Integrated Performance Simulations

of Ships' onboard systems

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Content

- Introduction
- System design philosophy
- Examples

Introduction

General Energy Systems (GES) simulation technology

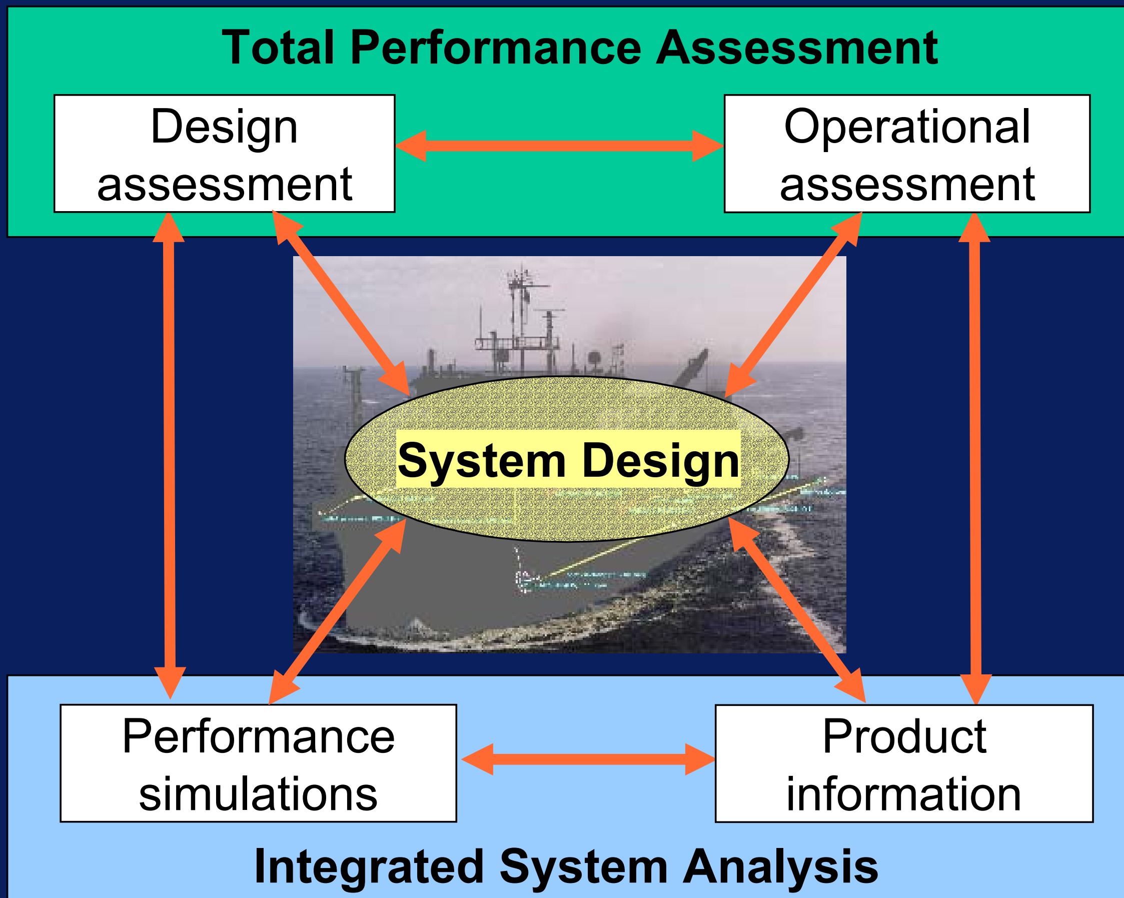
Developed by TNO
primarily for the Royal Netherlands Navy (RNLN)

Approach:

- Key focus: Total Ship System performance
- Concept variations and global assessment
- Technical & Economical results
- Component specifications, Rule-based, First-principle and Dynamics simulations

System Design Philosophy

For ships' onboard systems



Examples

- Operational profile analysis (Crane Vessel)
- First principle concept analysis (pump model, Dredger)
- Voltage design Guide

