VLVνT 11
Erlangen, 12-14 October 2011

# THE MEUST INFRASTRUCTURE FOR NEUTRINO ASTRONOMY

## Mediterranean Eurocentre for Underwater Sciences and Technologies

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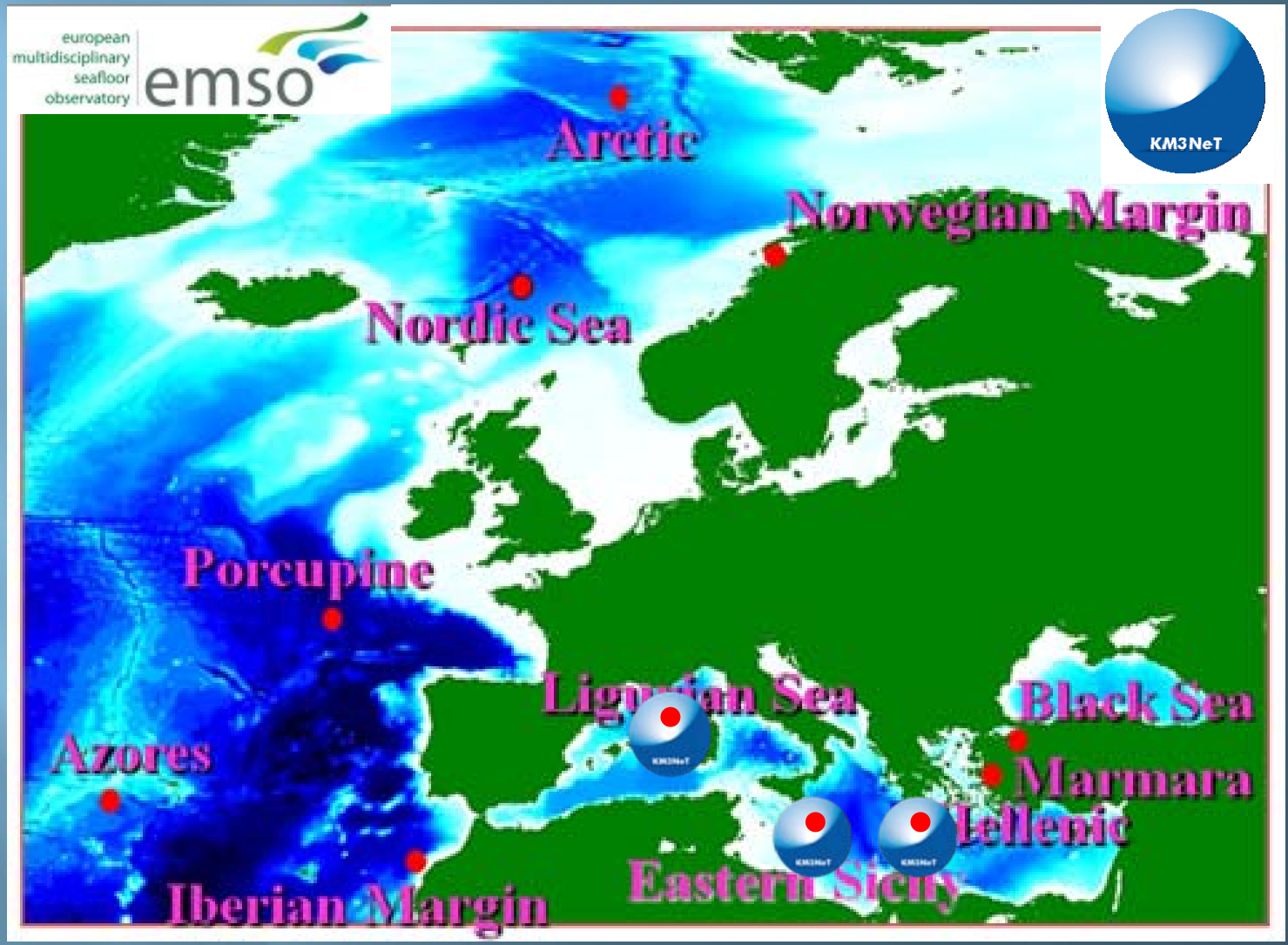
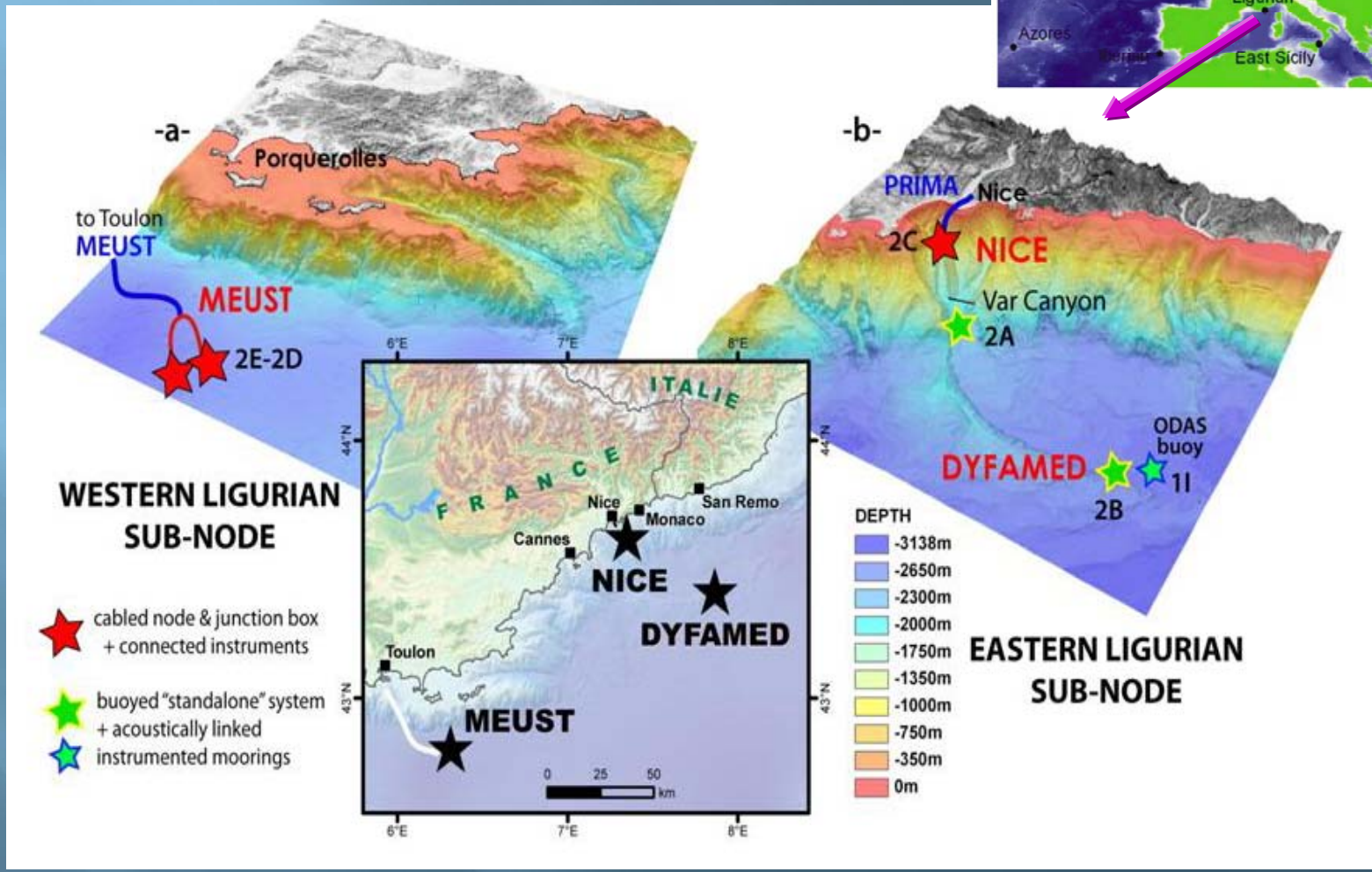
**Centre de Physique des Particules de Marseille**

