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Power System calculations and simulations

Power System calculations and simulations are an essential part of electrical power system design. Calculations and simulations are performed to verify that the electrical network design, including the network components, is specified with, or has, the required “performance data” and is protected against potential electrical failures.

International standards (Offshore facility regulations IEC, IEEE, DnV, ABS standards and more) are used as basis for “solid” system designs. They include requirements and recommendations for personnel and equipment protection, system response and equipment performance. Together with electrical component ratings, the regulations and standards form the basis for evaluation of calculations and simulations results.

Calculation tools include several computer software packages for power system analyses. Calculations and simulations using phasors and/or instantaneous quantities are used for electrical system analyses. Instantaneous quantities are typically used when higher accuracy is essential and results with “high sampling rate” is required.

Simulation models are built based on electrical equipment rating and performance data together with the overall system design. Simulations are performed throughout all project phases: From early concept, through as-built and during operation. The network model and the simulation results detail and accuracy level increases towards the as-built and operation phase. For many installations the model results/responses are validated against measurements of electrical system performance during operation. An as-built and validated electrical network model is a significant benefit for decision making during operation and for feasibility verification of future modification projects.

Network simulations typically include:

Load flow analysis. Calculation of equipment loading and stationary voltage variations at low and high load operation scenarios.

Short circuit analysis. Calculation of minimum and maximum prospective short circuit currents. Results are used for verification and specification of equipment thermal and mechanical withstand capabilities, and breakers’ breaking and making capabilities. Short circuit analyses are also essential for selection of the optimal over load and over current protections as well as relay protection settings for selectivity.

Protective device coordination studies. Protection of personnel, electrical systems and electrical equipment from electrical fault situations. The objective of a protection scheme is to keep the power system stable by isolating only the faulted components as fast as possible, while leaving the healthy part of the network still in operation. Thus, protection schemes must apply a worst case approach to clearing system faults. Protective device coordination covers both system protection and equipment protection.

Harmonic Analysis. Calculation of power quality, single and total harmonic distortion. Harmonics can cause problems such as degradation of conductors and insulating material in motors and transformers due to additional heating. Electro Magnetic Interference may also become a problem. Non-linear loads with distorted current and voltage wave forms cause harmonics.

Dynamic Analysis investigate the transient behaviour during and after disturbances. Typical studies include starting of large motors, short circuit faults with maximum clearance time, application and rejection of large loads, and energizing of transformers and long cables.

Earthing Studies. Earthing systems are critical to power systems. Protective devices rely on efficient earthing to operate correctly and reliably. Earthing studies include establishment of impedance diagrams, calculation of touch voltages, step voltages and potential differences.

Switching overvoltages and insulation coordination. Calculation of switching transients to identify and quantify transient over voltages that can occur as a result of switching events. The resulting switching over voltages may be part of an “Insulation Coordination Study”, resulting in required equipment insulation ratings (e.g. LIW/BIL) as well as proposal of suitable voltage suppression equipment, if necessary.

Contact us for more information and to discuss how we can serve your needs.

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Selected project references

Year: 2014
Customer: Wood Group Mustang

Ivar Aasen Electrical Studies
Electrical studies to investigate and predict the performance of the Ivar Aasen Platform's Electrical Power distribution System by conducting several electrical studies including: Switching overvoltage study (PSCAD), electromagnetic field assessment Study (FLUX 2D), resonance Study (Paladin DesignBase), electromagnetic compatibility (EMC) studies, electrical system technical review (ELHAZ), and transformer energizing studies (PSCAD).

Year: 2011-2013
Customer: TOTAL

Martin Linge Field Development

Basic Engineering of electrical transmission system from mainland to platform intake station, compensation system and distribution to 11 kV systems. Provide the required electrical power system calculations in liaison with selected vendors and simulations for development of the platform systems with power from shore, including cable design, size and weight estimate and compensation solutions.

Year: 2012-2013
Customer: GE Oil & Gas

Shell Ormen Lange LSPS Phase 4 Study

Verification of the detailed Ormen Lange LSPS design. Adapt recommendations from the completed study work and aim to include a vendor specific model of the onshore SVC compensation unit. Also including a high frequency model for the subsea power cable.

Year: 2011-2012
Customer: SMOE Singapore

Ekofisk 2/4 L Platform

Complete electrical power system studies and setting of protective relays related to detail design of the platform.

Year: 2010
Customer: Aker Solutions

Gjøa Semi Sub. Platform—System Studies

All electrical power system studies related to electrification of Gjøa with power from shore (Mongstad). HVAC transmission .

Year: 2011-2012
Customer: ABB

Høg Jæren Windpark

Electrical system studies related to grid interface of 28 wind turbines.

Year: 2012
Customer: Aker Solutions/ Statoil

Åsgard Sub-sea compression

Detailed electrical studies related to UPS control power distribution.

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