Operational profile analysis

Example: Semi submersible construction vessel (SSCV) Thialf

1. System design

2. Operational profile

3. Performance analysis

Operational profile analysis

Example: Semi submersible construction vessel (SSCV) Thialf

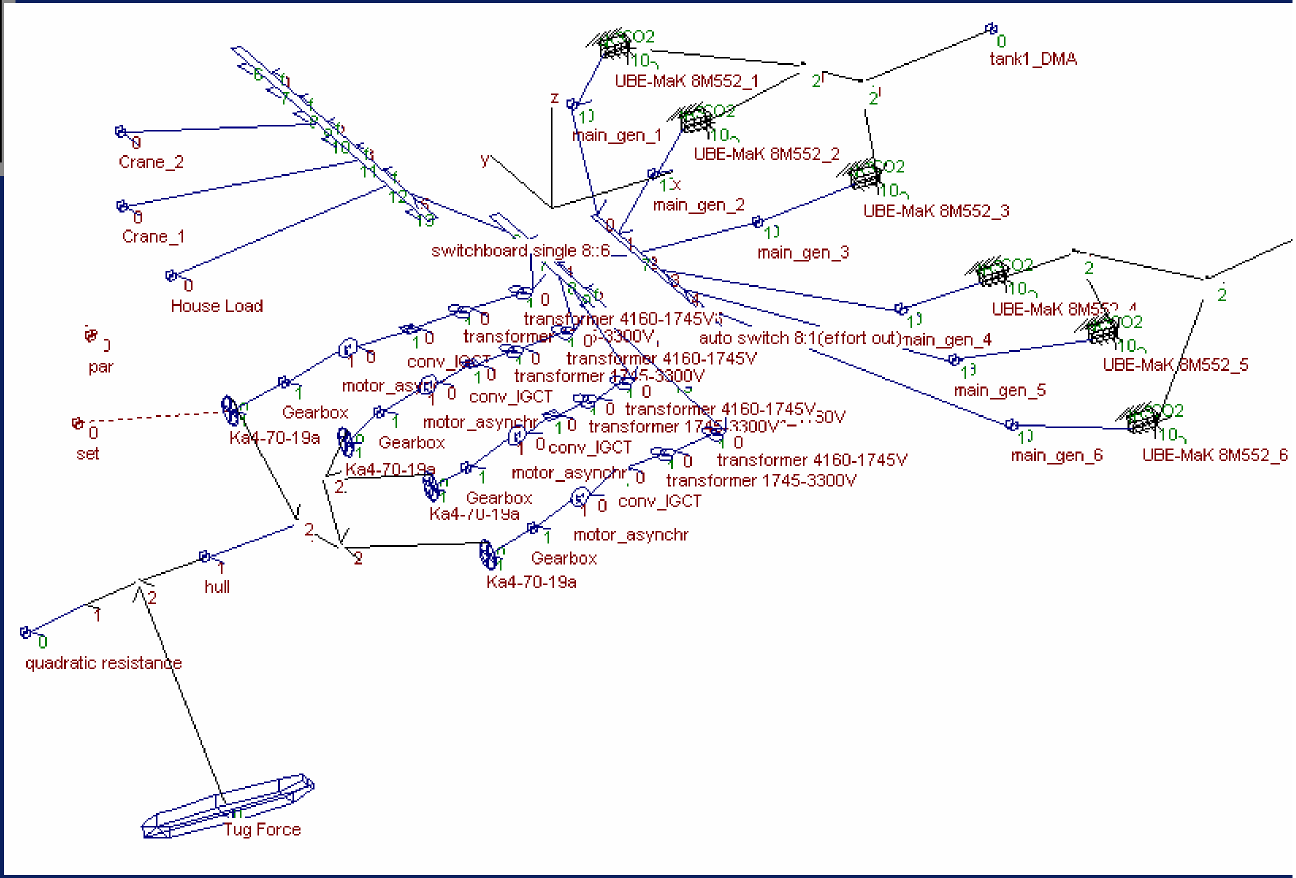
1. System design
2. Operational profile
3. Performance analysis

- 6 MaK diesel generator sets (4600 kW, 4160 V)
- 6 thrusters (Ka 4-70-19A)
  4 used in transit, 6 used in dynamic positioning (DP) operation
- use of one or two tugs during transit
- thrusters are driven by asynchronous motor (3300 V)
- speed asynchr. motor regulated by converter (1745 V)
- load of two deck cranes (5200 kW each)
- house load of 4000 kW, permanent

