IMPLEMENTATION OF TANKER ENERGY EFFICIENCY MANAGEMENT PLAN FOR A VLCC

Practical solutions for saving energy onboard and monitoring

Matti Salo
President, Onboard-Napa Ltd, NAPA Group
FINLAND

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NAPA - world’s leading software solutions company for ship design and operation

- Improve the safety and performance of the global marine industry
- Reliability first
- Commitment builds trust
- Courage leads the way
- Enjoy working together
- Success through knowledge

- 3D modelling
- Loading & stability
- Energy optimisation
- Fleet management
- Commitment to ecological sustainability and energy efficiency for ships

- Revenue €16M
- Continuously profitable
- Established in 1989
- 70% owned by employees
- Staff 130, 90 in Helsinki, Finland
- Shipyards and ship owners
- Design companies, institutes and authorities
- Used by 400 organizations, installed in 1200 ships

Global reach – Finland, China, Korea, Japan, India, Romania, Italy, USA & worldwide agents
Todays story:

- TEEMP
- MONITORING
- VOYAGE OPTIMISATION
- PROPULSION RESISTANCE MANAGEMENT
- CONCLUSIONS
TEEMP
MONITORING
VOYAGE OPTIMISATION
PROPULSION RESISTANCE MANAGEMENT
CONCLUSIONS
What is TEEMP?

- Tanker Energy Efficiency Management Plan, including:
  - Energy Conservation Awareness Plan
  - Cargo Handling Optimization
  - Machinery Optimization
  - Propulsion Resistance Management
  - Voyage Optimization

MONITORING
TEEMP

MONITORING

VOYAGE OPTIMISATION
PROPULSION RESISTANCE MANAGEMENT
CONCLUSIONS
Monitoring in TEEMP

“The continuous and consistent collection of data will require the establishment of a necessary recording system which should be operated and maintained ashore so as not to place any unnecessary administrative burden on the ship’s staff.”

- INTERTANKOS GUIDE FOR A TANKER ENERGY EFFICIENCY MANAGEMENT PLAN

“You can’t manage what you can’t control, and you can’t control what you don’t measure”

- Tom De Marco
SOLUTION FOR MONITORING – COLLECTING DATA FROM SHIPS TO SHORESIDE SYSTEM

Onboard the vessel

- Interfaces (Navigational system, Engine automation system etc.)
- NAPA Voyage Reporting (data input)
- NAPA Server

At the office

- Web browser (Reporting)
- NAPA Office

Email Based Automatic Synchronization
MONITORING THE FLEET PERFORMANCE

Dashboard

<table>
<thead>
<tr>
<th>Consumption, absolute values, Average: 84 ml/day</th>
<th>Consumption, corrected to 15kn. Average: 99 ml/day</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Graph" /></td>
<td><img src="image2.png" alt="Graph" /></td>
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</table>

VLCC Fleet, Loaded (draft > 12m), daily values and 90 days running average

May 28, 2011 7:00 PM
### Comparing Classes

#### Consumption, Absolute Values

<table>
<thead>
<tr>
<th>Date</th>
<th>D</th>
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<th>S</th>
<th>All Ships</th>
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#### Consumption, Corrected to 15kn

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<td>2011-05-12</td>
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**Class 90 days averages. Loaded (draft > 12m)**

May 26, 2011 7:52 PM

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## DAILY MONITORING WITH TRAFFIC LIGHTS

### D Class

<table>
<thead>
<tr>
<th>Ship</th>
<th>Date</th>
<th>Operating mode</th>
<th>Latest day's consumption [mt/day]</th>
<th>Compared to ship's LD/BLST average</th>
<th>Traffic lights</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>2011-05-24</td>
<td>Not steaming</td>
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<tr>
<td></td>
<td>2011-05-24</td>
<td>Loaded</td>
<td>77.93</td>
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<tr>
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<td>2011-05-24</td>
<td>Not steaming</td>
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**RED LIGHT, PROBLEMS?**

### H Class

**CLICK AND GET DETAILS**

### N Class

<table>
<thead>
<tr>
<th>Item name</th>
<th>Observed value</th>
<th>LL</th>
<th>L</th>
<th>H</th>
<th>HH</th>
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<tbody>
<tr>
<td>M/E NO.1 JACKET C.F.W OUT TEMP</td>
<td>86.40</td>
<td>88</td>
<td>200</td>
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<td>M/E NO.4 JACKET C.F.W OUT TEMP</td>
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<td>200</td>
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<td>M/E NO.7 JACKET C.F.W OUT TEMP</td>
<td>86.00</td>
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**All reported traffic light values**

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<tr>
<th>Date</th>
<th>Operating mode</th>
<th>Average</th>
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<td>Not steaming</td>
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</tr>
<tr>
<td>2011-05-24</td>
<td>Not steaming</td>
<td>37.54</td>
</tr>
<tr>
<td>2011-05-23</td>
<td>Not steaming</td>
<td></td>
</tr>
</tbody>
</table>
MONITORING EMISSIONS - EEOI

EEOI values based on measured fuel consumption and user input passenger count

Ship: NAPA Ropax
Begin time: 2009-05-01
End time: 2010-01-01

Dashboard - CO2 emissions - EEOI - NOx report

GCO2/(PAX*Distance)
MONITORING EMISSIONS – NO$_x$ and SO$_x$
TEEMP MONITORING

VOYAGE OPTIMISATION

PROPULSION RESISTANCE MANAGEMENT

CONCLUSIONS
SPEED OPTIMISATION

Click here to optimize...

