NEMO Phase2 mechanical design

G. Cacopardo

on behalf of NEMO collaboration

Outline of the talk

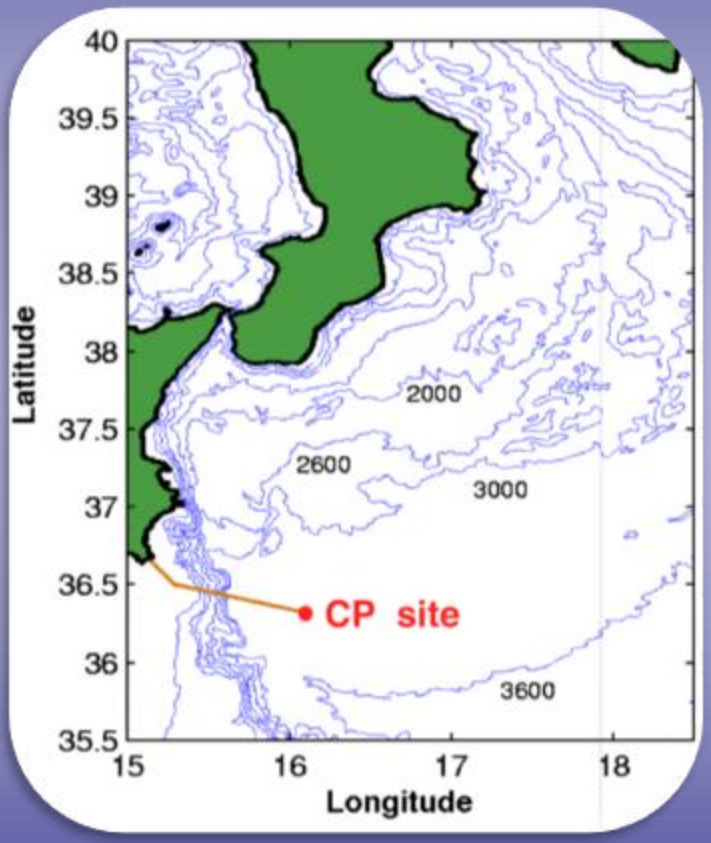
- NEMO Phase2 mechanical design.
- Electronic Vessel design
- Connectors & cable system
- Conclusions

The project

NEMO Phase2 is a project approved by INFN in 2007.

The project's objective is to build an instrumented mooring line to be installed in Capo Passero site in order to:

- Perform on line monitoring of the site.
- Test the Medium Voltage Converter (MVC).
- Conclusive test of the technologies developed by the NEMO collaboration.
- provide several useful information for KM3NeT development.



Tower's Technical Specification

Item	Value
# of Storey	8
Storey's length	8 m
Vertical spacing between storey	40 m
Vertical spacing anchor => 1st storey	100 m
# of Optical Module per storey	4 (single PMT 10" inside 13" glass spheres)
# Hydrophones per storey	2

The History

Main milestones in the mechanical design's development:

- F1 Scaled model 1:5 (referred to a 15m long storey =>3 m bar length) 2004
- F2 Nemo Phase1 2006
- F3 Mechanical Prototype 12 m 2010
- F4 Nemo Phase2 End of 2011

Scaled Model

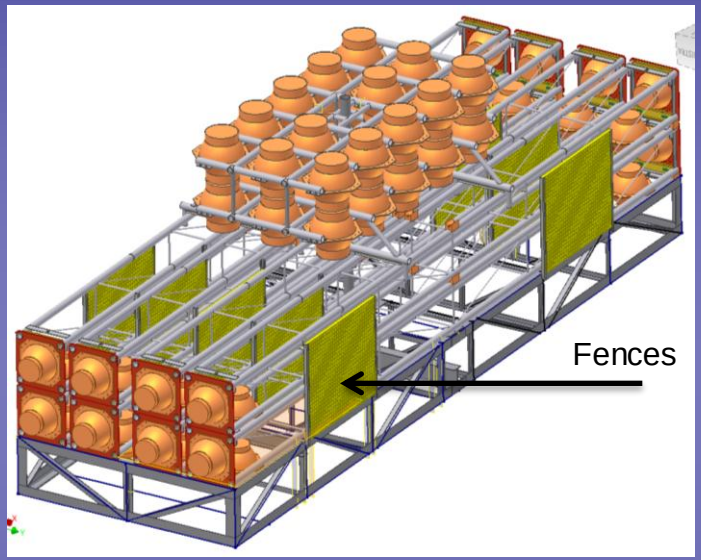
Nemo Phase1
Fully instrumented minitower (4 storeys, 15 m long)
Successfully unfurled

