Subsea Power Transfer

- What is the challenge

By Svend Rocke, ABB offshore Systems as SPE 110203 Page 1
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  - Trends, offsets and power need.

- Electric Power Distribution
  - Onshore to Subsea, how
  - Electric power system.
  - Critical components

- Main Challenge
Subsea Electrical Power Consumers

- **Trends**
  - 2003-2007
    - Single and multiple consumers at short offsets (10 km)
  - 2005-2020
    - Single and multiple consumers at long offsets (10 to >100 km)

- **Power Range**
  - 10 kVA to >100 MVA systems
    - Pumps 1-2,5 MW
    - Compressors 10-20 MW
    - Pipeline heating 0,1-1,5MW
    - Subsea Control 20-50 kW
    - Coalescers 10-20 kVA
Subsea Electrical Power Consumers

- **Power and stepout range**
  - Single consumer at short distances to large distribution systems with many consumer at different locations all at long offset from power generation.
  - Power requirement each function 10 kVA to 20 MVA
  - System power requirement 10 MVA to 70 MVA
  - Offset distances from <500m to 170 km

- Today's technology capable of supplying
  - 20-30 MVA up to 40-50 km
  - 10-20 MVA up to 150 km

- Future requirements can be met by increased voltages for AC transmission and utilisation of DC transmission.

Based on 36kV transmission.
Electric Power Distribution

- Onshore to Subsea, how?

- Overhead lines
- Open connections
- Open termination
- Large size
- Air isolated

Not applicable solutions for Subsea
Electric Power Distribution

- Onshore to Subsea, Electric distribution system.

**Onshore**
- Ring system.
- fault easy to isolate,
- High flexibility, easy to repair
- High reliability.

**Subsea**
- Point to point connection
- No alternative routing.

**Reliability** based on:
- System design and solution
- Component reliability
- Reparability
Electric Power Distribution

Critical components

- From open air cooled container design to compact closed design with heat convection to seawater.
- From “open winding” transformers to oil filled, pressure compensated transformers.
- From air isolation to solid insulation.
Electric Power Distribution

- Critical components

From “open air” termination to solid insulation
Clean environment and differential pressure.

CONNECTORS

MECON

- ABB own development for 12 – 24-36 kV
- Metal seal, controlled isolation medium
- Critical component needed, hence own dev.
- Appreciate and encourage other development programs.
Electric Power Distribution Main Challenges

RELIABILITY

- Reliability of each component
  - Components built, tested and qualified

- System design meeting the electrical requirements
  - Electric system design with alternative/backup solutions

- Subsea operational conditions/requirements.
  - Easy retrievability and reparability
Additional information presented verbally

Subsea Power Transfer
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Electric Power Distribution Main Challenges

- **System Design**
  - The subsea electrical power distribution system differ from a topside system by being a point to point system with limited routing alternatives.
  - The number of components shall be kept to a minimum, without loosing required flexibility.
  - There are limitations in available components, thus the electrical designer has to find the optimal solution based on available components.
  - Detailed electrical calculation and simulations are mandatory to ensure operation/transmission of the high voltage distribution network under all load conditions. (Full load, No load, rapid change in load, short circuits)
Electric Power Distribution Main Challenges

- The development, design, testing, qualification and manufacture of Connectors and Penetrators is a multidiscipline, challenging task.

- It is mandatory to have an advanced electro technical technology basis, familiar with necessary calculation and simulation tools, material technology and understanding of sealing mechanisms.

- To design connectors and penetrators easy to be assembled, installed and retrieved, is required to have a good understanding of, and experience with, subsea operations.
Electric Power Distribution Main Challenges

- Connectors and Penetrators are the most critical components in a Subsea Power Distribution System

- Critical functions & technologies
  - Water sealing of electric cable and conductors
  - Water blocking of water penetration from cable/conductor
  - Water blocking of ingress into connector/penetrator internals
  - Pressure compensation cable side
  - High differential pressure barrier in some applications.
  - Electric isolation for high voltages. (dielectric strength, IR, pd)
  - Electric current capacity. Low loss (ΔR)
  - Thermal capacity, electrical and mechanical
  - Long time stability, design life >30 years
  - Easy to assemble, install and retrieve