Operational profile analysis

Example: Semi submersible construction vessel (SSCV) Thialf

1. **System design**
2. Operational profile
3. Performance analysis



Operational profile analysis

Example: Semi submersible construction vessel (SSCV) Thialf

1. System design
2. **Operational profile**
3. Performance analysis

- transit 2.0 knots with 10 ton tug (nice wheater)
- transit 4.0 knots (nice wheater)
- transit 4.0 knots with 10 ton tug (nice wheater)
- transit 6.0 knots (nice wheater)
- transit 6.0 knots with 10 ton tug (nice wheater)
- transit 7.0 knots (nice wheater)
- transit 2.0 knots (nice wheater)
- transit 7.0 knots with 10 ton tug (nice wheater)

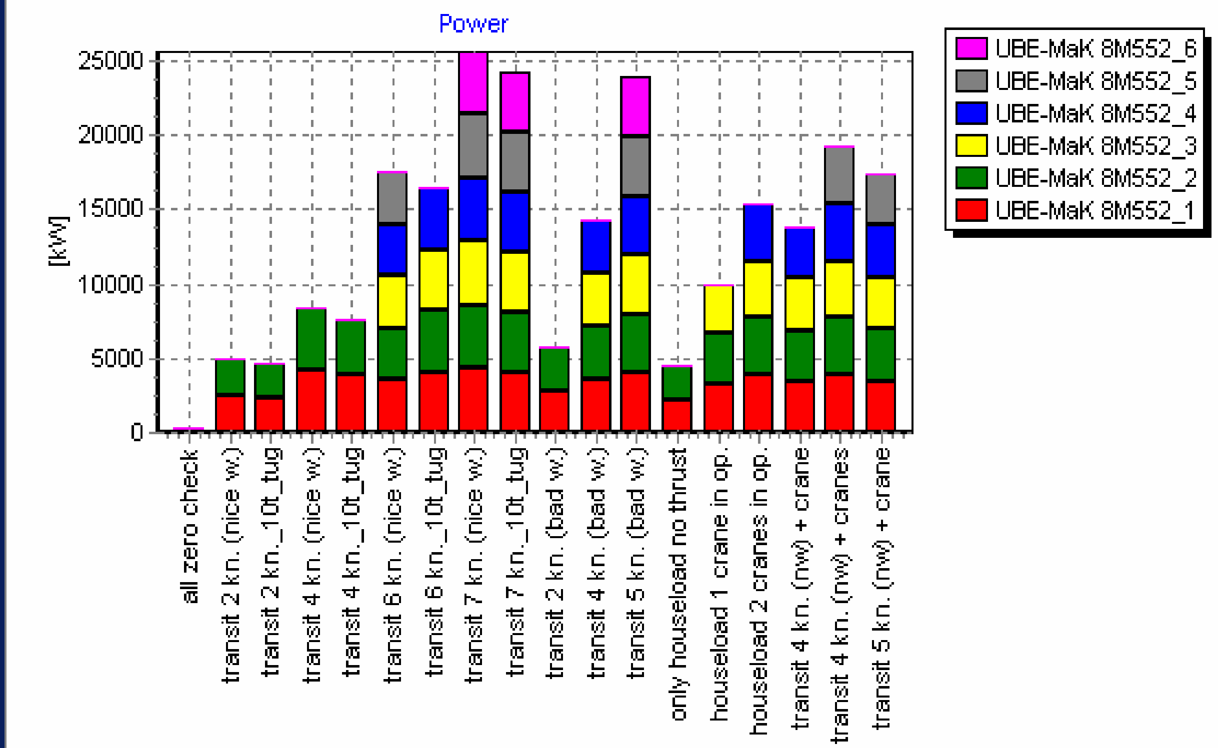
- transit 2.0 knots (bad wheater)
- transit 4.0 knots (bad wheater)
- transit 5.0 knots (bad wheater)

- houseload no thrust
- houseload with one crane operational
- houseload with two cranes operational

