



Summary of Architecture

Parallel Session

G. Hallewell/CPP Marseille

P. Piattelli/ LNS Catania

Parallel Session A1.2:

Architecture: First session mainly devoted to undersea connectivity

Chair: G. HALLEWELL, P. PIATTELLI

14:00 - 14:20 Sea con, K. HALL

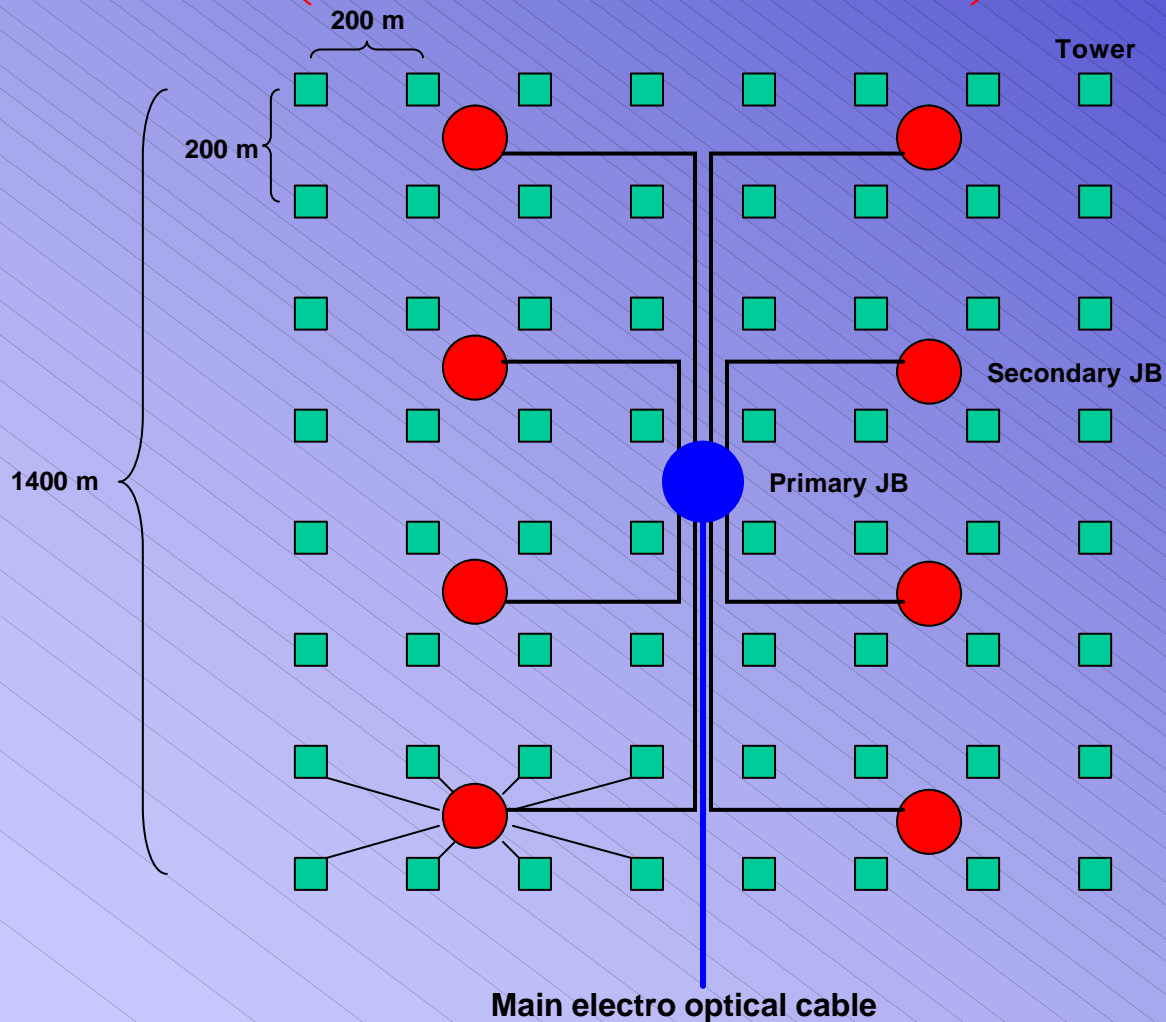
14:20 - 14:40 Ocean Design, S. THUMBECK

14:40 - 15:00 Nexans cables, J. SEIP

15:00 - 15:20 Antares Experience with Electro-Optical Cables, P. LAMARE

15:20 - 15:40 **DISCUSSION**

EXAMPLE OF SEA FLOOR GEOMETRY OF A KM3-SCALE DETECTOR (NEMO LAYOUT)



Some Architecture Concerns

(A) Connectivity

(1) Wet mateable electro-optic connectors

(determined by the need (or not) for a ROV for making underwater connections)

(What is/will be available from Ocean Design/Sea Con?) (8 fibers/4 conductors?)

(2) Dry mateable E/O connectors

(e.g. Sea Con 48/1 as used in Antares for shore cable termination)

(B) Junction Boxes

Layout with Primary and Secondary JBs?

What to put in JB?

How to Reduce Cost by separating Pressure Blocking and Corrosion Blocking

**Example of Hybrid (electrical, fibre-optic) wet-mateable connector:
(Ocean Design Mk II used in ANTARES:
2 electrical and 4 fiberoptic pathways)**

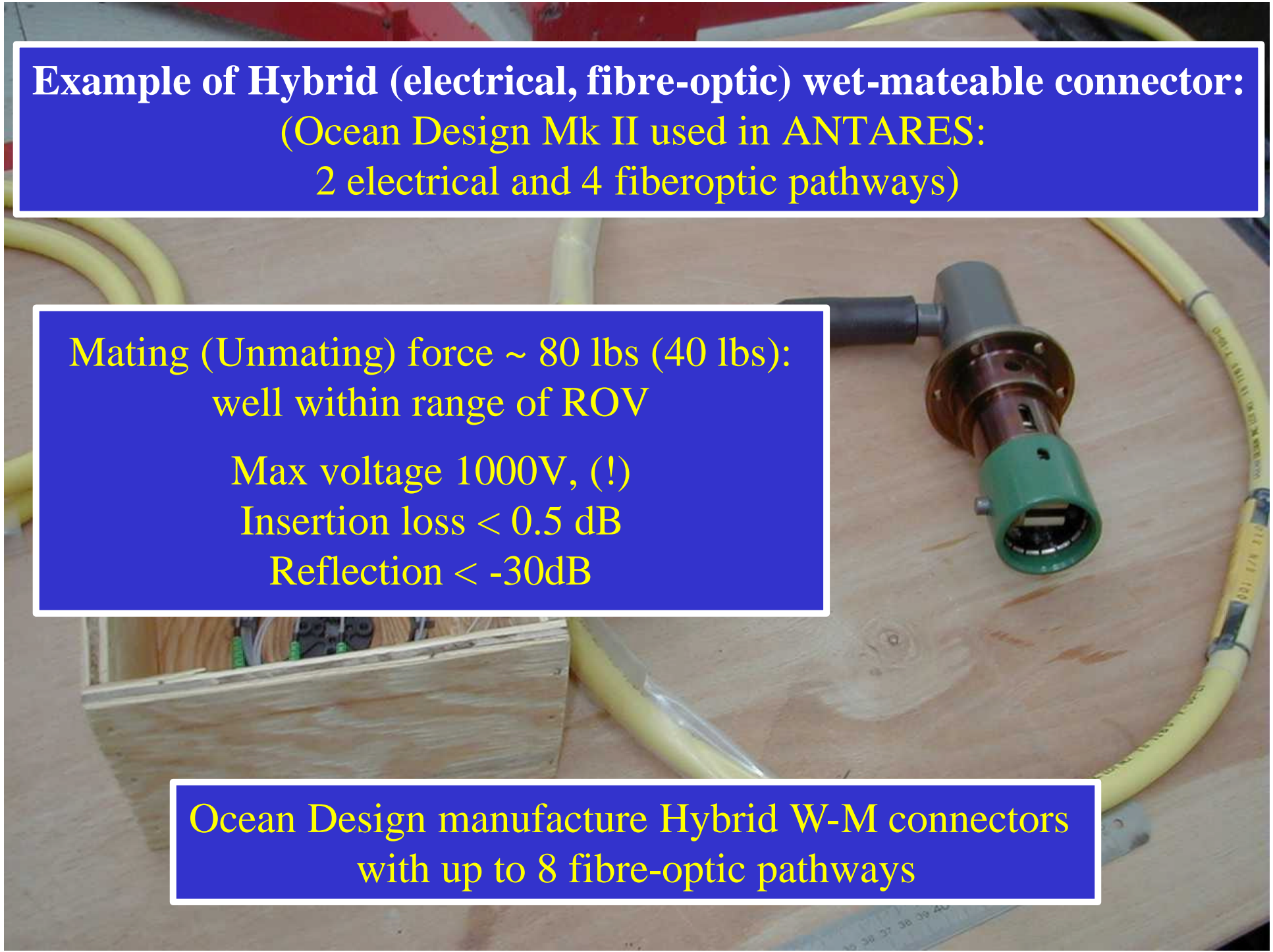
**Mating (Unmating) force ~ 80 lbs (40 lbs):
well within range of ROV**