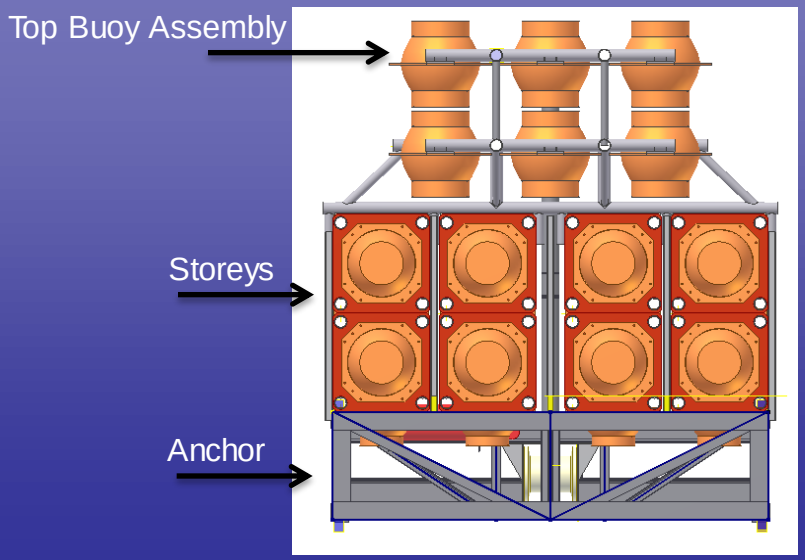
Mechanical Prototype
12 storeys (12m long)
Successfully unfurled

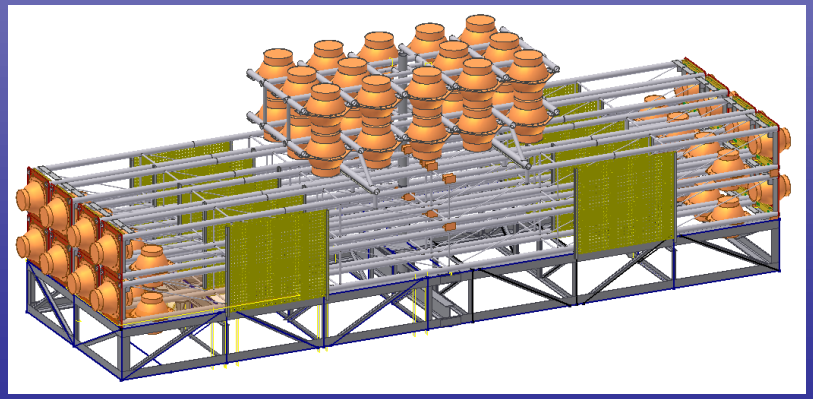
The mechanical structure

The tower is made by:

- 1 anchor
  - Material: Fe360
  - Weight (air): 986 Kg
  - Weight (water): 860 Kg
- 8 storey
  - Material: Aluminum Alloy 5083
  - Weight (air): 94 Kg
  - Weight (water): 59Kg
- 1 Top buoy
  - Made by 30 17" glass spheres hosted by an Al mechanical frame
  - Net Buoyancy about 630 Kg







