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SNAME United Kingdom Collegium Volatile Organic Compounds (VOC) – 11th October 2011

- This presentation is amended to the MARPOL Annex VI effective from 1 July 2010 plus up to IMO MEPC 62 meeting dated July 2011

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SNAME United Kingdom Collegium Volatile Organic Compounds (VOC)

Jonathan D. Morley,

11th October 2011

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Aims of presentation

- Background
- Regulation Requirements
- Complying with the requirements in the most cost effective manner.
- VOC management plans
- Ship-to-ship transfers
- Possible developments from further changes
- Conclusions
- Questions and Answers

Background

- Volatile Organic Compounds (VOC) refers to organic chemical compounds which have significant vapour pressures and which can affect the environment and human health.
- Oil Volatile Organic Compounds (VOC) are hydrocarbon gases (mainly methane, butane and propane) emitted from crude oil during transport

- Contribute to shipping carbon emissions
- Propane and butane, at low altitudes, break down in sunlight into Ozone

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- Ozone, in high concentrations, can damage vegetation and impair human health

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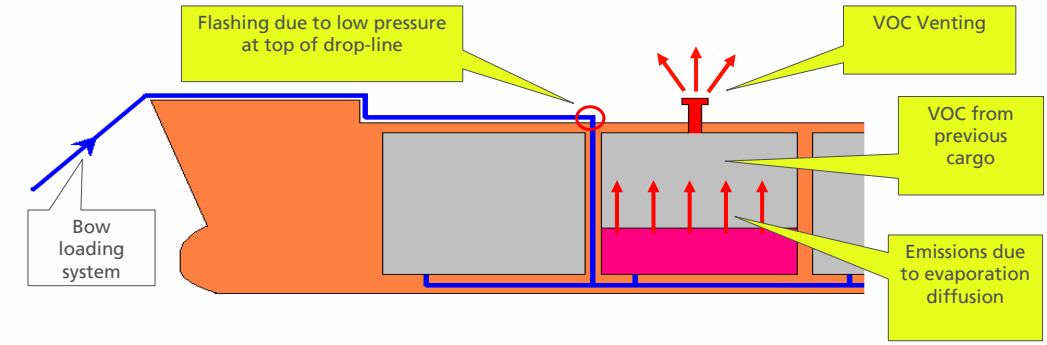
Background

- Sources of VOC emissions



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Background

- MARPOL Annex VI – Prevention of Air Pollution came into force on 19th May 2005

Revision Started in July 2005

Revision completed April 2008

Adopted on 10 October 2008

Revision came into force 1 July 2010

- Energy Efficiency For Ships, added requirements (EEDI + SEEMP)

Drafting completed 1 October 2010
Adopted on 15 July 2011
Revision coming into force 1 January 2013 ?

Regulation Requirements

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Regulation Requirements

- MARPOL Annex VI - Regulation 15 (Volatile Organic Compounds)
- Vapour Emission and Control System (VECS) - 19 May 2005

- Vapour Emission and Control System (VECS) requirements apply to all tankers, in accordance with Regulation 15.1 and 15.5, regardless of size, when trading to a designated port or terminal which regulates VOC emissions, in accordance with Regulation 15.2 to 15.4.

  •For tankers carrying crude oil, petroleum products or chemical cargoes; a vapour collection system is to be provided, complying with the requirements of MSC/Circular 585.

  • Tankers with a VECS system approved by LR under MSC/Circ.585, will also comply with the United States Coast Guard requirements.

  • Gas carriers have a vapour return line to shore as required by the various gas codes. See two slides time.

Regulation Requirements

- Designation of Ports requiring Vapour Emission Control Systems (VECS) - 19 May 2005
- A list of any designated ports and terminals at which VOC emissions from tankers are to be regulated by the use of Vapour Emission Control Systems (VECS) shall be circulated by the IMO as required in MEPC.1/Circ.509 dated 9 May 2006, and MARPOL Annex VI Regulations 15.2 to 15.4.
- VECS for terminals notification shall include;
    - Size of tankers to be controlled
    - Relevant cargoes requiring VECS
    - Effective date of application of such control
- Notification submitted to IMO at least 6 months before effective date of application

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Regulation Requirements

VOC Management Plan Approval – 1 July 2010

Tankers carrying crude oil shall have onboard and implement a VOC Management Plan.

