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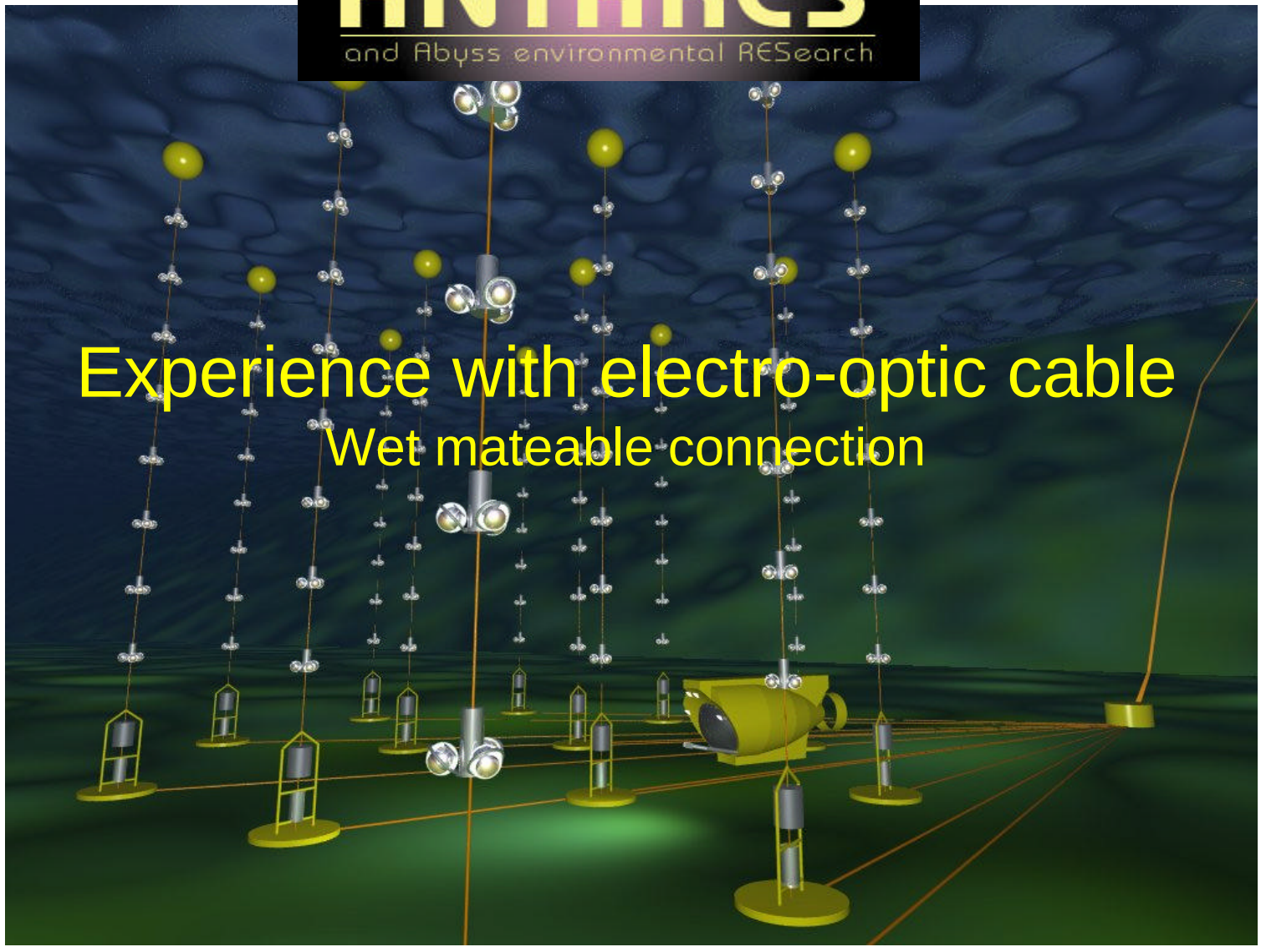
Astronomy with a Neutrino Telescope

