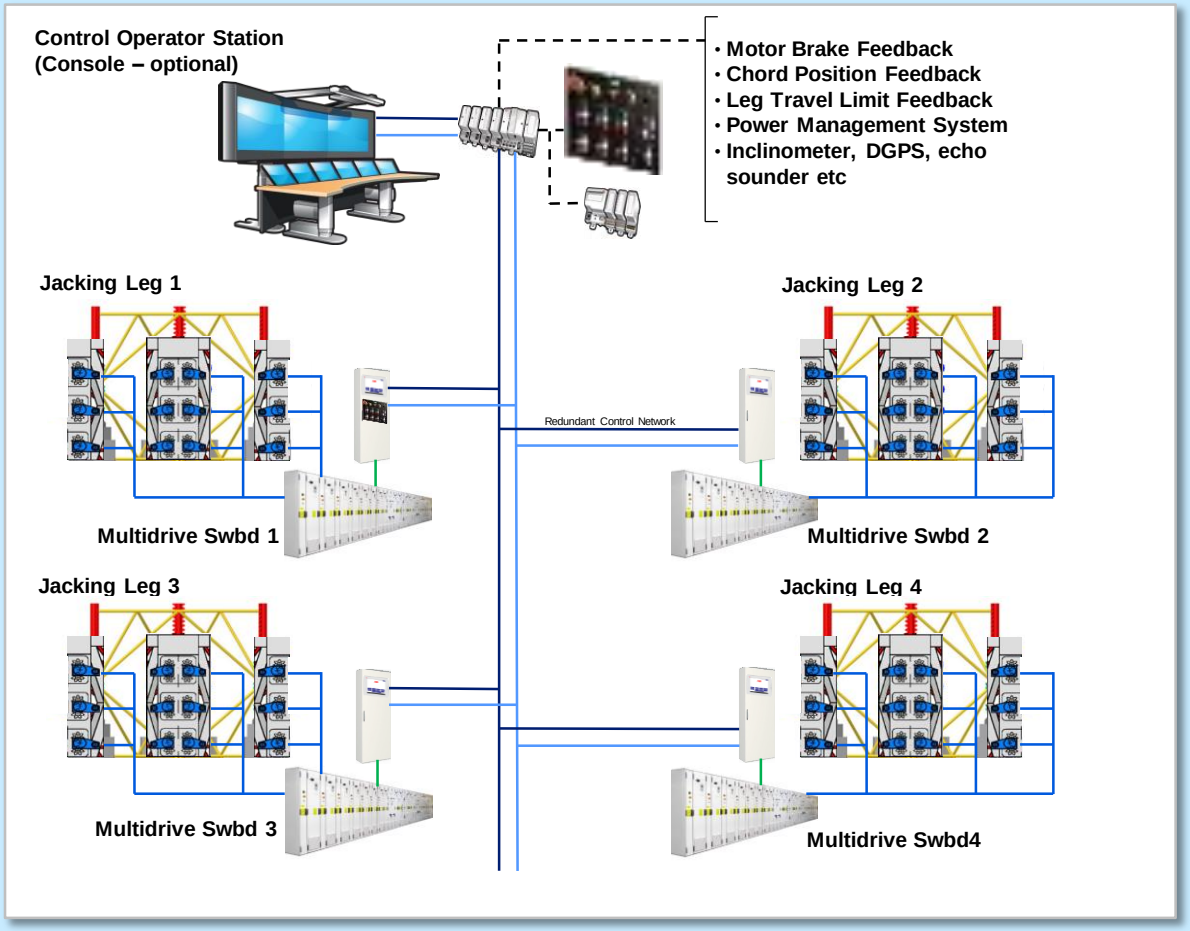
Jacking drive system
Setup and delivery scope (typical)

Delivery scope

- Jacking Motors
- Supply Transformers for Jacking Drive
- Jacking Drive System with Air or Liquid Cooled Variable Frequency Drive
- Integrated Jacking Drive Control System
- Braking Resistor
- Jacking Control Operator Station
- Supervision of installation
- Commissioning services
- Remote diagnostic system (option)