- Provides written procedures for minimising VOC emissions during the loading, sea passage and discharge of cargo
- Shall be approved by administration and take into account MEPC.185 (59) and be guided by MEPC.1/Circ.680 and MEPC.1/Circ.719.

Gas Carrier – 19 May 2005

- Vapour Emission and Control System (VECS) will apply to gas carriers only if the types of loading and containment systems allow safe retention of non-methane VOC's on board or their safe return ashore. See IGC Code, chapter 5.9 and MSC.30 (61)

Complying with the Requirements

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Complying with the Requirements

- There are a variety of other methods of reducing VOC emissions from crude oil including vapour recovery systems and controlling pressure

- Best Practices and Design
- Vapour Emission Control Systems (VECS)
- Vapour Pressure Release Control Valve (VOCON valve)
- Cargo Pipeline Partial Pressure control system (KVOC)
- Increased pressure relief settings
- Recovery of excess VOC and tank absorption (Venturi system)
- Direct Absorption of VOC in the Crude Oil (CVOC system)

- Vapour Recovery System – Condensation Systems
- Vapour Recovery System – Absorption Systems
- Vapour Recovery System – Absorption Carbon Vacuum-Regenerated Adsorption.

Complying with the Requirements

- Best Practices and Design
  - Manual pressure relief procedures (tank pressure control)
  - P/V valve condition and maintenance;
  - Condition of gaskets for hatches and piping;
  - Inert gas topping up procedures;
  - Partially filled tanks;
  - Loading sequence and rate; and
  - Use of vapour return manifold and pipelines when shore facilities are available.

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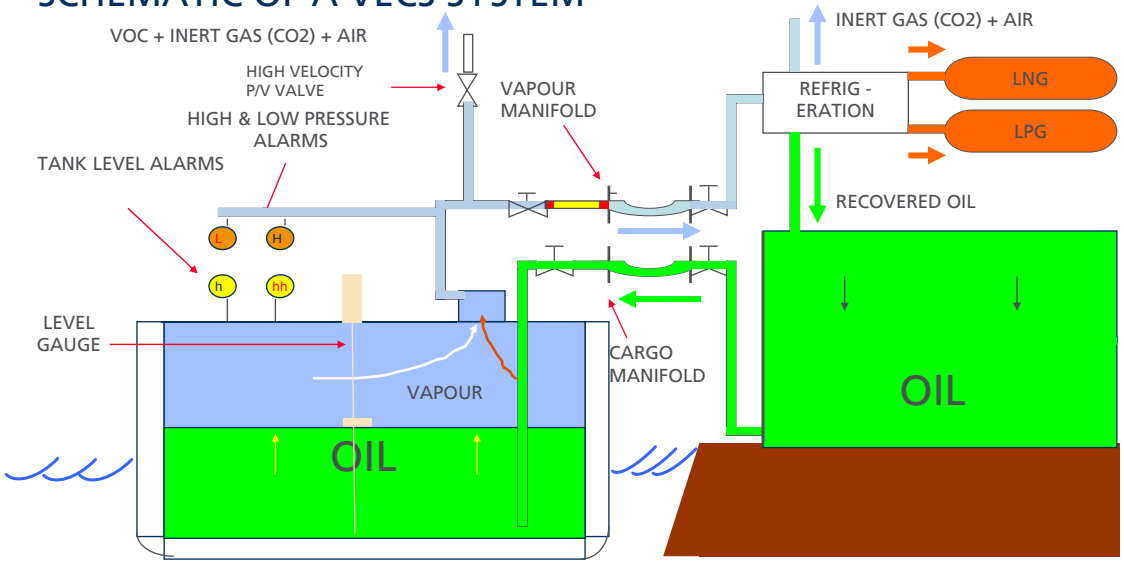
Complying with the Requirements

Vapour Emission Control Systems (VECS):

- Tankers with VECS for ships approved by LR will also comply with MSC/Circ.585
- VECS basic requirements are;
  - Vapour return line
  - Vapour manifold
  - Closed gauging arrangement
  - High pressure alarm
  - Low pressure alarm
  - Overflow control