Voyage not optimized

Singapore - Fujairah

No voyage description

Click here to optimize...

Singapore - Fujairah

No voyage description

Click here to optimize...

Click here to optimize...

Departure 4.5.2011 17:00 +8:00
Arrival 14.5.2011 9:18 +4:00
Distance 3337.0 nm
Sea time 9 d 20:18
Fuel consumption 1059.0 t
Total cost 233040 USD
EEOI [g-CO2/(mt*nm)] 3.294

Distance 3337.0 nm
Sea time 10 d 7:27
Fuel consumption 1028.8 t
Total cost 226398 USD
EEOI [g-CO2/(mt*nm)] 3.201

Optimized from waypoint 1 to 26
SPEED OPTIMISATION

WIND PROFILE:

WAVE PROFILE:

OPTIMAL SPEED PROFILE:

Slow steaming 15
->14 knots: 30 tons less

Optimal speed,
avg speed 14 knots: 8 tons less
ROUTE OPTIMISATION

- Possibility to optimise also position of waypoints within given boundaries
- Taking the best benefit of weather and sea current forecasts
- Additional savings in bunker 1-4 % in open sea areas
TRIM OPTIMISATION

- Trim or rather FLOATING POSITION has inevitably effect on propulsion efficiency
- Trimming during sea passage is difficult, specially when having full load unnecessary ballast should not be carried -> ballast increases displacement and therefore resistance and fuel consumption
- Trimming, if possible with the cargo is often optimum solution
TO TRIM, OR NOT TO TRIM: THAT IS THE QUESTION

Trimming even keel with cargo, Displacement does not change. Calm water, power requirement for 15 knots: 24.6 MW = 2.7% less power and fuel needed
SOLUTION: OPTIMISE THE FLOATING POSITION DURING LOADING OPERATION
TEEMP
MONITORING
VOYAGE OPTIMISATION

PROPULSION RESISTANCE MANAGEMENT

CONCLUSIONS
Normalising for environmental factors

Added resistance due to hull roughness/fouling

Power losses due to yaw and steering to compensate drift

Speed 12.5 knots

To the propeller: 30 MW
- Power losses in shaft line (~2%)
  = 29.4 MW

Final thrust power = Shaft power x efficiency rate of propellers (0.5) = 29.4 x 0.5 = 14.7 MW. Weakened efficiency because slower speed and propeller fouling

Finally the ship finds equilibrium between the thrust power and the resistance. Thrust power = Resistance = 14.7 MW.
After Filtering and normalisation breaking down the power and fuel usage

- **Hull (clean) resistance:** 71.93 MT / 54%
- **Added resistance:** 11.11 MT / 8%
- **Hotel power:** 50.60 MT / 38%
- **Drift:** 0.19 MT / 0%
- **Waves:** 3.66 MT / 3%
- **Fins:** 0.59 MT / 0%
- **Wind:** 3.94 MT / 3%
- **Hull & Propeller fouling/roughness:** 2.65 MT / 2%
- **Shallow water:** 0.09 MT / 0%
The end result showing hull & propeller performance index for seeing the effect of hull cleanings or differences in coating.
With these results, savings with different hull cleaning scenarios can be calculated.
CONCLUSIONS
Results

- 1st VLCC where these TEEMP related systems have been implemented show following measured daily consumption curve after 2 years:

  - 113.7 MT / DAY
  - 78.6 MT / DAY
CONCLUSIONS

• The drop in consumption is partially caused by slower steaming, partially by voyage optimisation and partially by improved hull condition

• Even though not all means of TEEMP have been implemented the effect is significant – one reason for the drop is also increased awareness on the subject through constant monitoring!
Results

• Based on the previous we can estimate the savings potential of different initiatives:

• Voyage Optimisation
  • Speed optimisation can save anything from 0.5-5%. The biggest savings require slow steaming and direct arrival on the terminal.
  • Weather routing 1-4% depending on the route, schedule and engine configuration.
Results

- Propulsion Resistance Management

  - This initiative involves more indirect savings that can be capitalised for example by following up the hull condition. It has been shown that having the hull in bad condition especially after anchoring period can increase the required propulsion energy even 5-10%. This approach helps also comparing the paints and how they perform in the hull.
## SEEMP and NAPA for Operations

<table>
<thead>
<tr>
<th>TEEMP (Intertanko’s version of SEEMP)</th>
<th>NAPA for Operations</th>
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<tbody>
<tr>
<td>Measuring and monitoring</td>
<td>NAPA Voyage Reporting</td>
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<td>NAPA Office</td>
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<td>NAPA OptiFloat</td>
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References in Korea

- **DSME and NAPA** have developed together a Green Ship solution called “**NAPA-DSME Power**” ®

- **NAPA** and **STX Offshore and Shipbuilding** have started Co-operation in Green Ship Deliveries (Press release published this week)
Thank you! Any questions?