Jacking drive system
Control system

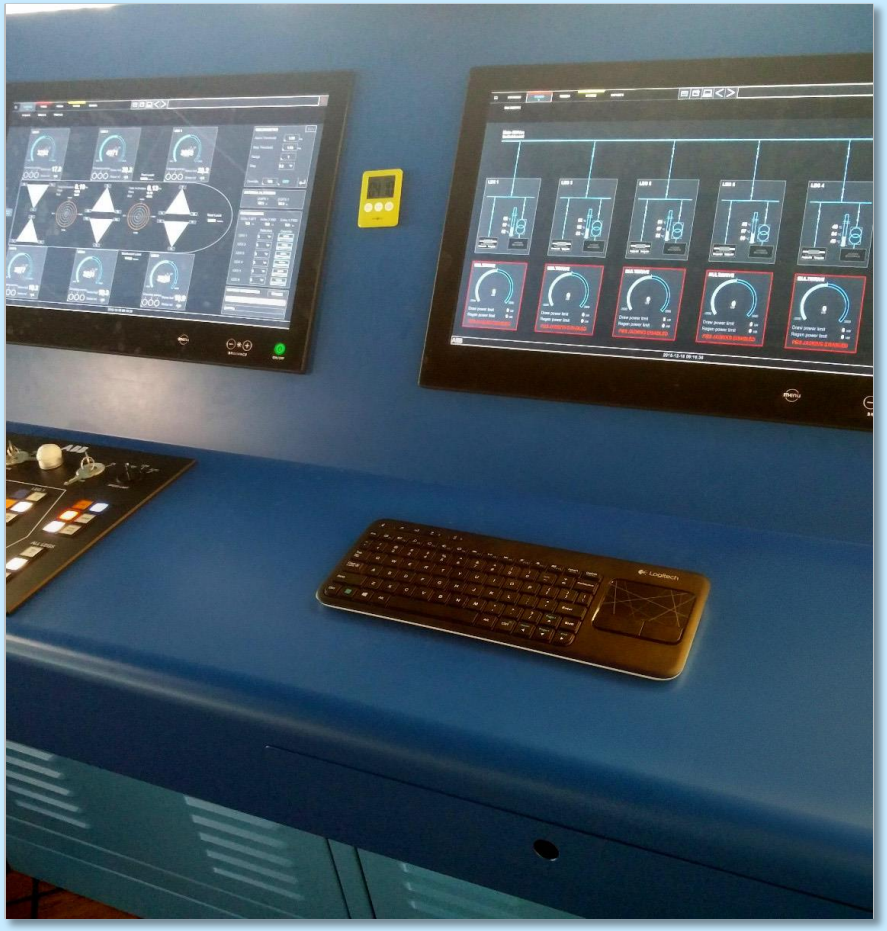
Control system setup

Control system is based on the ABB 800xA control platform, in common with other ABB marine control systems.

Redundant controllers are optional.

Redundant network is provided between control cabinets and bridge.

Local control panel and bridge remote control panel are included



Jacking drive system
Functionality

Feature

Each motor is controlled to share the load with the other motors.

Precise leg speed control and a global speed limit are used to keep the hull horizontal in cases of uneven rig loading or limited available power.

Creep speed is provided for easy rig levelling or adjustment of load distribution.

The jacking speed is automatically controlled based on the load and the available power.

Jacking control panel

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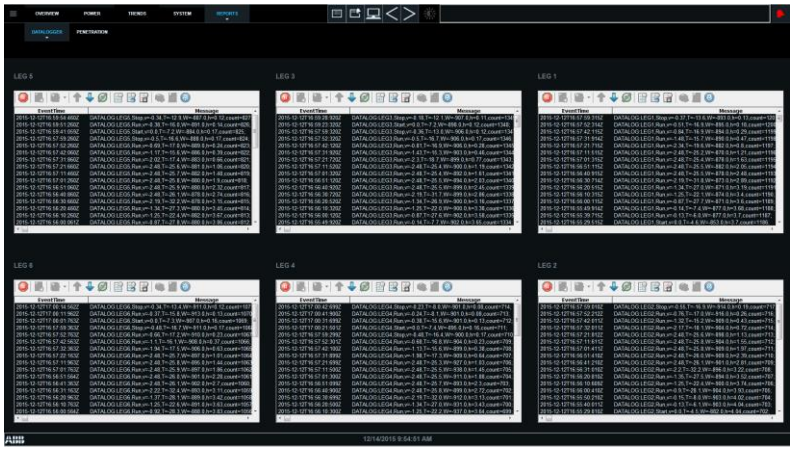
Jacking drive system
Advanced Functions