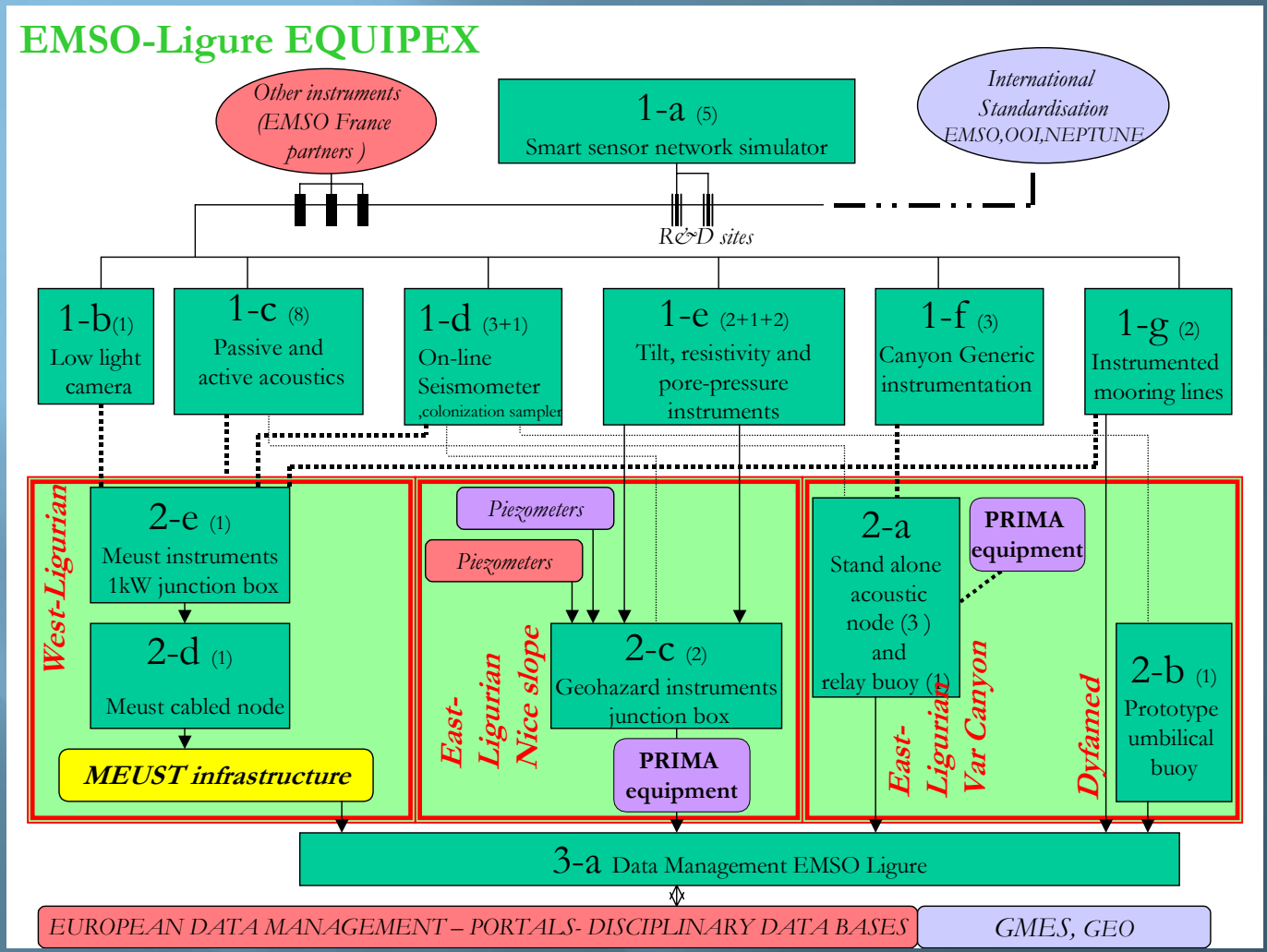



**MEUST goal:**
**deploy offshore of Toulon a 2nd generation shared submarine infrastructure within the frameworks of EMSO and KM3NeT**

# The French EMSO ligurian node



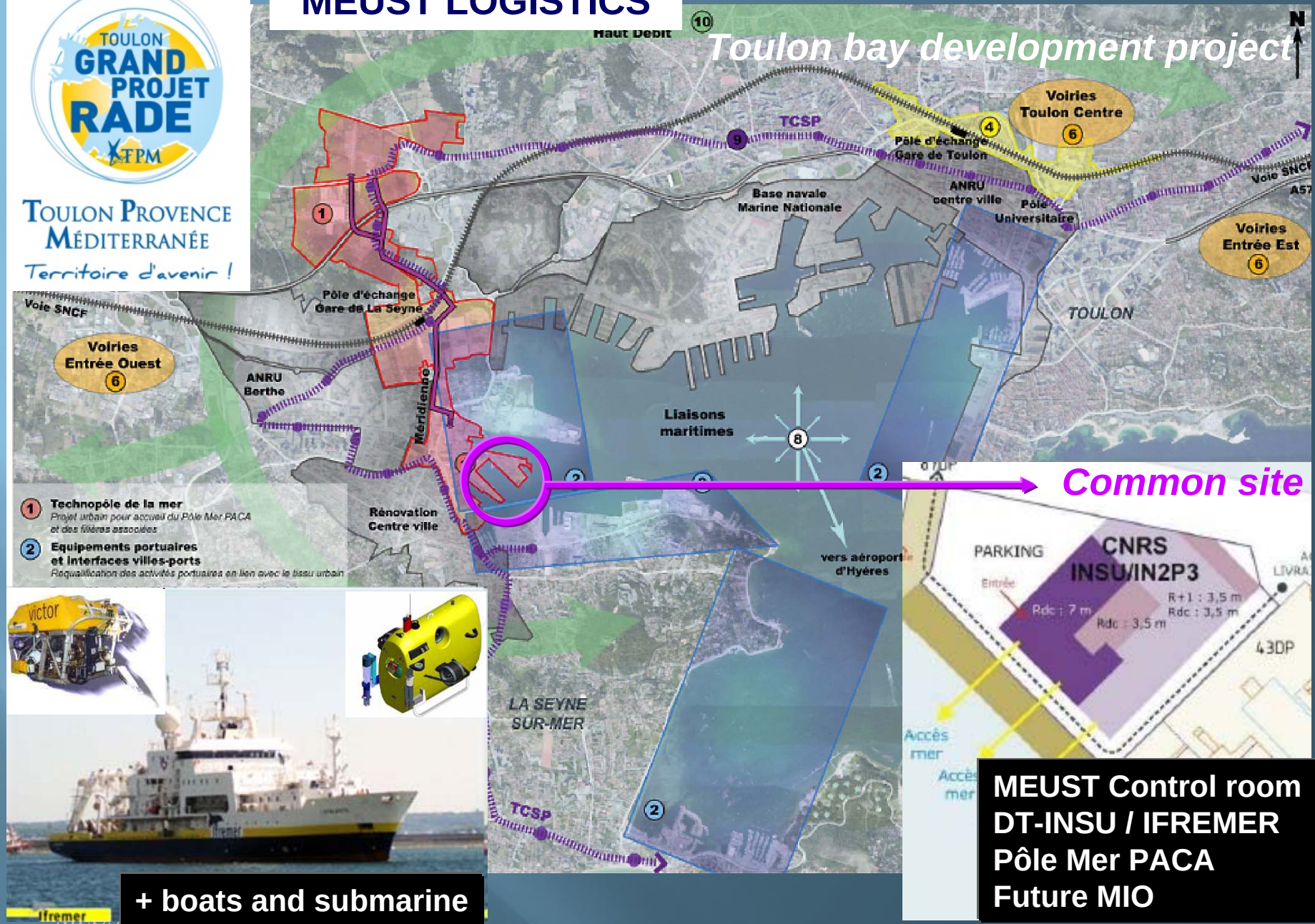
# *Equipment funding request recently submitted to the French « Grand Emprunt National », coordinated by CPPM*