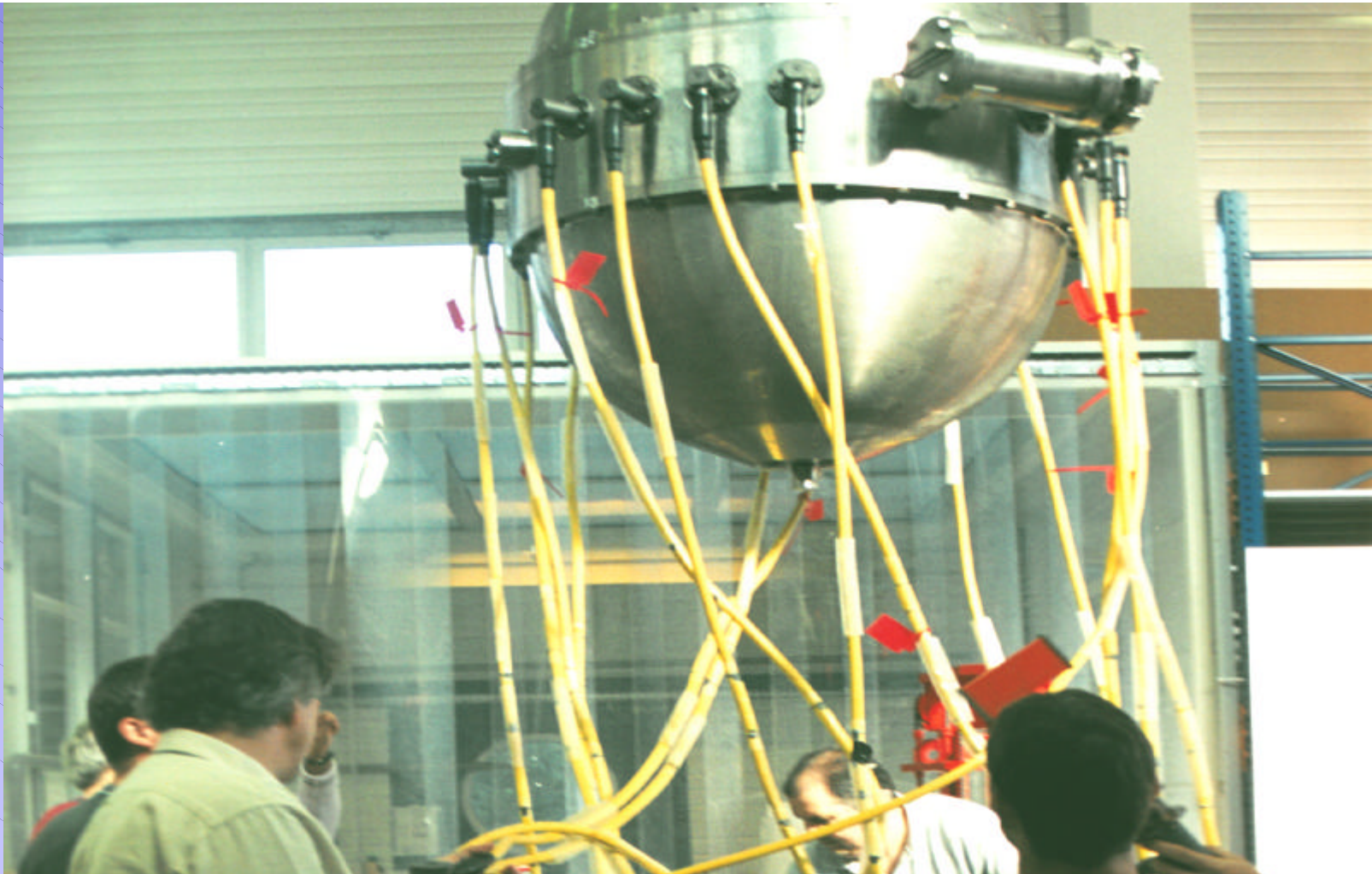
Max voltage 1000V, (!)

Insertion loss < 0.5 dB

Reflection < -30dB

**Ocean Design manufacture Hybrid W-M connectors
with up to 8 fibre-optic pathways**





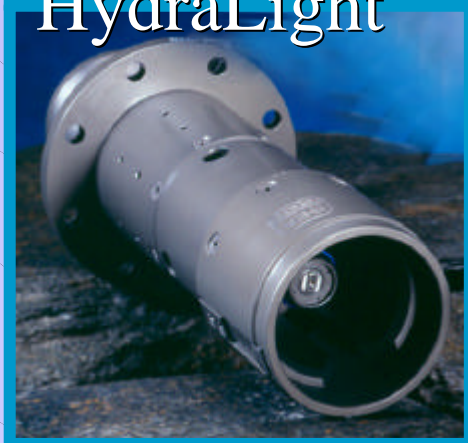
**ANTARES JB OUTPUTS:
16 ELECTRO-OPTIC HYBRID WET-MATEABLE CONNECTORS
(~50% COST OF JUNCTION BOX)**