Feature

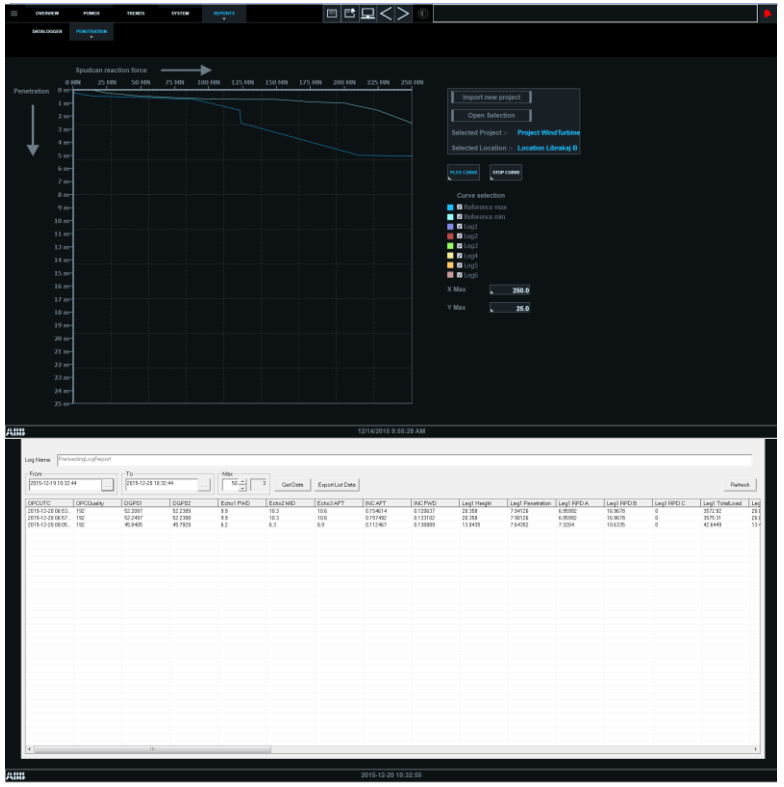
Penetration calculation and plotting

Semi-automatic preload reporting

Jacking operation data logging



Graphical Display



Jacking drive system
Case Study: Wind Turbine Installation Vessel

Control topology

One central jacking control console, with one local control panel

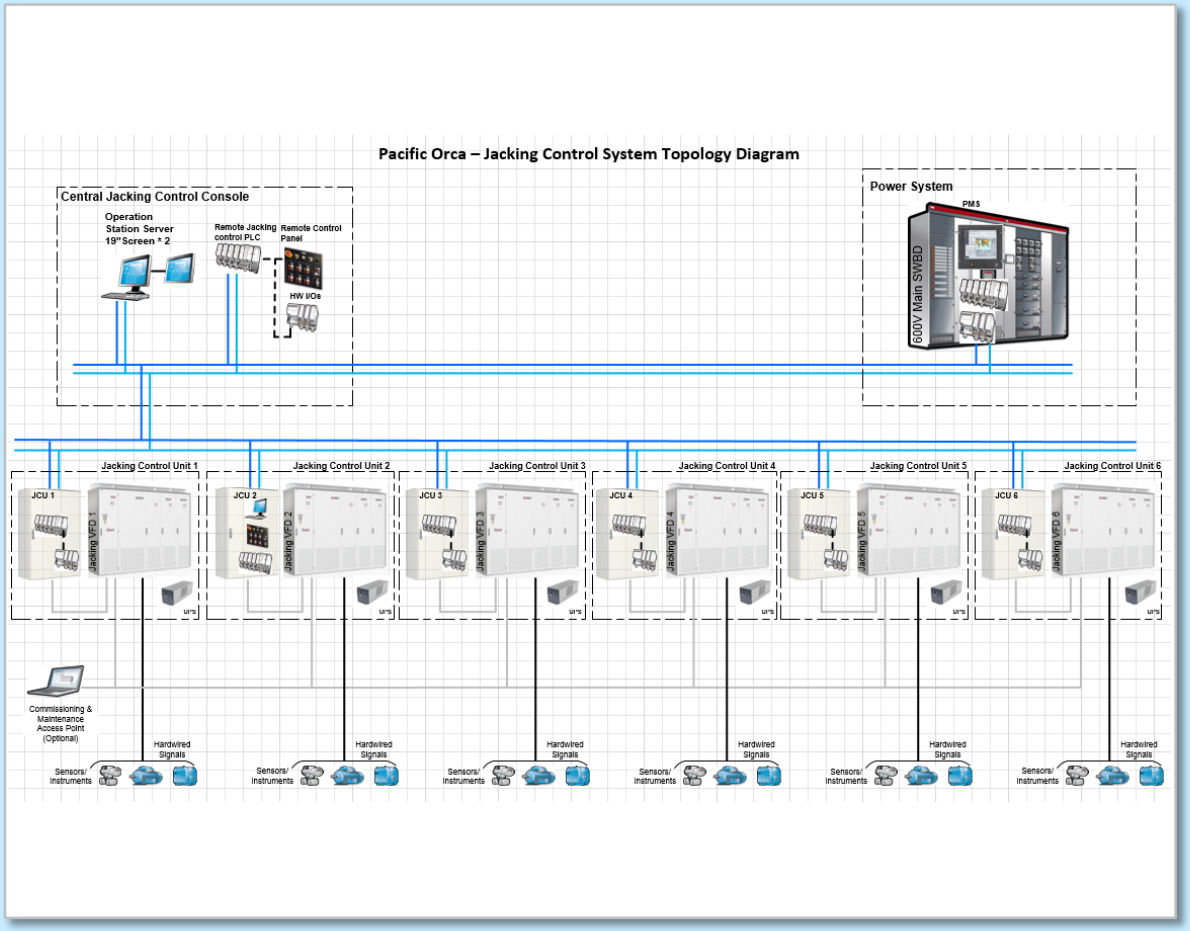
Jacking Control Unit for each leg via drive bus