ANTARES

and Abyss environmental RESearch



Experience with electro-optic cable

Wet mateable connection

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Contents

- Configuration
- Specifications
- Choice
- Experience
- Future
- Conclusion

Configuration

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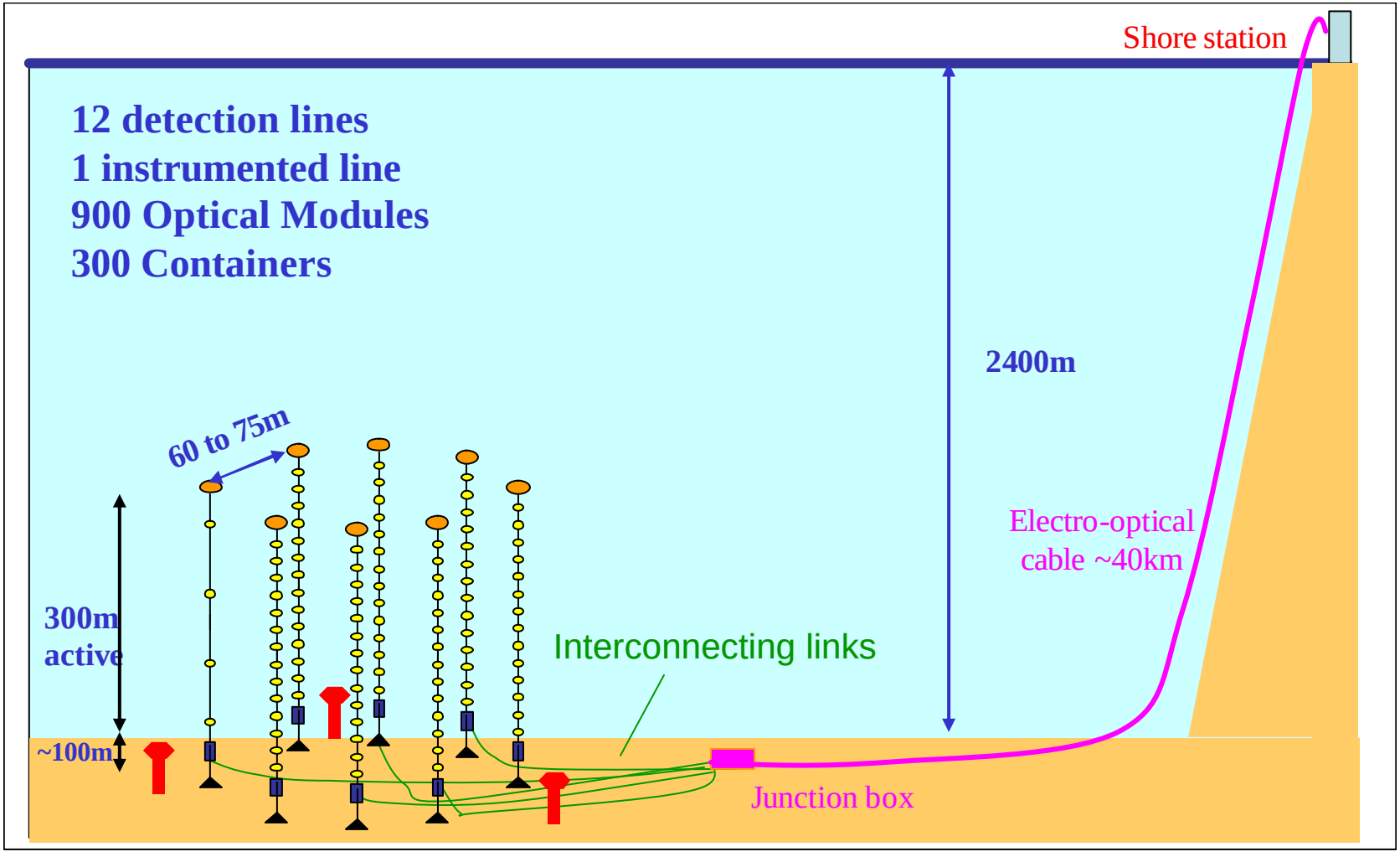

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Detector installation sequence

Line connection :

- Junction box already on the seabed with 16 output connectors for lines
- The line is deployed
- The submarine (manned or ROV) connects the line to the junction box with the interconnecting link

Need an underwater mateable connector

Line recovery :

- Line is released by acoustic signal
- Underwater mateable connector is automatically disconnected