Operational profile analysis

Example: Semi submersible construction vessel (SSCV) Thialf

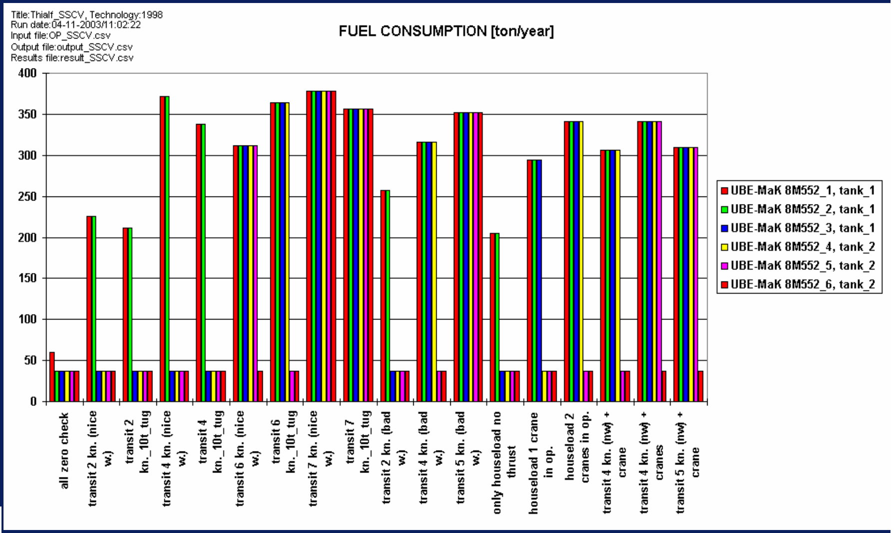
1. System design
2. Operational profile
3. **Performance analysis**