Redundant control network

Ethernet communication with PMS

Interface with 3rd party equipments

Available for Remote Diagnostic System (RDS)



Jacking drive system
Case Study: Wind Turbine Installation Vessel

Single line drawing

ACS800LC regenerative multi-drive system

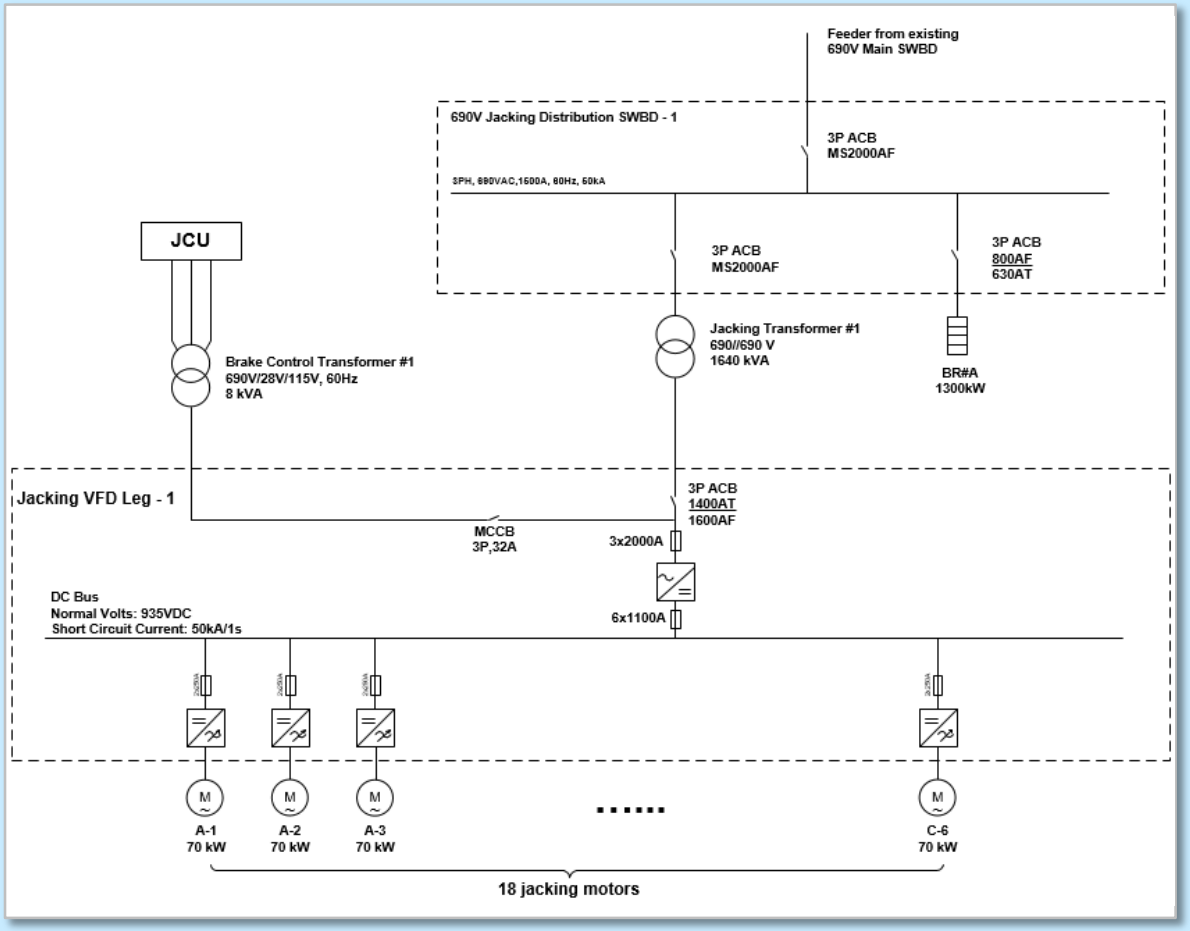
18 jacking motors per leg

Braking power regenerated to AC network or brake resistor in AC network

Brake control transformer: 690V/28V/115V 8kVA

Interfacing with VFD

- Pinion load monitoring
- Motor speed encoder
- Motor heater power
- Motor Temp. monitoring



