National Defence / Défense nationale

Ballast Water Management Study for Halifax Class Frigates

MATERIEL

Canada

Overview

1. Regulations: International, Canadian, American, Great Lakes, Navy
2. Halifax Class
   - A. Current Procedures
   - B. Ballast System
   - C. Life Extension
3. BWM Options
   - A. Military Exemption
   - B. Treatment Systems
   - C. Onshore Treatment
   - D. Permanent Solid Ballast
   - E. Fuel
   - F. Grey & Technical Water
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     - I. Integrating Freshwater into Halifax Class
4. Conclusions and Proposed Solution

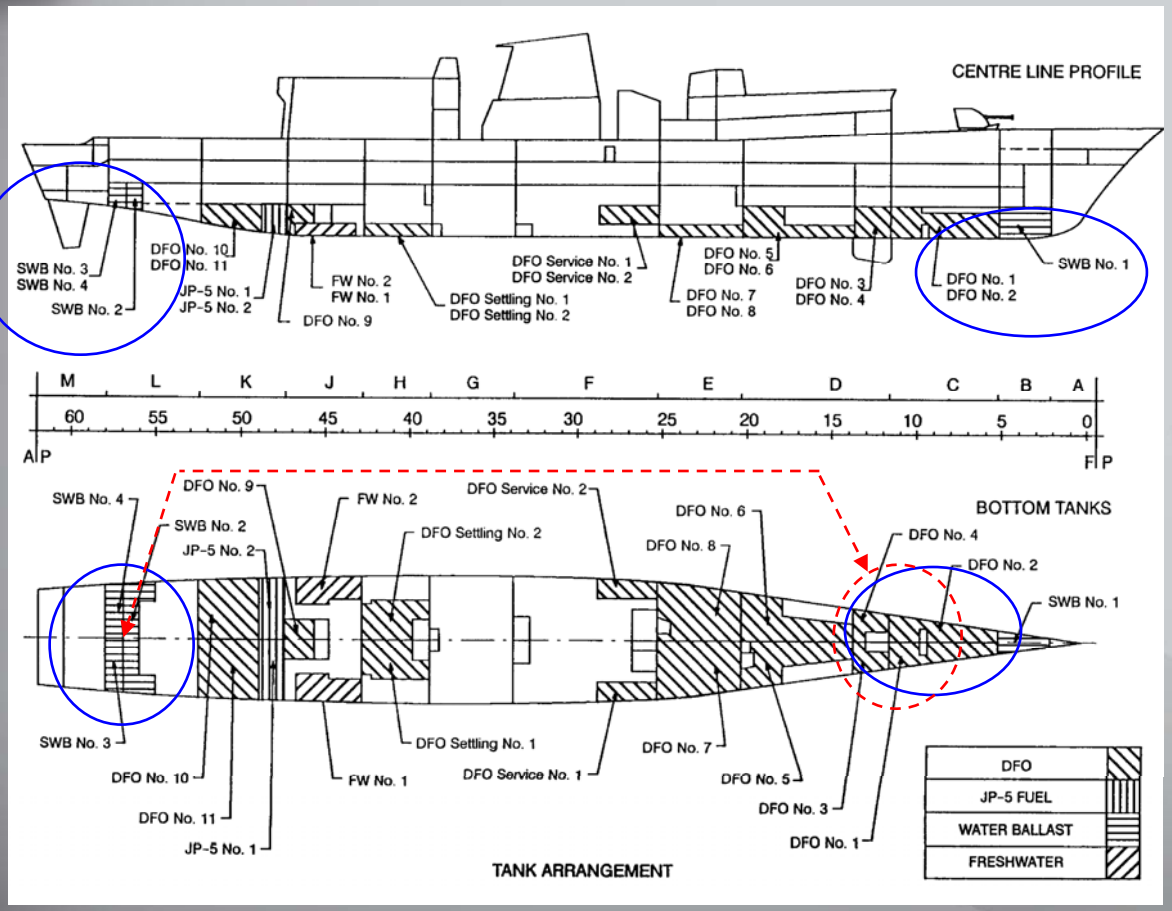
Halifax Class – Ballast Water Management

1. **Halifax Class**
   A. **IMO Regulation D-2 would apply in 2016 (about 164 m^3 ballast)**

