



Towards a cleaner world

Sea Water Scrubbing  
Presenter - Andy Osbourne

Faster Freight Cleaner Air Conference – Long Beach - February 2007

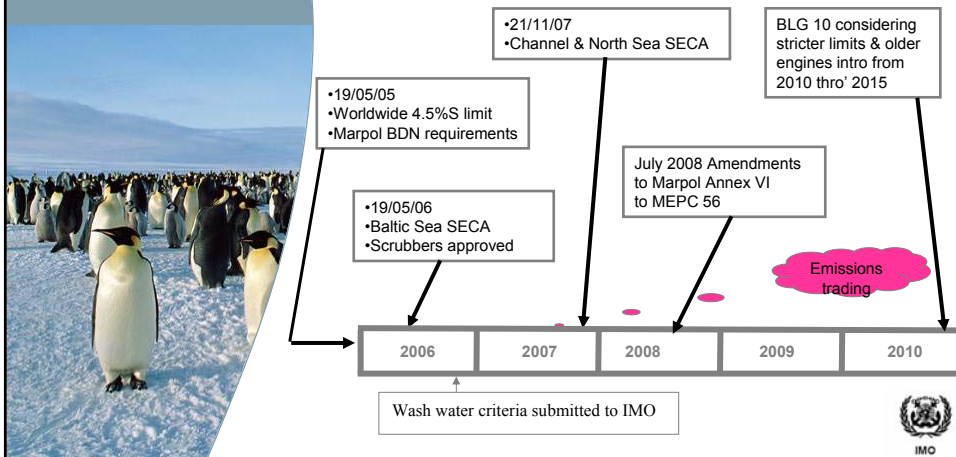


 bp marine | Krystallon, a BP group company

## Krystallon – BP/Kittiwake JV

- BP Group Company
- JV partner – Kittiwake, Littlehampton, UK
- Emissions solutions and energy security
- Six years of expertise & experience

## Marpol Annex VI – sulphur emissions



## Sea Water Scrubbing Facts

### SOME POWER PLANT INSTALLATIONS

- Shenzhen, China
- Guam
- Puerto Rico
- Longannet, Scotland, (approved by EU and Environmental Groups– sulphur into sea – equivalent to 40 super tankers in port at one time)
- Mongstad, Norway
- Tata, India
- Bankside & Battersea, London (1930s)
- Manjung, Malaysia 2,100MW (2003)



Total Sulphur in all fossil fuel

10microns

Sulphur in the ocean

1.7metres



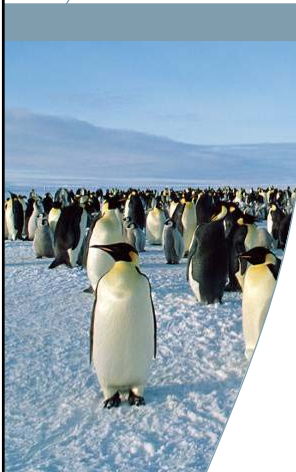
## First fully functional commercial installation

1 MW Krystallon Sea Water Scrubber  
Installed 18<sup>th</sup> December 2005  
Zero sulphur emissions from start-up  
85% Particulate removal