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Jacking drive system
Case Study: Wind Turbine Installation Vessel

HMI

- Advanced intergrated HMI with ABB 800xA platform
- System status feedback
- Jacking operation from control panel
- Signal trending
- Alarm and event list
- Fault handling
- Penetration monitoring
- Preloading report
- Data logger

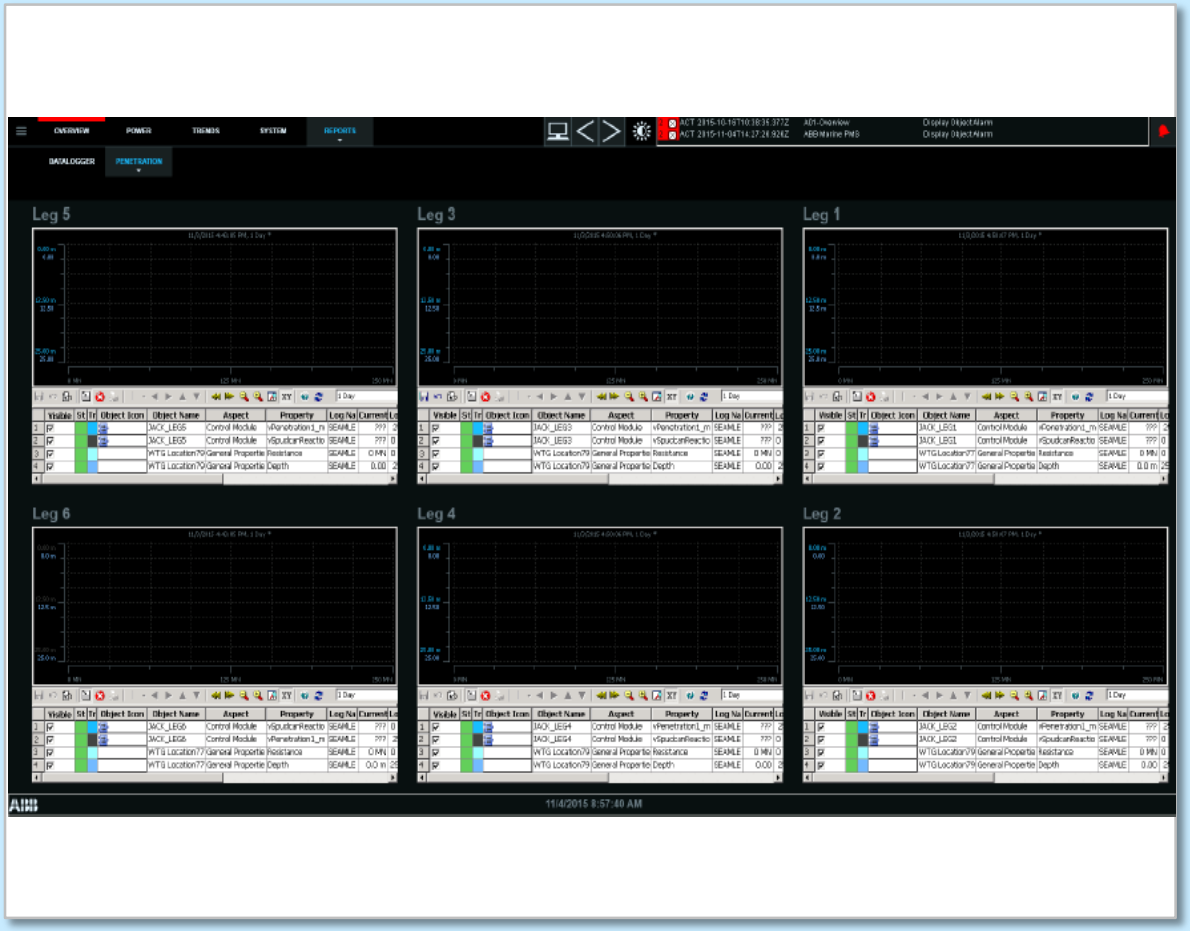
Jacking drive system
Case Study: Wind Turbine Installation Vessel

