Defence Materiel Organisation
Ministry of Defence

New Air Monitoring System (AMS)

Walrus Class Submarines

DMO MARSYS & RNLN DMI ENG
Isaac Barendregt & Bert Scholte
Sr. Eng.

Introduction

- History
- Temporarily solution
- Program of Requirements
- Selection process
- The result of selection
- Progress and planning
- Summary and outlook

History Walrus-Class

- New build submarines RDM
- First construction start: 1979
- First seatrials: 1988
- Commissioning: first 1990, last 1994.
- Initial lifetime: 30 years.

History of Air Monitoring System Walrus-Class

- CAMS system from Perkin Elmer-Hamilton Sundstrand
- Maintainability became problematic:
  Defects, obsolescence, downtime in years, costly modifications, poor service.
- Costs too high: decision made in 2012 to shut down CAMS.
- Maintenance budget used for temporarily solution.

Temporarily air monitoring solution

- Hand held/portable instruments.
  Per submarine:
  - 5 Analox SUB Aspida's (CO2 en O2)
  - 2 Dräger X-AM 5600
    - CO (compensated for H2)
    - CO2 and O2

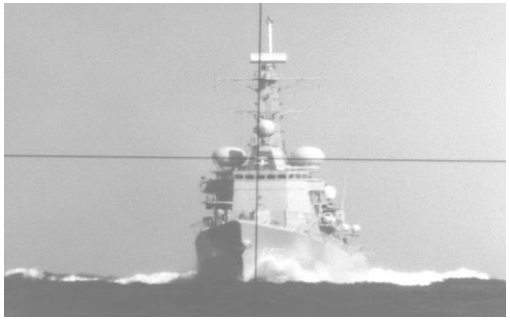
- Always on board for escape/emergency:
  (extra info)
  - 2 Analox SUB MKIIp

Midlife Upkeep Program Walrus Class

Midlife upkeep program of the Walrus class (IPW) has amongst others the intention to extend operational life of the class until at least 2025.

→ New air monitoring system required.

Project is part of IPW.
Start project: 2010



Program Of Requirements new system

Aim:

Original functionality, extended with lessons learned.

Main technical requirements:

- No preference for central suction or distributed sensors
- Built in redundancy
  (e.g. malfunctioning sensor, closed bulkheads)
- Continued measurement at complete closure of bulkheads (suction lines closed)
- General Design Requirements Walrus-class
  (shock, voltage, EMC, noise, pitch/roll, etc.)
- Dynamic and static pressure variations
  (750 mbar – 1300 mbar/ RoC of pressure variations 10 mbar/s)
- Pressure compensation

Program Of Requirements (continued)

- Gases to be monitored i.a.w. MOD-regulations (3VVKM4):
  - O2
  - CO2
  - CO
  - H2
  - R134A
- No cross sensitivity for H2 (ref. CAMS).
- Ranges and accuracy:

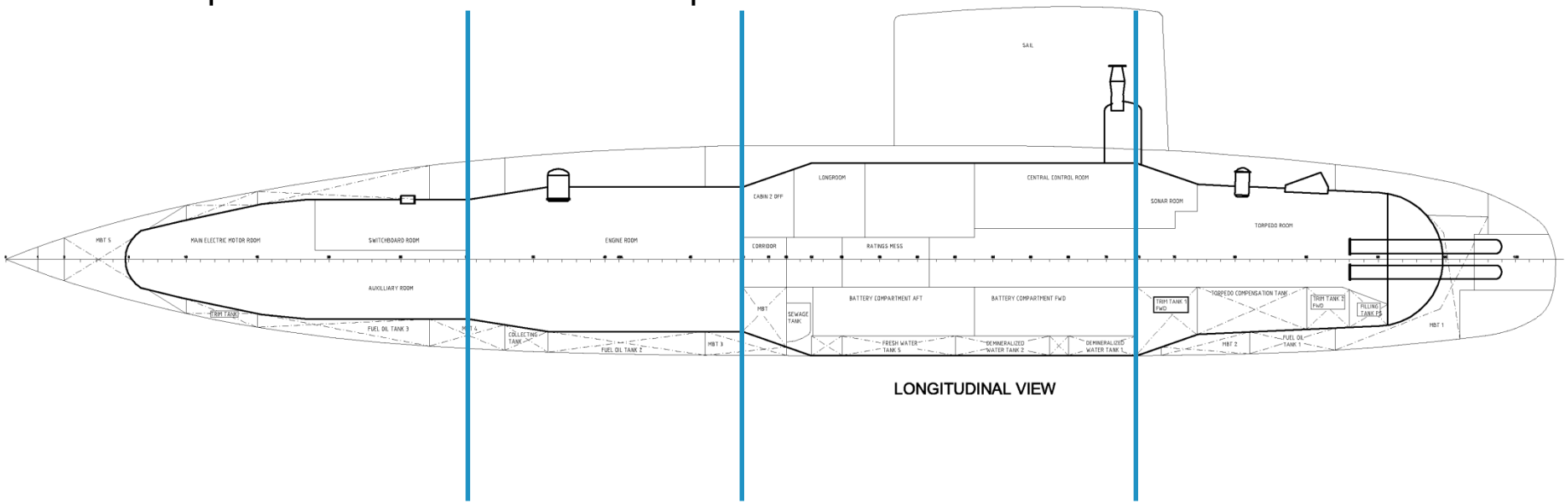
Substance/ quantity	Range	Accuracy[3]	Typical alarm level(s)
Oxygen	14 – 25 %	max 0.5 %	≤ 18.0 % and ≥ 22.0 %
Carbon Dioxide	0 – 5 %	max 0.1 %	≥ 1.5 %
Carbon Monoxide	0 – 150 ppm	max 7 ppm	≥ 100 ppm
Hydrogen	0 – 4 %	max 0.5 %	≥ 1.5 %
Refrigerant R134a[4]	0 – 1000 ppm	max 30 ppm	> 250 ppm
Refrigerant R404a[4]	0 – 1000 ppm	max 30 ppm	> 250 ppm
Absolute pressure	750 – 1300 mbar	max 10 mbar	≤ 800 mbar

