Det Norske Veritas Shipping Seminar

26 April 2012 – Åland Maritime Day

Tomas Tronstad, MSc
Principal Consultant
DNV Maritime Advisory
tomas.tronstad@dnv.com
# Agenda

1. The ECA challenge

2. The 3 main ECA solutions

3. Selection process and tools

4. Main challenges

5. Summary
Agenda

1. The ECA challenge
2. The 3 main ECA solutions
3. Selection process and tools
4. Main challenges
5. Summary
Emission Control Areas, ECA: A Perfect Storm

- A "Perfect storm": A rare combination of circumstances will aggravate a situation drastically, resulting in an event of unusual magnitude.

- Implementation of ECAs is a "Perfect storm" due to a confluence of events:
  - Low rates/weak markets
  - High fuel prices
  - Increased surveillance
  - Solutions based on novel technology
  - Yard capacity stressed

- Which factors causes this phenomenon, how can they be dealt with and what are the risks for the maritime industry through the “perfect storm”?

(After Warner Bros out of Wiki)
Politics – Some important organisations, bodies and issues

International Maritime Organisation
• Marpol convention was amended 1997, introducing Annex VI.
• The requirements was even further amended in 2008
• Progressive reduction global emissions and opening for ECA’s

European Union
• Harmonising EU rules with MARPOL requirements
• Ambitions to spearhead environmental requirements
• Air emissions from ships exceeding onshore by 2020

US & Canada
• Strong record of local and regional requirements
• However, now adopting IMO regulations as equivalent to national regulations (EPA) on quite some issues

Flag states
• Should support development of core technology (scrubbers etc), political/financial instruments and availability of low sulphur fuels
• Flag states that are party to Annex VI must enforce Annex reg. on their international fleet

Port States
• Port States that are party to Annex VI; right to inspect international going ships to verify compliance
Overview Sulphur Emission Regulations

<table>
<thead>
<tr>
<th>Year</th>
<th>EU ports</th>
<th>California waters</th>
<th>ECA’s</th>
<th>EU waters</th>
<th>Oceans</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>0.1%</td>
<td>0.5%</td>
<td>1.0%</td>
<td>3.5%</td>
<td>4.5%</td>
</tr>
<tr>
<td>2012</td>
<td>0.1%</td>
<td>0.1%</td>
<td>1.0%</td>
<td>3.5%</td>
<td>3.5%</td>
</tr>
<tr>
<td>2015</td>
<td>0.1%</td>
<td>0.1%</td>
<td>0.1%</td>
<td>0.5%</td>
<td>3.5%</td>
</tr>
<tr>
<td>2020</td>
<td>0.1%</td>
<td>0.1%</td>
<td>0.1%</td>
<td>0.1%</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

1) Current EU proposal, yet to be finally approved by parliament and member states
2) 0.5% for MGO. If MDO is used requirement will be 0.1%.
3) Subject to review in 2018; req. will enter in 2020 or 2025 depending on available low sulphur oils worldwide.
4) Passengers ships: max 1.5% from 2006.
### Sulphur level control regime

#### Sampling and analyses of fuel:

<table>
<thead>
<tr>
<th>Port state controls:</th>
<th>Spot check at any time</th>
</tr>
</thead>
<tbody>
<tr>
<td>USCG:</td>
<td>Spot check at any time</td>
</tr>
<tr>
<td>Class societies:</td>
<td>Spot check at Annual survey (+intermed./renewal)</td>
</tr>
</tbody>
</table>

**Ship owner/Operator’s routines:**

- Keep Bunker delivery notes
- Records of scrubber being in operation if use of HFO + scrubber in ECA

**Awaiting further details…**
- Equal & harmonized level of control throughout ECAs?
- Consequence for transportation modal shift?
Agenda

1. The ECA challenge
2. The 3 main ECA solutions
3. Selection process and tools
4. Main challenges
5. Summary
Basically 3 options available