Penetration

Automatically calculates the depth of the spud can penetrate into the seabed

Calculation from DGPS and Echo-sounder

Penetration curve will be plotted once touchdown

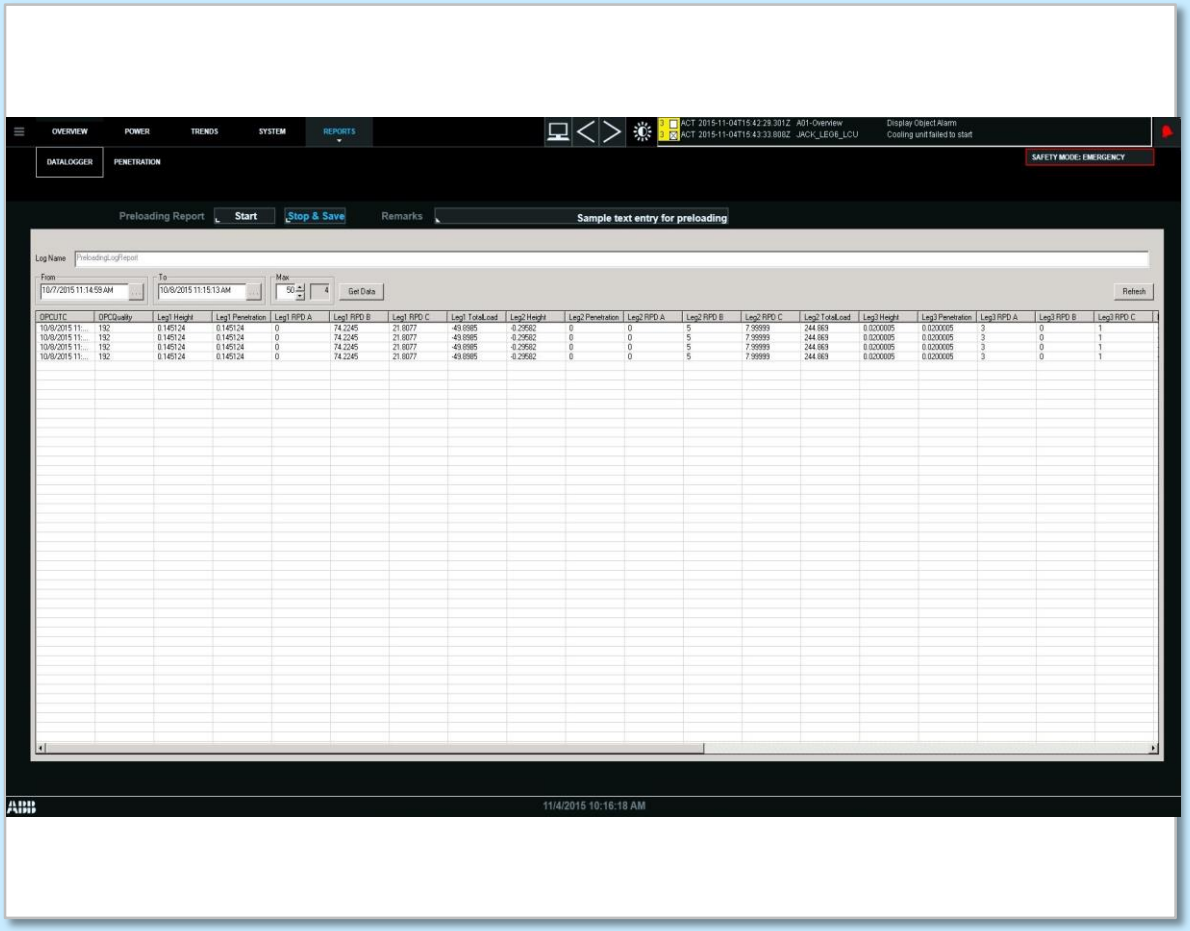


Jacking drive system
Case Study: Wind Turbine Installation Vessel

Pre-loading

Generate pre-loading report on demand by click “Start” to record a snapshot of the data including:

- Timestamp
- Leg heights
- Leg loads
- RPD values
- Inclination measurements
- DGPS antenna altitude
- Echo-sounder depth



Jacking drive system
Case Study: Wind Turbine Installation Vessel

Data Logger

Record data of jacking system performance every tenth second during all leg movements