SeaCon Fibre Optics Wet-Mate



HydraLight



HydraStar



Photon



S Series



MicroStar

NEW

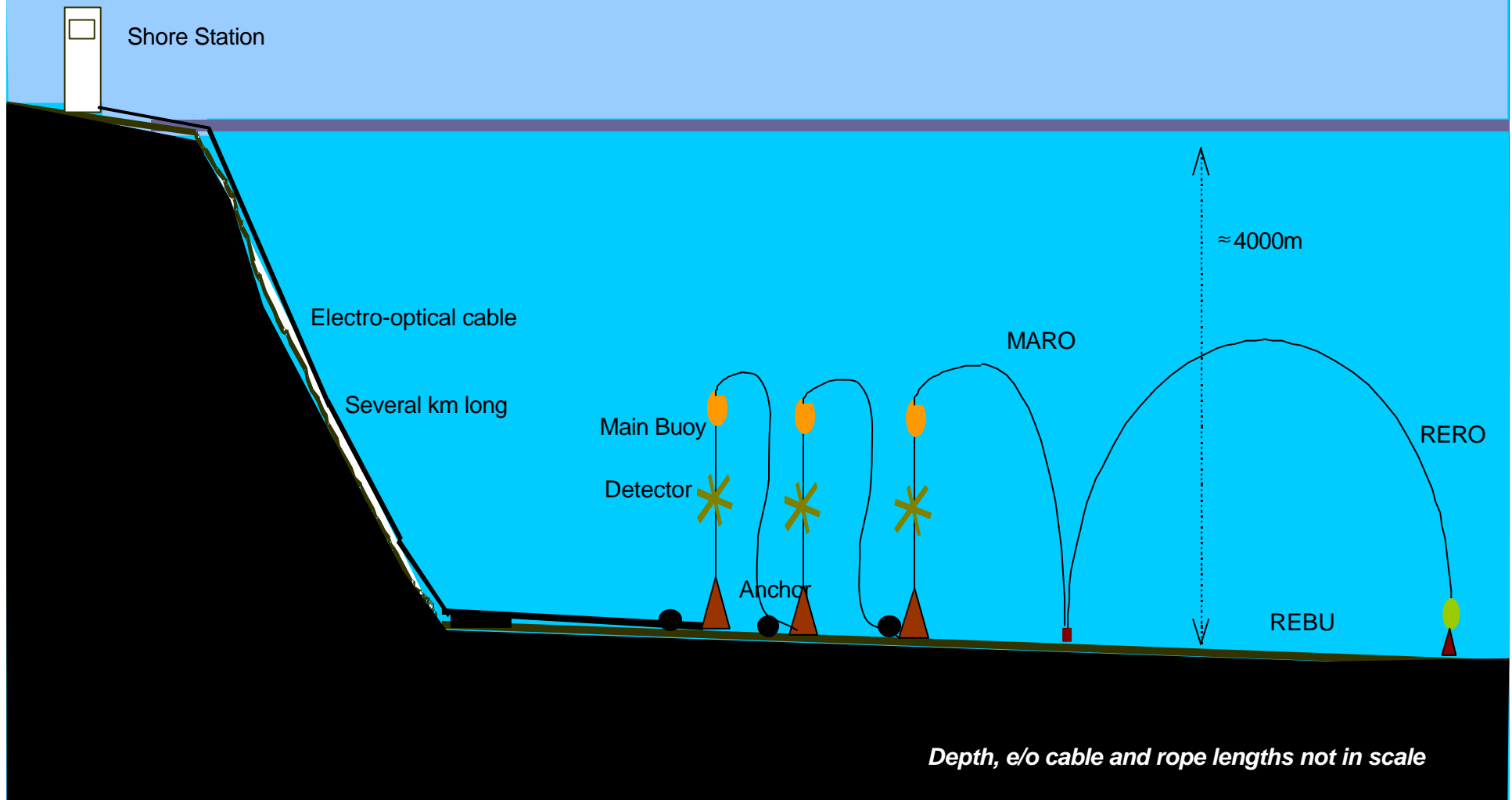
HydraLight – Features

The ROV HydraLight version offers the following additional features over the successful HydraStar series:

- Significantly improved optical performance
- Superior highly compatible fluorosilicone elastomers
- Superior synthetic oil compensation fluid
- Protective cover over plug sliding sleeve
- Fully seawater compatible interior
- Additional qualification testing
- Stronger operating springs
- 8-channel optical only
- Modular ROV handle interface



Deployment schematic of towers



STATUS OF WET-MATEABLE CONNECTORS

- ❖ **Two Companies (Ocean Design, SeaCon) manufacture these connectors:**
- ❖ **Fully mateable down to lowest depths envisioned
for an underwater neutrino telescope:**

(1) Hybrid Wet-mateable connectors

**presently limited to 8 fibreoptic pathways with Max. Electrical Rating 1000V DC
(Ocean Design, SeaCon 'Hydra star')**

(ANTARES does not exceed 500V AC at its junction box outputs)

(2) Fibre-optic Wet-Mateables:

SeaCon HydraLight (8 f/o), Microstar (4 f/o: non-retentive: vertical insertion)

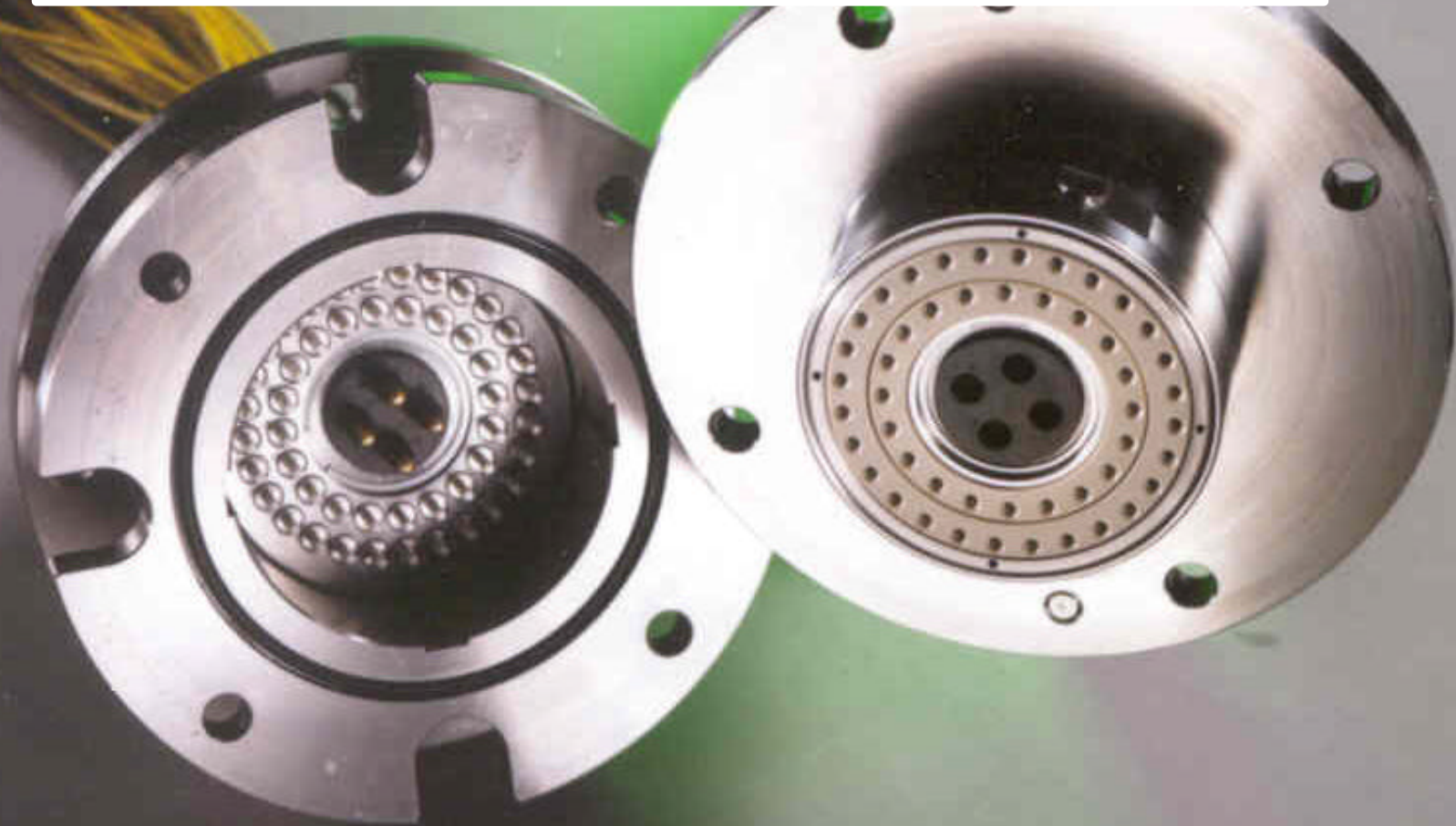
(3) Electric Wet-Mateable

SeaCon CM series: up to 3.3kV AC

**PRELIMINARY CONCLUSION:
SEPARATE ELECTRICAL AND FIBREOPTIC CONNECTORS
UNLESS VOLTAGES < 1000V CAN BE ASSURED
FROM PRIMARY JUNCTION BOX**

**Dry-Mate Hybrid Electro-optical Connectors
are less of a problem for High Voltage:**

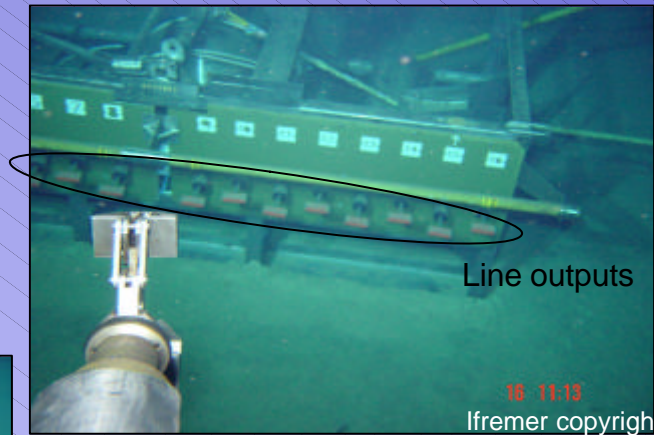
**Example from SeaCon:
(48 fibres, 1 electrical conductor (4 parallel pins):
used at 5000V AC in ANTARES)**