No submarine needed to recover a line

Link specifications

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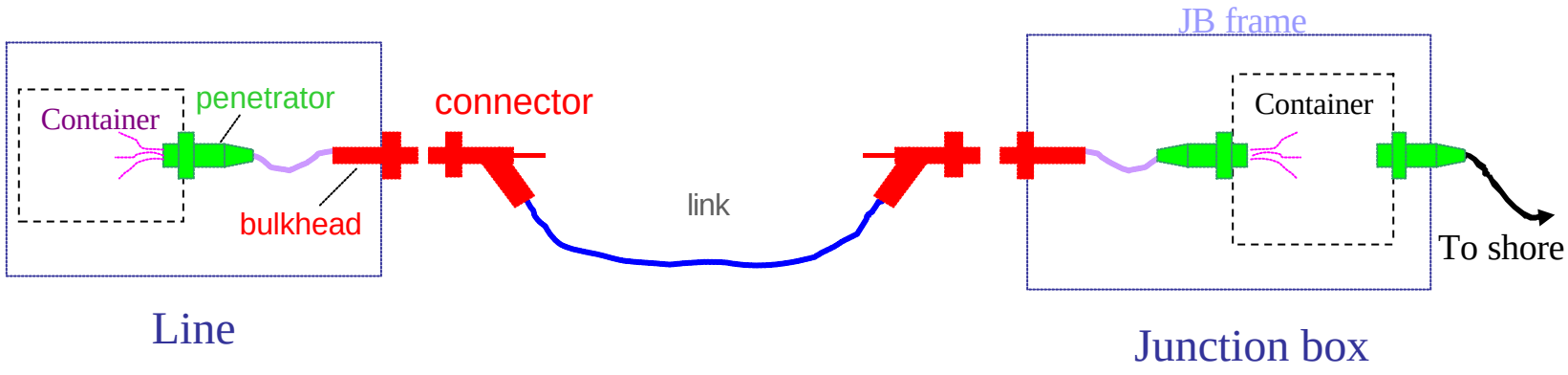
Function : power a line and transfer command and data from/to shore



Main characteristics :

- Power :
  - ✓ 2 electrical wires : Voltage : 500 VAC, Current : ~2.5 A, wire section : 3mm²
- Data :
  - ✓ 2 single mode optical fibres for slow control and data transmission
  - ✓ 2 single mode optical fibres for clock distribution (1 fibre for redundancy)
- Length of the link : 120 m to 350 m
- Weight of the link : < 50 kg in water
- Cable OD : < 20 mm
- Optical losses < 2 dB per optical channel

Selection

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2 candidates : Seacon with Hydrastar connector

Ocean Design Inc. with MKII connecter

Choice parameters :

- Reliability
- Connector experience
- Test results
- Price

Test program according the IFREMER qualification procedure on both links :

- Vibrations : 1 axis, 1-16 Hz amplitude 1mm,16-55 Hz acceleration1g
- Thermal chock : 50°C to 10°C in 10 s
- Wet temperatures : 50°C, 93% relative humidity, 96 hours
- Pressure tests :
  - ✓ 1 cycle @ 310 bars, 24 hours in pressure
  - ✓10 cycles @ 256 bars, 1 hour in pressure (5 mated, 5 de-mated)
- Connections/disconnections under pressure :
  - ✓ 30 connection cycles @ 256 bars

Choice

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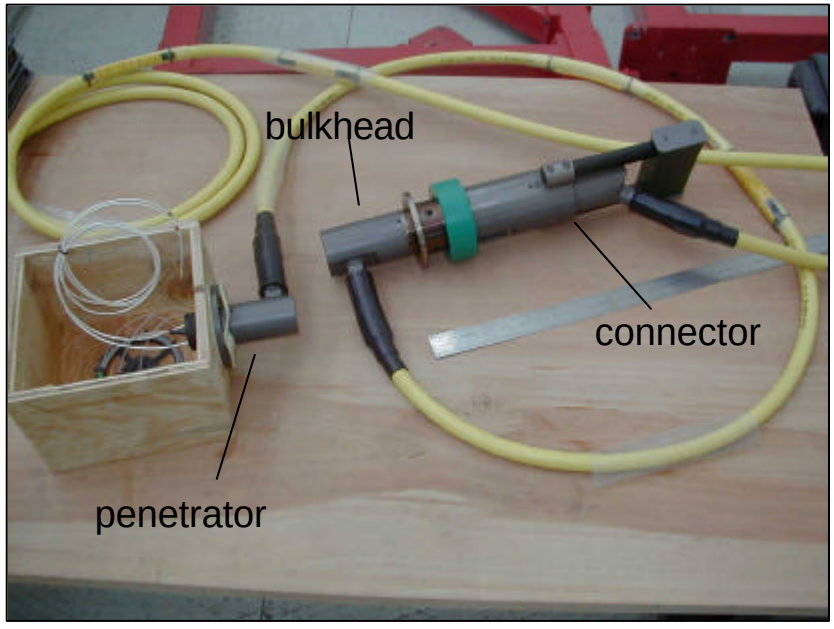
- ODI passed successfully all the tests
- Seacon failed during test (sleeve kept open after disconnection)
- More experience on ODI connector MKII