SCHEMATIC OF A VECS SYSTEM



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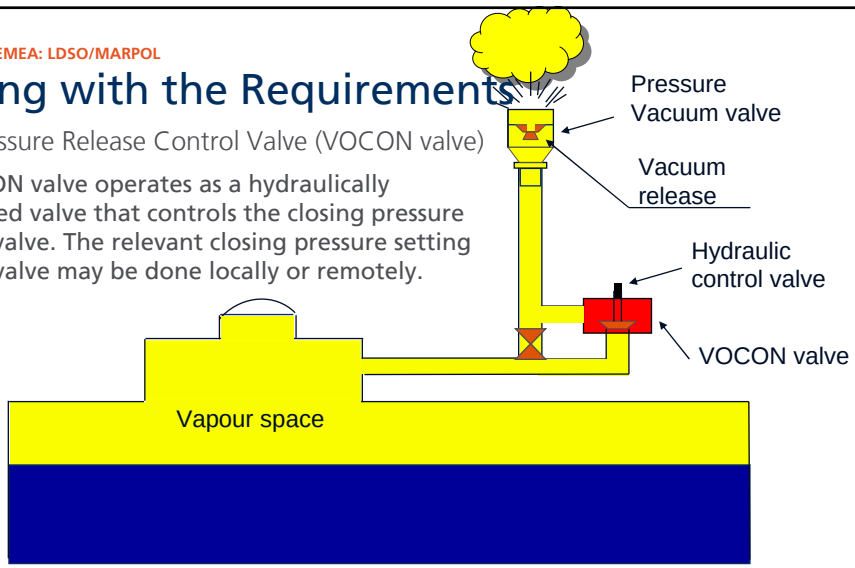
Complying with the Requirements

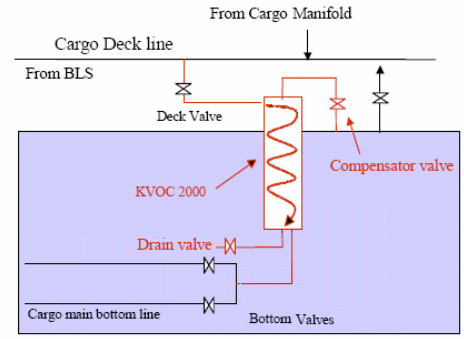
- Vapour Pressure Release Control Valve (VOCON valve)
  - VOCON valve operates as a hydraulically controlled valve that controls the closing pressure for the valve. The relevant closing pressure setting for the valve may be done locally or remotely.



- For the loading programme, the valve also allows a higher pressure to be maintained throughout loading process limiting vapour evolution.
- During transit, allows remote operation of release of vapours.

Complying with the Requirements

- Cargo Pipeline Partial Pressure Control System (KVOC)
  - Purpose is to minimise VOC release to atmosphere by preventing the generation of Non-Methane VOC (NMVOC) during loading and transit
  - Flashing can be prevented by keeping the pressure of the oil at the oil's True Vapour Pressure (TVP) or higher during the loading period



- This is done by increasing the diameter of the drop-line which will decrease the velocity of the oil ensuring a balance between the pressure inside the drop-line and the oil TVP
- The amount of VOC's released during transit are also reduced as gas bubbles will have been prevented from forming

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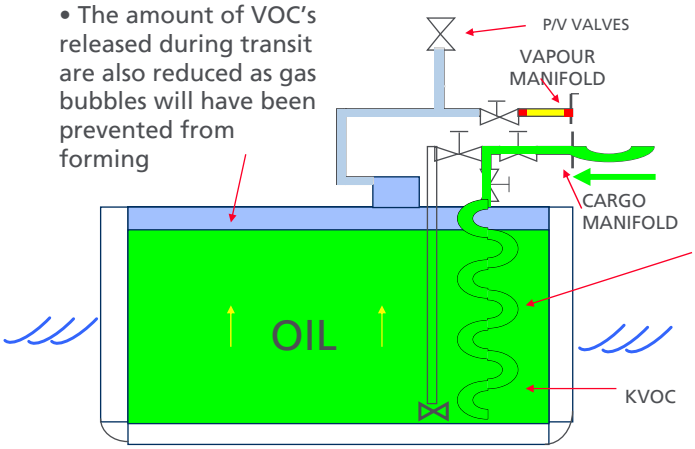
Complying with the Requirements