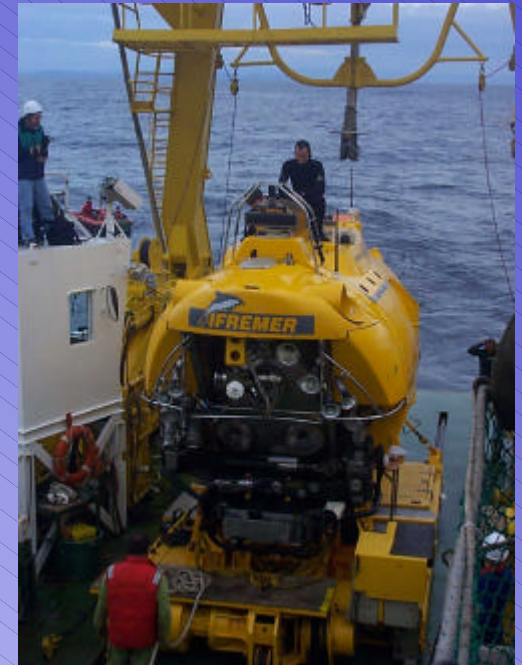


Experience

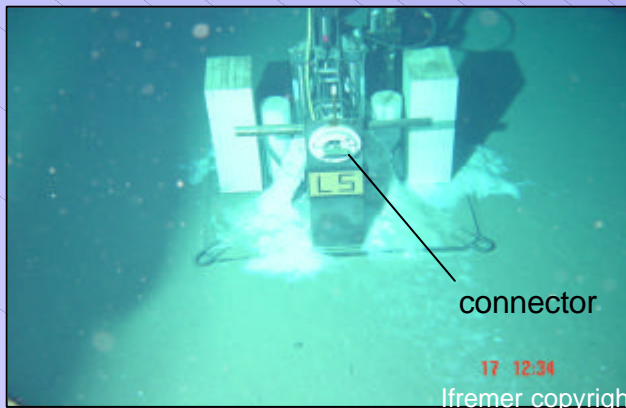
- Junction box installed at sea December 2002
- 1 sector line immersed in December 2002
- 1 instrumented line immersed in February 2003
- 2 lines connected in March 2003 by the manned submarine Nautille from IFREMER



Junction box



Nautille

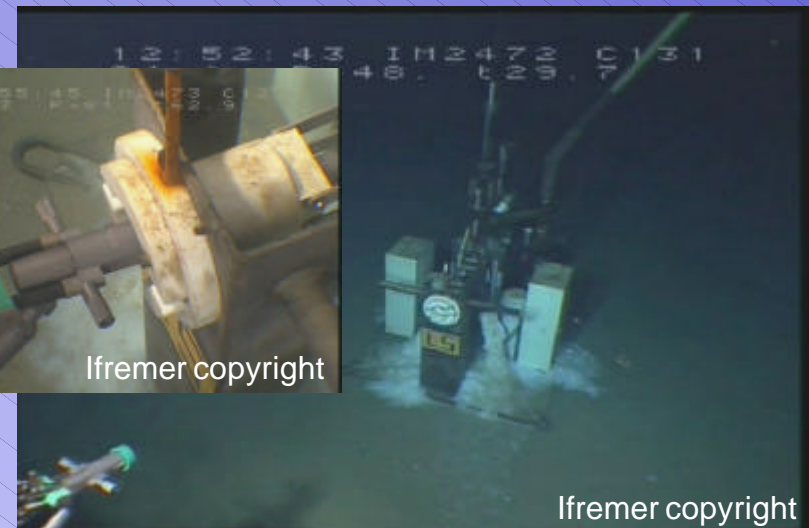
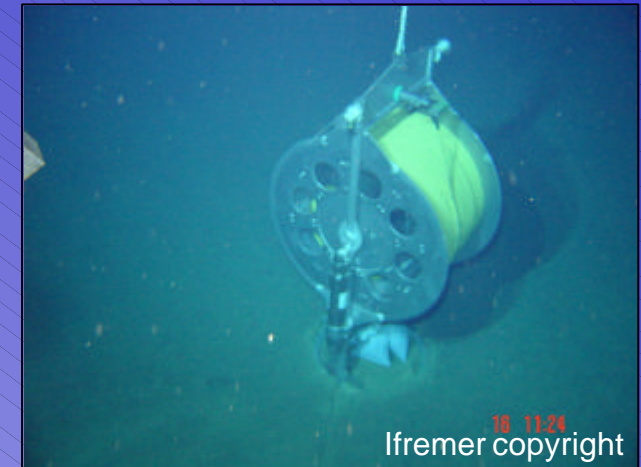


Line socket



Line connection sequence

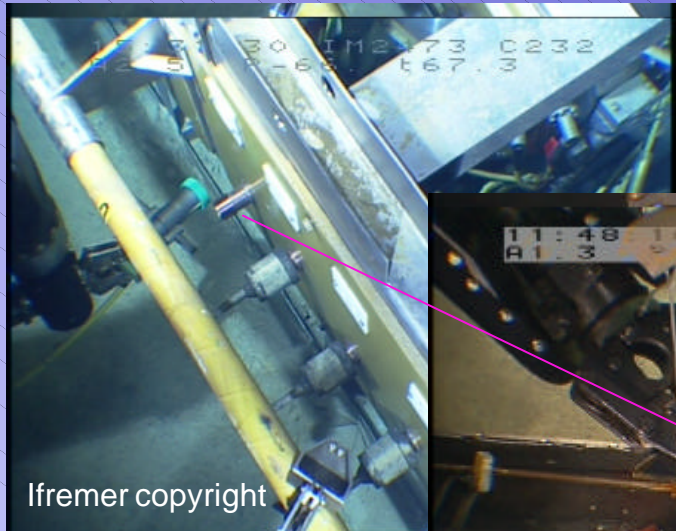
- Link rolled on a drum
- Drum launched from the boat
- Submarine launched
- Drum recovery
- Drum placed near the JB
- JB connection (checked from the shore)
- Link unrolled
- Line connection (checked from the shore)
- Drum released to surface
- Submarine recovery





Sector line connection

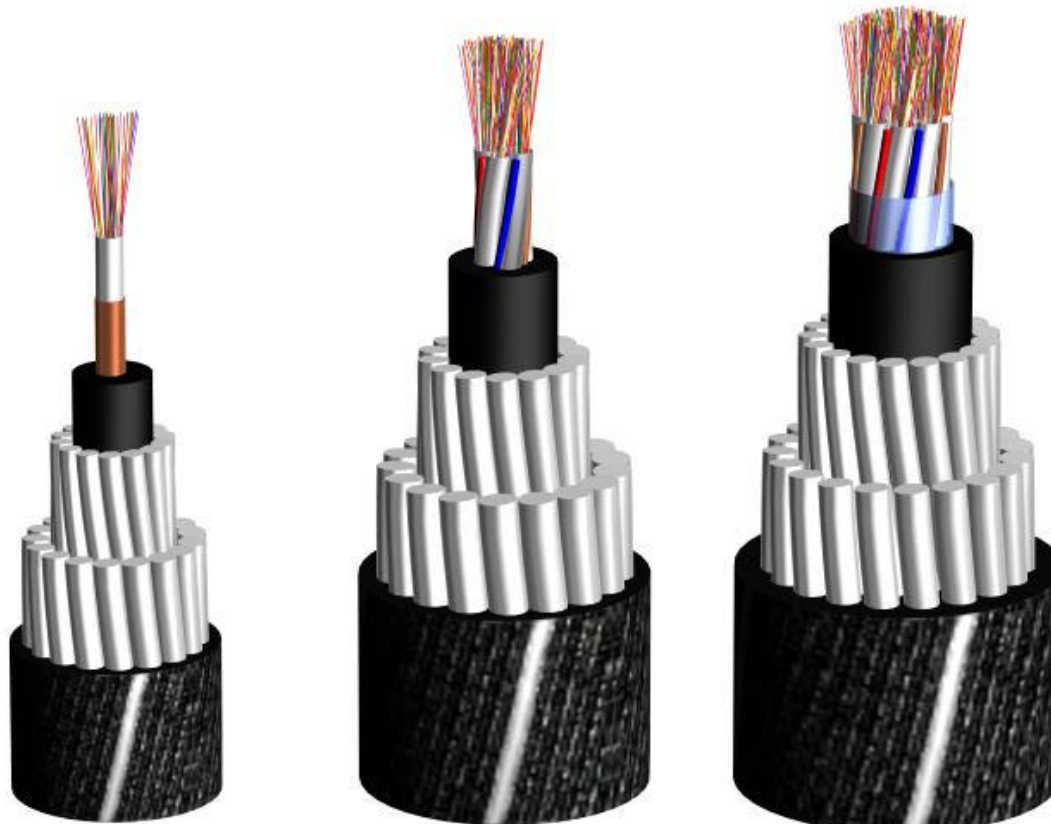
- Mechanical problem on a bulkhead during JB connection
 - ✓ Connector misalignment during connection