Data is recorded as event message in the event log

Data can be used for predictions of the lifetime of the mechanical system

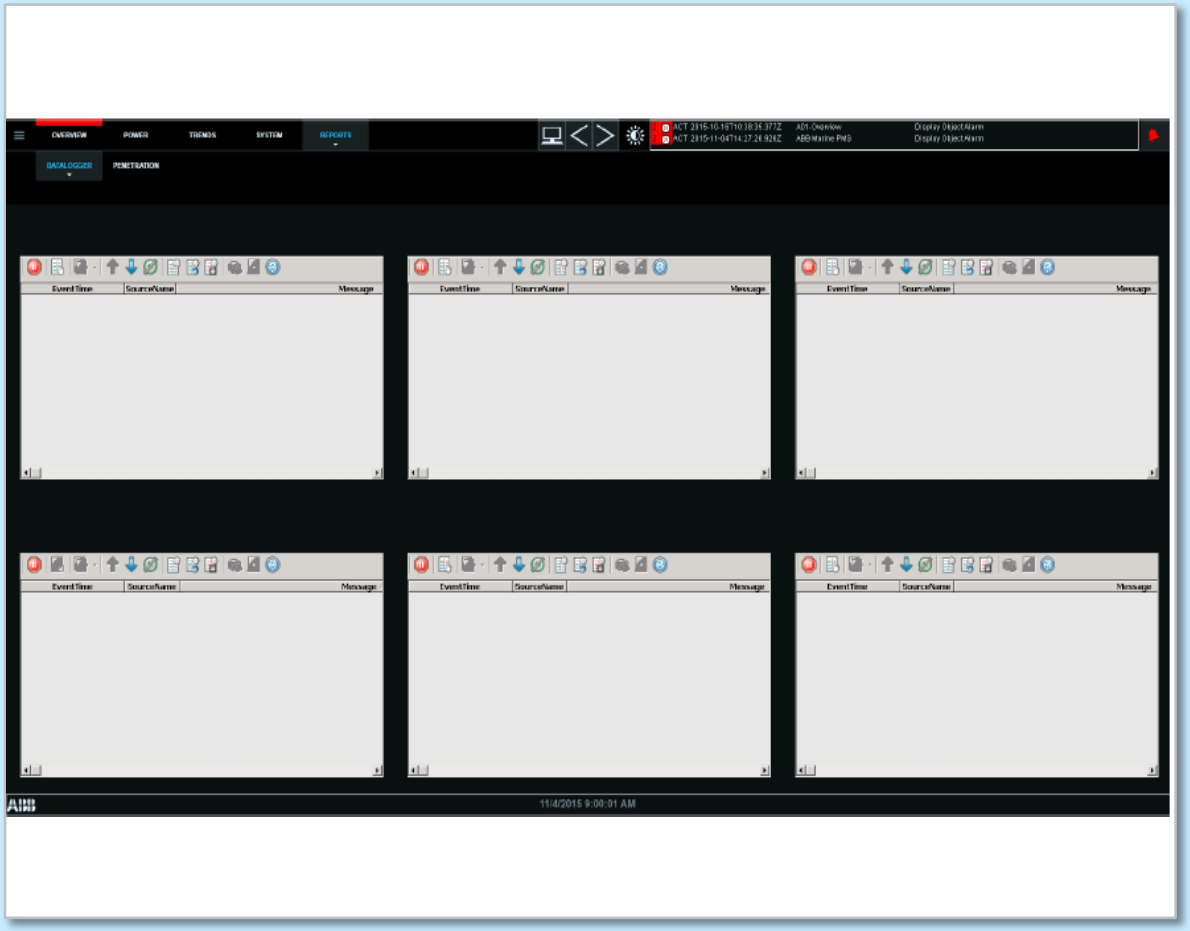


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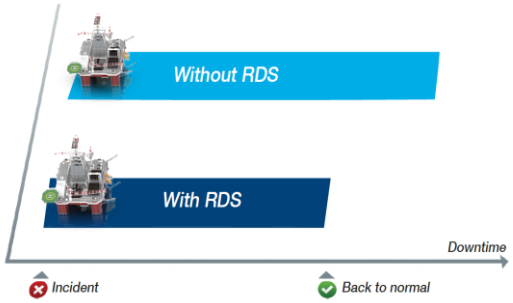
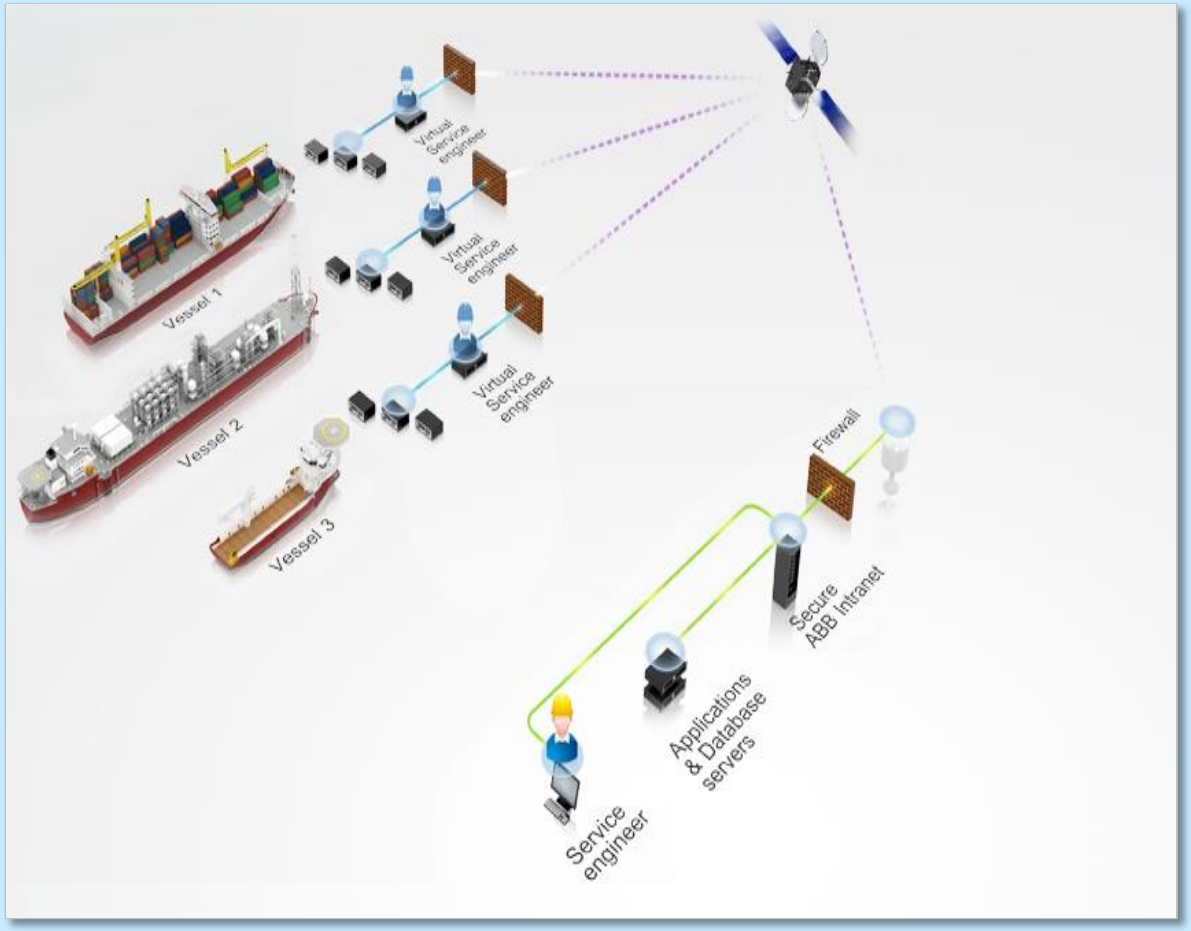
ABB Marine and Ports Services
Remote Diagnostic System (RDS)

RDS

Diagnose your drives system without the need for a service engineer travel all the way to your vessel.





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Remote Diagnostic Services
What best fits your business

Troubleshooting

Gives access to on-demand assistance in diagnosing specific events and failures

Provides assistance / guidance in taking corrective actions

Preventive

Adds periodical system audits and health checks, including recommendations for further actions

Continuous

Extends the latter two within continuous proactive condition monitoring, based on hourly system updates and the automatic transfer of events

* to be released

RDS system can be offered as an integrated part of the delivery to newbuildings or installed as a retrofit

ABB Marine and Ports
Summary – focus on important tasks

ABB Marine Integrates jacking drive system from top class components
ABB Marine takes Responsibility for the complete system package including:
- Electrical and system engineering
- Project management, Commissioning

ABB Marine takes care of the Control System Interfacing for the jacking drive system with other suppliers
ABB Marine handles installation Supervision and Commissioning
ABB Marine provides Training
ABB Marine offers widest Service support network globally located
ABB Marine supports from Integrated Operation Centre with Remote Diagnostic System access
ABB provide Experienced and Certified team to carry out engineering and project management.
ABB has Vast knowledge on Power, Drive and Automation system
ABB provide Global 24/7 hotline Technical Support

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