HYBRID ENERGY- AND PROPULSION SYSTEMS FOR VESSELS IN TIMETABLE OPERATION

ZKR-WORKSHOP 20.04.2021:
ALTERNATIVE ENERGY SOURCES FOR ELECTRICAL PROPULSION SYSTEMS IN INLAND NAVIGATION
Shiptec AG

- Engineering and shipbuilding since 1931 in Lucerne/Switzerland
- Type of Ships:
  - Passenger and commuter ships
  - Car Ferries
  - Old-timers / Steamships
  - Yachts
  - Work boats

Shiptec – Vessel
- Modern, nautical styling
- Highly efficient hull design, weight optimized
- Highly efficient energy and propulsion systems
- Individual optimized for the specific operation
- Remote monitoring of most important operation parameters
- Optimized for low life-cycle-cost

What can we do to make our costumer (more) successful?
Initial Starting Points, Motivation

• Environment protection => to meet strict (future) regulations CO₂ reduction => first step to the carbon neutral, timetable operating passenger vessel in Switzerland (2022)

• Considering multiple, dynamic requirements concerning energy supply and energy distribution in passenger vessels in timetable operation (knowing the operational profile as a base => system simulation as a base)

• Reduce the total installed power (downsizing) at a lowest possible risk concerning, cost, dimensioning and functionality (nominal operation speed 25-38 km/h)

• Reduction of operating costs thanks to a holistic projection (propulsion and hotel load)

• High level of availability and high level of safety
Hybrid and E-Ships (CH until now)

- Different purposes:
  - Touristic Applications
  - Public Transport
  - New Vessels, Revamp

MS Diamant
MS Waldstätter
MS Jungfrau
MS Berna
MS Bürgenstock
eMS MobiCat
MS Aurora
eMS Heimat
Different Architectures (holistic approach: prolusion & hotel load)

Parallel Hybrid => Bridge-Technology for high shaft power and two clear stage operation profile
(MS Diamant, MS Bürgenstock, MS Aurora, MS Waldstätter)

Serial Hybrid => base for Zero-Emission technology
(MS Jungfrau, MS Berna, eMS MobiCat, eMS Heimat,)

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**Operation options**

**Parallel-Hybrid**
- Typical peak shaving
  - Downsizing of components, operation in best efficiency
  - High dynamics
  - Shaft Generator/Booster
  - See detail
- Source switch under load
  - Downsizing of components, operation in best efficiency
  - High dynamics
  - Shaft Generator/Booster
  - Full flexibility
  - Operation like serial-hybrid
  - See detail

**Serial-Hybrid**
- Energy source combination
  - Downsizing of components, sequential operation of sources => in best efficiency
  - High dynamics
  - Peak shaving
  - See detail
- Source switch under load
  - Downsizing of components, sequential operation of sources => in best efficiency
  - High dynamics
  - Full flexibility
  - See detail
- Alternative fuel and/or pure electric
  - Sequential operation of sources => in best efficiency
  - High dynamics
  - Full flexibility
  - Zero-Emission
Peak-Shaving function (touristic application, pier maneuver every 8 min)

- a) Cruising
- b) Speed reduction
- c) Disengage
- d) Engaging and astern thrust
- e) Stop
- f) Acceleration
- g) Cruising

〇 Booster
〇 Shaft generator
Combi-Operation (pure E and peak shaving) & switch under load

- Electric-Mode: Pure electric drive
- Diesel-Mode: charging the batteries
- Switch under load
- Engine Power > Shaft Power
- Engine Power = 0; Shaft Power > 0

20.04.2021
Operation experiences

- Fuel saving: 13 – 26 % under comparable conditions (weight compensated)
- Maintenance cost saving 30-50% on main engines (downsizing) and because of no Gensets

- With system investment costs about 27% higher than a conventional, comparable system, payback is about 3.5 years
Next steps (Hybrid => Zero-Emission)

• Pure Electric (incl. shore charging strategies)
• H2 fuel cell (incl. Logistics)

Challenges: Rules partial not clear, H2 logistics (Swiss benefit 😊), charging strategies
Questions?

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