ABB MARINE & PORTS

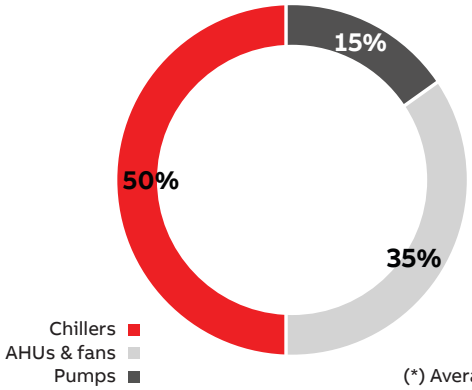
HVAC Energy Efficiency Improvement Program

Optimizing the full energy saving potential of onboard HVAC systems

HVAC Energy Efficiency Improvement Program

In passenger vessels, the heating ventilation and air conditioning (HVAC) system is the second largest consumer of energy after propulsion. It is estimated that up to 30% of the total energy consumption of a passenger ship comes from HVAC systems for cabins, public areas and galley ventilation. When the ship is berthed in the port, the HVAC system even becomes the main energy consumer. Needless to say, HVAC is not a negligible value and the gains with regards to energy efficiency are more than clear.

HVAC energy consumption % (*)



(*) Average value

Where are the energy savings?

The total energy consumption of a HVAC system can be divided amongst the following areas:

- Chillers
- Air Handling Units and Fans
- Pumps

1. Checklist

A standard check list is sent to the ship owner for a preliminary check in order to obtain the main data about the HVAC system.

2. Survey

During the survey onboard an assessment of all HVAC components and equipment is performed, operational data is acquired.

3. Analysis

An overall technical analysis is carried out. The available project documents of the HVAC system are reviewed and analyzed.

4. Solutions

The applicable energy efficiency solutions are identified; the impact is verified through a feasibility study.

5. Saving

The energy percentage saving of each solution is evaluated and the cumulative annual energy saving is calculated.

6. Cost

The investment cost of each solution is estimated and the required onboard activities and modifications are planned.

7. Payback

The payback time is calculated for each solution.
The focus is on items having a payback period of less than two years.

8. Report

Final report includes the collection of all applicable energy efficiency solutions, togheter with a proposal including the best solutions for the vessel.

Solution examples

The 8 steps HVAC Energy Efficiency Improvement Program can lead to a number of different energy efficiency solutions which are all part of ABB's integrated automation solutions. A few examples are:

- **Chillers**
  - Chilled water set-point optimization:
    The solution optimizes chiller plant performance based on advanced algorithms, managing chiller plants using real-time data, weather forecasts and active learning. Chiller energy consumption can be reduced up to 15% without affecting cooling capacity or indoor climate through the optimization of chilled water temperature set-point. A local onboard controller is interfaced to HVAC control system and chiller control panel. Client interface allows for active monitoring and con-

trol both onboard and offshore via remote connection. Energy savings can be monitored trough a real-time online dashboard.

- High efficiency chiller:
  Chillers spend about 95% of their operating hours at part-load conditions. In new high efficiency chillers the compressor is coupled with a variable frequency drive (VFD); the chillers are considerably more efficient since the VFD allows to operate at increased efficiency at part-load. Moreover, the usage of latest technology applied to flooded type shell and tube evaporator/condenser can improve the overall efficiency of the chiller system.

- The main benefits are the following:
  - Chiller energy consumption can be reduced up to 25%
  - Improved efficiency, especially at part-load
  - Negligible start-up current
  - Accurate capacity control
  - Equipment operates at lowest motor speed.

  When multiple chillers are installed, a new high efficiency chiller can be used as a lead chiller to take care of the variable load and existing conventional chillers as backup operating at near full-load whenever they come on.

- **Air Handling Units (AHU's) and Fans**
  - Variable frequency drive on AHU fan motor:
    A variable frequency drive can improve the operating efficiency of fan motors that operate 24h a day, 7 days a week. By doing so, the energy consumption of air handling unit fan motors can be reduced up to 60%. The Load profile and cooling demand of an air conditioning system are not constant, and they are subject to continuous variation depending on outdoor climate conditions, people presence and the required ambient set point. The airflow of air handling units is designed to maximum cooling demand that is requested only during short periods, approximately 10% of yearly running time. During other periods the airflow can be reduced while maintaining the required indoor set point and ambient air quality conditions. Reducing the airflow at 80% of design value, the power consumption of fan motor is reduced by half.

  - Premium efficiency motor:
    Since a standard motor for AHU consumes its initial capital investment in electricity in approximately 2000 running hours, the total cost of ownership should be taken into account when planning an investment for a new motor. Replacement of the old standard motors with new “Premium Efficiency” IE3 motors, the motor energy consumption can be reduced up to 5%.

    The IE3 motors provide the following benefits:
    - High availability of motors, throughout low temperature rise
    - High quality, lower maintenance, longer lifetime
    - Fully compatible with variable frequency drive
    - Meeting the highest efficiency requirements, especially at all load points

Pumps

- Variable frequency drive on pump motor:
  Chilled water and condenser seawater flows are dimensioned according to the design point so that they can deliver the cooling demand for all the extreme conditions that the vessel may operate in. The easiest and most efficient way to reduce the power consumption in these processes is to install a variable frequency drive to control the flow from chilled water and condenser seawater cooling pumps, when they operate at less than extreme conditions. A modest speed reduction can yield significant energy savings: by reducing the motor speed by 20%, the power consumption of pumps motor is reduced by 50%.

Savings for the forced ventilation system

Apart from the above mentioned solutions that are directly related to HVAC system, similar technology can be applied to the forced ventilation system. By implementing variable frequency drives, the energy consumption of ventilation fans that are used in places such as the engine room, car deck and cargo spaces can be reduced by up to 60%.

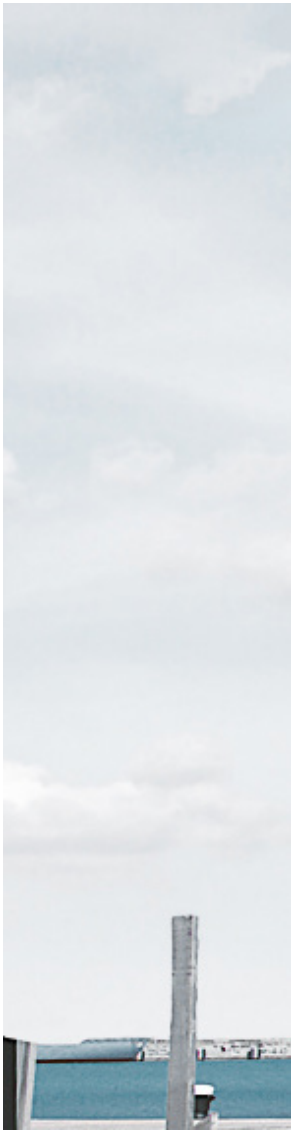
Our holistic approach

The total offering from ABB’s digital portfolio is the most comprehensive available within the maritime industry. It provides a seamless exchange of data, full integration of sensors, automation, ship software and cloud solutions. Important elements within the portfolio are decision support software for safe, comfortable and efficient operations, as well as remote diagnostics technology that preventatively and continuously monitors critical equipment onboard a ship.

Furthermore, ABB has invested heavily in shore side expertise, analytics firepower and engineering availability to provide 24/7 support from our ABB Ability™ Collaborative Operations Centers that support troubleshooting, maintenance planning, benchmarking and interventions based on predictive diagnostics.

ABB S.p.A., Marine & Ports
Via Molo Giano
16128 Genoa
Italy

abb.com/marine



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