- Cargo Pipeline Partial Pressure Control System (KVOC) - simplified

• The amount of VOC's released during transit are also reduced as gas bubbles will have been prevented from forming



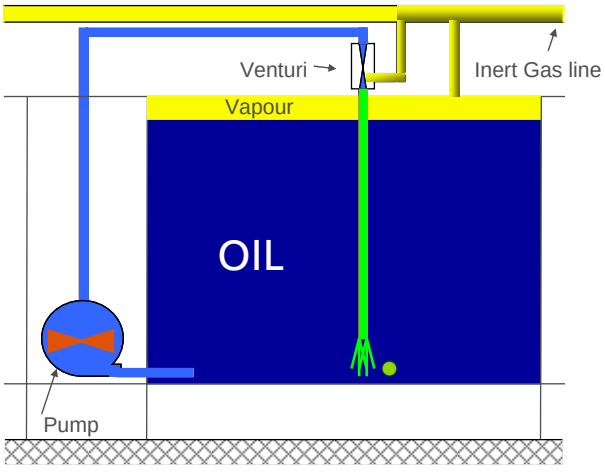
• This is done by increasing the diameter of the drop-line which will decrease the velocity of the oil ensuring a balance between the pressure inside the drop-line and the oil TVP

Complying with the Requirements

- Increasing cargo tank pressure
  - Increasing cargo tank pressure can result in a reduction in VOC emissions
  - If equilibrium occurs between the liquid and vapour phase of the cargo, then no further Non Methane VOC (NMVOC) will evolve from the cargo
  - This will happen so long as the tank pressure is maintained above the Saturated Vapour Pressure of the cargo
  - Increasing the tank pressure will also limit the existing vapour in the tanks generated during the previous discharge
  - However, cargo tanks may need to be designed to meet the new pressures

Complying with the Requirements

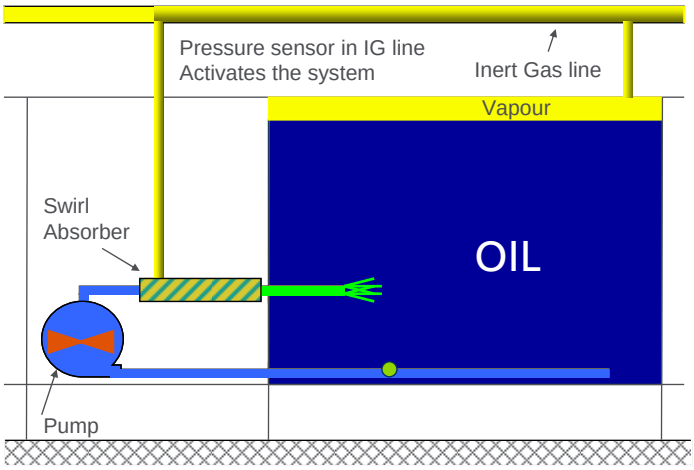
- Recovery of excess VOC and tank absorption (Venturi system)
  - The Venturi draws VOC, H2S and inert gas from the common cargo tank venting/inert gas main line.
  - The Venturi system involves a process where evolved VOC is reabsorbed back into the cargo.
  - The inert gas will eventually surface back above cargo.



  - This system is suitable for use during transit with the cargo.

Complying with the Requirements

- Direct absorption of VOC in the crude oil (CVOC system)
  - The Swirl Absorber draws VOC, H2S and inert gas from the common cargo tank venting/inert gas main line.
  - The CVOC system involves a process where evolved VOC is reabsorbed back into the cargo.
  - The inert gas will eventually surface back above cargo.



- This system is suitable for use during transit with the cargo.
- They claim can be used a bit during loading and cargo transfer operations.