The mechanical structure

Image of the NEMO Phase2 Anchor + 8 storeys
at LNS Laboratory

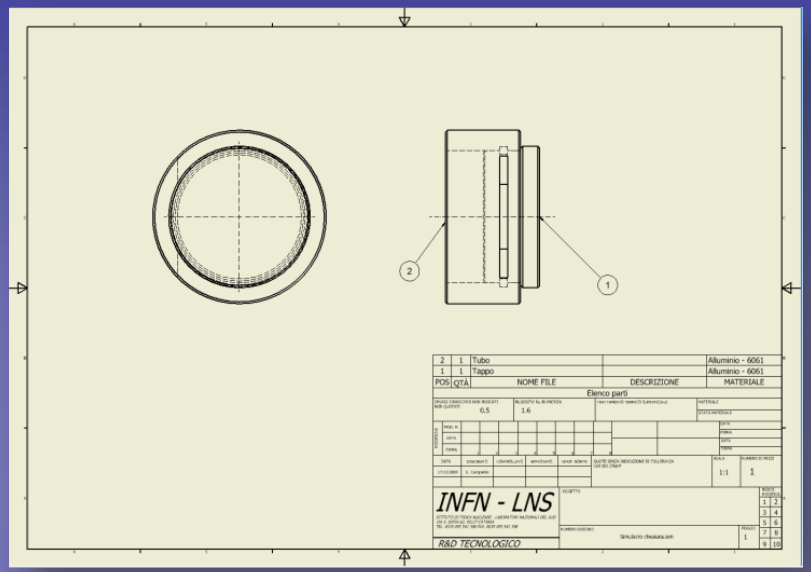
Electronic Vessel

- Each storey of the NEMO Phase2 hosts an electronic vessel which houses all the electronics PCB useful to power supply the system and for the data acquisition
- Electronic vessel is designed for 3.500m depth (tested @ 40MPa)

Electronic vessel

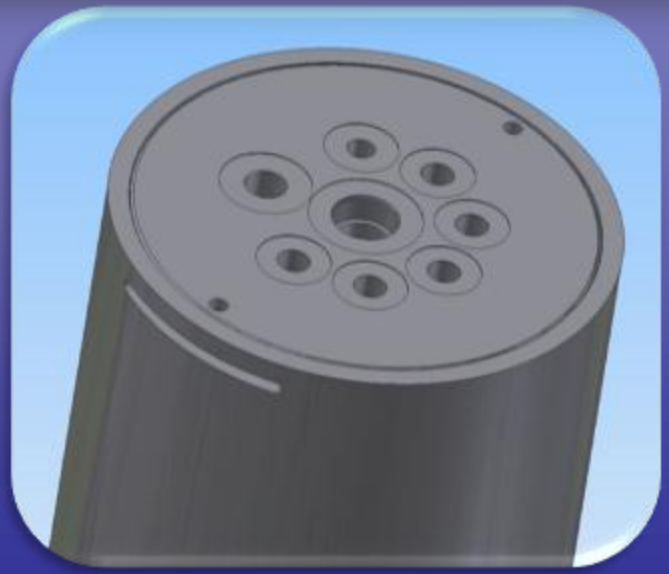
Design objectives:

- Limit the vessel's length (in order to avoid Eulerian instability phenomena, and to reduce the vessel's cost as well)
- Fastening the cap without using screws (in order to avoid galvanic corrosion)



Results :

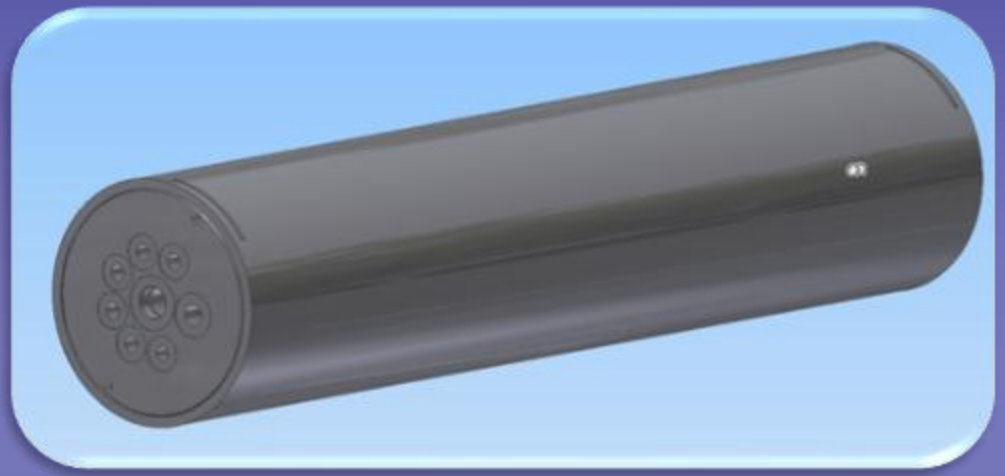
- A well tested axial mounting criteria as been applied by inserting a plastic wire inside two half grooves, machined in the cap and in the cylinder