Halifax Class – Ballast Conditions

Condition	Sea Water Ballast State
Deep Departure	**All tanks empty.**
Deep Departure w/ Fuel	**Each tank filled with DFO to 95%**
Operational Light	**All tanks empty. If DFO < 1/3 full, lost weight replaced by SWB to maintain stability**
Operational Light w/ Fuel	**Each tank loaded to 31.6% capacity with DFO**
Operational Light w/ Ice	**All tanks empty**
Operational Light w/ Ice or Extreme Weather and SWB	**Each filled with Sea Water Ballast to 100% capacity. Not essential but provides additional measure of safety**
Docking	**All tanks empty**

Halifax Class – Ballast Capacity



Tank	Capacity
SWB No. 1	**30.5 m³**
SWB No. 2	**76.6 m³**
SWB No. 3	**28.5 m³**
SWB No. 4	**28.5 m³**
DFO No. 3	**27.55 m³**
DFO No. 4	**27.55 m³**
Total	162.2 m³

Tank #	Ballast In/Out	Amount	Water/Fuel	Reason for Ballasting	Date
4 SWB	**In**	**2 t**	**water**	**Line Flushing**	**02-Sep-99**
4 SWB	**Out**	**2 t**	**water**	**Tank Cleaning**	**04-Sep-99**
3 SWB	**In**	**13.62 t**	**water**	**Port List**	**08-Sep-99**
3 SWB	**Out to #4 SWB**	**7.4 t**	**water**	**Transfer Water, Stbd List**	**22-Sep-99**
4 SWB	**In from #3 SWB**	**7.4 t**	**water**	**Transfer Water, Stbd List**	**22-Sep-99**
1 SWB	**In**	**2 t**	**water**	**Trial**	**23-Sep-99**
3 SWB	**Out/In**	**2.5 t /2.5 t**	**water/water**	**Trial**	**23-Sep-99**
1 SWB	**Out**	**2 t**	**water**	**Flush**	**29-Sep-99**
4 SWB	**Out**	**8 t**	**water**	**Even Keel**	**18-Nov-99**
3 SWB	**In**	**12.5 t**	**water**	**Even Keel**	**18-Nov-99**
3 SWB	**In**	**10.3 t**	**water**	**Even Keel**	**24-Nov-99**
2 SWB	**In**	**73.31 t**	**water**	**Trim for Rough Weather**	**29-Nov-99**
2 SWB	**Out**	**71.43 t**	**water**	**Humidity Aft Mess Decks**	**30-Nov-99**
F/W	**In**	**29.7 t**	**water**	**Undocking**	**25-Nov-01**
C5 Dome	**-**	**-**	**seawater**	**SONAR Prep**	**-**
2 SWB	**In**	**75 m^3**	**seawater**	**Stability Improvements**	**14-Sep-02**
1 SWB	**In**	**29.199 m /29.918 t**	**seawater**	**Stability Improvements**	**15-Sep-02**
1 SWB	**Out**	**108.9 t**	**seawater**	**Pre-fueling**	**17-Sep-02**
2 SWB	**Out**	**33.889 m^3**	**seawater**	**Pre-fueling**	**17-Sep-02**
2 SWB	**Out**	**43.86 m^3**	**seawater**	**Deballast the remaining SW for fueling**	**-**
3 SWB	**Out**	**23 t**	**water**	**Even Keel**	**09-Sep-03**
3 SWB	**In**	**23 t**	**freshwater**	**Even Keel**	**07-Nov-03**

HMCS MONTREAL Ballast Log

IMO Ballast Water Convention – Ballast Water Management Options Considered

1. Military Exemption
2. Treatment System
3. Discharge to Onshore Treatment Facility
4. Permanent Solid Ballast
5. Alternate Liquid Ballast

1. Military Exemption

1. Canadian Navy's mandate to meet or exceed environmental regulations
2. Other navies are considering BWM options
3. IMO Convention, Article 3:

   "Each party shall ensure, by adoption of appropriate measures not impairing operations or operational capabilities, that ships act in a manner consistent [...] with this Convention"
4. Fisheries Act prevents pollution of water (AIS could be considered); Navy is not exempted, but precedence of Acts is convoluted.
5. Not recommended as a BWM Solution