Choice : ODI for the main criteria **reliability**



- All jumpers in equipressure
- 1 link in equipressure (instrumented line)
  - ✓ OD hose : 18 mm
- Other links with dry cable (copper section)
  - ✓ OD cable : 13 mm

Experience

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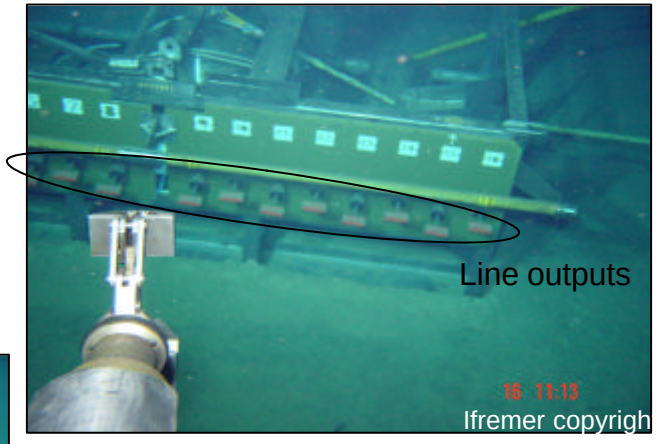
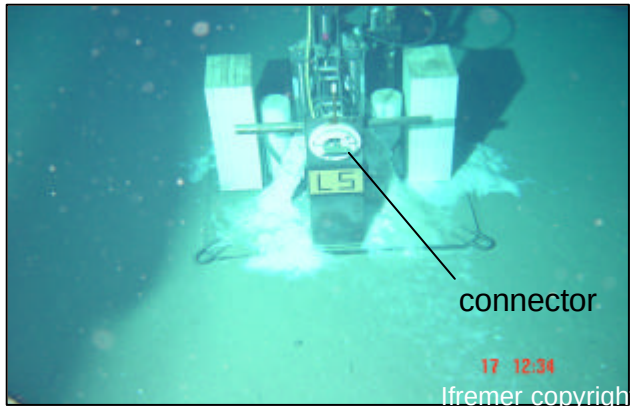
- Junction box installed at sea December 2002
- 1 sector line immersed in December 2002
- 1 instrumented line immersed in February 2003
- 2 lines connected in March 2003 by the manned submarine Nautile from IFREMER