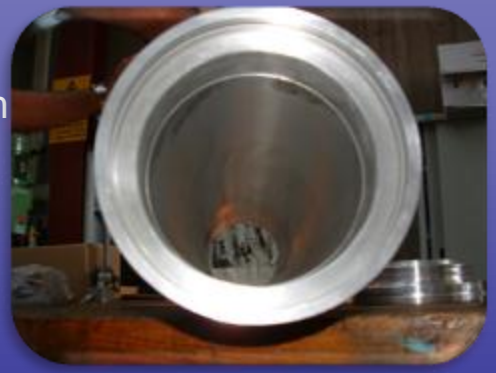


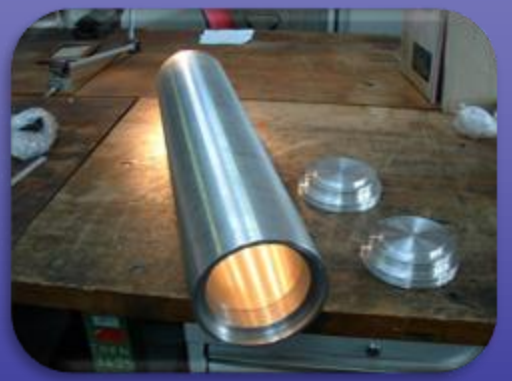
Electronic Vessel

E-Pod's characteristics :

- Outer diameter: 170 mm
- Inner diameter: 132 mm
- Length: 810mm
- Design pressure : 40MPa
- Operative pressure : 35MPa
- Material: Aluminum alloy 6082 T6
- Protection against corrosion: Hard anodization coating
- Weight in air: ~ 260N (without PCB)
- Weight in sea water: ~ 70N (without PCB)