Program Of Requirements (continued)

- Central (CCU) and Local control units (LCU) in a network (screens, information, alarms, control, connection to ship's IMCS).
- Logging of concentrations and alarms.
- Min. 6 weeks continuous operation without calibration.
- 6 hours UPS time for CCU.
- Not for submarine in distress (big calamity).
- Ambient temperature (0 ºC - 60ºC)
- And a lot more detailed requirements.

Gas Sampling Locations

1. Electrical switch room in the aft (gastight) compartment
2. Engine room in the aft compartment
3. Junior rates mess in the middle compartment
4. Central command room at the upper deck in the middle compartment
5. Torpedo room or forward compartment.



Selection of supplier

- Companies invited for an offer:
  - Analox
  - DCNS (Simtronics)
  - Dräger
  - Hamilton Sundstrand
  - Imtech/Bionics
  - SICK Maihak
- 3 out of 5 offers satisfied the requirements and were ranked (Hamilton Sundstrand did not offer, Bionics offer was not competitive and withdrew themselves from competition, DCNS was above budget (nuclear price))
- Analox, Sick Maihak, Dräger remained.

Ranking criteria

- Price 25 %
- Compliant to POR 24 %
  - Cross sensitivity H2
  - Future expansion (extra sensors)
  - Ease of maintenance and calibration
  - Integration in ships automation
  - Demand for calibration
- Planning/delivery time 11%
- Used techniques 10%
  - Proven, innovative, small, light weight.
- Redundancy 10%
- Space/volume 10%
- Platform integration 10%
  - Electric power, heat production, weight.

Involved organisation parts: (all filled out ranking sheet)

- DMO (project management, design authority)
- Naval Dockyard engineering (maintainer)
- Navy (user)