2. Ballast Water Treatment – Direct Biocide Dosing

1. Manual or automatic biocide dosing often cheaper, more compact that a BWTS
2. Often very effective but effectiveness in different water conditions and residual toxicity have not been fully evaluated
3. Environment Canada Peraclean® Ocean in St. Lawrence River:
   A. Final approval from IMO in 2008
   B. Effective in cold, brackish water (0.1°C to 0.5°C), destroying organisms
   C. Long period of residual toxicity, up to 91 hrs
   D. Approximate cost of $US 200 per 1000 m^3 of ballast water treated (200 m^3/hr)

2. Use of Ballast Water Treatment Systems

1. Concerns:
   A. Appropriate technology not mature
   B. Regulatory uncertainty
   C. Operational and maintenance costs
      I. System 1 : $US 542 257 + piping, installation, labour (200 m^3/hr)
      II. System II : $US 178 500 + piping, installation, labour, consumables (150 m^3/hr)
   D. Retrofit design
   E. Varying residual effects

2. Not recommended as BWM Solution for the HFX Class

3. Onshore Treatment

1. Technology advanced
2. General lack of facilities
   A. Wastewater treatment facilities freshwater only
   B. Complex and costly, only limited feasibility studies complete
   C. Shore treatment must be combined with onboard treatment

3. Not recommended as BWM Solution

4. Permanent Solid Ballast

1. Some solid ballast will be added during Life Extension process
2. Post-Modification Departure Displacement: 5258 tonnes
3. Structural Limit: 5384 tonnes
4. Not recommended as BWM Solution due to weight restrictions and operational restrictions

5. Alternative Liquid Ballast – Fuel

1. **Fuel**
   A. **Increase in Diesel Fuel Oil capacity by 29% (35 tonnes)**
   B. **Permanent Diesel Fuel Oil in Sea Water Ballast tanks was never recommended due to weight restrictions**

2. **Extra fuel capacity required for long deployments and Arctic deployments**
   (Arctic Pollution Prevent Act)

3. **Not recommended as a BWM Solution**

5. Alternative Liquid Ballast – Grey & Technical Water

1. Grey water
   A. Wastewater from showers, kitchens, boilers, etc., variable composition (may contain bacteria, pathogens, detergents, etc.)
   B. Can only be discharged more than 3 nautical miles from shore

2. Technical Water:
   A. Treated black and grey water
   B. OMNIPURE Marine Sanitation Device used onboard Halifax Class

5. Alternative Ballast – Grey & Technical Water

1. **Disadvantages include:**
   A. **Variable supply and composition**
   B. **Some jurisdictions restrict dumping**
   C. **Complex piping would be needed**

2. **Not recommended as BWM Solution**

5. Alternate Liquid Ballast – Freshwater

1. Currently generated by two Reverse Osmosis plants
   A. Water temperature, salinity, feed water pressure, rate of recovery (ratio of drinking water to feed water)
   B. Treatment with bromine (1% of stream diverted)

Pass	Production at Specific Temperatures [Tonnes per Day]		
	-2°C	25°C	35°C
1st (Drinking Water)	25	33	42
2nd (Boiler Water)	5.4	6.5	7.6
1st + 2nd (Drinking Water)	-	12.5	-

Dimensions	2.77 m long x 1.82 m wide x 2.39 m high
Weight	3596 kg
Volume	12.06 m^3
Range of SW Total Dissolved Solids (TDS)	28 000 ppm – 39 000 ppm
Maximum Roll	40°
Maximum Pitch	10° Up/Down, 5° Fore/Aft
Maximum List	20° Port/Starboard
SW Feed Pump	160 – 178 L/min

Alternate Liquid Ballast – Fresh Water

1. **Advantages: Installation of extra Reverse Osmosis plant can solve production issues:**
   A. **In demand for several services onboard**
   B. **Demand for ballast relatively small**
   C. **Location : Available space**

2. **Disadvantages:**
   A. **Weight (3.6 tonnes)**
   B. **Cost (new plant is about $CAD 1 million)**
   C. **Variable FW production**
   D. **Cannot quickly fill tanks**