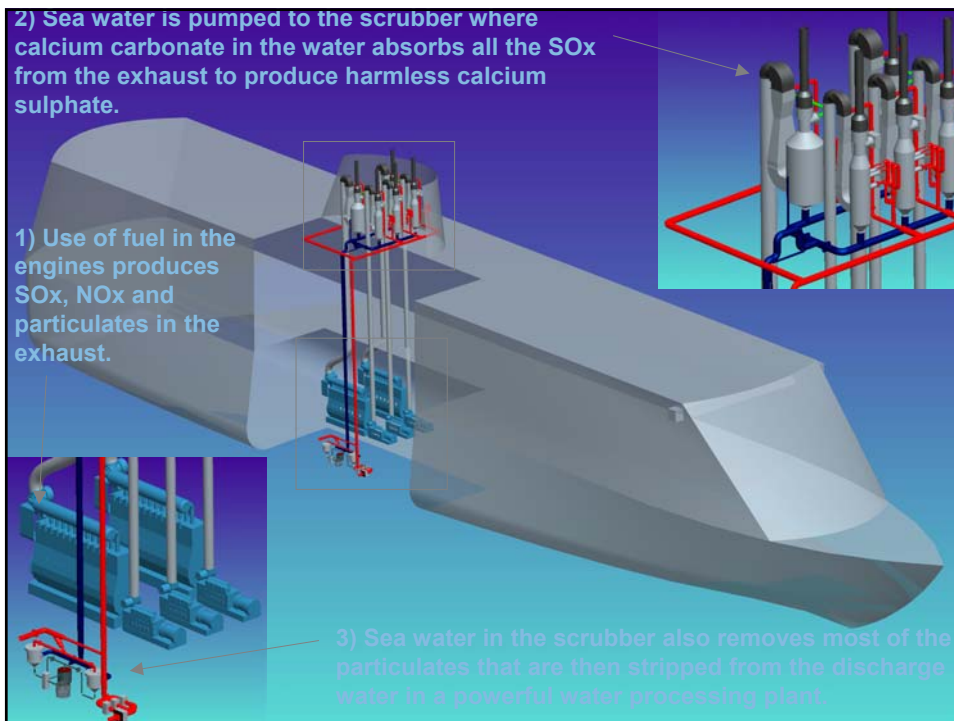
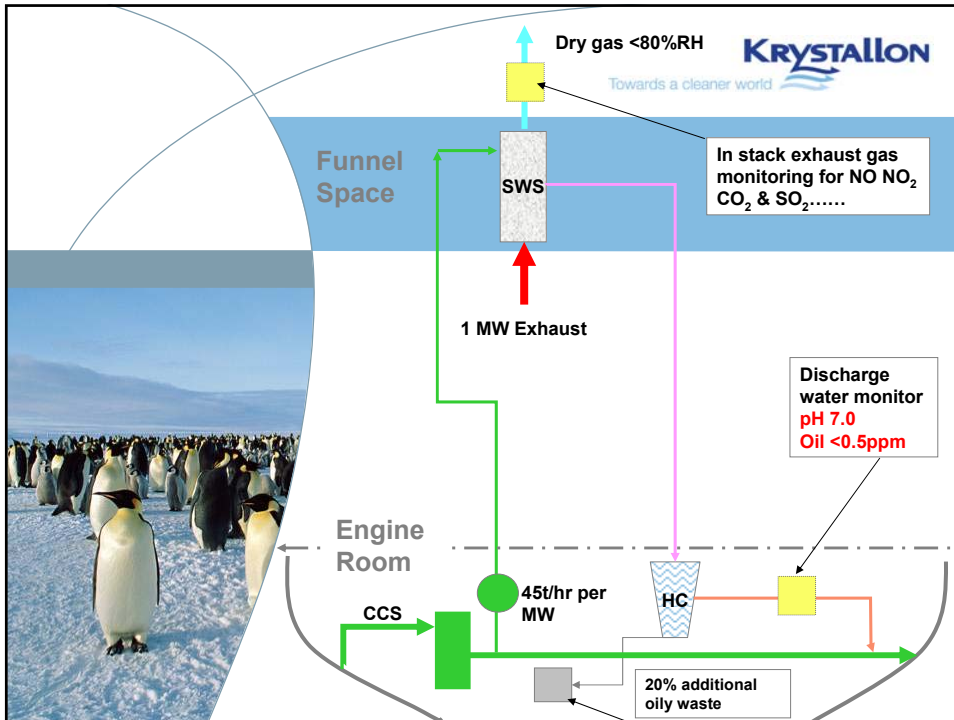


P&O Ferries - mv Pride of Kent

## PofK Scrubber Performance – real data from working unit



- SOx reduction > 99%
- NOx reduction < 5%
- Particulate reduction ~ 85%
- Within diesel engine backpressure envelope
- Water discharge already to IMO guidelines (from Environmental Impact Assessment by Terramare Inst + Newcastle University)
- Installed during normal drydock periods
- No unplanned stoppage since installation (ten months trouble free operation)
- Zero crew intervention

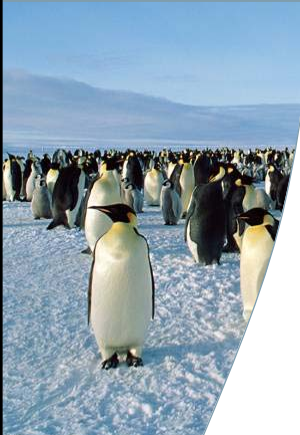


## Waste production



- The water treatment plant will typically produce approximately 20% of the vessels usual oily waste.
- This waste will go into the vessels normal oily waste sludge tank and will be disposed of in exactly the same manner.
- IMO already classifies this waste as “oily waste”
- It is not classed as hazardous waste