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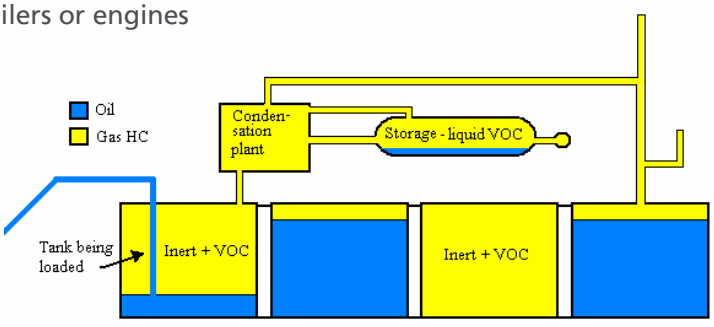
Complying with the Requirements

- Vapour Recovery Systems - General
  - In the late 1990's certain Administrations required offshore installations to reduce their emissions of VOC and this led to the development of vapour recovery systems on board shuttle tankers in the North Sea.
  - The initial efficiency requirement was set to 78% less VOC emissions when using vapour recovery systems.
  - The systems can recover VOC in all operational phases.

Complying with the Requirements

- Vapour Recovery Systems - Condensation
  - VOC's are pressurised and liquefied in a two stage process
  - The resulting liquefied gas is stored under pressure
  - It can then be either discharged to shore or used as a fuel for boilers or engines



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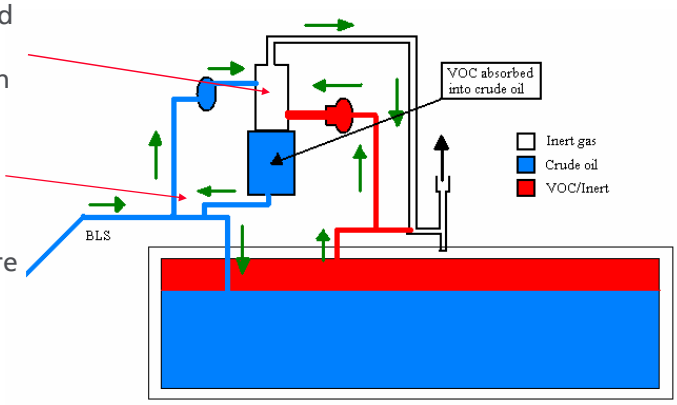
Complying with the Requirements

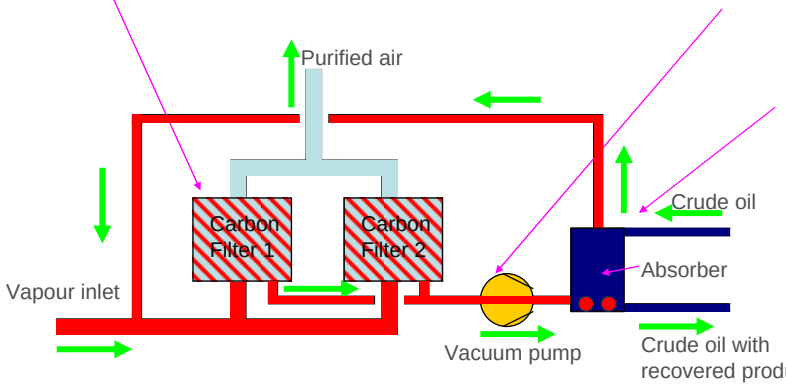
- Vapour Recovery System - Absorption

- VOC's are absorbed in a counter-current flow of crude oil in an absorber column
- The oil containing the absorbed VOC is then routed back to the loading line where it is mixed with the rest of the crude oil



Complying with the Requirements

- Vapour Recovery System - Adsorption
  - VOC's are filtered through activate carbon which adsorbs the hydrocarbons
  - The VOC's are then desorbed by lowering the pressure of the carbon bed



- The extracted vapours are then absorbed into a stream of crude oil taken from and returned to the cargo tanks

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Complying with the Requirements

- Others VOC reduction methods include
  - reducing the content of light ends in the cargo before loading
  - reducing the temperature of the cargo
  - filling the cargo tanks sequentially instead of in parallel
  - reducing the amount of crude oil washing
  - reducing the roll and pitch of a vessel

Complying with the Requirements

- VOC's are to be minimised – there are no specific targets. Therefore, current arrangements can be used
- Most common method currently used is a Vapour Emission Control System (VECS)
- VECS enable a vessel to return vapour produced during loading operations back to shore instead of releasing it into the atmosphere
- However, not all terminals or ports allow the vapour to be returned ashore and so arrangements must be made to store the vapour onboard the vessel
- In addition, care must be taken not to over or under pressurise the vapour or include too much oxygen