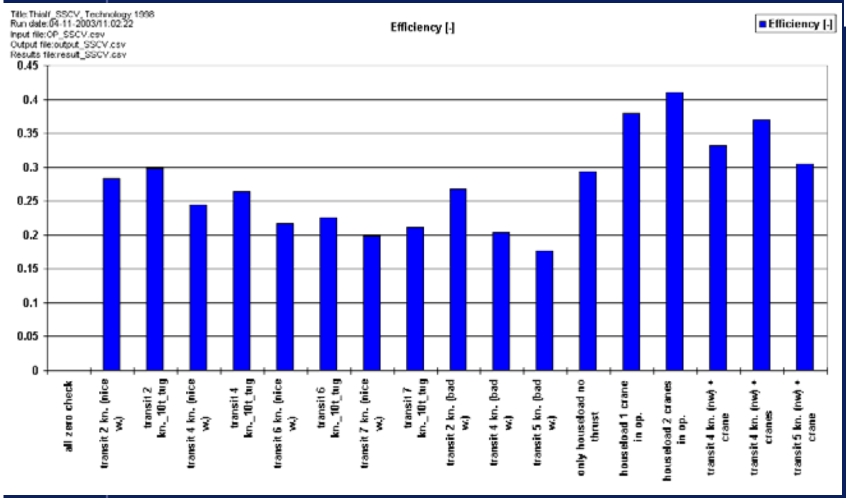
Operational profile analysis

Example: Semi submersible construction vessel (SSCV) Thialf

1. System design
2. Operational profile
3. **Performance analysis**



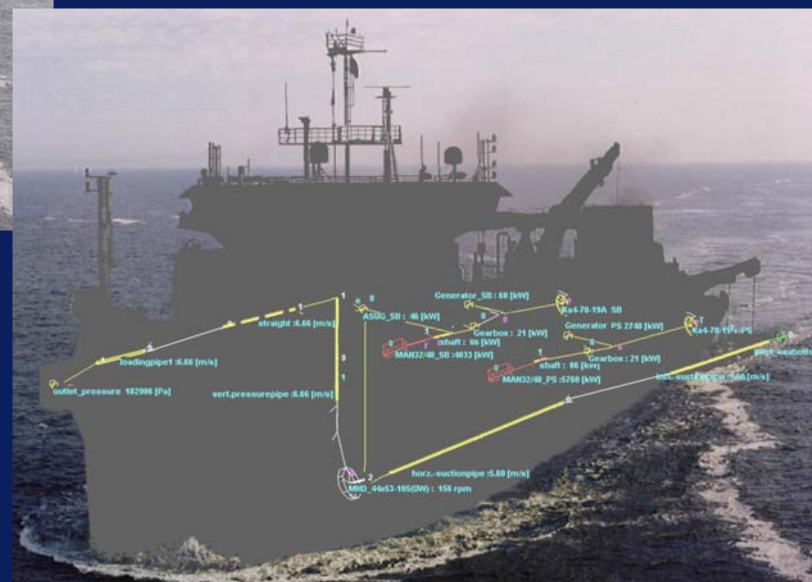
System efficiency



Fuel consumption

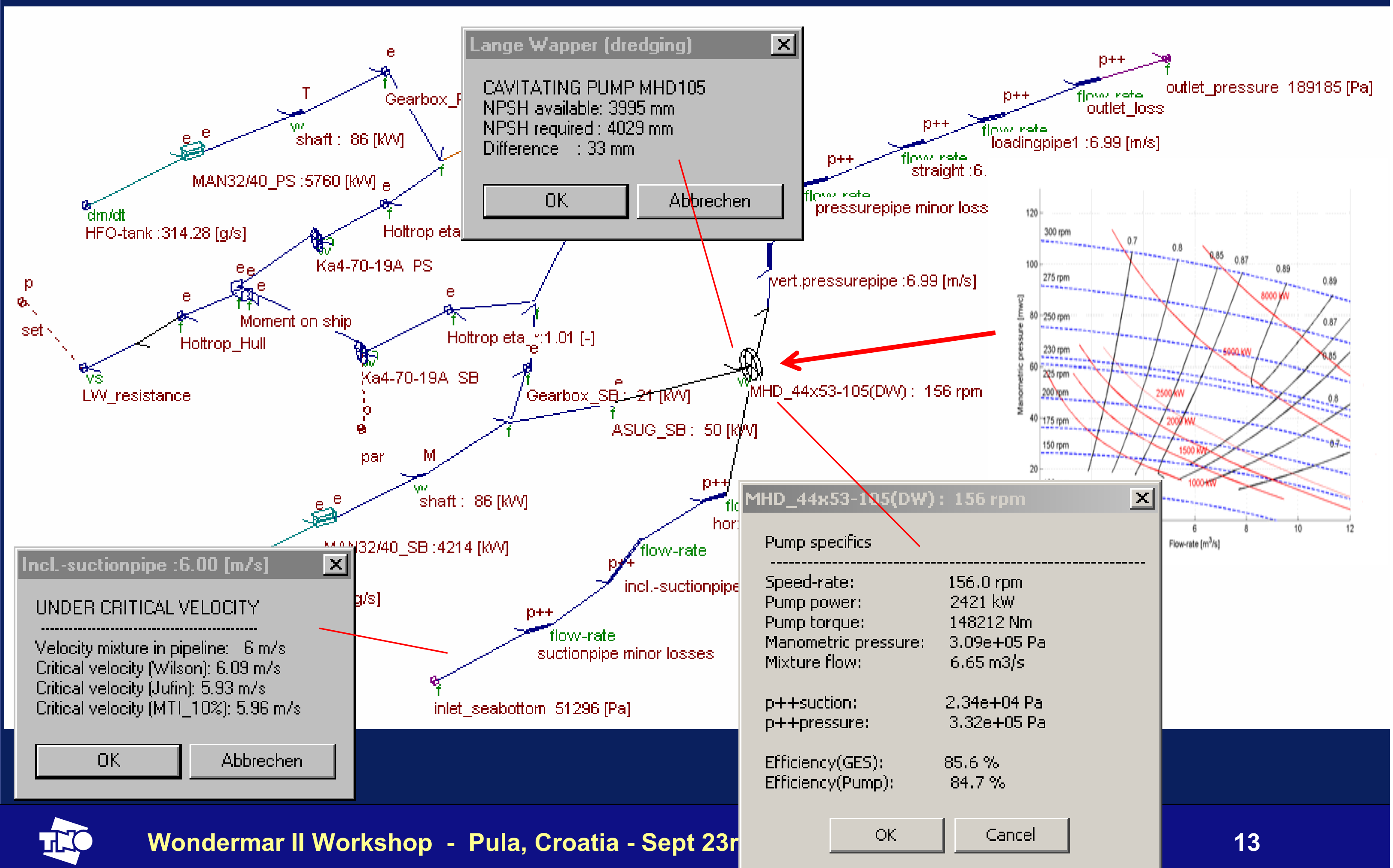
First principle system concept analysis

Trailing Suction Hopper Dredger with dredging pump model