- Connection on new JB bulkhead : OK
- Connection on the line : OK

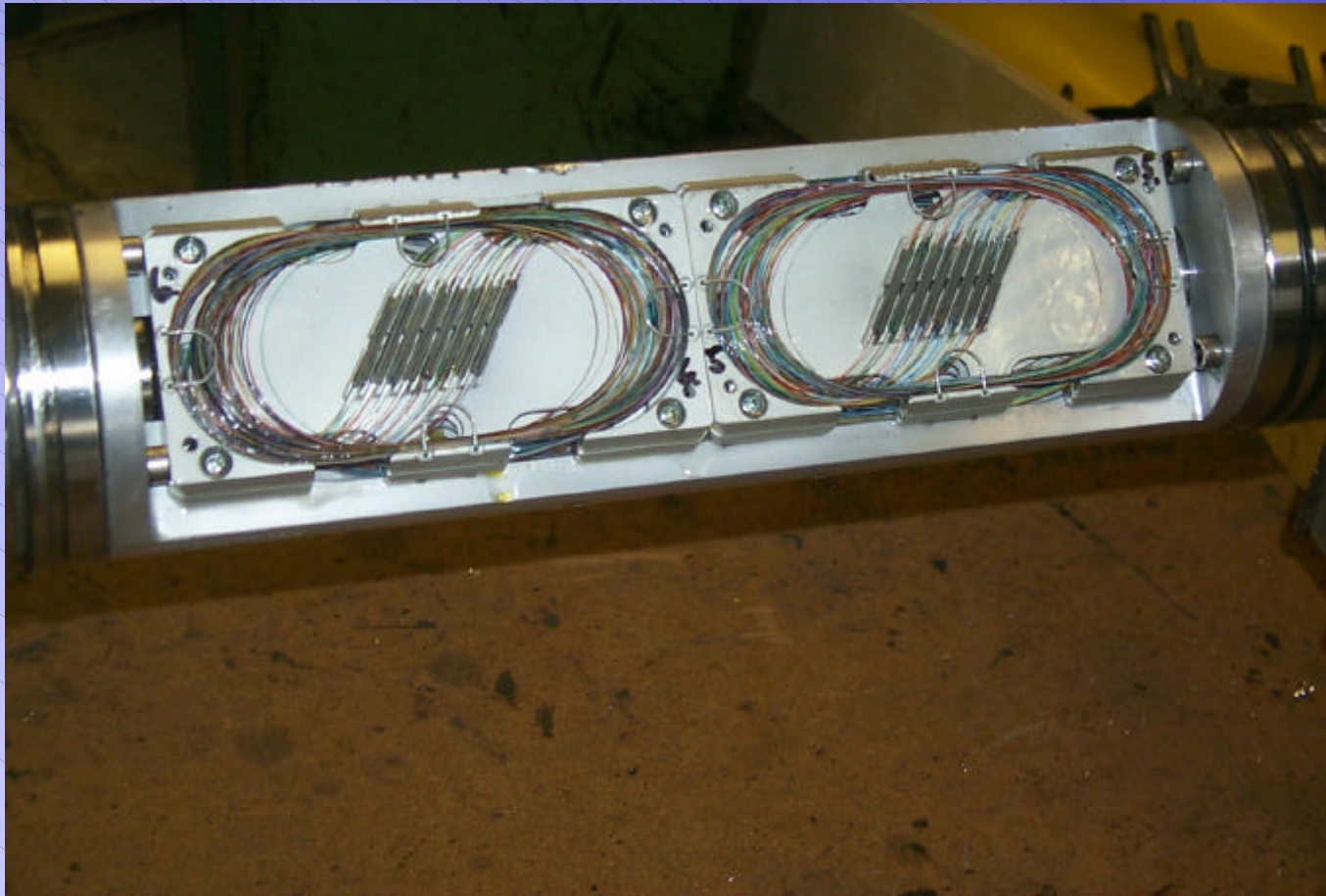
The 2 lines were operated from this date

NEXANS URC-1, >8000 km



Nexans URC-1 Double Armoured Cables with fibre counts up to 384 fibers

A reminder view is pictured below:



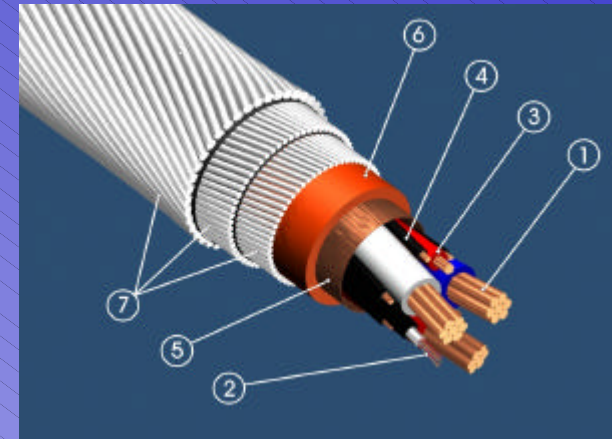
URC-1 Joint box for 384 fibres after qualification test disassembly

Steel Armoured ROV Umbilical with 4000m depth rating

Investigation of the submarine topography and geology, installation on seabed and exploration of resources are moving towards deeper waters. Hence, control umbilicals used for ROV's must be designed for more challenging operational conditions.

By going deeper, attention has to be paid to the cable weight and dimensions as these are the main contributors to the mechanical forces acting on the cable. At the bottom section, the hydrostatic pressure has to be taken into account. It is of importance to keep the outer dimension at the lowest possible level, so as to reduce hydrodynamic drag forces and strumming acting on the cable.

A Technical Description of the 4000m cable design is available upon request; refer to RS035.



1 Power Supply, ROV motor

Three 16mm² Copper Conductors rated to 3.3kV. Capable of transferring up to 200kVA over 4500m of cable.

2 Signal

A selection of max 12 SM/MM optical fibres protected by a laser welded steel tube.

3 Power Supply, Instrumentation

Two 1.5mm² Copper Conductors supplying power to the ROV instrumentation.

4 Earth Conductors

Copper Conductors with semiconductive insulation, used to detect fault currents and drain any charges building up in the cable.

5 Shield

Copper Laminate increases the effect of Earth Conductors.

6 Sheath

A layer of thermoplastic polyester is applied. Protects the cable core and enables easy termination.