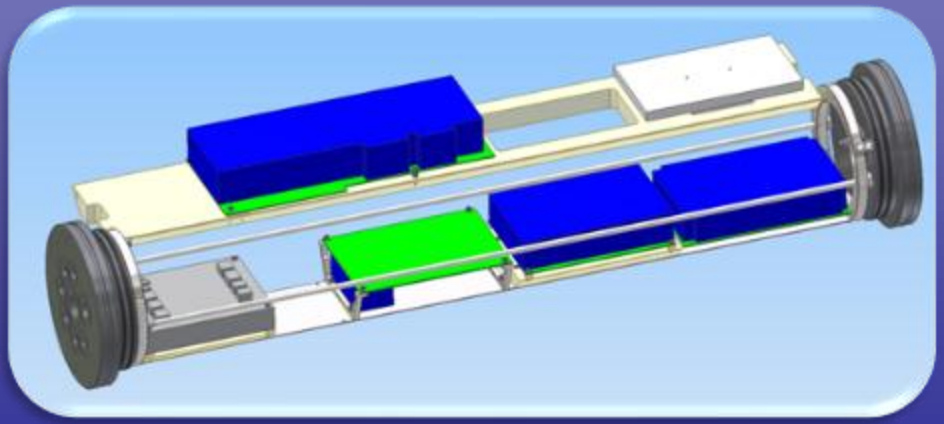




Electronic Vessel

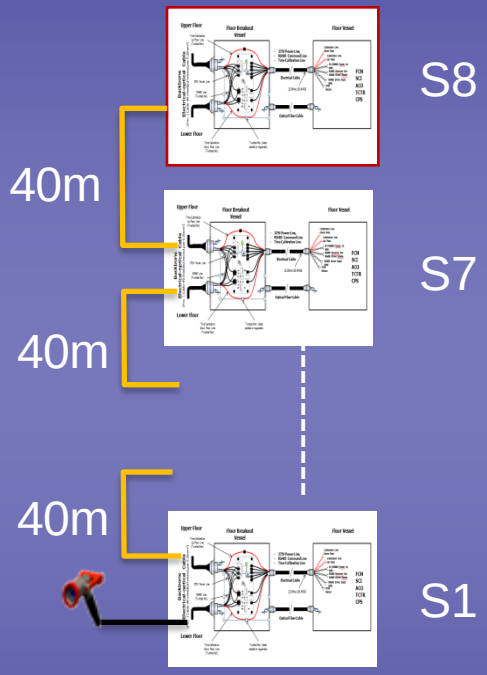
Design Objectives:

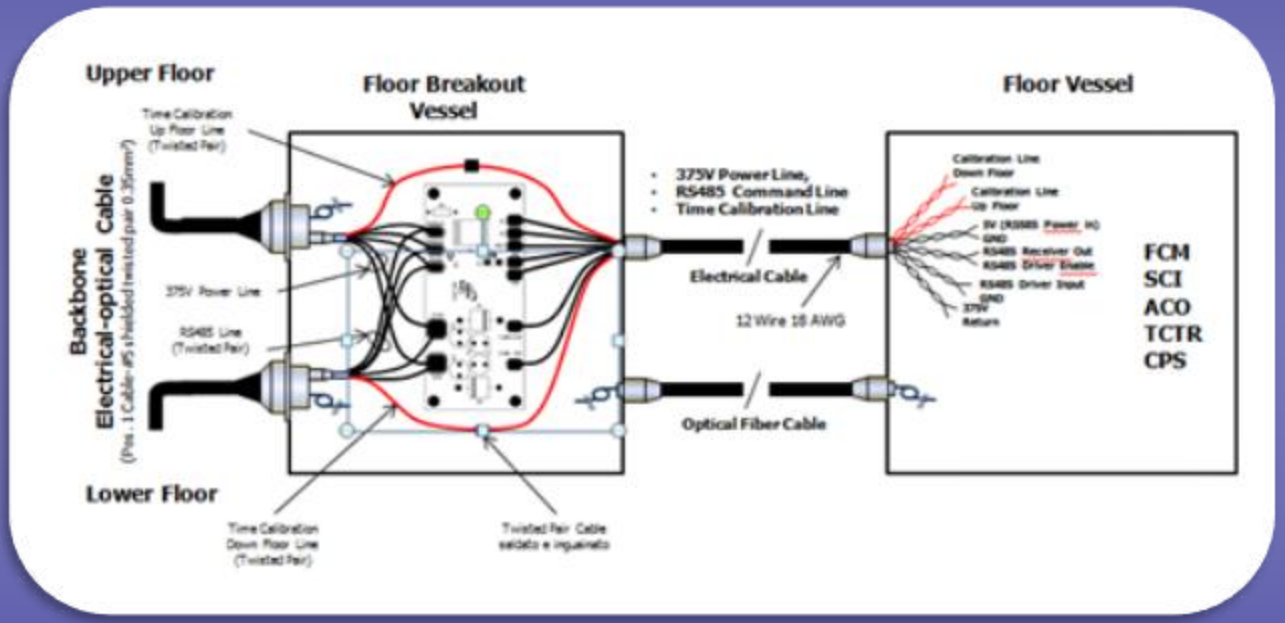
- Minimize weight and size.
- Decouple the rack during assembling and testing of the PCB, from the vessel's cap
- Ease PCB's assembling (it's possible to unfurl the rack)