# MEUST LOGISTICS

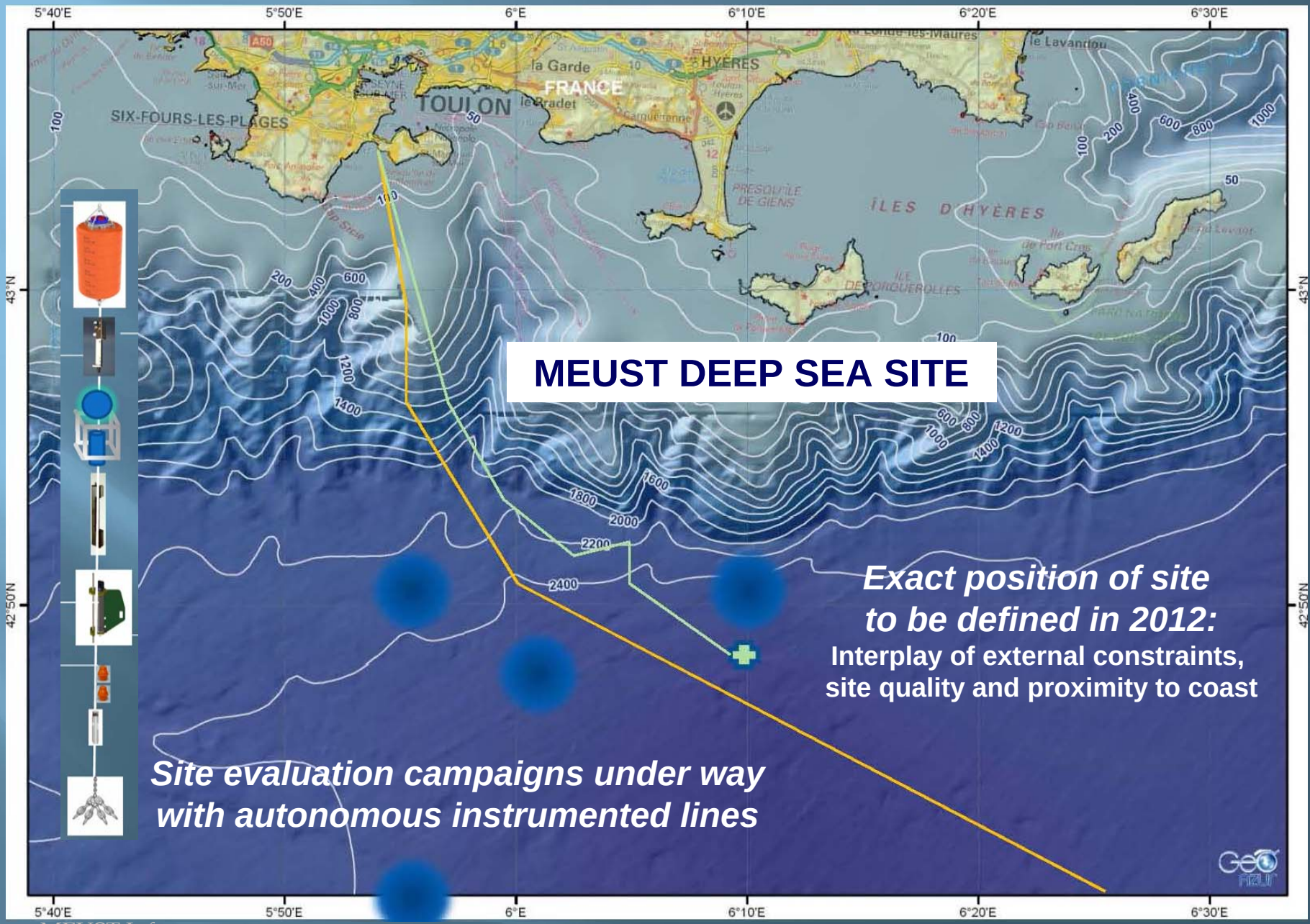
*being set-up within the*

*Toulon bay development project*

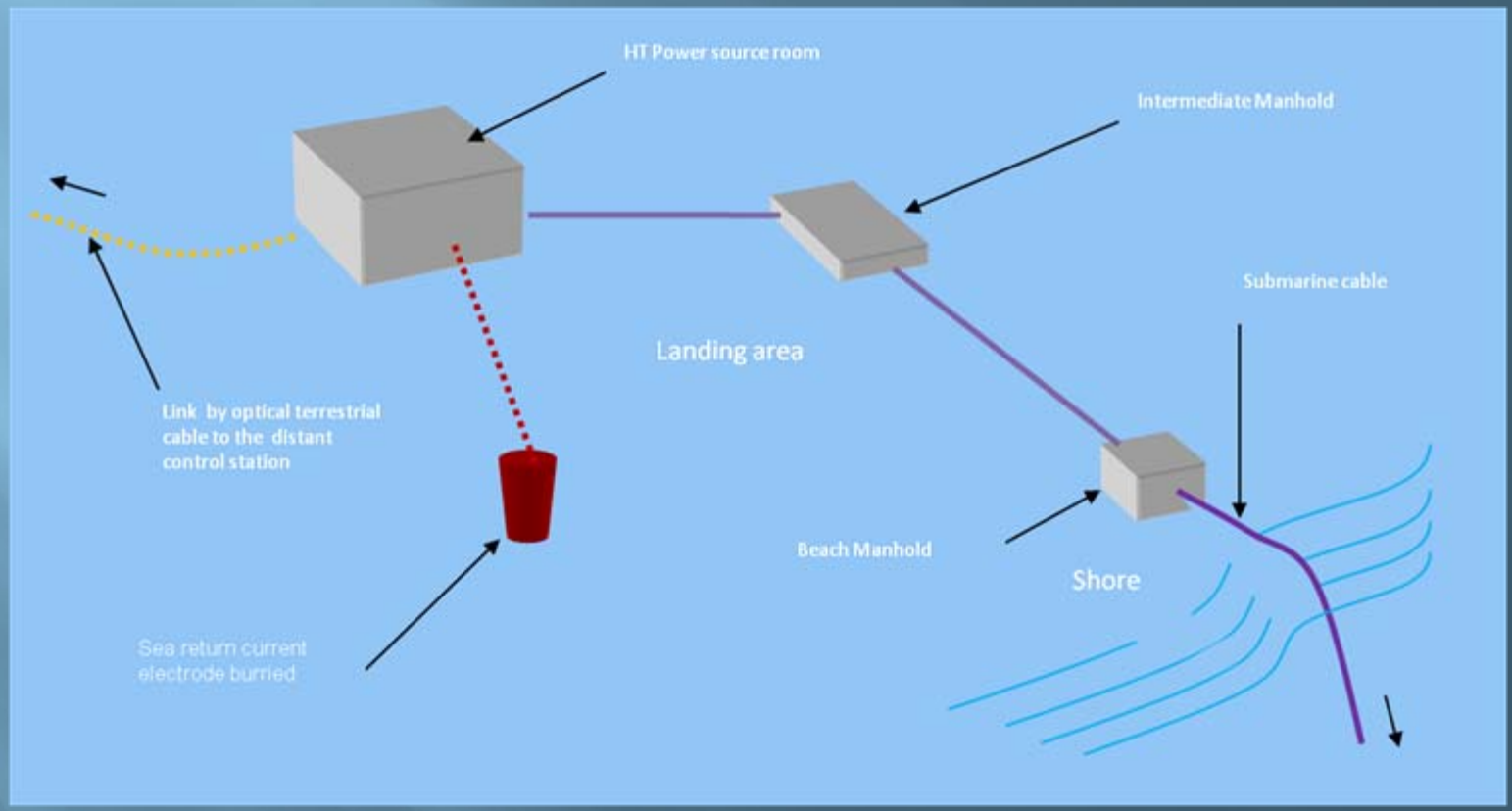



+ boats and submarine Intervention tools

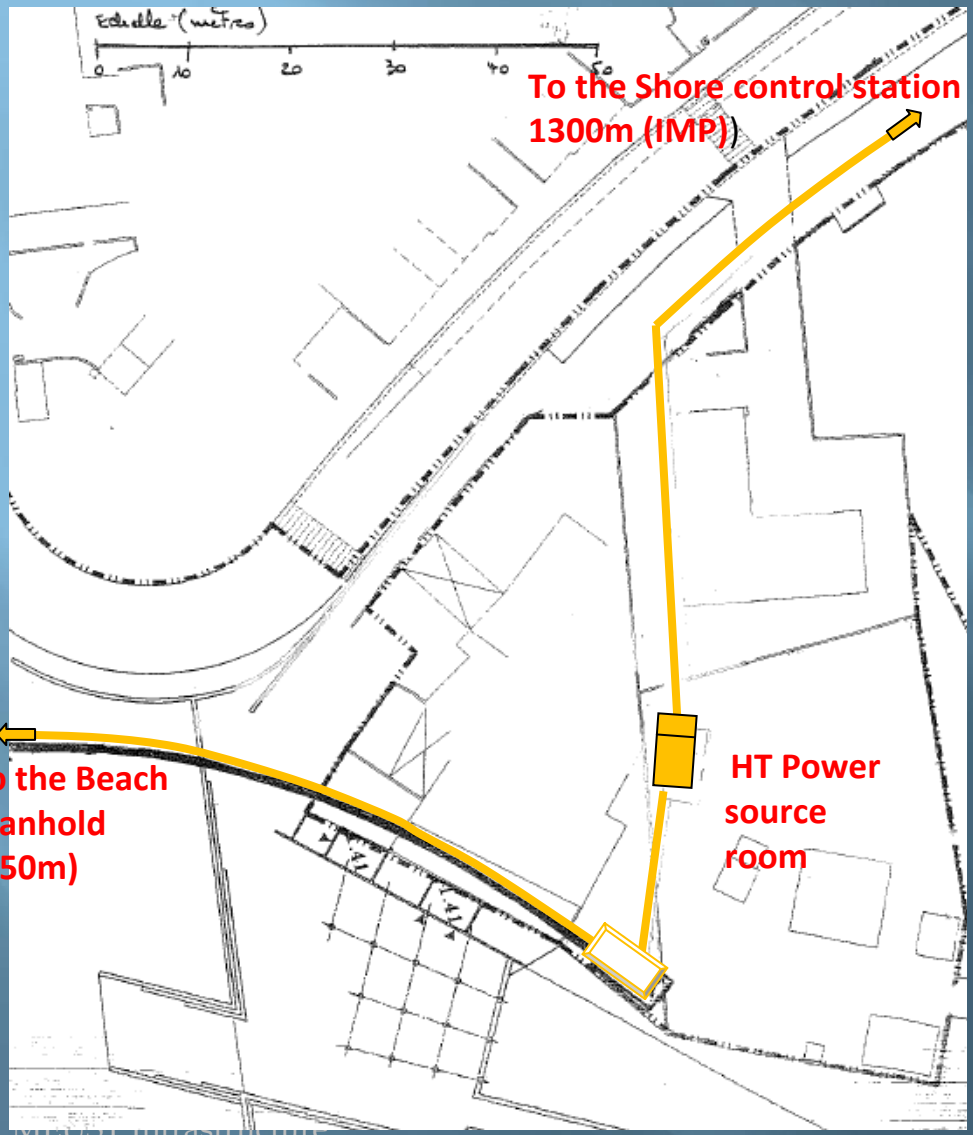
MEUST Control room
DT-INSU / IFREMER
Pôle Mer PACA
Future MIO


MEUST DEEP SEA SITE
Exact position of site
to be defined in 2012:
Interplay of external constraints,
site quality and proximity to coast
Site evaluation campaigns under way
with autonomous instrumented lines
TOULON
HYÈRES
la Garde
FRANCE
SIX-FOURS-LES-PLAGES
ÎLES D'HYÈRES
5°40'E
5°50'E
6°E
6°10'E
6°20'E
6°30'E
43°N
42°50'N