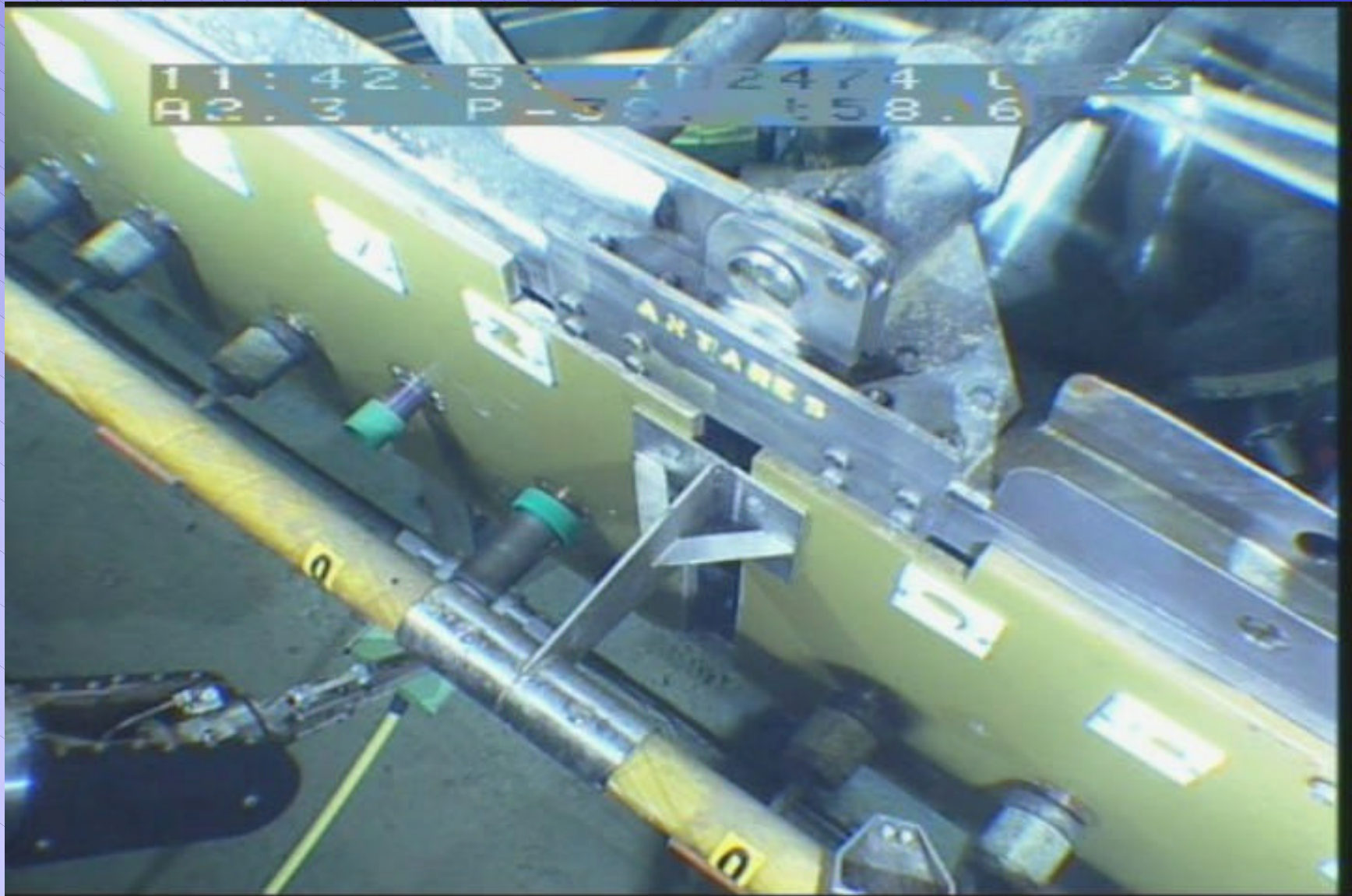
7 Armouring

Three layers of high-strength steel wires provide tensile strength and torque balance.