- LNG as fuel
- Scrubbers + HFO
- Low sulphur fuel

Continuously

Switch in ECA
Additional cost for meeting SO\textsubscript{X} requirements in ECA for newbuild with 7000kW installed, 100% ECA operation

**Compliance conditions:**

- **Abatement tech.**: SO\textsubscript{X}
- **Retrofit / New-build**: New-build
- **Gas price**: European level
- **Diesel price**: European level
- **Ship type**: Reefer
- **Installed power**: ca. 7000 kW
- **Time in ECA**: 100%
- **Base Case**: HFO
Additional cost meeting ECA SO\textsubscript{X} and NO\textsubscript{X}, retrofit installation with 7000kW installed, 100% ECA operation

Assumptions

Abatement tech. SO\textsubscript{X} and NO\textsubscript{X}

Retrofit / New-build Retrofit

Gas price European level

Diesel price European level

Ship type Reefer

Installed power ca. 7000 kW

Time in ECA 100%

Base Case HFO
### LNG as fuel

**+**
- A safe, proven and available solution
- Reduces NOx, SOx, PM, CO2
- Particularly suitable for fixed trading routes
- Boosting CSR profile
- Can give supreme NPV

**-**
- Additional CAPEX needs
- No worldwide bunkering and fuel standards
- Inadequate LNG bunkering grid
- LNG tank steals space onboard
- Lagging 2-stroke market
- No experience from industrial shipping
- Additional training and certificates

**?**
- LNG fuel prices
- De-coupling of LNG price from oil price?
- Price pressure from land based LNG consumers?
- Rate of bunker grid expansion
- Development of space-efficient LNG tanks
- Dual fuel vs mono fuel engines?
The European LNG bunkering grid

LNG bunker can be delivered by truck for small volumes of LNG supply to any remote area. This is done in the Oslofjord, Boknafjord etc.

However, Ship to Ship bunkering is a more permanent solution and seems viable in the Baltic Sea.
Low Sulphur Fuel

**+**
- A safe, proven and available solution
- Reduces SOx, and PM
- Available globally through current bunkering system
- Very limited investments needed (pump parts etc)
- Limited additional crew training required
- Bunker recording regime already established

**−**
- ~40% OPEX-increase; an expensive ECA solution over time
- Risk of engine shut-down during switch-over, potential ship adrift and in danger
- Low flash point challenges
- Increasing concentration of abrasive ‘cat fines’
- Does not help meeting new NOx demands 2016 newbuilds

**?**
- Distillate availability/Refinery capacity around the globe?
- Future distillate costs increases even more than oil?
- Is 0.1% the actual quality?
Loss of Propulsion Incidents in California

- 2005: 25 incidents
- 2007: 24 incidents
- 2009: 67 incidents
- 2011: 93 incidents
Loss of Propulsion Incidents - Fuel Switching related

- 2011 - California: 32
- 2015 - All ECAs (est): 425
Low sulphur fuel - refinery capacity

- Capacity upgrade primarily coking and cracking units; likely more attractive to produce higher margin products than LS fuels

- Capacity growth in Asia – but LS fuel demand growth expected primarily in North-America and Europe

- Will refineries deliver sufficient volumes in the right geographies?
2. Areas of challenge

The main issues are:

- Low viscosity (MGO)
- Lubricity (MGO/MDO)
- Acidity (MGO/MDO/HFO)
- Flashpoint (MGO/MDO/HFO)
- Ignition and combustion quality (HFO)*
- Increased catalytic fines (HFO)*