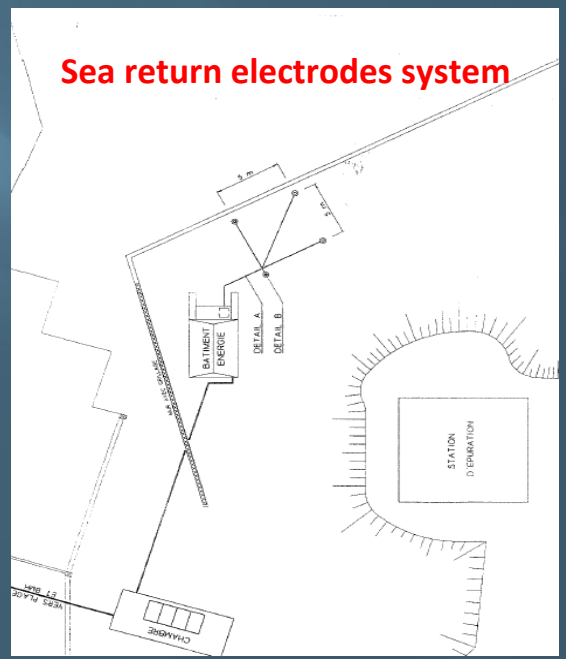
# Landing area requirement



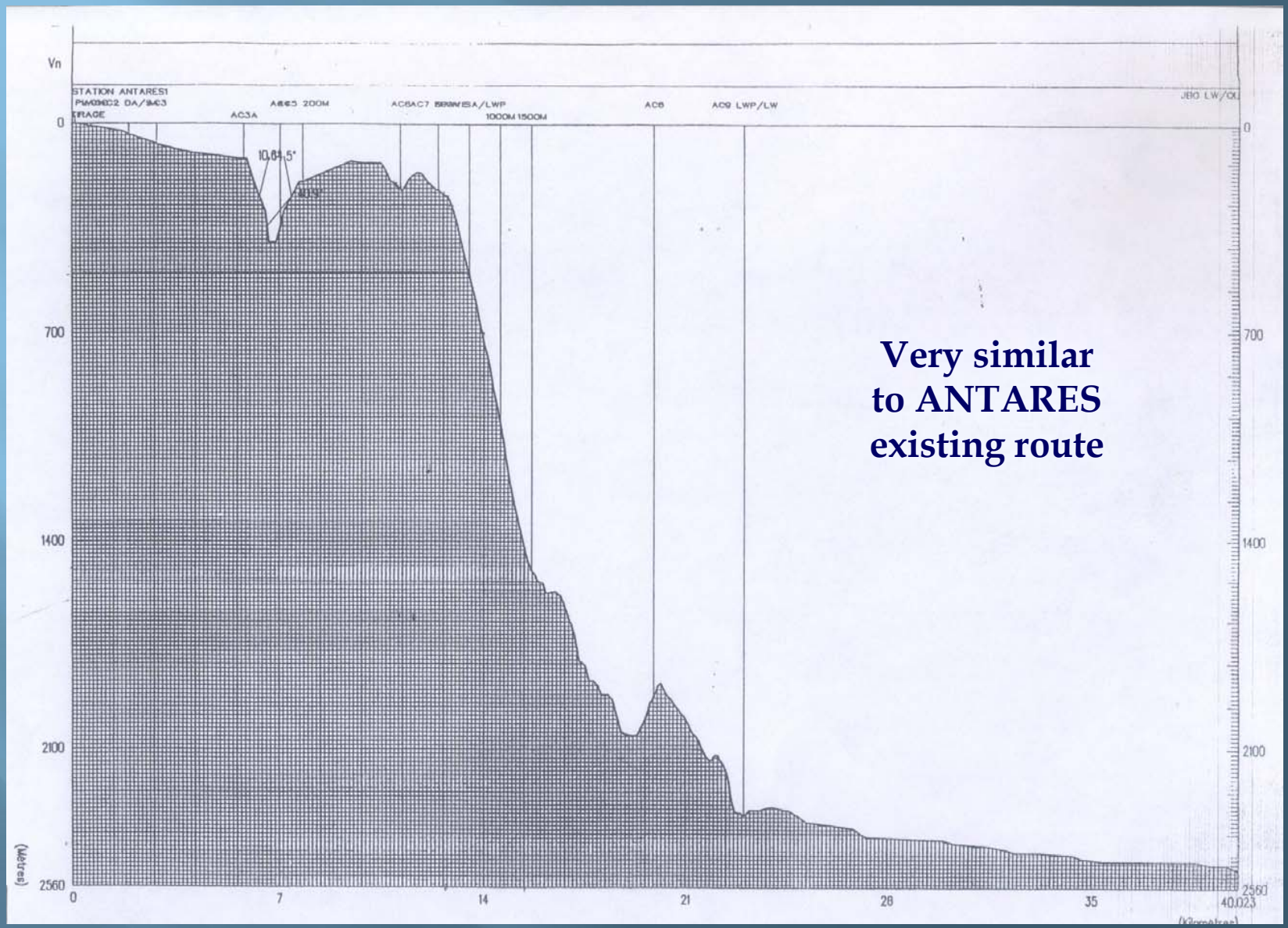
# Landing area existing




**ANTARES**
**« Les Sablettes »**
**present operational arrangement.**
**Need only power room enlargement**



# Cable route diagram



# Cable route diagram

**Requirements for the MEUST connection to shore are similar to the ANTARES main electro-optical cable :**

DA

SA

LWP

LW

Landing Area

Beach Manhole

Sea Bed Termination

Depth : 2350-2450m

Supply Room

located 150m back from the beach manhole

Control Room

1300 m link of optical terrestrial cable

**Submarine cable section lenghts required**

| | |
|---|---|
| Double Armoured : | 1500 -2000 m ( baie des Sablettes) |
| Single Armoured : | 10000-12000m ( plateau< 1000m) |
| Light Weight Protected : | 10000m – 12000m (slope->2000m) |
| Light Weight : | 5000 m - 15 000m ( according site choice;) |

# Specific MEUST requirements for MEOC (Main Electro-Optical Cable)

***Dimensioned to handling one KM3NeT Building Block with KM3NeT DU power and data transfer specifications***

## General provision:

- Standard components from Telecom industry
- AC current power transport
- Total length : 30-50 km depending on final site location
- Depth max: 2500m
- Sea water: North Mediterranean 38g/kg
- Temperature: 5 to 45 °C

## Electrical requirements :

- Conductor: one
- Permanent  max duty voltage: 6500 VAC (peak value 50Hz)
- Permanent  max duty current: 30A AC (RMS value)
- Resistance: less than 1 ohm/km
- Capacitance: less than 200nF/km
- Inductance: not specified

# Specific MEUST requirements for MEOC

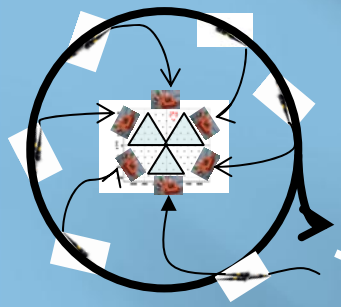
## Optical requirements:

- Optical fibers: min 36 monomode fibers per branch according to ITU-T G.655 specifications
- Main bandwidth: 1550nm (band C)
- Attenuation: better than 0.25 dB/km
- Fibers periodically identified with factory marker process

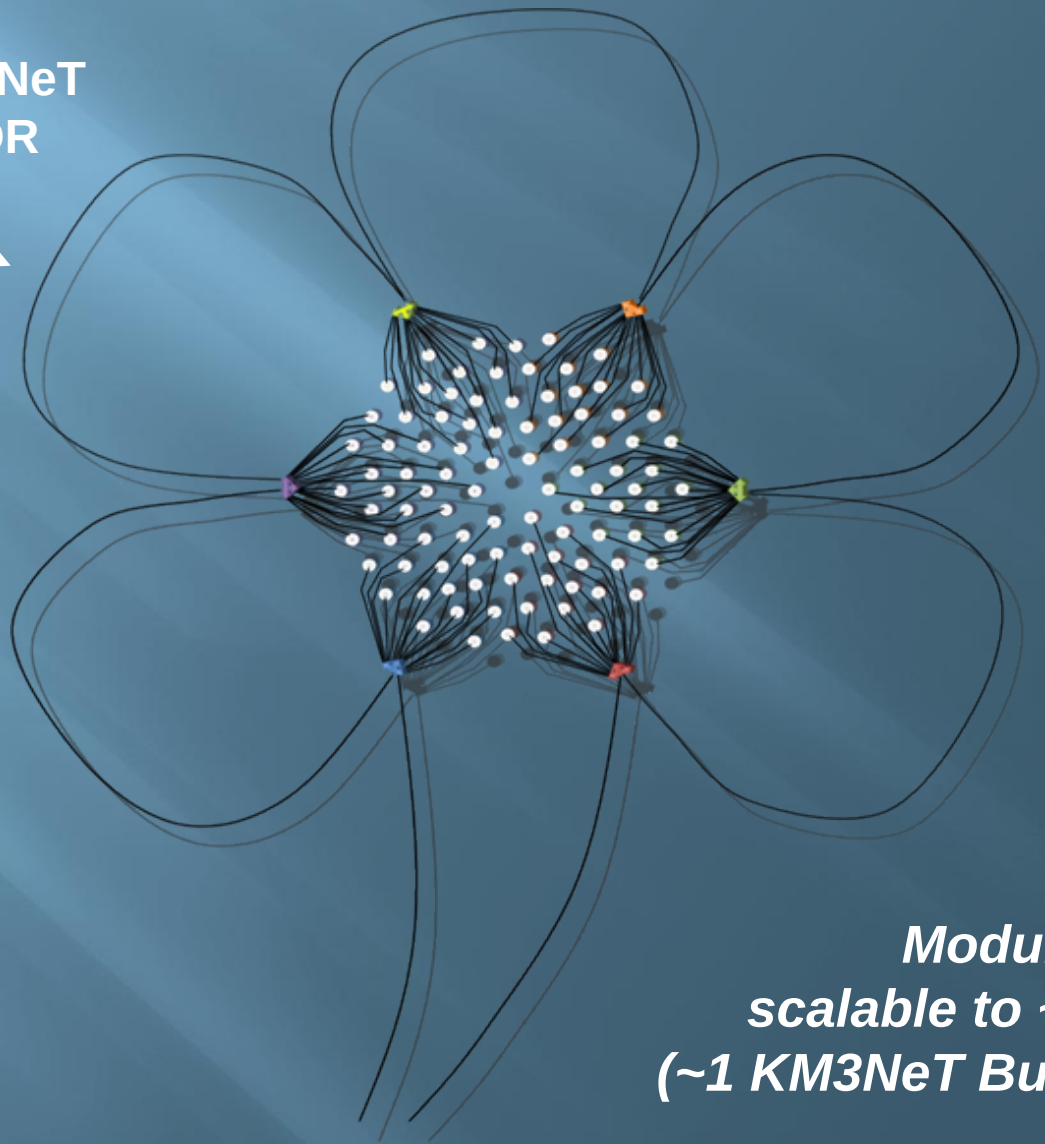
## Mechanical requirements:

- **Favourite construction :**Water blocking in the cable to ingress water penetration in case of damage events. Metallic vault design.
- **Armoured section for landing route** (depth < 1000m): Length to be considered: 15km. External diameter non specified. Density>3. Acceptable repeated and storage min bending radius ~ 1.5m. Tensile strength resistance without damage: larger than 1500m of its own weight in water.
- **Light section for layout route** (depth >1000m):External Diameter < 21.5mm.Density >1.1. Acceptable repeated and storage min bending radius ~1m. Tensile strength resistance without damage: larger than 3500m of its own weight in water. Ultimate tensile stress: 3 times the previous figure.