Volatile Organic compound (VOC) Plans

Picture by kind permission of Jonathan Morley ©

VOC Management Plan

- The purpose of the VOC Management Plan is to ensure that the operation of a tanker prevents or minimises VOC emissions as much as possible as per MARPOL Annex VI Regulation 15
- Emissions of VOC's can be prevented or minimised by;
  - optimising operational procedures to minimise the release of VOC emissions
  - using devices, equipment or design changes to prevent or minimise VOC emissions

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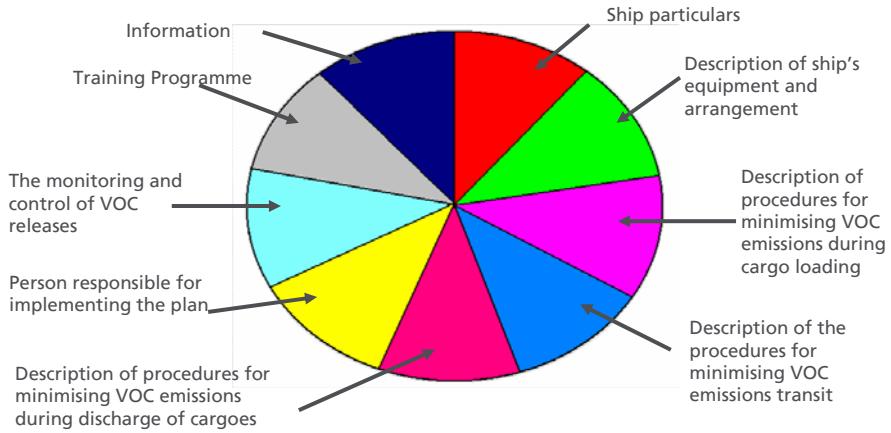
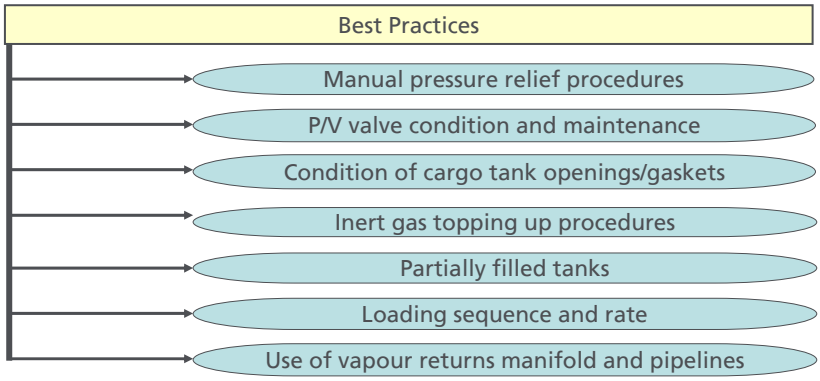
VOC Management Plan

- The VOC Management Plan should include the following information



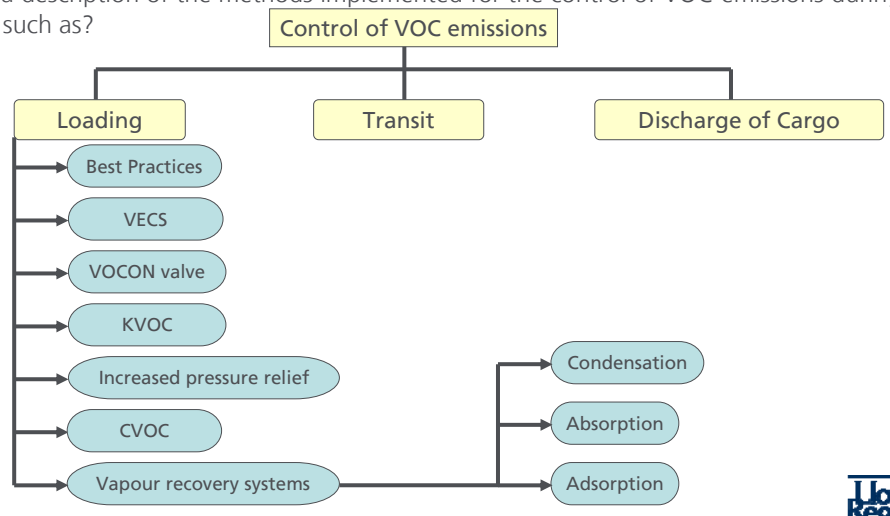
VOC Management Plan

- Are best practices such as the ones listed below included?