First prototype assembled

Bacbkone layout





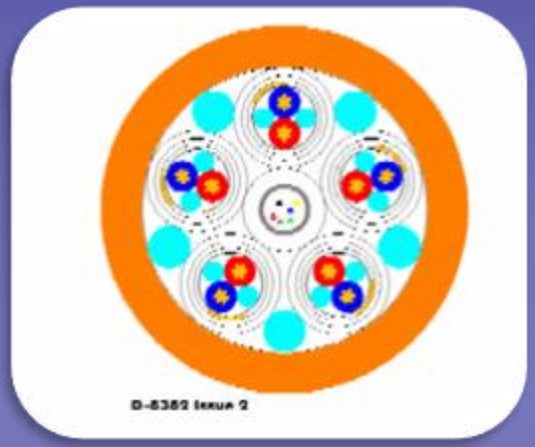
Electrical connection scheme

Backbone components

- Nexans backbone

Process/ Material		Nom. thickness (mm)	Nom. outer diameter (mm)
UNIT-FO	**Fibre Optic element**		
Optical fibre	12SM (9/125µm)		0.25
Tube	Steel tube with filling compound	0.2	2.3
Sheath	Polypropylene, natural		3.7
UNIT-SP	**Screened Pair, 0.35mm²**		

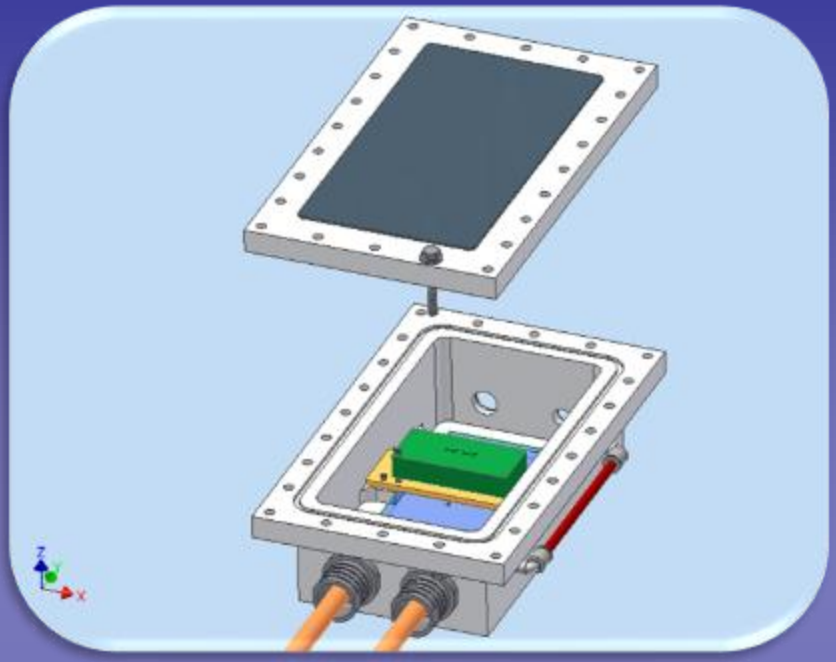
Physical characteristics	Unit	Nominal value	±
Cable outer diameter	mm	16.4	0.5
Weight in air, approx.	kg/km	280	
Weight in seawater, approx.	kg/km	65	
Minimum dynamic bending diameter	m	500	
Safe working load	kN	0.7	



- SEACON electrical and optical connectors
- ODI ROV Wet Mateable connector

The breakout is a custom made design (INFN). The design criteria are an industrial standard in the ROV field. It's a pressure compensated system. It is composed by :

- MAIN BOX: it hosts all electrical and optical interface between electronic vessel and the backbone and is used to decouple it from the backbone in case of water leakage;
- COVER MEMBRANE: it equalizes the inner oil pressure with the surrounding water pressure (it is made by viton rubber).



Conclusions

- NEMO Phase2 will be assembled within 2011
- The DU will be deployed and connected at the MVC converter in Capo Passero site at 3430 m.w.d.
- It will be the conclusion of the NEMO collaboration activities, performed to study and develop innovative technologies to construct an underwater deep sea neutrino detector