# Marigold design with two cables access



KM3NeT
TDR



***Modular,***
***scalable to ~100 DUs***
***(~1 KM3NeT Building Block)***

# Specific MEUST requirements for seabed network

## General provision:

- Ring network topology : double supply by looped connection
- Six nodes delivering 10 to 12 kW output power each
- Input node voltage 5000V AC 50Hz
- Fibers distributed in two branches.

## Shore MEOC termination :

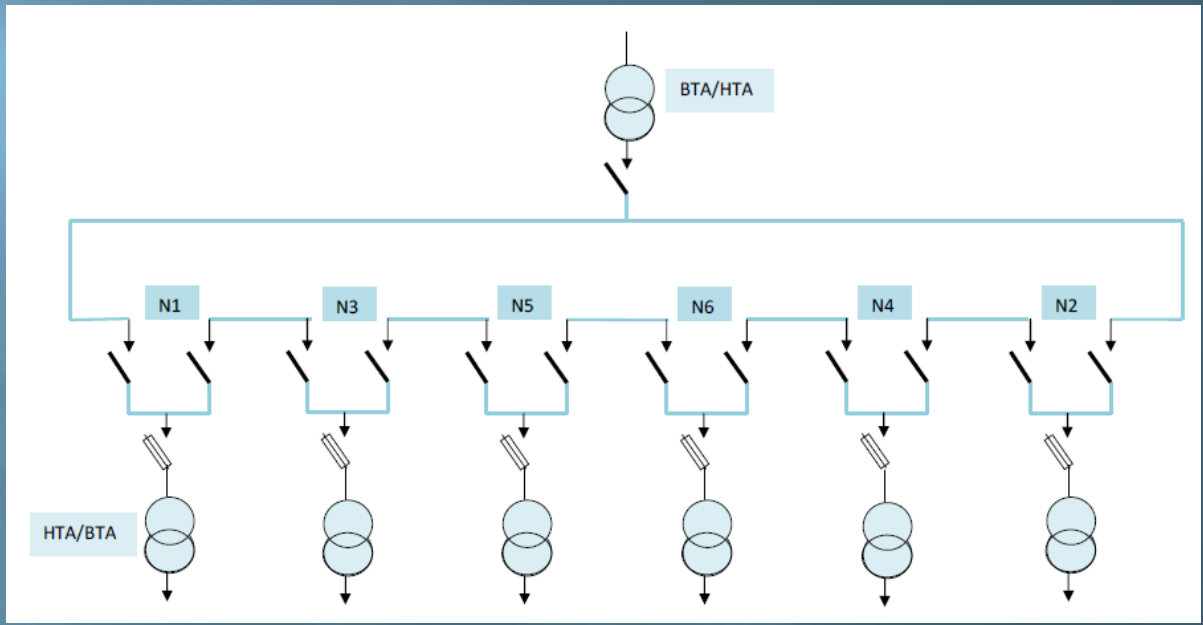
- A passive termination unit similar to extremity jointing box or dry connector.

## Inter node links :

- Made of 2x3km cable lengths same as MEOC light weight section protected.
- Required quantity : 4-5 per branch ( depending of node layout process).
- Endings required with a universal joint coupling or dry connectors