SICK was selected

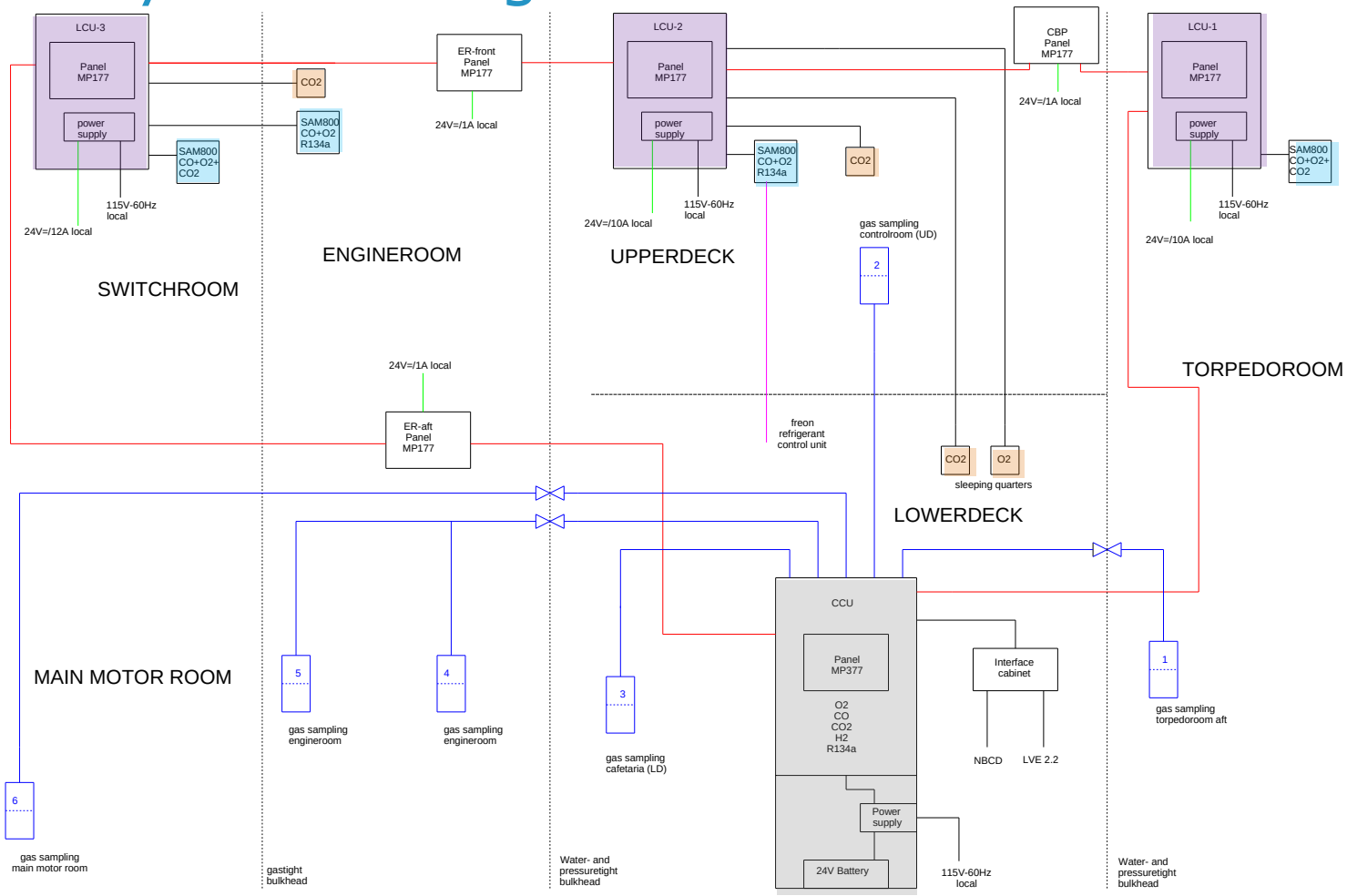
PROs

- Great redundancy
- Great track record of more than 50 submarine systems (all submarines from HDW)
  (Italian navy (U212, HDW) satisfied customer)
- Price competitive and within budget
- All sensors commercial available and large numbers supplied
- All sensors shock tested and reports available

CONs

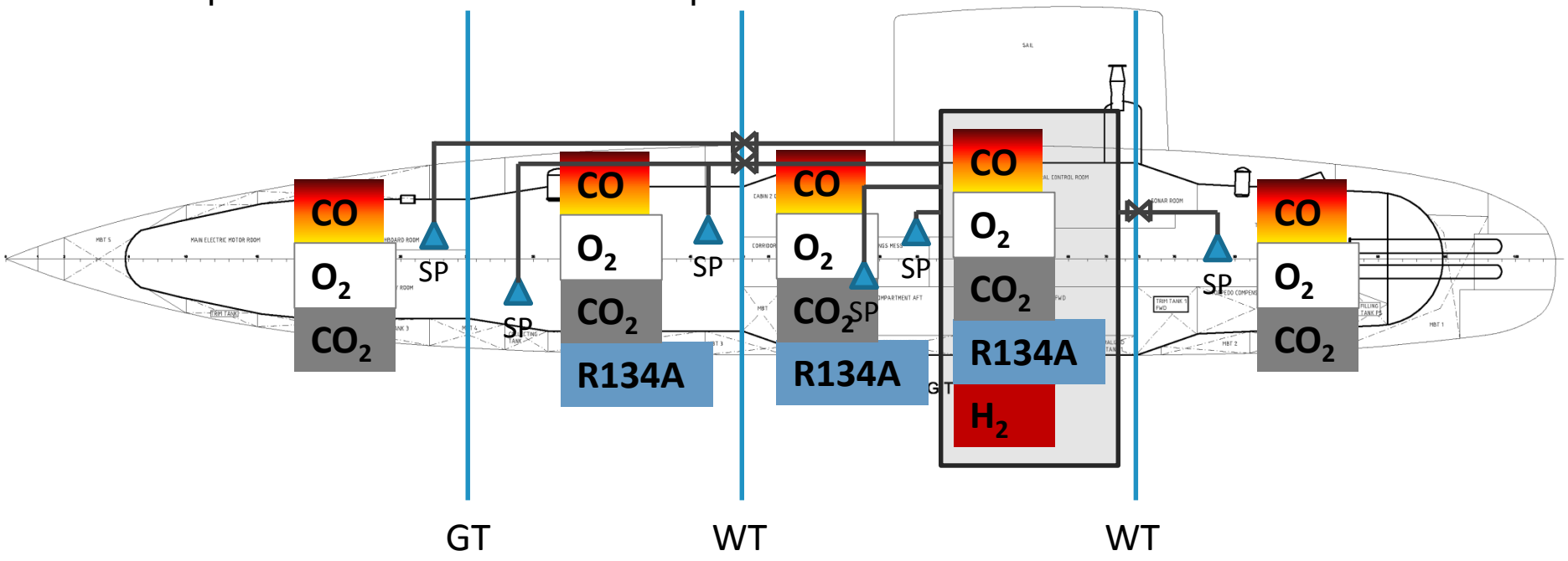
- Largest power consumption (delta accommodated in energy balance IPW-program)
- Largest volume/weight (could be accommodated on board and weight balance)
- Not a system integrator