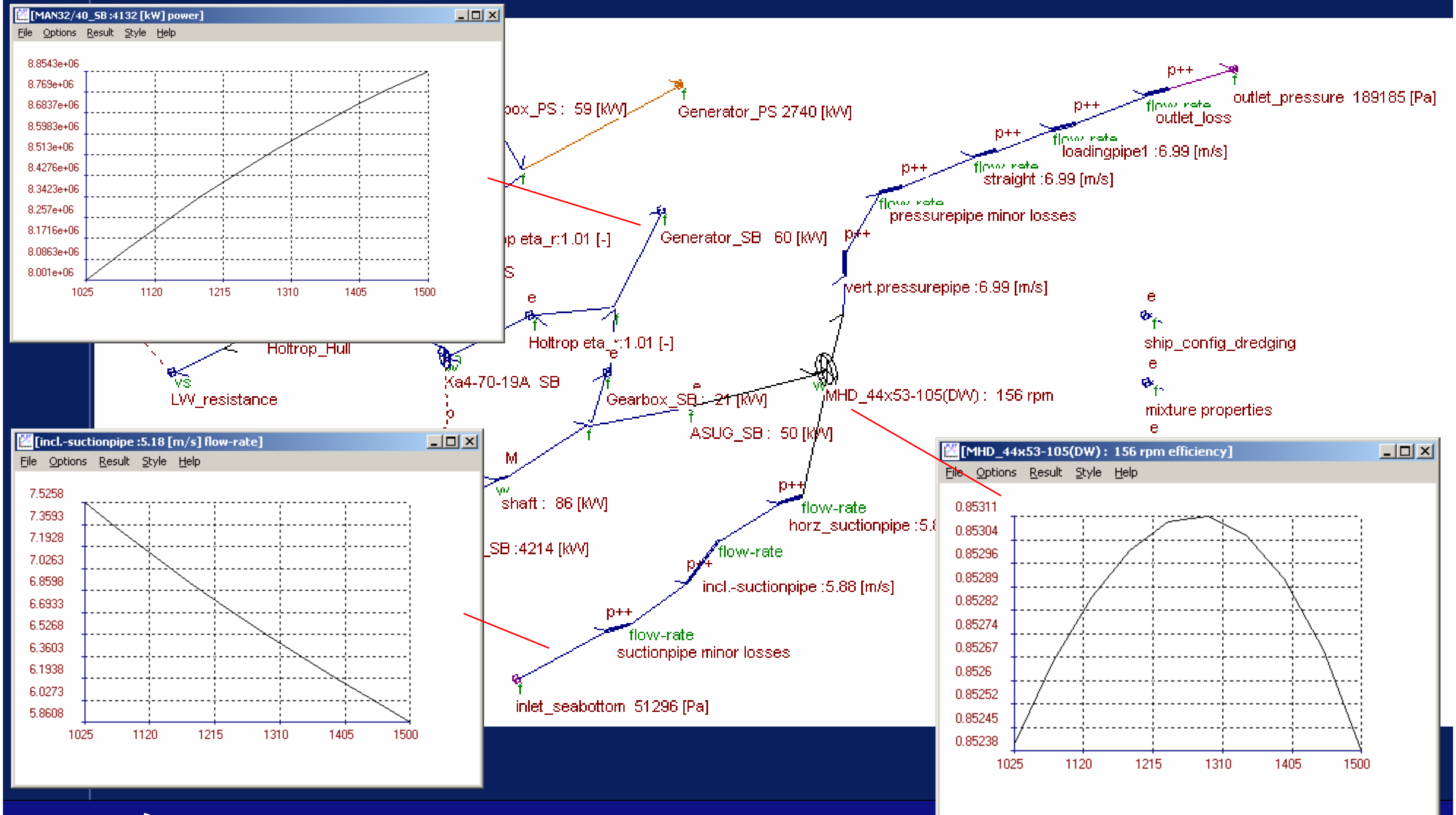
First principle system concept analysis

Trailing Suction Hopper Dredger with dredging pump model



First principle system concept analysis

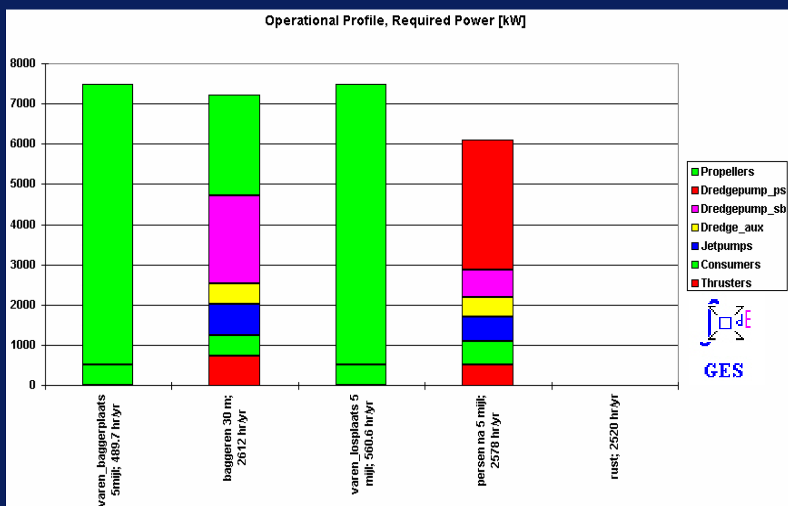
Trailing Suction Hopper Dredger with dredging pump model

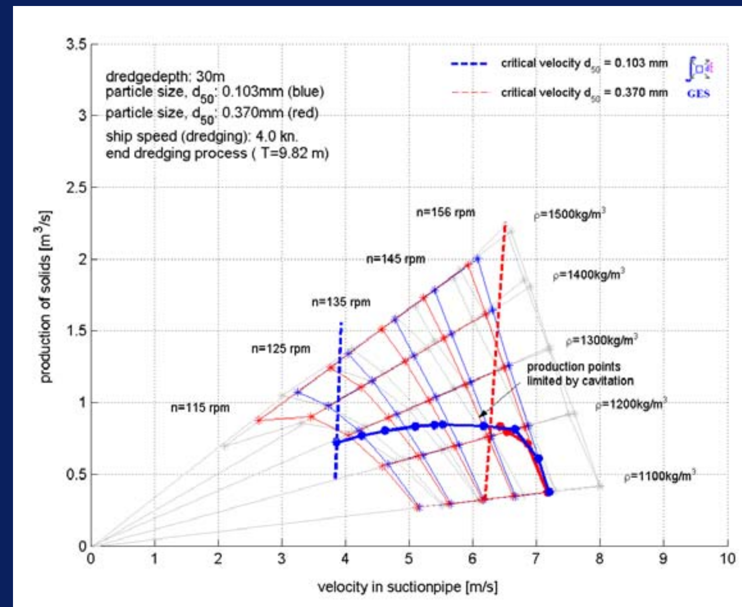


First principle system concept analysis

Trailing Suction Hopper Dredger with dredging pump model

Power balance during the operational profile (dredging cycle)





Production graph, including system limits

Voltage Design Guide

A design application module

For electrical installations under various conditions

Goal of the guideline is:

- **To determine the optimum voltage levels of the components**

Voltage Design Guide

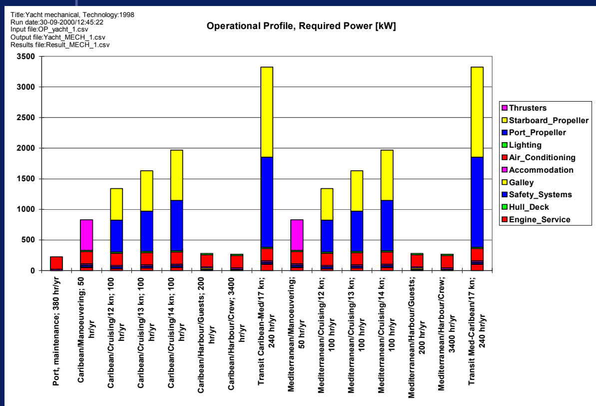
Step by step design of the electrical circuit