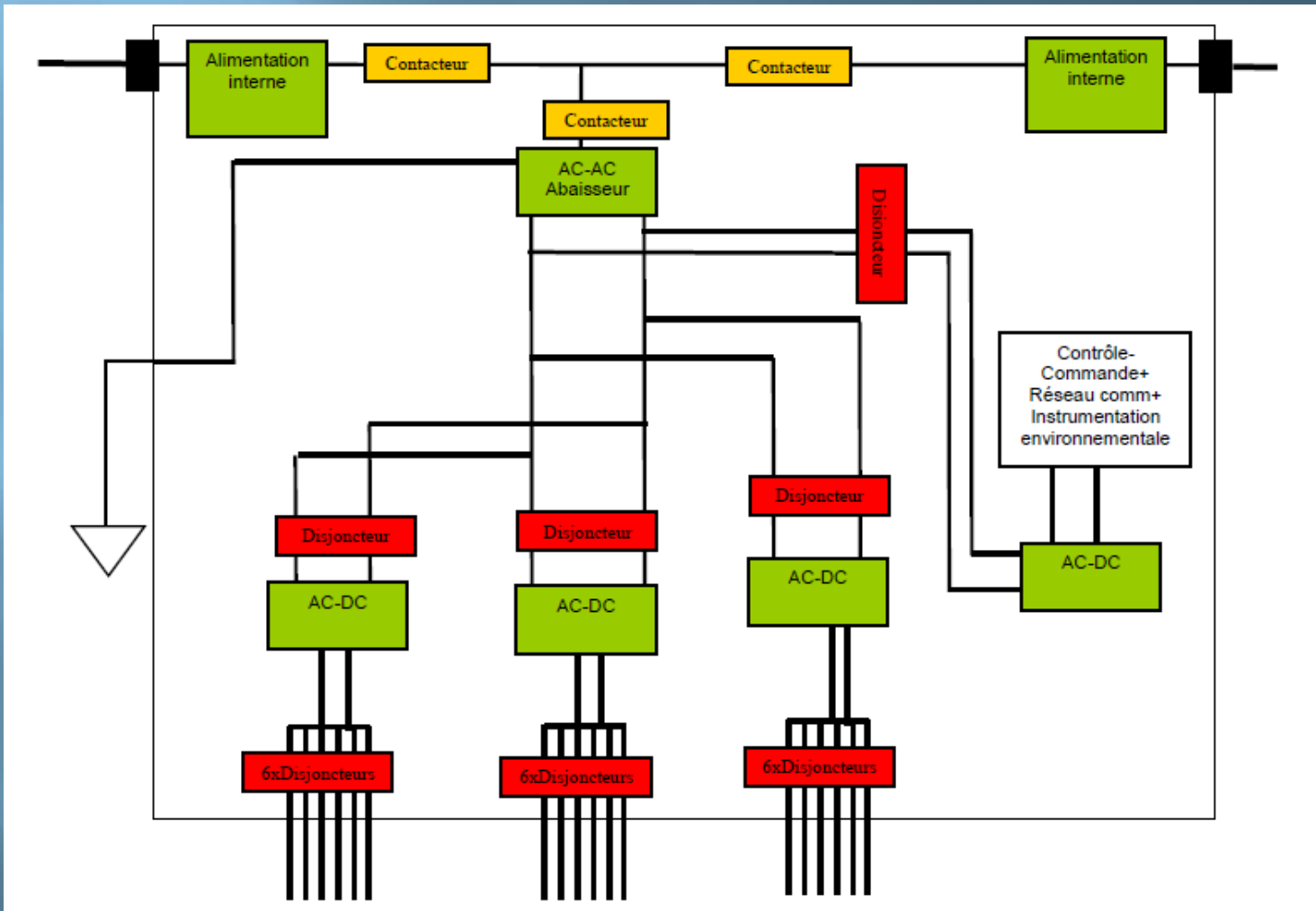
# MARIGOLD Electric power distribution

## General Structure

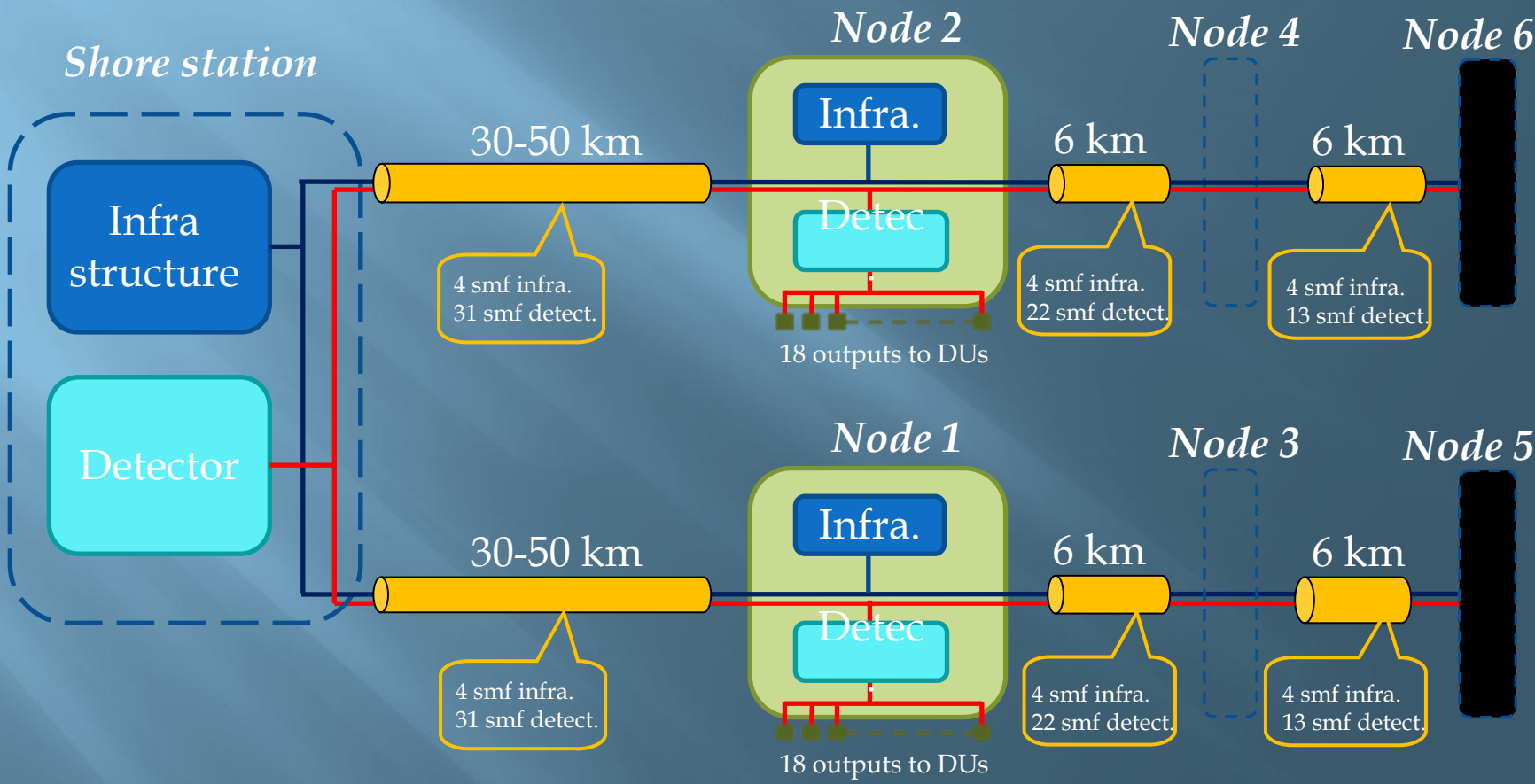



- Energy transport is considered in single phase AC current.
- Voltage is raised to up to 6500 volts in shore source substation for transport.
- High specific submarine capacitance compensated to reduce reactive power.
- Sea return current.
- Network designed in double supply by looped connection.
- ***Network functionality has been validated with quantitative simulation of the whole loop***

# Junction box electric layout diagram

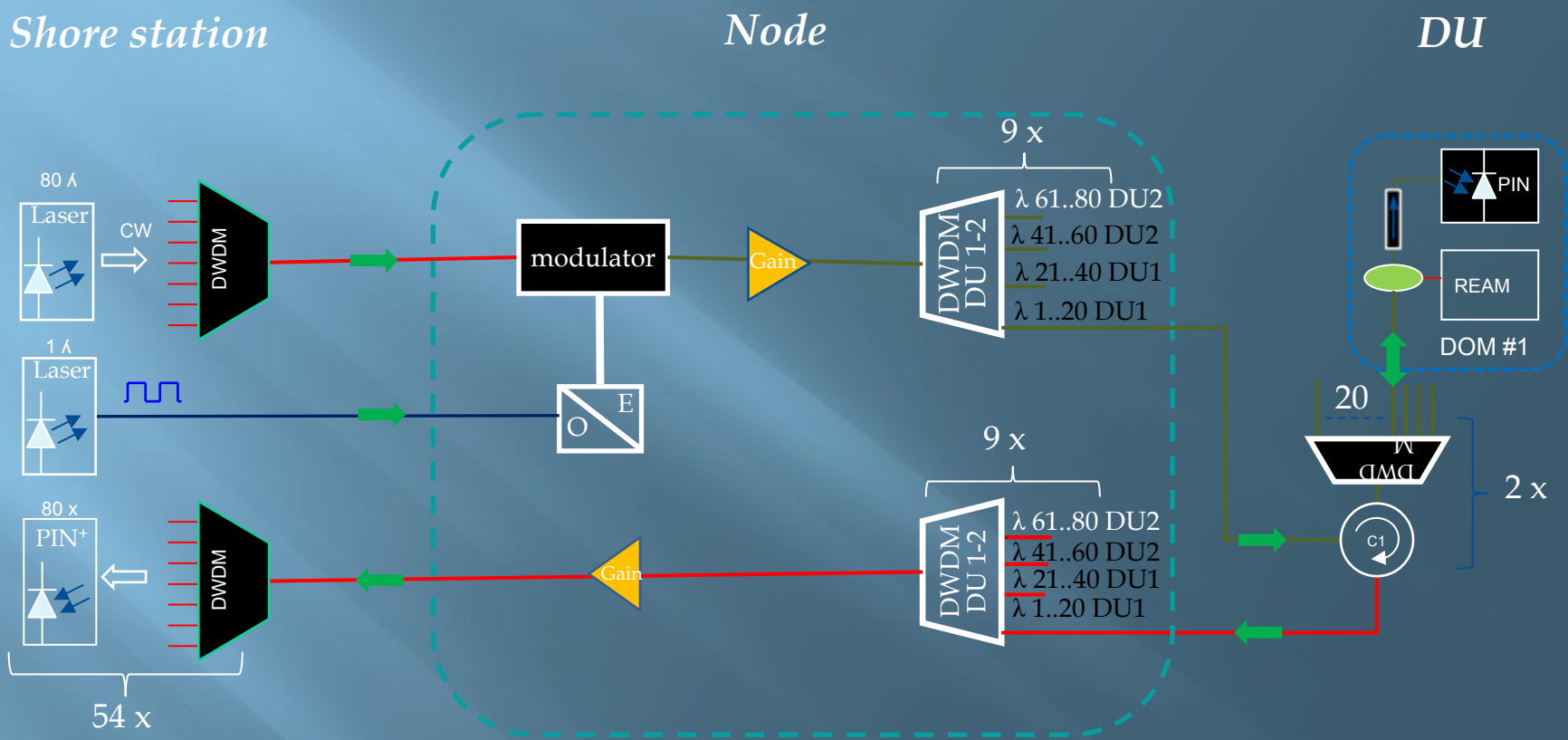


# General optical layout




All nodes almost identical

# Detector: optical architecture



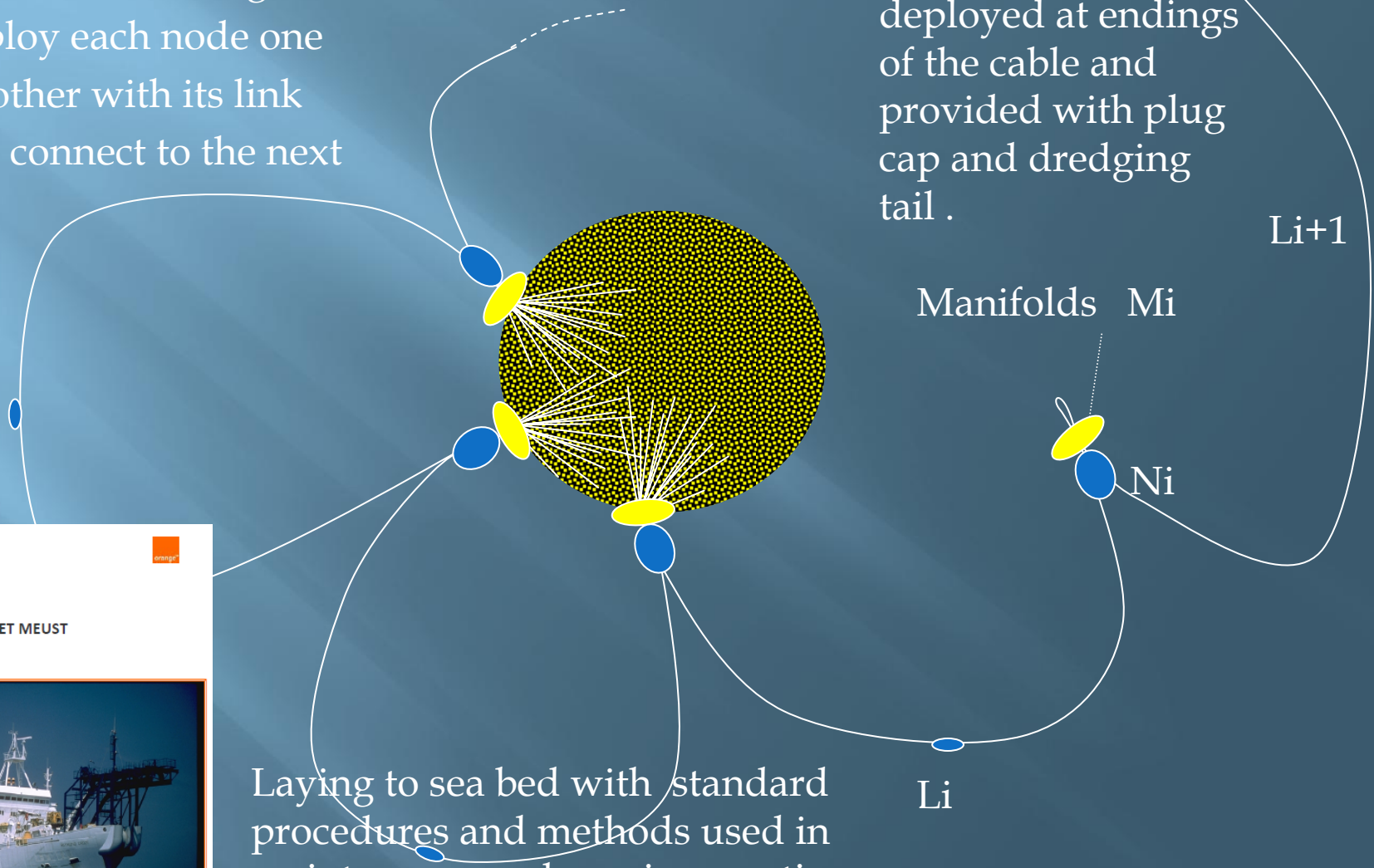

Key parameters:

- Point to point 10 Gb/s Ethernet
- Clock (<1ns) embedded with Ethernet
- DWDM 50Ghz grid
- No laser offshore

# MARIGOLD Deployment

The main idea of Marigold is to deploy each node one after another with its link ready to connect to the next node.

Network links are deployed at endings of the cable and provided with plug cap and dredging tail .

