DYNAMIC POSITIONING CONFERENCE
October 15-16, 2013

POWER SESSION

Integrated Power and Automations System for Enhanced Performance of DP Class Drilling Vessels

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ABB
Integrated power and automations system for enhanced performance of DP class drilling vessels
Outline

Introduction

Closed bud operation
  Requirement for closed bus operation
  Advanced power system with integrated intelligence

Integrating power and automation
  IEC 61850 vertical communication
  Operational information
  Maintenance solutions
  Quality of information

Concluding Remarks
Introduction

Electric Propulsion system has always been designed for closed bus operation for best possible fuel efficiency.

Requirement for closed bus operation by owners for DP 2 and DP 3 operation. This is a matter of operational principle

Revised DP rules from class with Enhanced Systems and Reliability. Technology development for providing higher integrity against failures.

Designs capable of operating with closed transfer breakers under the most stringet rules and requirements.
## Closed bus operation
### Requirement for Closed Bus Operation

<table>
<thead>
<tr>
<th>Key Design Requirements</th>
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<tr>
<td><strong>Enhanced and robust power plant design</strong>: implemented zone protection concept with fast failure detection and discrimination of failed components or system</td>
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<td><strong>Resistance to hidden failures</strong>: protection with backup arrangement as alternative action to isolate faulty system or components, self-diagnostic.</td>
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<td><strong>Enhanced Generator Protection system</strong>: protection for over- or under-fuelling and excitation as well as load sharing</td>
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<td><strong>Autonomous systems</strong>: autonomous and decentralized thruster and generator systems to achieve segregation in order to minimize the effect of failures and dependencies</td>
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<td><strong>Blackout prevention</strong>: Fast load reduction to avoid overload due stopping of one or more generators in large consumers (mainly thruster and drilling VSDs)</td>
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<td><strong>Fast blackout recovery</strong>: with no manual interaction and full thruster control on DP within 45s (Dynpos-ER)</td>
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<td><strong>Transformer pre-magnetising</strong>: reduce large inrush current and related voltage drop (mainly thrusters and drilling supply transformer) especially with one generator out of service.</td>
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<td><strong>Fault ride through capability</strong>: for essential systems</td>
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### Key Design Requirements

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<th>Requirement</th>
<th>How they are Addressed</th>
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<tr>
<td>Enhanced and robust power plant design</td>
<td><strong>MV Switchboard</strong>; Additional and sophisticated switchboard (zone) protection scheme</td>
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<td>Resistance to hidden failures</td>
<td><strong>MV Switchboard</strong>; New protection relay with sophisticated self diagnostic functions, additional protection scheme</td>
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<tr>
<td>Enhanced Generator Protection system</td>
<td><strong>MV Switchboard</strong>; Integration of diesel generator monitoring system</td>
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<td>Autonomous systems</td>
<td><strong>Autonomous Thruster VSD</strong>; Integrated thruster auxiliary control</td>
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<tr>
<td>Blackout prevention</td>
<td><strong>Autonomous Thruster VSD, Drilling VSD, MV SwBd</strong>; Fast load reduction scheme for ‘intelligent loads’, fast interface between MV-SwBd and thruster and drilling control</td>
</tr>
<tr>
<td>Fast blackout recovery</td>
<td><strong>Autonomous Thruster VSD</strong>; Design for fast energizing, blackout auto-restart sequence incl. auxiliary control</td>
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<td>Transformer pre-magnetising</td>
<td><strong>Autonomous Thruster VSD, Drilling VSD, MV SwBd</strong>; Thruster and drilling and large distribution transformers with pre-magnetising,</td>
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<td>Fault ride through capability</td>
<td><strong>Autonomous Thruster VSD, Auxiliary System, MV SwBd</strong>; Protection and control considering the worst case fault clearance time</td>
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Closed bus operation
Advanced power system with integrated intelligence

Comparison between block based zone (primary) protection and traditional time-current selectivity (secondary).

Typical Time to Trip
Relion Zone Protection
Typical Time Current Selectivity

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<tr>
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<th>F1</th>
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<td>100ms</td>
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<td>400ms</td>
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<td>100ms</td>
<td>100ms</td>
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<td>600ms</td>
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1) Low voltage feeder breaker part of the Relion Zone Protection
Closed bus operation
Advanced power system with integrated intelligence
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Advanced power system with integrated intelligence

Examples of signal flow in case of block based zone protection.

1) -Status ‘Protection Start’

Short circuit current flow

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Closed bus operation
Advanced power system with integrated intelligence

Any single failures shall not lead to loss of position
Allows operation with closed bus/tie/transfer
 Diesel Generator Monitoring System (DGMS)

- The purpose of the DGMS is to protect the power plant against faults which are not handled well by the normal protections in the main switchboard.

- The most important such faults are **over- or under-fuelling** of diesel engines and **over- or under-excitation** of generators. These faults are not easily detected by the protection relay of the faulty generator, and can lead to disconnection of any healthy units which become overloaded or begin absorbing power in an attempt to maintain correct system frequency and voltage.