## Design developments (Krystallon)



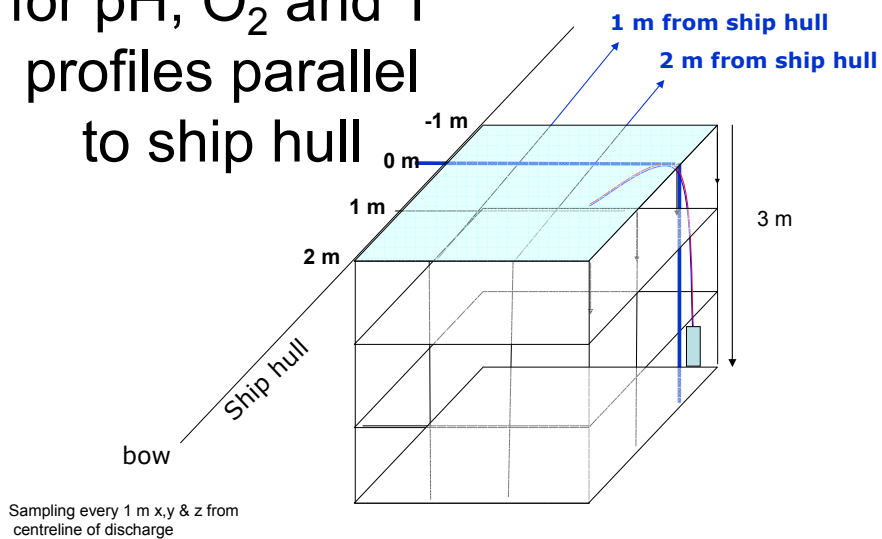
- Currently able to provide scrubbing to 12MW
- Commercial units now being installed
- Design being evaluated to 15 – 25MW (end 2007)
- Range 25MW to 50MW probably 2008
- Web based emissions monitoring

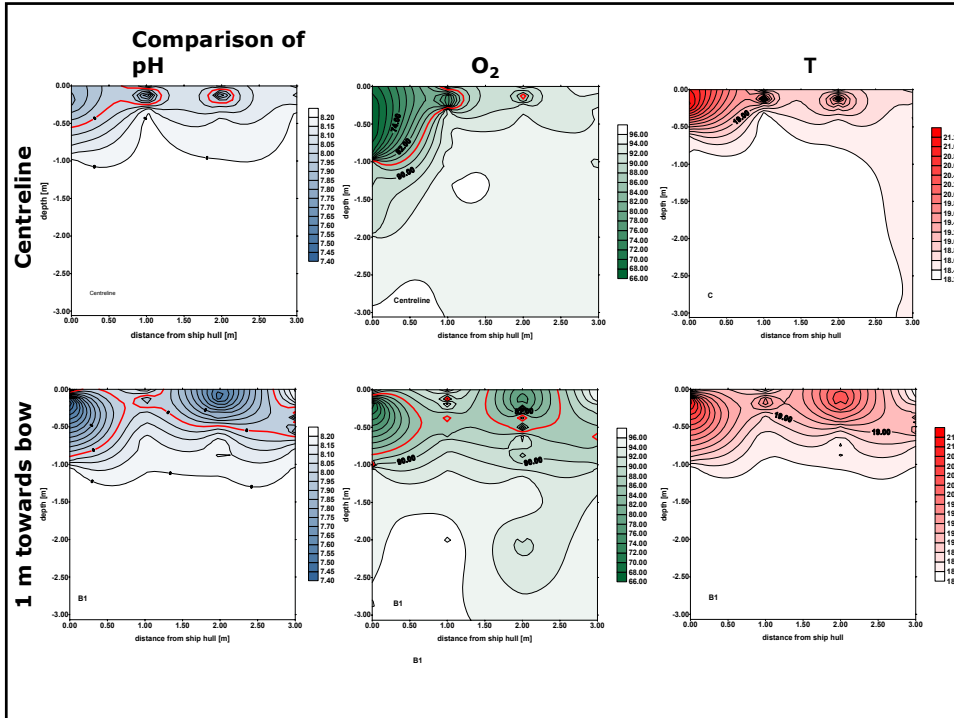
## Performance Monitoring



- **Continuous monitoring** of
- SO<sub>2</sub>,
- CO<sub>2</sub>,
- NO
- NO<sub>2</sub>
- Linked to GPS for ship positioning and data availability
- Assessment of oil monitor capabilities with sensitivity in the region of ppbillion for water discharge!