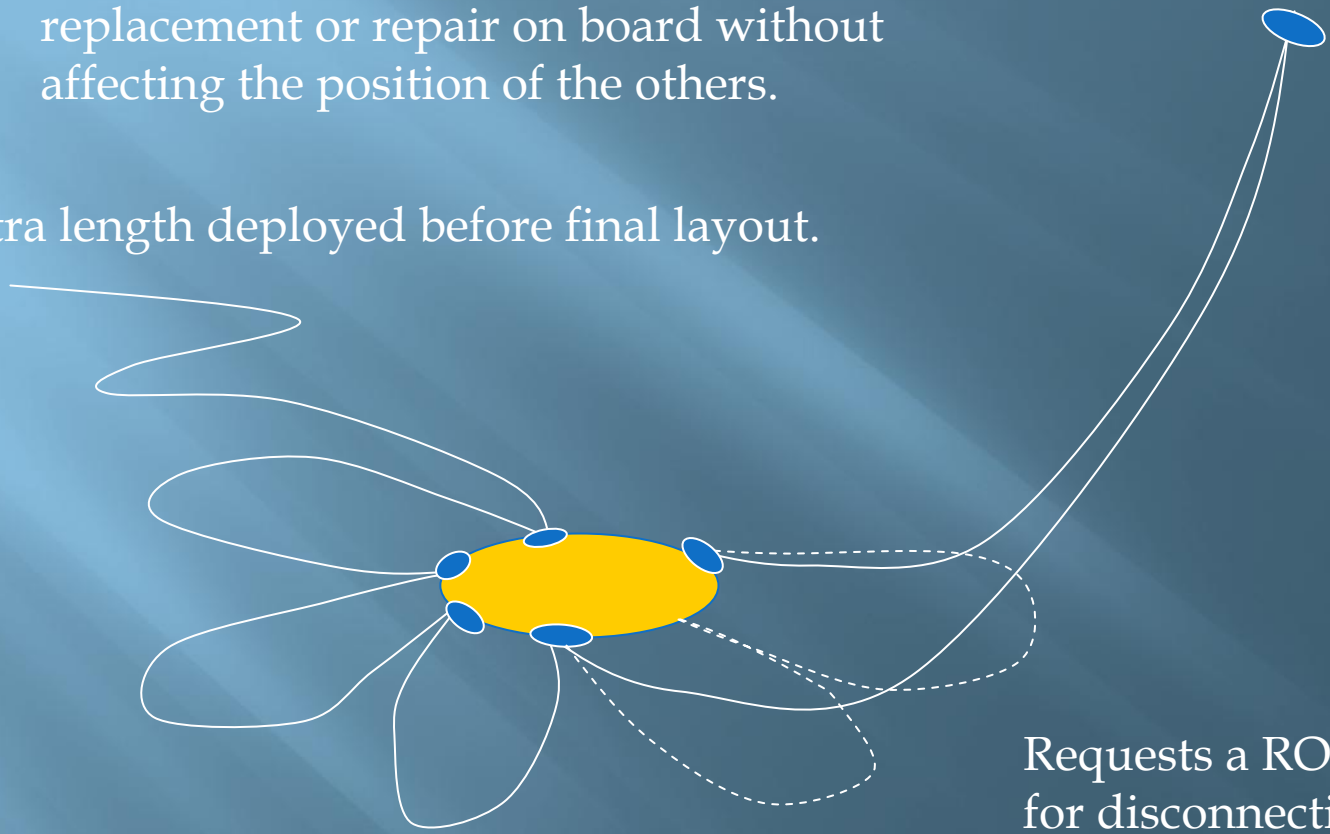


Laying to sea bed with standard procedures and methods used in maintenance and repair operation by specialized cable ship.

# Marigold Deployment scenarios

Each node could be recovered for replacement or repair on board without affecting the position of the others.

Extra length deployed before final layout.

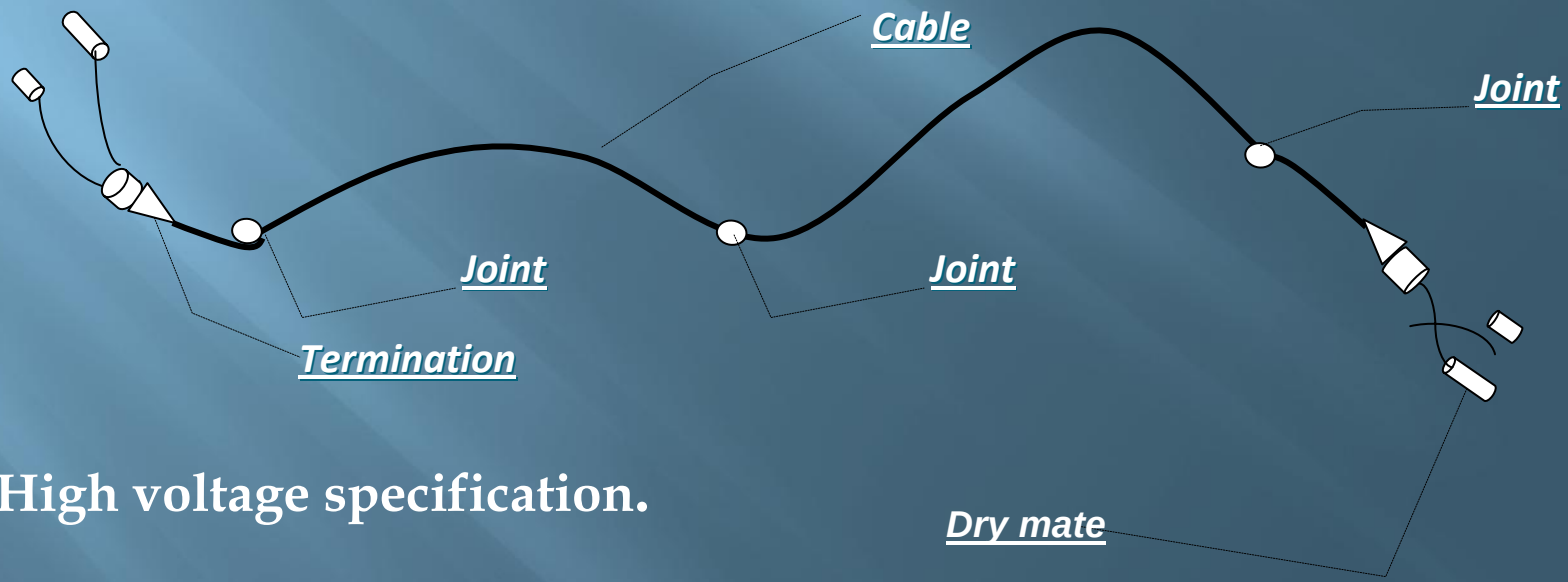


Requests a ROV intervention for disconnecting all the users of the node and hooking the cable winch recovery.

# MARIGOLD Network components

## *Electro-optical Marigold links :*

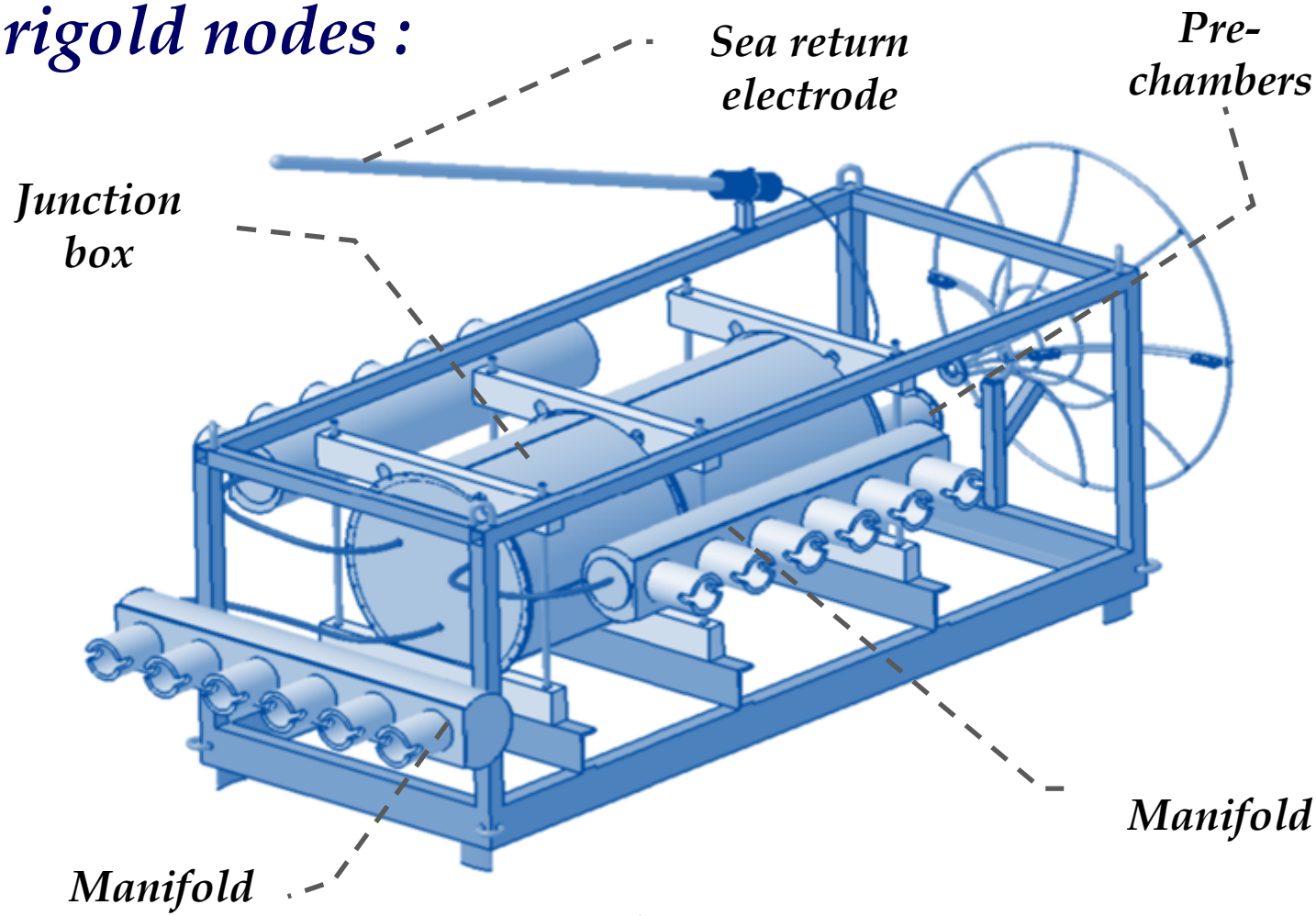
- 2x3 km lengths jointed section
- Designed to allow dry connection to the nodes and standard jointing on board.