Junction box



Line socket

Nautile

Line connection sequence

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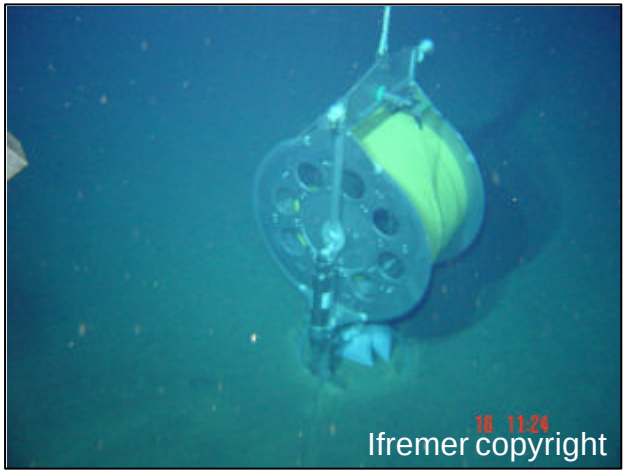
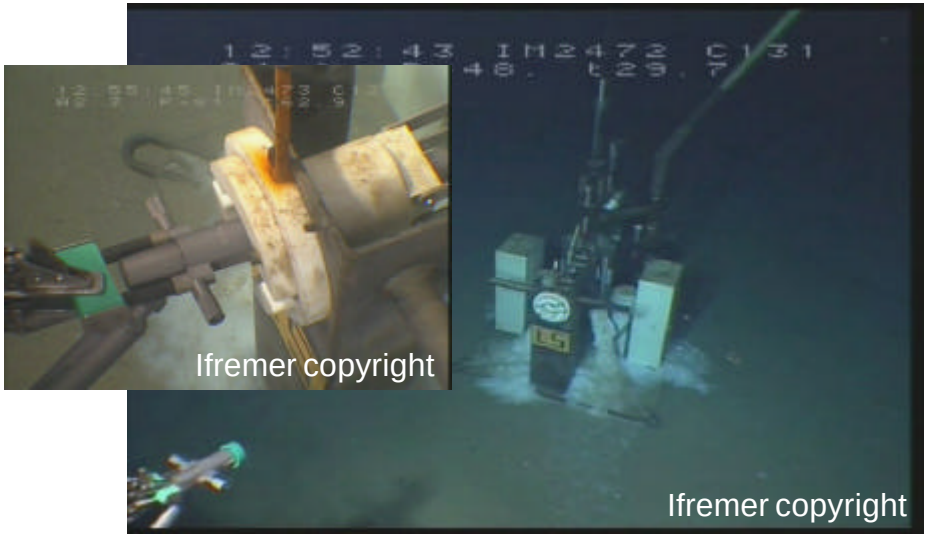
- Link rolled on a drum
- Drum launched from the boat
- Submarine launched
- Drum recovery
- Drum placed near the JB
- JB connection (checked from the shore)
- Link unrolled
- Line connection (checked from the shore)
- Drum released to surface
- Submarine recovery





Instrumented line connection

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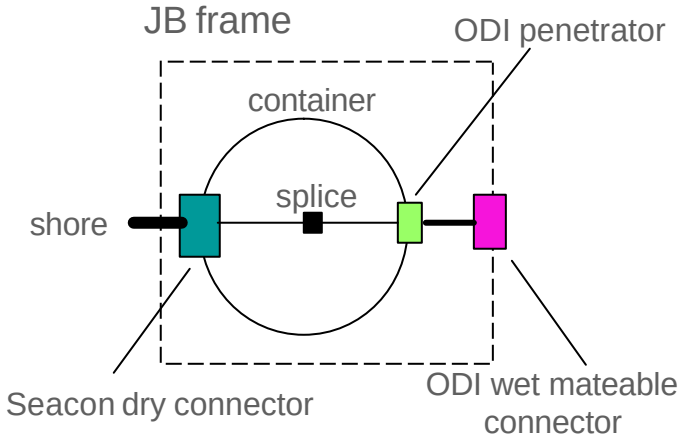
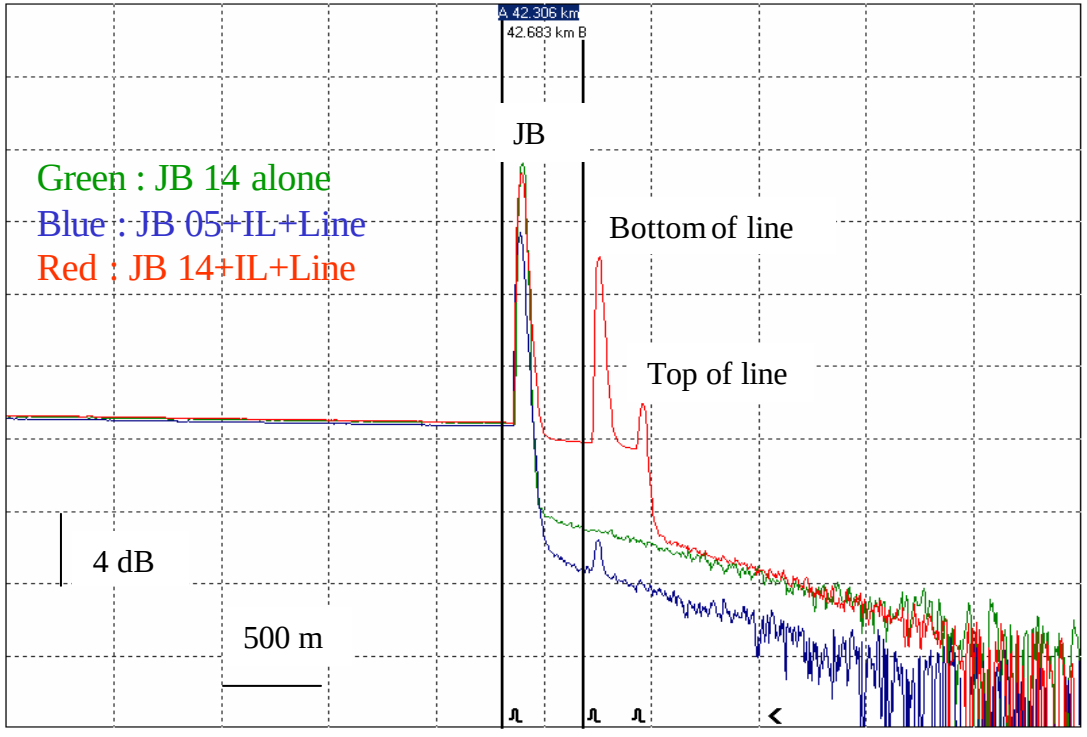
- Extra optical attenuation (~8dB) measured at the Junction box side on output 05 on 2 fibres (2 others can't be checked)
- Connection 3 times : same results
- Change connection on output 14 : OK < 1dB
- Connection on the line side : OK



