



INNOVATIVE SOLUTIONS FOR EXCEPTIONAL SYSTEM PLANNING TASKS

Special **power** **supply** systems

At a glance

Special requirements, such as isolated networks, or unique ambient conditions require custom planning and design of a power system. Siemens Power Technologies International (Siemens PTI) has long-term experience in developing individual solutions for power systems of any kind, including

- state-of-the-art technologies, with solutions for advanced planning analyses,
- high-end software tools from the PSS® product suite to design your network for safe, reliable operation,
- support to determine possible weak points and to define necessary mitigation measures.

The challenge

Special power supply systems are occasionally required for unique electricity end-user needs. Among these are

- offshore installations in the oil and gas industry,
- converter-fed underwater pumping stations,
- networks for ships or mobile manufacturing plants,
- underwater DC systems,
- underwater systems for power evacuation in wind farms,
- supply of offshore installations from ashore and/or among one another,
- special isolated networks such as LNG systems or mines.

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Our solution

All these special requirements and systems call for different planning analyses to ensure safe and reliable operation of the specialized power supply system, despite the many components and aspects involved. Using comprehensive know-how and long-term experience, Siemens PTI offers solutions for power supply systems of any kind.



Figure 1: Container vessel

Application example – container vessel

An example of a special electricity system is a container vessel with a generation/distribution system with waste heat recovery. This modern generation system enables clean, economic power generation from the exhaust gas on board of a vessel. The energy surplus, available from the exhaust gas flow, in addition to the demand of the turbocharger, is utilized to drive the turbo generator. This generation concept is shown in Figure 2.

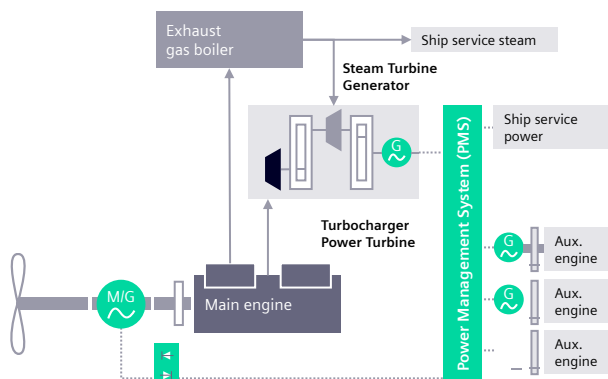


Figure 2: Generation concept for a container vessel

The generation system consists of a steam turbine generator, which uses the exhaust gas of the exhaust boiler, and three additional diesel generators which are operated depending on the ship's operational mode.

In harbor mode, an adequate number of diesels will be running depending on the load situation. In maneuver mode, the shaft generator/motor will not be in operation. Above a minimum speed of the main engine, the exhaust boiler produces enough steam to drive and synchronize the steam generator to the busbar. The production of waste heat is not sufficient for utilizing the full rating of the steam generator in cruise mode.

Thrusters are used for maneuvering in and out of the port. Standby power for start and full-load use of thrusters will be fed in depending on the maneuvering situation. In sea mode, the steam generator produces the maximum possible power. As required, the shaft generator/motor will serve as primary motor by supporting the steam engine with excess energy or producing additional energy as a generator.

The shaft generator/motor mode can be selected by the operator.

During the thermal run up, the main engine is supported by the shaft motor. In case of energy surplus, the shaft motor load is reduced. In case of energy shortage, the shaft motor switches to generator mode. If the demand in power cannot be supplied by the main engine and shaft generator, a diesel will be started. Only if all diesels are in operation and the required energy is supplied, the power of the shaft motor is reduced.

To control and coordinate all modes and power interconnection, a power management system (PMS) is necessary to automatically coordinate the operation and startup of diesels and the mode change of the shaft generator/motor. The coordination and rules for the PMS are designed and tuned by simulation of the whole generation/distribution system given generation and load situations.

In all operation modes, the reliability of the system is critical. Outages of generator units, outages of the shaft generator/motor and fault situations have to be managed in such a way that generation is not interrupted. The PMS coordinates the pre-fault situations with suitable reserve, and in addition, uses a load shedding system as backup reserve.

Application example: Underwater pumping station

In a number of oil fields, with distances up to 50 km of the platform, underwater pumps need to be installed to keep up the pressure and to evacuate the oil. Using the simulation tool PSS[®]NETOMAC, the complete design of such a system is modeled and simulations support the analysis and optimization. Standard components are used or optimized (standard indirect voltage converter, standard cable operated at 62% of the rated voltage due to harmonics, standard pump-transformer). The converter transformer is designed for frequencies ranging from about 0 Hz to 100 Hz. Control is optimized for all frequencies in steps of 10 Hz to minimize the harmonic stresses on the motor and for the system to function without a communication link to the motor.

The result is a robust system with minimal cost and a minimum number of devices (no additional filtering or controlling devices).

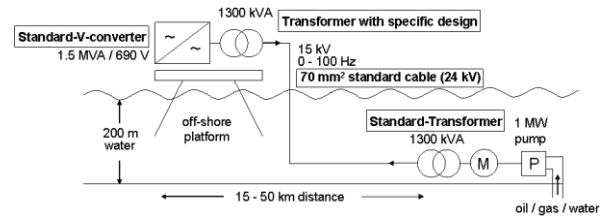


Figure 3: Configuration of a multi-phase underwater booster station

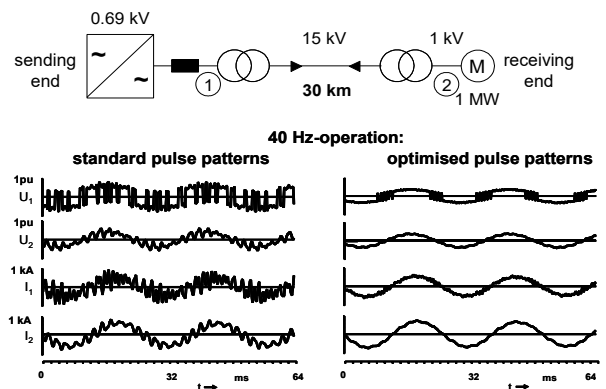


Figure 4: Electrical circuit and voltage and current at the sending end (U_1 , I_1) and receiving end (U_2 , I_2) of the converter configuration with and without optimized pulse patterns

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