## Sampling grid for pH, O<sub>2</sub> and T profiles parallel to ship hull





## Some options for compliance



- **Cold ironing**
  - High investment, transfer of pollution
  - Niche solution & possibly regret investment
  - Doesn't address out-of-port running (3 mile limit)
  - Most operators look for other options
- **Use only diesel oil**
  - High cost, tank size
  - Convenient, lower maintenance, no fuel changeover
  - Diesel to HSFO differential gives very quick payback for scrubbers
- **Use 1.5% sulphur fuel**
  - Higher cost, availability, tank segregation, fuel changeover
  - Flexible option, little investment
- **Blend fuel prior to use**
  - Investment, maintenance, verification, reliability
  - Flexible option, low cost
  - Most operators not confident of 100% compliance
- **Install abatement technology**
  - Investment cost
  - Lowest cost fuel, emissions credits, use in port
- **Join an emissions trading group (not yet an option)**
  - Provides an assured means of achieving compliance, choice and lowest cost options for the ship operator

• Trade to different or unregulated port !!

difficult



easier

## Some advantages operators have observed so far during discussion.



- The ability to continue to burn HSFO and fully comply whilst operating in SECA or controlled area.
- No exposure to potential future difficulties on low sulphur fuel availability.
- No logistical or engineering difficulties with regard to burning different fuel or using different lube oil.
- Environmental responsibility – publicly taking “green” stance
- Zero operational maintenance. Turn it on and forget about it ! No crew training or intervention.
- Early positioning on achieving emissions credits.
- Partnered with large trading and proactive environmental BP parent group.

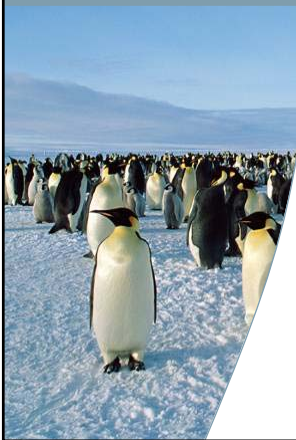
## Current status of scrubbers



- Krystallon - Successful current working installation (100% sulphur removal + PM 85% by mass)
- Others – bench testing and some onboard-type testing – results variable. (Effectiveness from 30% to 50%)
- Actively quoting and now engaged in commercial negotiation. (including funding options)
- Ferry industry affected (potentially) the most – Funding is an issue.
- Huge global interest in realistic and cost effective alternative to low sulphur fuels and cold ironing. West Coast of the USA now expressing large interest.
- Active participation in various legislative input (including scrubbing input as well as wash water discharge criteria)
- Working with BP parent company to facilitate wider offer linked to fuel supply and trading options.

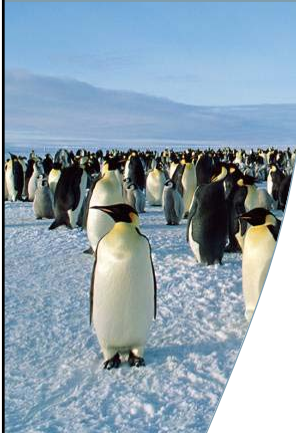


## Particulates – the next legislation??

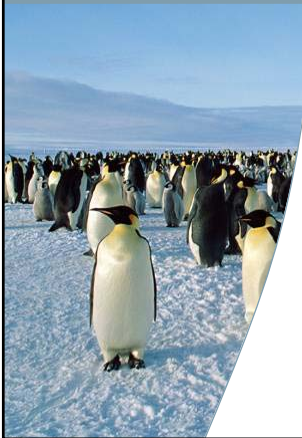


- ARB – USA. Current Auxiliary already effective in January 2007. This has PM limit as well as SOx and NOx.
- Port Authorities in USA (West Coast – Long Beach and Los Angeles) introducing 0.5% sulphur rule also – but with ACP (Alternative Compliance Plan) to effect required levels.
- Other US regulatory bodies also now looking at PM emissions in addition to sulphur
- Lower sulphur fuels will not be the answer for PM emission>Cold ironing (Shore Power) in port – but what in monitored zone??

## Current Cost of Scrubbers



- **Dependent upon vessel type and utilisation**
- Cruise Lines (high use and high utilisation) = \$30 per tonne over 3 year period (3 year payback)
- Ferries - \$40 - \$45 per tonne over 3 years. ( Offsetting will potentially halve this number )
- Current high to low fuel diffs quoted from \$15 up to \$40 per tonne.
- Payback on Auxiliaries versus diesel = 6 months !!



**THANK-YOU**