- High voltage specification.

# MARIGOLD Network components

## *Marigold nodes :*

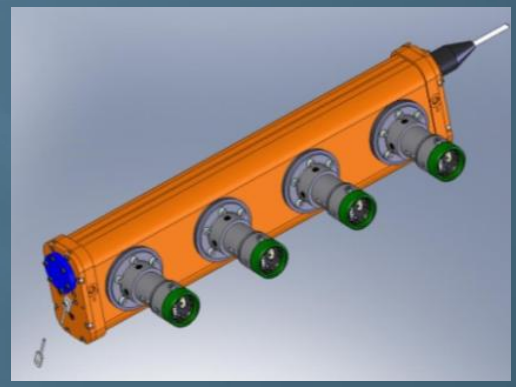



**Two main components : node = Junction box + manifolds**

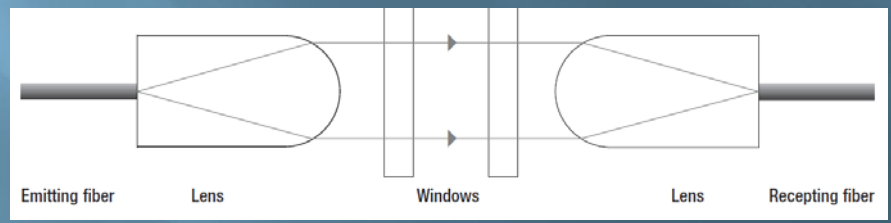
# BJ/DU ROV wet connection

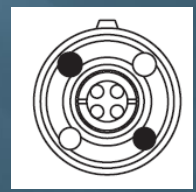
## Distribute signal and power to multiple points

- Existing standard connectors (marinized) connected in oil



- On going R&D 4 beam expanded
  +4 electric contacts



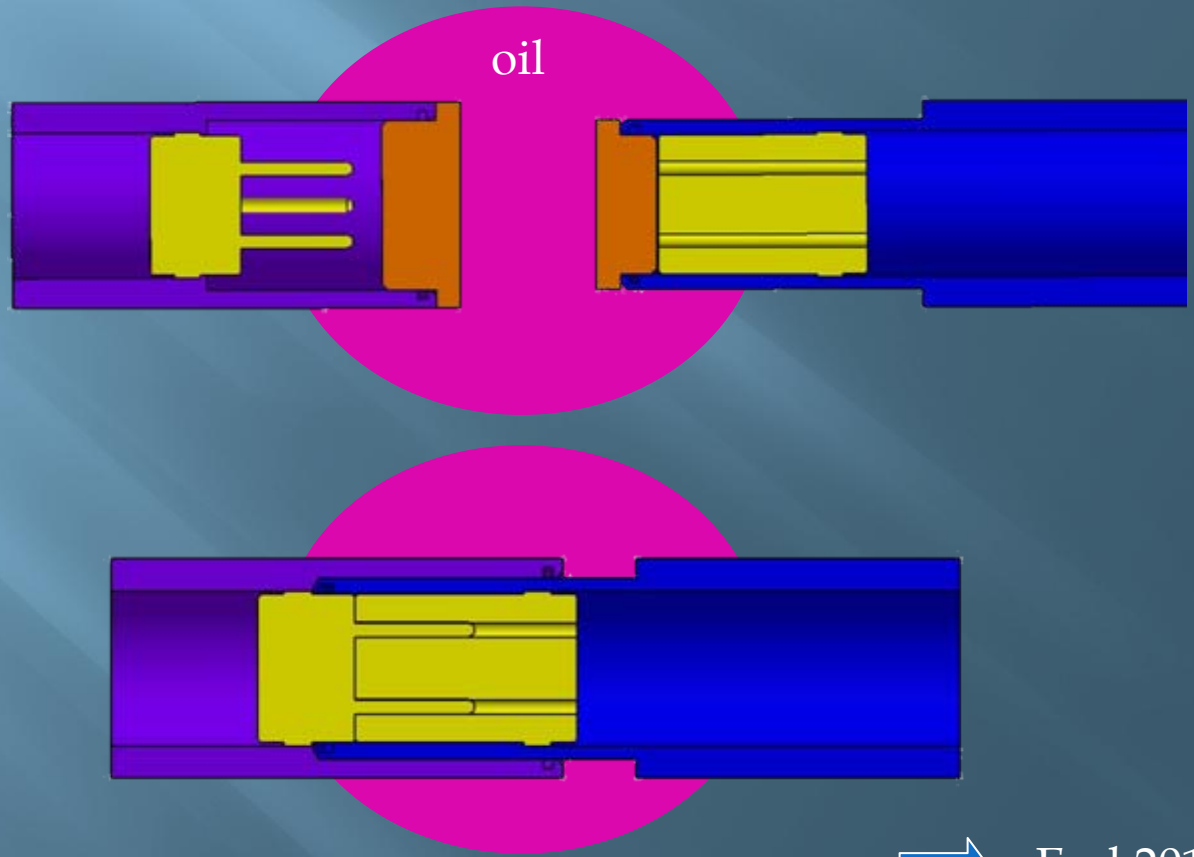



- New Industrial R&D Project (EDF+COMEX+CNRS)

# BJ/DU wet connection

## PowerMate

- Industrial R&D Project (EDF+COMEX+CNRS)
  - Standard connectors (marinized) connected in oil




End 2012

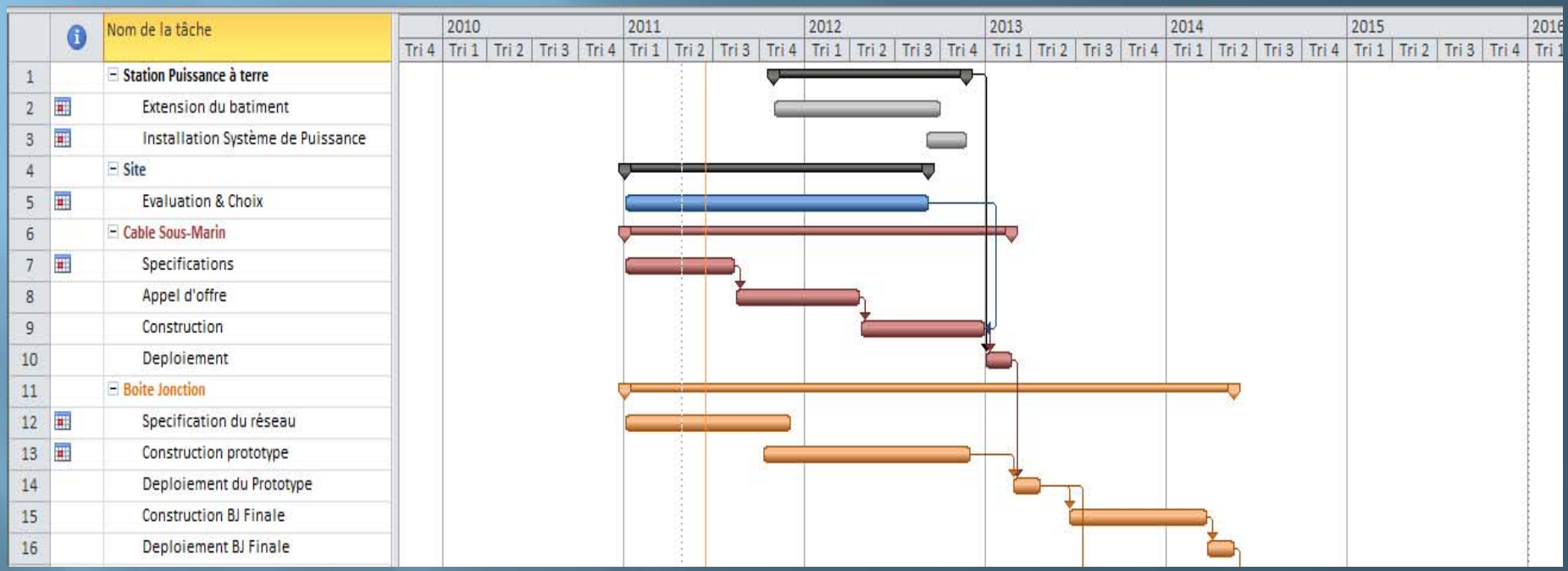
- New “light” ROV under design by IFREMER
- Medium size ship
- Reduced operation team
- Suited for wet connection of KM3NeT DUs
- Time scale: 2013

Ifremer

**HROV**

# MEUST Seabed network schedule

***Time constraint of the CNRS-EU FEDER funds***



# SUMMARY and OUTLOOK

***Design and construction of the MEUST deep sea infrastructure has started in the context of EMSO and KM3NeT***

***Deployment and operation will benefit from the growing concentration of marine logistics tools on the Toulon site***

***All components and procedures are mastered based on the experience gained on ANTARES and studies performed in KM3NeT***

***The proposed solutions are of interest for other KM3NeT sites***