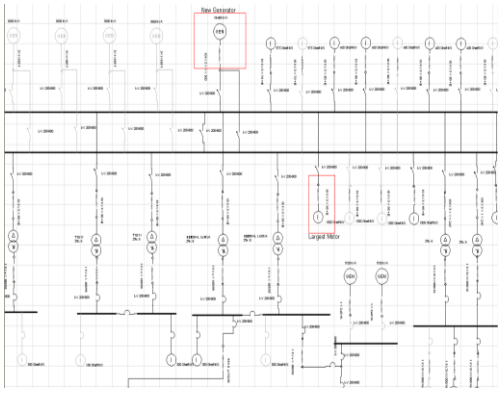
Electrification

Techno-economical risk management of onshore power connections

As a consequence of the increased focus on reducing carbon emissions to the environment, more and more offshore oil and gas installations are now being electrified with power supplied from the onshore power system. Many oil and gas installations are located from 10-100 km from shore. This creates a major challenge concerning design of reliable and cost efficient land based power supply systems.

A large portion of the challenge lies in calculating the impact the new load has on the existing power system, as the grids are often not designed for handling large and sudden load increases in a single load point.

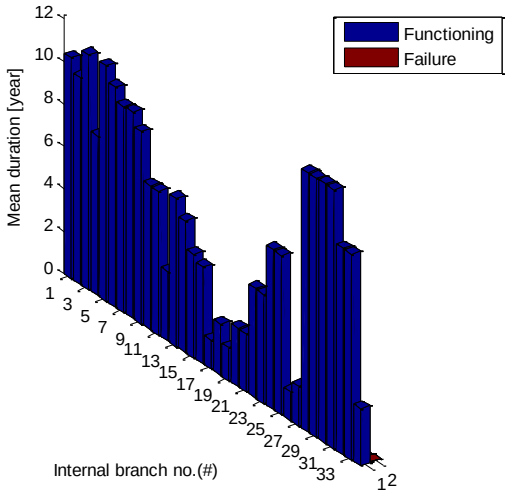


Power system calculations

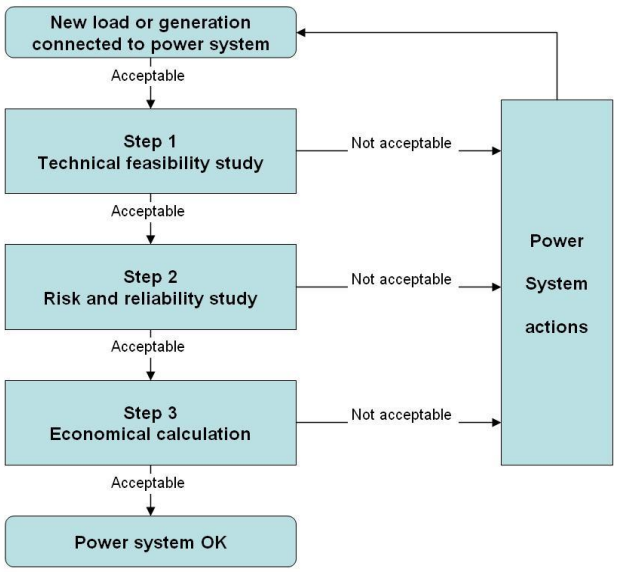
Electrification

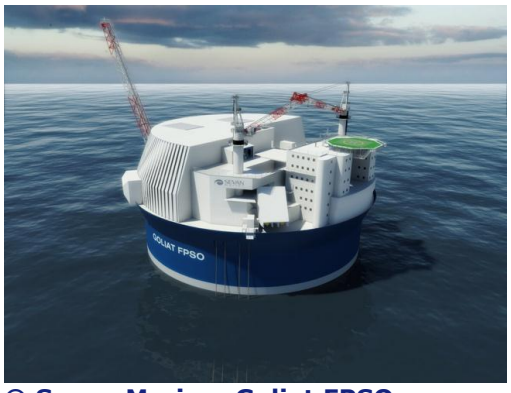
Goodtech has developed an electrification specific process using the simulation software PROMAPS and DIgSILENT PowerFactory which combined covers technical feasibility, regularity of the onshore connection, and economical consequence analysis. All large offshore projects can be evaluated regarding the onshore connection for electrical power supply.

- Evaluate different concepts and verify that the selected voltage level and cable size are optimal
- Propose complete and feasible solution which can be served from the national grid and facilitate transmission of the necessary electrical power at a suitable voltage level
- Evaluate the security/reliability for the offshore connection
- Evaluate and quantify the regularity impact the new load has on the on shore regional power system
- Identify critical elements where qualification or further studies and verifications are necessary
- Define functional requirements and cost estimates
- Propose a schedule for realization of the concepts



Visualization of probability





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Electrification process

The methodology is designed to evaluate the offshore power system as well as the effects that an increased load will have on the onshore power system. The process also includes interaction with grid owner and licensing with the Norwegian Water Resources and Energy Directorate.

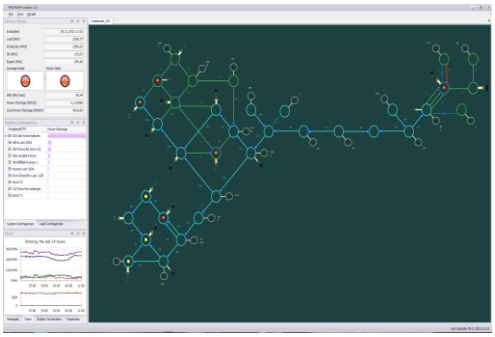
Furthermore, these extensions of the grids are usually only evaluated from an electrical point of view, not from a total system regularity point of view. In Norway we have seen an example on this and, in consequence, a large part of the system in the middle of Norway has experienced a decrease in power system regularity. This decrease on regularity resulted as a consequence of connecting a large offshore oil and gas installation to the onshore power system.

When analyzing complex meshed power systems all influencing factors have to be included to achieve satisfactory results. Very often too many simplifications are made to fit the analysis into a manageable size suitable for available theoretical models and analysis programs. This can result in reliability results that do not give a real picture of the actual system reliability, and create a false understanding of the impact that the grid extension has on the total power system.

Identification of the various power system functioning levels is crucial for the analysis. To achieve this, it is important to bring into the simulation model all influencing factors. Actual factors are: component reliability including all primary and secondary equipment, branch reliability, system reliability, load flow, production, spinning reserve, power demand, load priority and system protection. Furthermore, the analysis must comprise a large enough part of the connected existing power system. In addition it is also important to understand how the power system is operated by the area Transmission System Operator.

By using our recently developed mathematical method based on segmented Markov models built together of unit models, we are able to simulate large complex systems without affecting the degree of details. As a result of the model segmentation a new world of possibilities arises to build and analyze large complex models and still maintain the original level of details. Our method is realized in the simulation tool PROMAPS.

Photo: Source: Scandoil



PROMAPS presentation of grid

Benefits of Goodtech's electrification process

- PROMAPS simulation software for risk and reliability calculation in large meshed power systems
- Brings both theoretical and practical knowledge to the project
- Personnel with offshore and offshore power system experience
- Improved risk management support
- Results in techno-economical terms
- Comparison of technical solutions, risk and outage costs

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