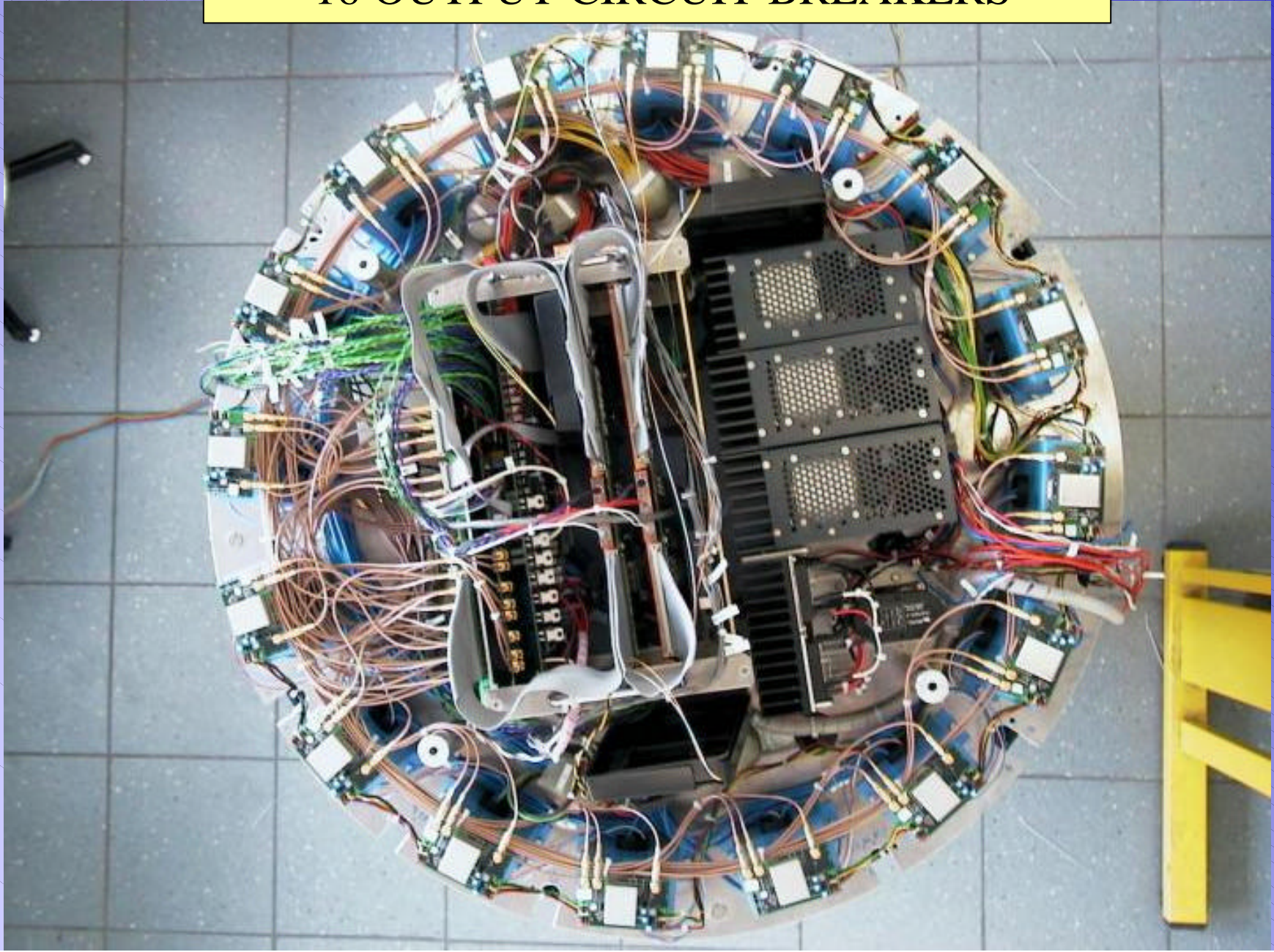
ANTARES JB on Castor Deck

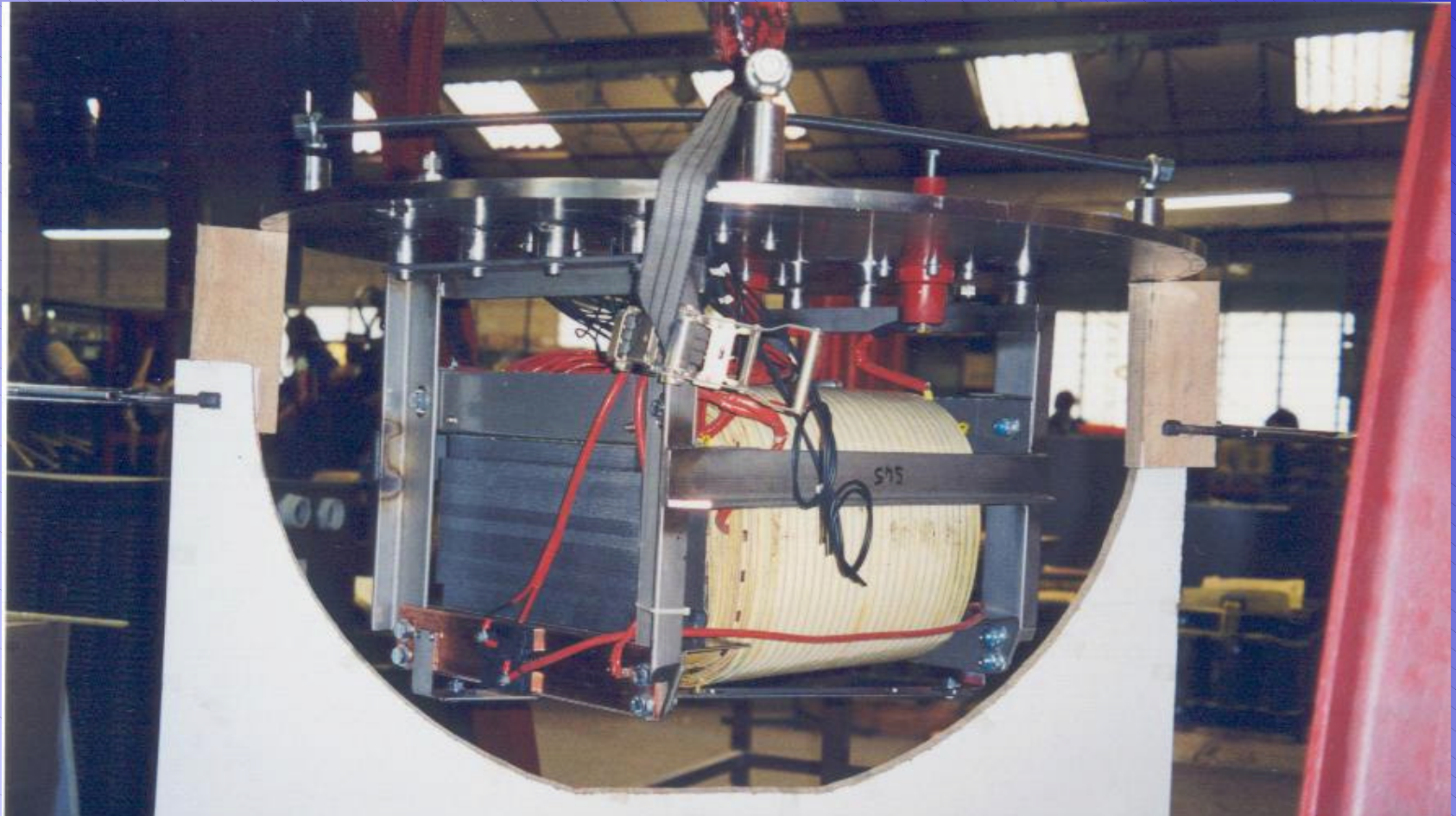


Underwater Hookups March 2003, see June 2003 CERN Courier



ANTARES JB: INTERNAL ELECTRONICS, 16 OUTPUT CIRCUIT BREAKERS



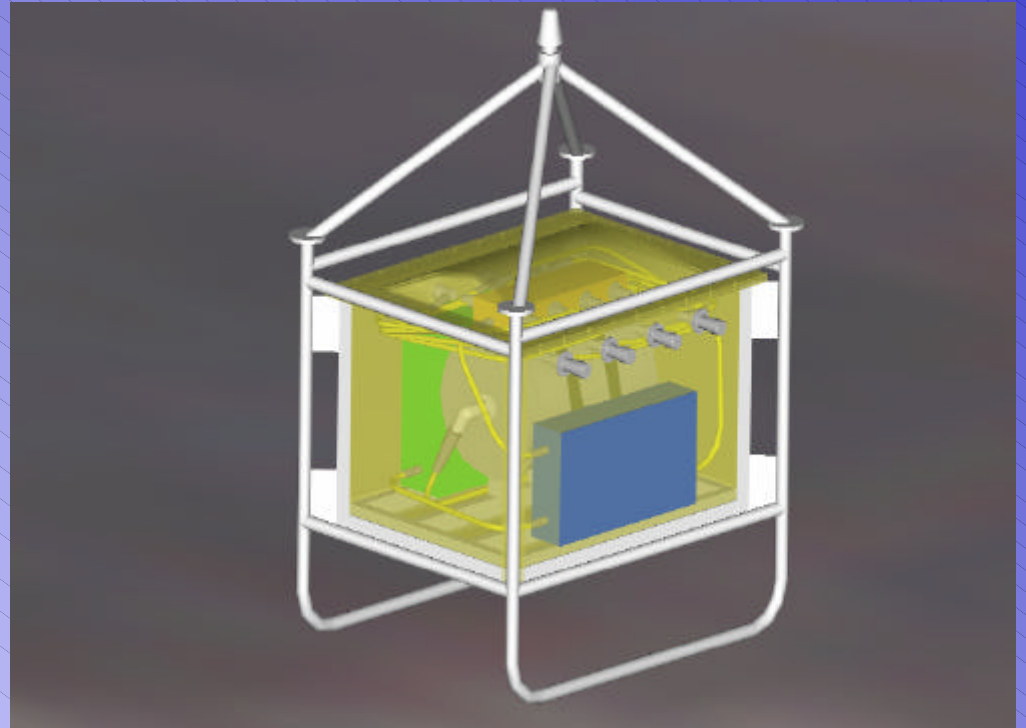


**ANTARES JB 4400V → 500V Transformer
(lower hemisphere)**

NEMO Junction Box Concept

JB oil filled, pressure compensate:

- 1. internal lay-out*
- 2. steel pressure vessel*
- 3. step-down transformer*
- 4. fiberglass container, with internal*



