



# GESAMP

Joint Group of Experts on the  
Scientific Aspects of Marine  
Environmental Protection

“A summary of findings from the first 42 ballast  
water treatment evaluations  
(25 systems, benchmark 1 Feb. 2010)

– are we on the right track?”

Tim Bowmer, Chairman of GESAMP

*Science for Sustainable Oceans*





IMO



FAO



UNESCO



IOC



WMO



UNIDO



IAEA



UN



UNEP

## GESAMP

Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection, an inter-agency advisory body of the United Nations

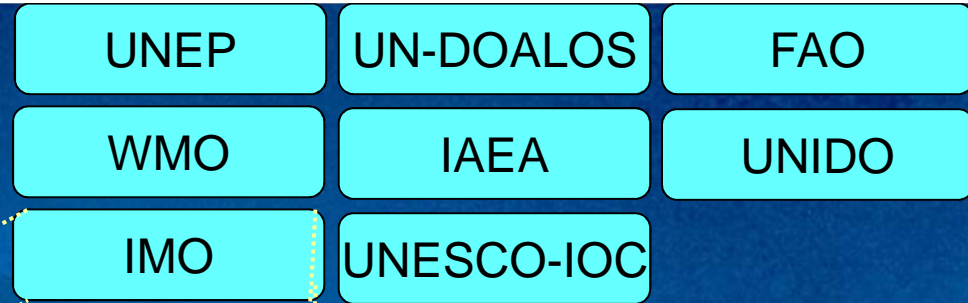
FAO	Food & Agriculture Organization	Rome
IAEA	International Atomic Energy Agency, Marine Env. Laboratory	Monaco
IMO	International Maritime Organization	London
UNDP	Development Programme	New York
UNEP	Environment Programme	Nairobi
UNIDO	Industrial Development Organization	Vienna
UNESCO-IOC	Education, Science and Cultural Organization Inter-Governmental Oceanographic Commission	Paris
UNITED NATIONS	Div. of Legal Affairs & Law of the Sea	New York
WMO	World Meteorological Organization	Geneva



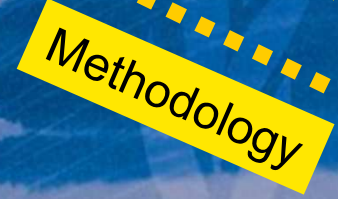
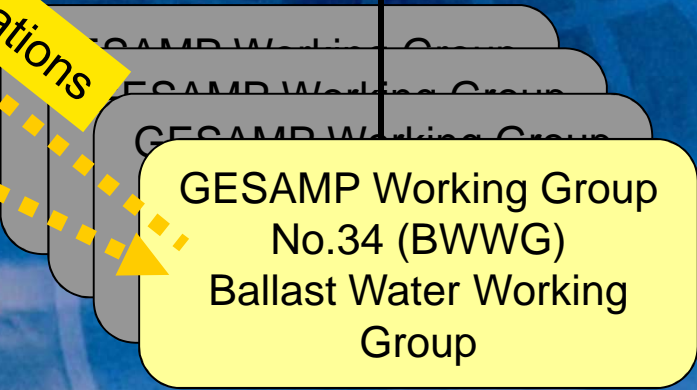
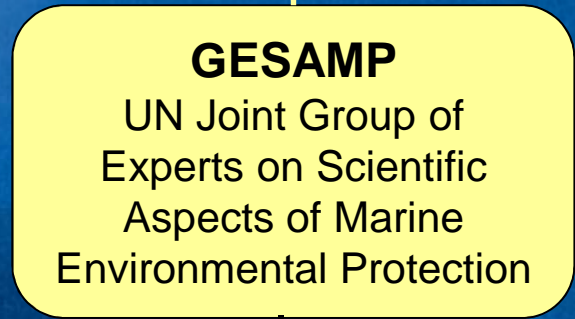
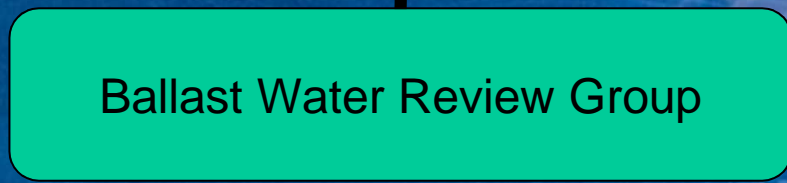
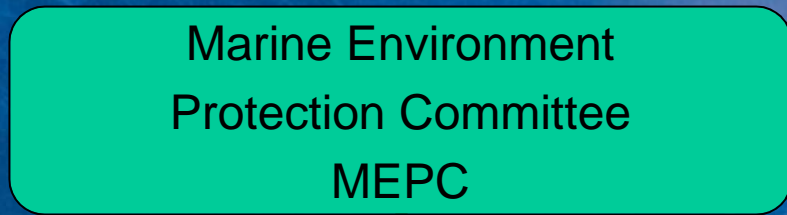
# GESAMP Ballast Water Working Group