* May be affected through blending with some “Cutter Stocks”
## Scrubbers + HFO

<table>
<thead>
<tr>
<th>+</th>
<th>-</th>
<th>?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Often the most cost-effective solution</td>
<td>Space requirements, structure &amp; stability</td>
<td>Ability to perform in all operating modes?</td>
</tr>
<tr>
<td>Very efficient SOx (and particulate) removal under right conditions</td>
<td>Quite extensive integration with ship</td>
<td>Thermal fatigue?</td>
</tr>
<tr>
<td>Well established theory, long track record</td>
<td>Requires operator’s attention and maintenance</td>
<td>Capability of operating in series with NOx abatement technology and exhaust gas boilers</td>
</tr>
<tr>
<td>No need for new fuel tanks, new fuel supply routines etc</td>
<td>Condensation/corrosion?</td>
<td>Sludge production and disposal, Port State Controls in this regard</td>
</tr>
<tr>
<td>Easier to refit than LNG</td>
<td>Fuel penalty</td>
<td>How to prove compliance (air/sea)</td>
</tr>
<tr>
<td></td>
<td>Does not help meeting new NOx demands 2016 newbuilds</td>
<td>Manufacturer and installation capacity?</td>
</tr>
</tbody>
</table>
Categorisation of EGCS systems and main suppliers

Exhaust Gas Scrubbers for Marine Use

- Dry systems
  - Open loop
    - Couple Systems
      - Marine Exh. Solutions
      - Hamworthy
      - Ecospec
  - Hybrid (Open/Closed)
    - Clean Marine
    - Belco
    - Clean Air
    - Aalborg Industries
    - Hamworthy
  - Closed loop
    - Wartsila

- Wet systems
Description of working principle – Wet scrubber open loop

Diagram; Courtesy of Exhaust Gas Cleaning System Association
Example Wet System, Open Loop

Picture; Courtesy of Hamworthy Moss, Norway
Description of working principle – Wet scrubber closed loop

Diagram; Courtesy of Exhaust Gas Cleaning System Association
Description of working principle – Dry scrubber loop

Diagram; Courtesy of Couple Systems GmbH
Dry system installed on MV Timbus

Picture; Courtesy of Couple Systems GmbH
DNV approach complex systems by Risk Methodology

Failure mode and criticality analysis

Hazard studies of Installation and operation
Agenda

1. The ECA challenge

2. The 3 main ECA solutions

3. Selection process and tools

4. Main challenges

5. Summary
High-level structure of DNV’s “ECA survival model”

Scenario data
- Fuel, interest rate, sailing patterns etc.
- Scrubbers
- LNG
- Fuel Switch
- SCR

Model data

User selection
- Measure combination
- Fuel price scenarios
- Time in ECA
- Operational profile
- Ship parameters

Model analysis

Cost effective Solution
Agenda

1. The ECA challenge
2. The 3 main ECA solutions
3. Selection process and tools
4. Main challenges
5. Summary
Not all issues equally important – but the decision space is complex, and cost implications significant

- There is a lot of money at stake
  - Major investments or increased operating costs
  - Vessel second-hand value?
  - Non-compliance consequences?
  - Contractual consequences?
  - CAPEX vs OPEX prioritization?

- Different trading patterns requires different solutions
  - Time in ECA
  - Fleet flexibility?

- Fleet characteristics/age profiles will impact decisions & solutions
  - Is selling or scrapping a viable option?
  - Repositioning?

+ Additional unknown risks for “First Movers”
Agenda

1. The ECA challenge
2. The 3 main ECA solutions
3. Selection process and tools
4. Main challenges
5. Summary
Summary

- ECA poses a threat to traditional ship operation
  - The risk picture is complex since many solutions are based on novel technologies. But upcoming positive developments!

- The overall risk exposure can be reduced and managed by:
  - Getting an overview of your various exposures to ECA
  - Manage your risk exposure and reduce where your ECA consequences are highest
  - Start planning now, involve your top management

- ECA adaptation can give competitive advantages!

- Inadequate ECA performance can give:
  - Port detention, media coverage, break of IMO, EU, USCG regs.
  - High OPEX, Off-hire, reduced second hand value, market exclusion
Safeguarding life, property and the environment