1. Internal lay-out

sea water

cables form the frame

titanium ROV operable connectors

316SS dry mate connectors

oil filled hose

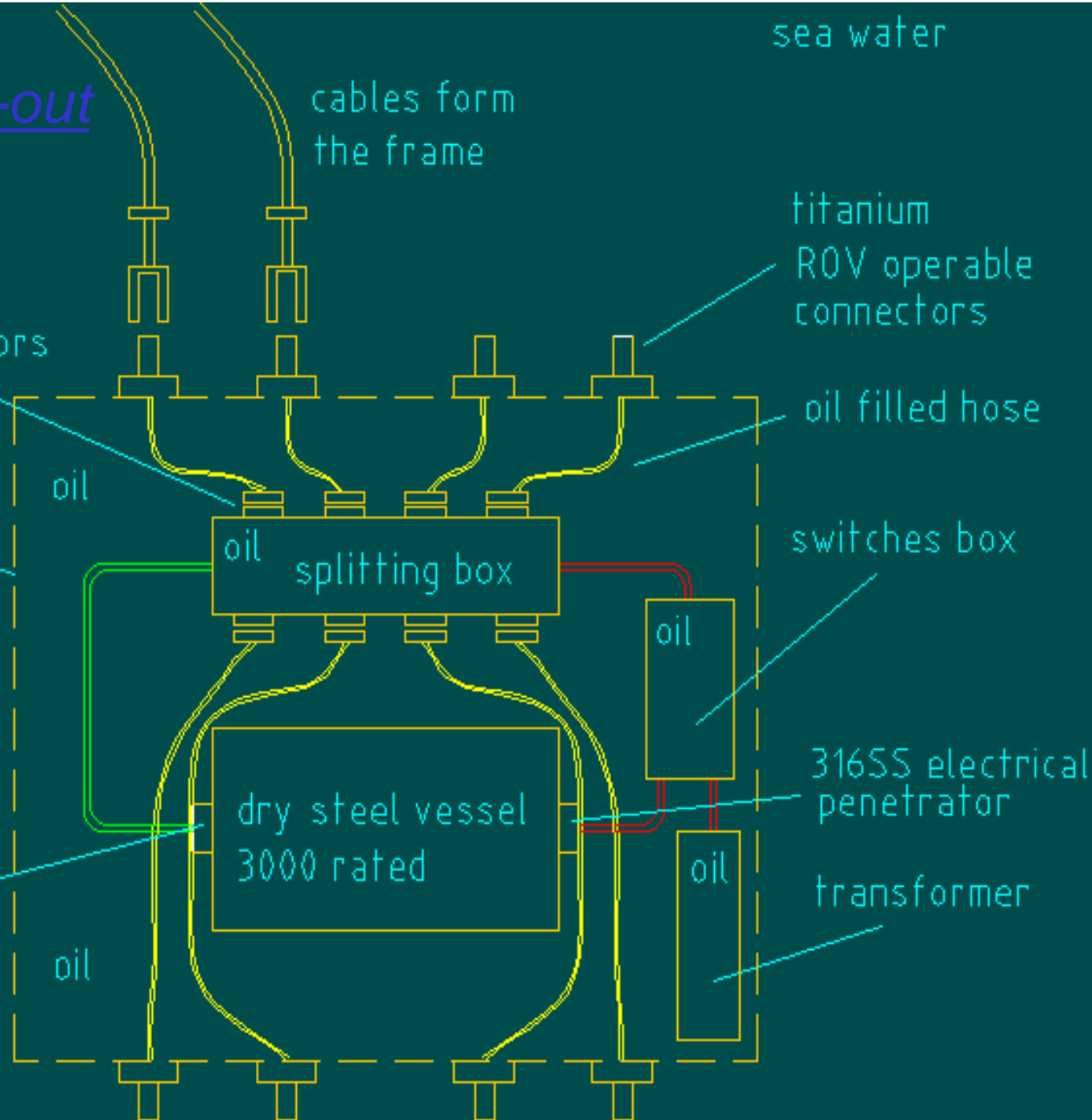
fiberglass container

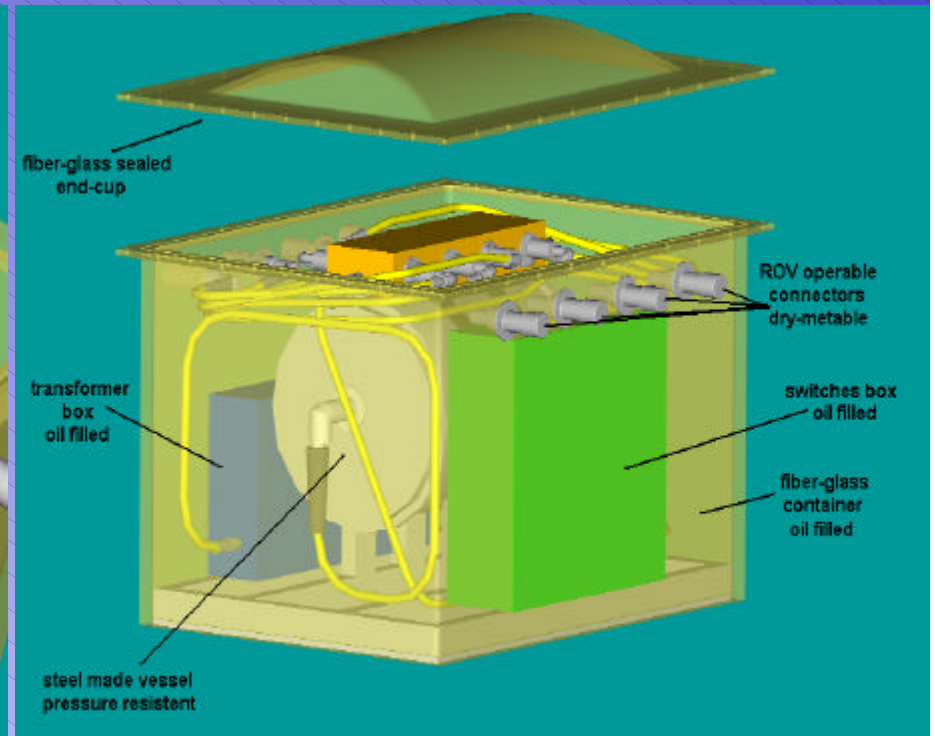
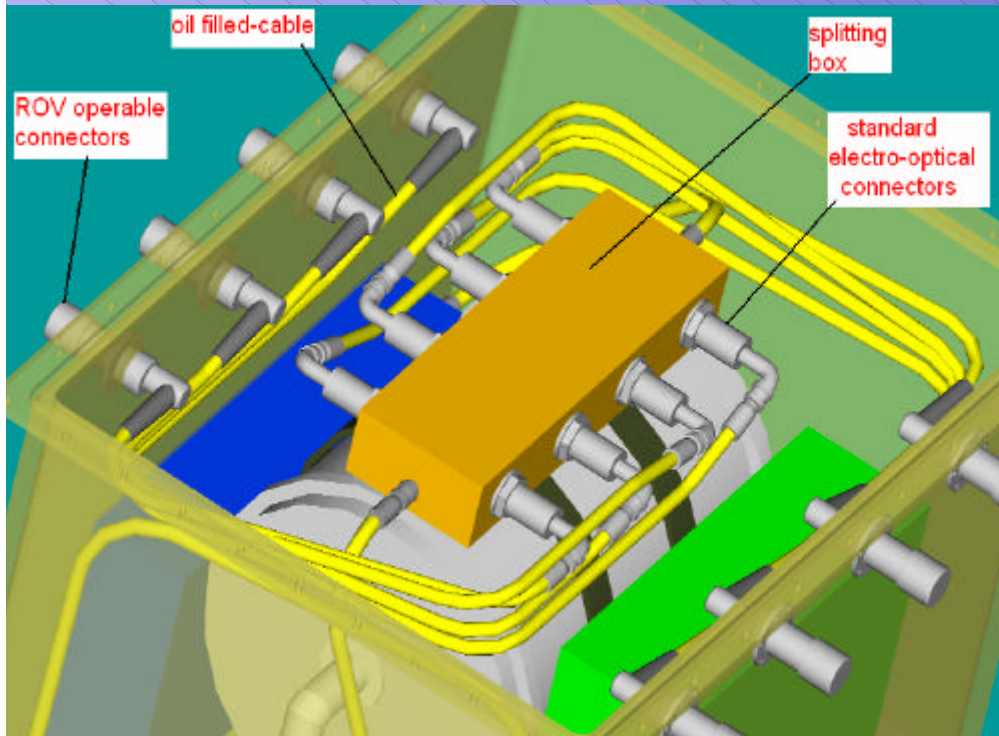
switches box

316SS optical penetrator

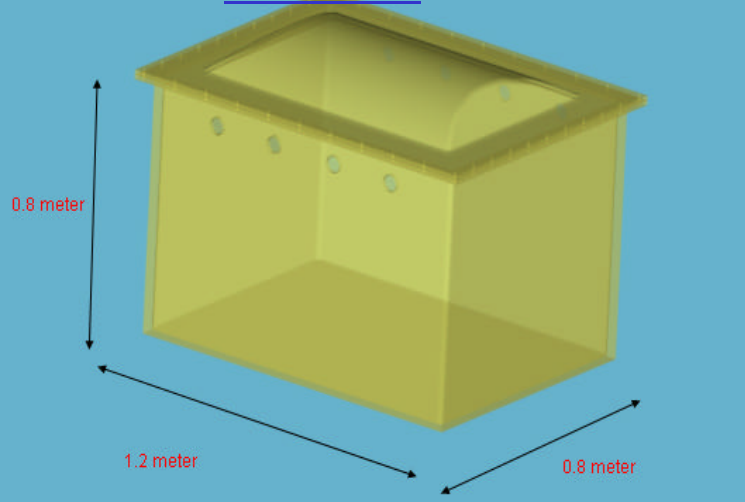
316SS electrical penetrator

transformer

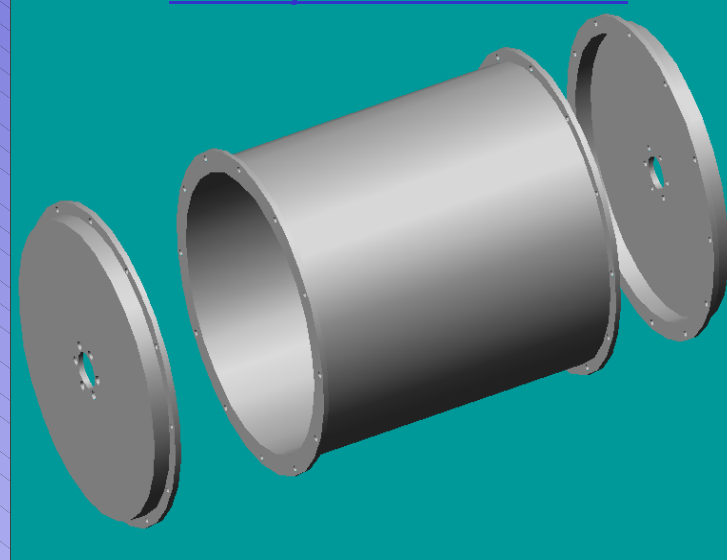




2. JB fiberglass container



3. Steel pressure vessel



4. transformer



5. Internal frame