- The DGMS also implements several additional safety functions which are designed to protect the generator against governor or excitation faults on another generator, which for any reason have not been detected by the DGMS of the faulty generator.
Integrating Power and Automation
IEC 61850 and GOOSE communication

- Peer-to-peer high speed GOOSE ¹ communication between IED ² s in SwBd
- All measurement and status values can be shared between IEDs and IEC 61850 supporting control systems
- More I/O within system without hardware changes or additions
- Less wiring between IEDs and Automation
- Supervised connections with preconfigured fail-safe value in case of failure
- Data transmission time between IED’s <10ms (faster than hardwired signals)
- Industrial Ethernet communication technology with one common communication link
Integrating Power and Automation
IEC 61850 vertical communication

- Client/Server based communication, defined by IEC 61850
- Not as fast as GOOSE
- Suitable for larger amount of information
- Suitable for generic communication
- E.g measured and calculated data to the server for visualization, debugging and logging.
Seamless operation all Devices, Equipment & Systems

Topological View

System Networks

Field Networks

Power Automation

Process Electrification

Process Instrumentation

Safety

PLC & DCS

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The Power of Integration
A myriad of Objects AC800m Controller
Information that follows the asset
Unique Aspect Objects AC800m Controller

- Faceplates
- Control
- Trend
- Graphics
- Video
- Asset Health
- Reports
- Documentation
- ERP/CMMS
- ……
When an alarm sounds
800xA Alarm Management

**Operation:**
- Right-click makes alarm-related information instantly available

**Monitoring and assessment:**
- Alarm Analysis allows for continuous analysis and optimization

**Identification:**
- Alarm Analysis with alarm system KPI's

**Rationalization:**
- Hiding, Shelving and Grouping minimizes alarm list entries

**Design:**
- Automatic alarm structuring simplify alarm delegation

800xA - Dealing with large volumes of alarms and streamlining alarm handling processes
Ensures fast and correct process interaction

800xA Alarm Management

Snapshot reports

Alarm related Snapshot searches
Enables safe and effective ongoing change management

Searches/reports can be saved in excel

Improved application quality and process safety

Alarm Help

Alarm Helper (new from FP4) provides direct access to more supplementary information under separate tabs particular alarm.

Fast navigation from an alarm reveals detailed information needed to handle it correctly

Simple and safe alarm delegation

Utilizes 800xA structures with specified sections and objects
Simplifies alarm list engineering – just add on top of already-engineered structures
Operators only need monitor alarms for their ‘own’ objects
Adding a new object alarm automatically updates the alarm list
Solution Hierarchy and Decision Loops

Level 0 – 2

Operational Field Equipment
Monitoring Minutes to days

Level 3 – 4

Predictive Maintenance
Days to Months

Maintenance and Reliability management
Months to years

Local MMIX

Maintenance Workplace

Process Performance Monitoring

System Viewer

Specialised Dashboards

Technology Exams

ERP/EAM

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Use 800xA Asset Management as facilitator
Choose a reliability centered approach
Increased lifetime
Less need for storage
Safer (HSE)

Online condition monitoring makes it possible to predict condition - based on long time logging and deeper analysis.

Use 800xA Asset Management as facilitator
Choose a reliability centered approach
Increased lifetime
Less need for storage
Safer (HSE)
**Transistor protection relays**

- Trip coil
- Contact wear
- Energizing circuit
- Breaker inactive time
- Breaker travel time
- Spring charging time
- Transient disturbance recorder

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**Electro Condition Monitoring – IEC61850**

**Condition Details**

- **Condition:** Spring charging time
- **SubCondition:** [good]

**Timestamp:** Friday, September 02, 2011 9:50:06 AM

**Severity:** 250

**Description:** Spring charging time has crossed the set value.

**Possible Cause:** The spring charging motor or CB springs are not working properly.

**Suggested Action:**
1. Check that spring charge motor supply is on and that voltage level is within the given limits. (With low voltage the motor torque will not be sufficient)
2. Check that the spring charge motor is operating.
3. If motor is operating check that aux contacts is working correct.
4. If motor is not operating change motor.
5. If spring charge function still gives alarm contact an ABB service centre. Then the CB open/close spring may be damaged.

**Corrective Action Taken:**
Contactless IR temperature monitoring of contact points and conductor rails on MV-level

Reporting to Maintenance Workplace by Asset Monitor
DriveMonitor™ diagnostic system:

- Early detection of potential failure
- Alerts including possible cause and recommendations for corrective actions through Maintenance Workplace
- Remote access allows support from external expert
- Predefined diagnostic logging functions, processing and reporting
- Monitoring of drive’s performance, and, if required, other shaft line components (main circuit breaker, transformer, motor)
Goliat FPSO - Condition Monitoring System

- Asset Management System (AMS)
- Condition Monitoring of Rotating Equipment
  - Turbines
  - Compressors and diesel driven generators
  - Vibration and Performance Monitoring System
- Valve Monitoring
- Smart Instrument Monitoring
- Condition Monitoring for Static Equipment
- Metering System Monitoring
- Electrical Monitoring
  - Monitoring of the sea cable
  - UPS Monitoring
  - Dry transformers
  - Oil Filled Transformers
  - Circuit breaker monitoring
  - Heat Tracing
  - Low Voltage Switchboards
  - High Voltage Monitoring
  - Variable Speed Drive Monitoring
- HVAC Monitoring
- Fire and Gas Detectors Monitoring
- Sub Sea Monitoring
- Marine Monitoring
  - Monitoring of the hull structure
  - Offloading Station
  - Anchor Winches
  - Offshore Cranes
- Analyzers Monitoring
- Telecommunication Surveillance and Monitoring Systems
- PC, Network and Software Monitoring
- Performance Monitoring
- Rotating equipment performance monitoring
- Loop Performance Monitoring
Concluding Remarks

- Market driven requirements for closed bus operation in DP2 and DP 3.
- New class rules for allowing closed bus operation in DP 2 and DP 3
- New technologies as IEC 61850 communication standard brought into marine power systems
  - Designs capable of operating with closed transfer breakers under the most stringent rules and requirements.
- Opens almost unlimited possibilities for acquiring and processing data from various sub systems.
  - Smart integration with high level, integrated automation systems we create an overview of all assets condition.