Alternate Liquid Ballast – Fresh Water

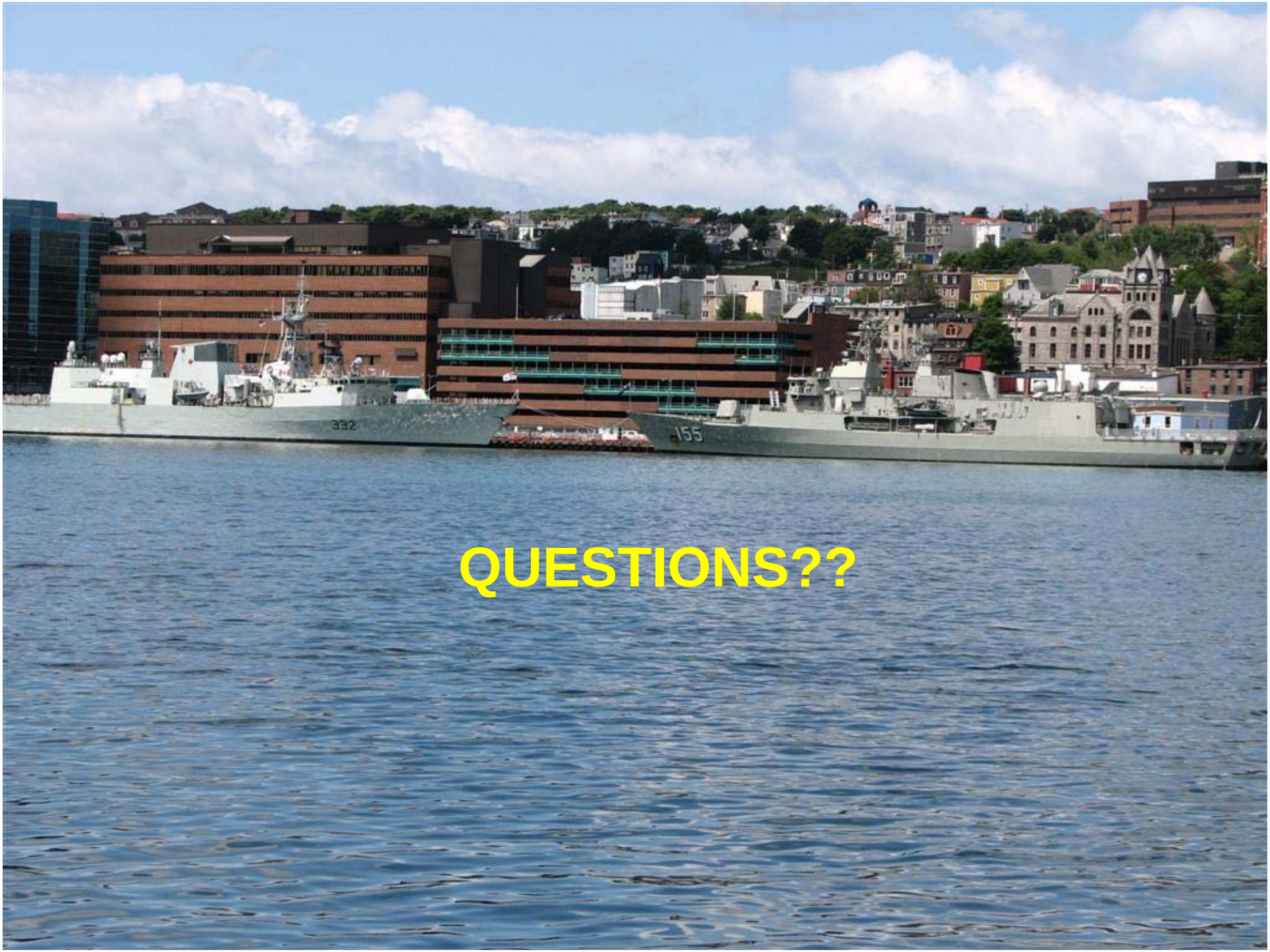
1. Integration into current ballast system and develop FW production schedule

2. Current ballast system will have to remain in place (emergencies or when rapid fillings of tanks is necessary)

Way Ahead

1. Installation of additional Reverse Osmosis plant

2. Integrate with existing piping


QUESTIONS??