- Set up by GESAMP in 2006, at the request of IMO
- BWWG evaluates the risks of BWMS to the environment, to the crew and safety of the ship
- GESAMP reviews and approves the recommendations of BWWG before communicating them to MEPC
- BWWG does not evaluate efficacy, it has no information on whether the systems actually work

# Evaluation of Ballast Water Management Systems under the Ballast Water Convention 2004



*Marine Environmental Assessments*





# Principal disinfecting chemicals

- **active chlorine species:** chlorine, hypochlorite and  $\text{OCl}^-$  radicals (electrolysis)
- **reactive oxygen species:**  $\cdot\text{OH}$  radicals, ozone, hydrogen peroxide, and  $\cdot\text{O}_2^-$  radicals,

BWWG has seen all of these in submissions – to date and for very good reasons, no chemicals other than oxidizing biocides have been submitted, e.g. no bromine releasers, organic pesticides, etc



## Success rate of systems: BWWG 1 to 11

- GESAMP BWWG has evaluated 42 (now >55) submissions on 25 (now >35) different systems
- 2 of 25 systems failed Basic Approval and never reappeared in the same form again
- 23 of 25 achieved basic approval first time
- 14 of 25 systems have been evaluated for final approval,
  - 9 gained final approval on the first attempt,
  - 5 (35%) failed final approval on the first attempt
  - 3 gained approval on the second attempt
  - 2 have yet to be resubmitted



# Common reasons for rejection of final approval

## System components poorly integrated

- Control system is still incomplete at FA
- Neutralization step is still conceptual at FA

## Environmental performance

- Relationship between efficacious dose and safe discharge concs. not established - concentrations on discharge too high
- Environmental risk assessment poorly carried out and unconvincing



# Disinfection methods of first 25 systems

Main disinfection method	No. of systems
Electrochemical (mainly chlorination)	9
UV irradiation	4
Ozonation	4
Stored chemicals which are dosed to the ballast water as preparations	3
Combination of 2 main (electrochemical/physical) disinfection techniques	2
Titanium photo-catalysis	1
Drinking water flocculation technology	1
Plasma technology	1



# Environmental concerns

- Residual oxidant (TRO) at toxic levels upon discharge
  - Dosed concentrations too high
  - Die-away time too short
  - Adequate mitigation through neutralization
- Conc. of by-products is determined by organic matter conc. in the treated water interacting with chlorine
  - Effective pre-filtration is therefore important with electrochemical and chemical systems generating or using chlorine
- Spillage of stored chemicals

How do systems perform in terms of by-product emissions?



# Chlorination by-products

A total of 18 substances have been identified as common to nearly all chemical and electrochemical systems

- Trihalomethanes (Cl and Br)
  - Bromoform is volatile and carcinogenic
- Trihaloacetic acids



# Conclusions

- The emission of chlorination byproducts (CBP) needs further consideration as part of integrated local and regional exposure scenarios (overall impact as well as individual systems)
- The human health risks associated with bromoform need further consideration
- The effective operation of filtration units to reduce CBP: e.g. hydrocyclone technology could help to reduce organic matter levels
- The most environmentally friendly systems appear to be: UV, Titanium photo-catalysis, and flocculation. Of the electrochemical systems, ozonation and systems designed to reduce free chlorine are potential improvements.
- Not all electrochemical systems are the same – there is room for further development & improvement – there is currently much ongoing research in the fields of electrochemical disinfection, energy efficiency and by-product reduction



# Some final thoughts

IMO is finalising a discussion document aimed at MEPC on non-chemical, ballast-water management systems:

- No ballast
- Solid ballast
- Flow-through ballasting

These involve radical redesign of the 'ship' – aside from performance and safety issues, equivalence in BW performance standards is a concern for IMO





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**Thank you for listening**

**This talk represents the  
private reflections of the  
author and not the opinion of  
GESAMP or of IMO**

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*Fiets met dank aan Gemeente  
Westland!*