VOC Management Plan

- Is there a description of the methods implemented for the control of VOC emissions during loading such as?



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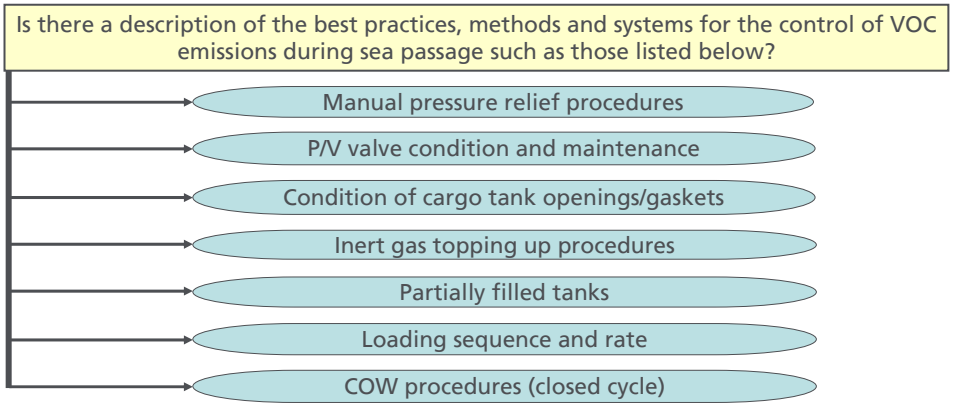
VOC Management Plan

Description of the procedures for minimising VOC emissions during transit



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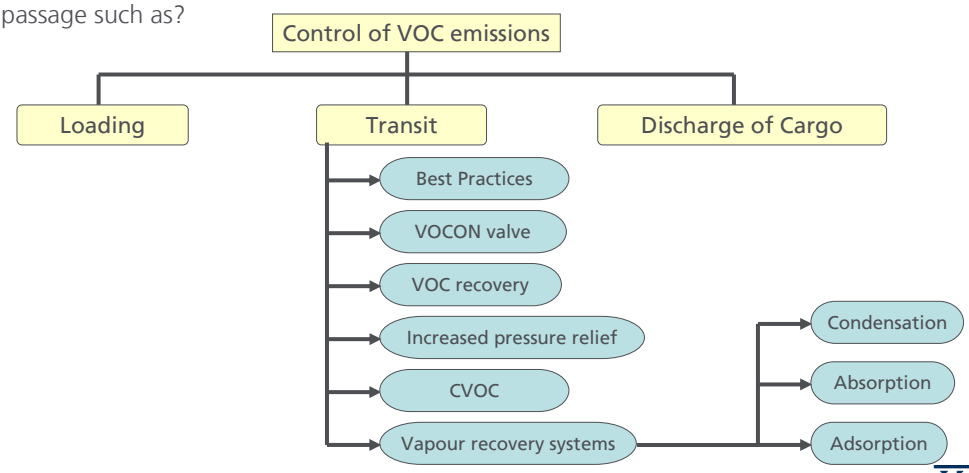
VOC Management Plan

- Is there a description of the methods implemented for the control of VOC emissions during sea passage such as?



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VOC Management Plan

Description of procedures for minimising VOC emissions during discharge of cargoes

- Is there a plan onboard describing unloading procedures?
    - Is the pressure monitored and recorded to avoid excessive supply of inert gas to cargo tanks
- Are closed cycle procedures included in the manual to reduce VOC emissions when using COW?
- Is there a written procedure followed when purging cargo tanks to reduce toxic gases?
- Is there a written procedure followed when gas freeing cargo tanks?