SICK system configuration



System layout

1. Electrical switch room in the aft (gastight) compartment
2. Engine room in the aft compartment
3. Junior rates mess in the middle compartment
4. Central command room at the upper deck in the middle compartment
5. Torpedo room or forward compartment.



System components

CCU

- Central suction system
- Pre-suction / suction cycles
  - 1 min measuring per compartment
  - 4 min pre-suction other comp's
- Connection to all LCU's and IMCS

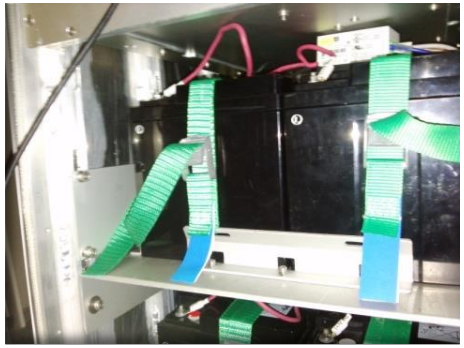
LCU

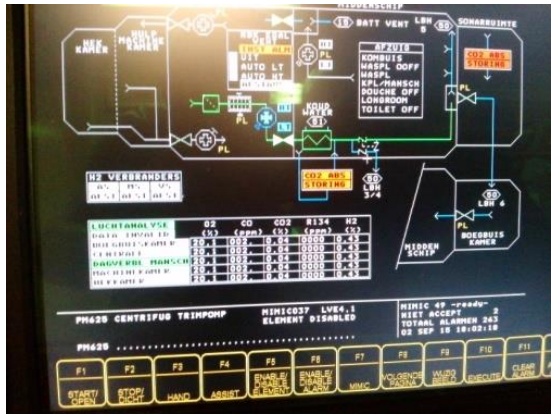
- Controls lo
  - SAM80
    - Sens
  - Dräger
    - Limi
- Network hu

115 V / 24 4V UPS

The result at FAT

Installed on board HMS Zeeleeuw





Progress and planning

- FAT system 1: February 2014
- HAT system 1: 7/8 September 2015 HMS Zeeleeuw.
  - Some minor issues (software, defects)
  - HAT2 system 1: October/November 2015
- SAT system 1: Spring 2016 HMS Zeeleeuw
- Successful HAT2 triggers start construction of systems 2, 3 and 4
- System 2 on HMS Dolfijn 2016/2017
- Option: standalone CCU of System 3 and 4 on operational boats HMS Bruinvis and HMS Walrus 2016/2018
- 2017-2021 completion of systems 3 and 4
- 2015 service contract with Sick for repairs and calibration

Summary and outlook

- CAMS was no longer maintainable, new monitoring system required.
- Redundant system with proven components selected.
- First system is installed, HAT in progress.
- Future growth possible for other sensors (VOC's, …?).

<u>New submarine program (OZB20XX):</u>

- Probably (much) longer operational underwater time.
- Research project will start Q1 2016, addressing a.o.:
  - Determination of species in the boat's atmosphere;
  - Determination of max permissible concentrations;
  - Investigation into technologies to reduce concentrations, including market survey;
  - Impact on submarine design.


50
1965 jaar 2015
flipper
Questions?