JB fibre path



OTDR measurement @ 1550nm

Sector line connection

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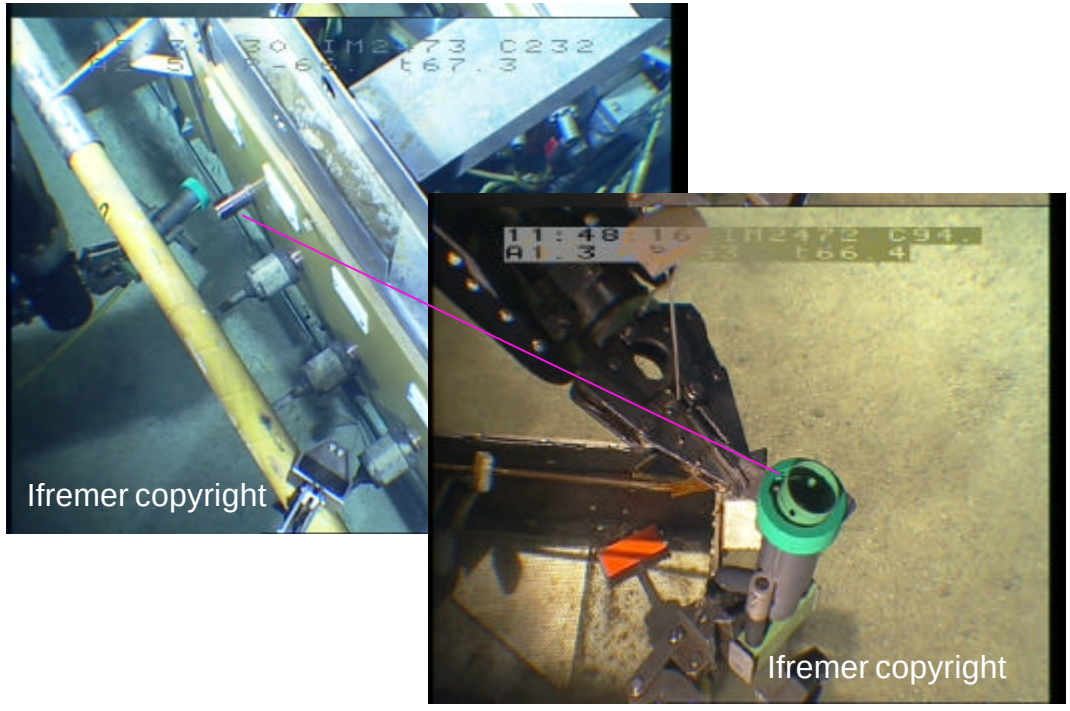
- Mechanical problem on a bulkhead during JB connection
  - ✓Connector misalignment during connection



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

The 2 lines were operated from this date

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Future

Some points to investigate :

- Voltage capability of hybrid connectors
- Electrical versus optical link
- Equipressure versus dry cable
- Wet mateable optical connection very expensive
  - ✓ Connector cost
  - ✓ Operation cost (both optical/electrical connection)
- New architecture to avoid (or limited) wet mateable connection

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Conclusion

- Successful connection of 2 lines done
- Successful automatic disconnection performed
- External connector guide useful
- Reliability must be demonstrated
- Knowledge on wet mateable connection started…