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Ship to Ship Transfer

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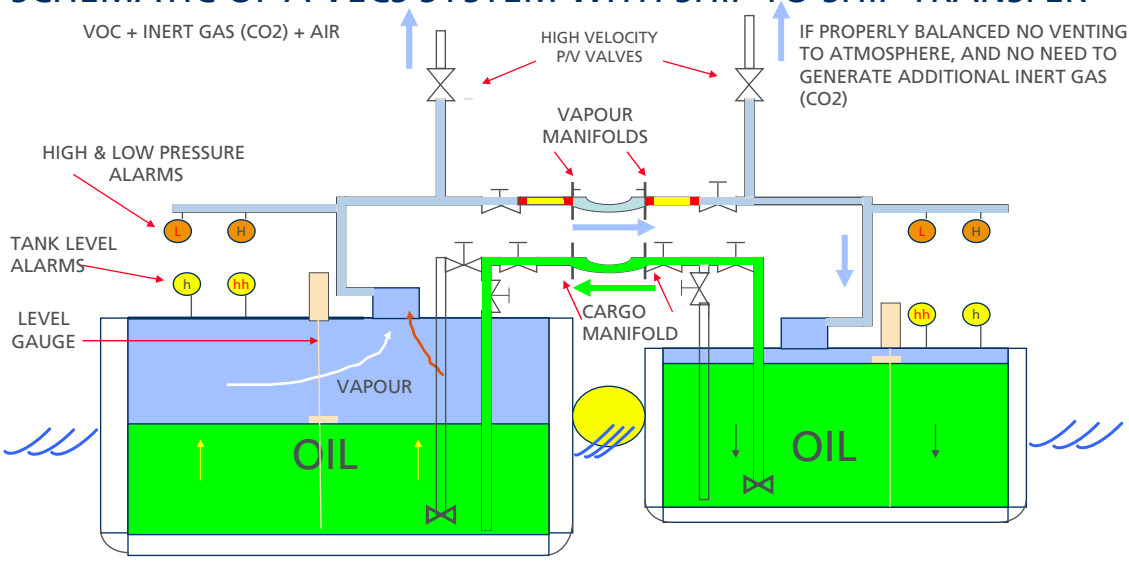
Ship to Ship Transfers

- In the latest amendment to MARPOL Annex I, all tankers doing ship to ship transfer of oil cargoes, except FPSO, bunker tankers etc, will need approved plans at the next survey after 1 January 2011.
- In the MARPOL version there is no requirement for vapour balancing during the operation.
- In the US requirements they tend to use vapour balancing requirements, also understand Amsterdam also require it.
- This reduces the consumption of fuel to generate more inert gas, as well as saving the waste Inert gas from being released into the air.
- Gas carriers (LNG & LPG), and Chemical Tankers also do ship to ship transfers.

SCHEMATIC OF A VECS SYSTEM WITH SHIP TO SHIP TRANSFER



Possible developments from further changes

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Possible developments from further changes

- Energy Efficiency For Ships, added requirements (EEDI + SEEMP)
  Adopted on July 2011; Revision expected to come into force 1 January 2013
- Lloyd's Register is getting requests from managers since some charterers are requesting compliance.
- To improve Energy efficiency, new equipment will be developed, fitted to new vessels and retrofitted to existing ships.
- New equipment will need to be more efficient in energy consumption than the energy emissions saved.

Conclusions

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Conclusions

- Approved VOC Plans were required by 1 July 2010 for Crude Oil Tankers.
- In the VOC Plans it advises what you do during loading, transit and discharge.
- All VOC emissions are Wastes.
- There was no emission limits set, so you can continue your present procedures.
- As discussed at MEPC 62, there is a proposed amendment to MARPOL Annex VI for: Energy Efficiency Design Index (EEDI) and Ship Energy Efficiency Management Plans (SEEMP).
- This is likely to bring in reduction of VOC emissions from ships in the long term.
- If VOC is not emitted from ships, then oil refineries are going to have to be designed to cope with refining Crude Oil with VOC still in it.

Conclusions

- With the continued pressure for the reduction of ship emissions.
- There will be a continued research and development in equipment that reduce VOC emissions. Ideally any new equipment it should be suitable for retro fit to existing vessels, not increase power consumption too much.
- There will be an increase in the request for tankers to carry cargoes at higher pressures. This could feed through to Chemical tankers carrying volatile chemicals under IBC Code paragraph 15.14.
- There will be targets for emissions in the future. There will need to be a standardized and automated means of recording the emissions.
- This is an area we are likely to see continued change in the future.

Cleaner Seas – Life Matters

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Questions?

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