For each operational condition several parameters must be supplied:

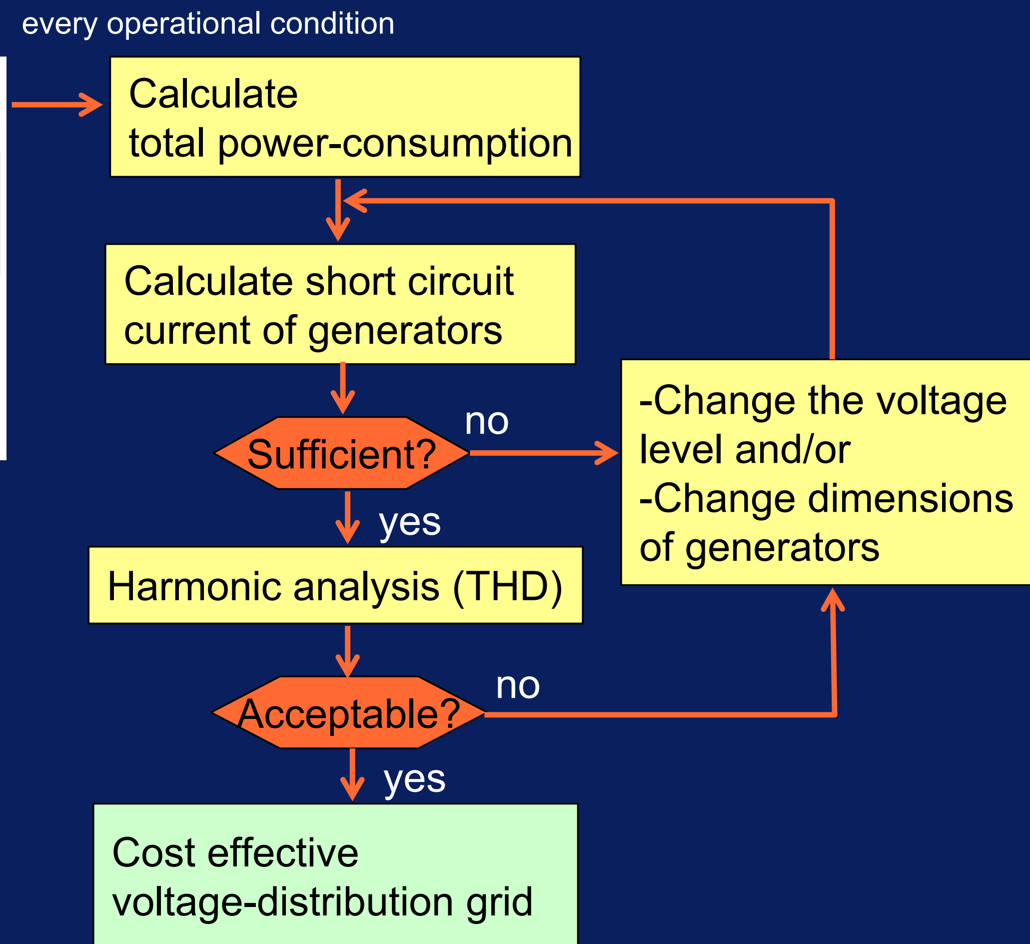
- **Duration of the operating condition**
- **Ship speed or propulsion power**
- **Power usage of all power consumers**

Voltage Design Guide

Step by step design of the electrical circuit



Operational Ship Profile



Voltage Design Guide

Step by step design of the electrical circuit

Results:

- **Total consumer's power**
- **Main voltage**
- **Maximum short current**
- **Controllable design of power drive (converters)**
- **Maximum THD**
- **Cost effective voltage distribution grid**

ICT Aspects
Process & Information

Process

- **System design and assessment (owner, yard)**
- **Product configurator (owner, yard, supplier)**
- **Benchmarking of supply products (yard, supplier)**

Information

- **Information need at a component level**
- **Standards for information in- and output**
  (A STEP structure for the component library is available)

ICT Aspects

Integration of onboard systems?

Then exchange and use of information is a need

Wondermar statement

- In the near future,
  all necessary information from ship owners and suppliers will become available to the designers