Organisation of TESTS on observatory methodologies on cabled ESONET observatory sites

Partner:	INFN		
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TEST SITES

Do you propose a cable site for tests?			Yes X	NO ☐
Water depth?	2100 m	Distance from the shore ?	25 km	
Please join a description of the infrastructure : junction, connectors, interfaces , existing sensors and instruments; servicing operations (availability of ROV, cost by day…)				

TESTED EQUIPMENTS

Do you propose any equipment to test			Yes X	NO ☐
Do you know of any European company who could be interested to provide equipment for tests			Yes X	NO ☐
Do you know of any not ESONET Institution who could be interested to provide equipment for tests			Yes ☐	NO X
	Model	Deployment time	Provider	
CTD				
Oxygen				
Turbidity				
Fluorescence				
Chemical analyser				
Current meter				
ADCP				
PH probes				
Penetrometer				
Geophone				
Hydrophone	SMID TVR 401 V(1) RESON TC 4037	2009	INFN	
Accelerometer				
Still camera				
Video camera				
Lights				
Temperature probes				
Samplers				
….				
Underwater mate able connectors	ODI electro optical ROV mateable connectors	2005, 2006, 2009	INFN	
Acoustic modem				
Power and real time data transmission systems	Custom		INFN INGV	

Qualification Tests

Can you offer testing facilities at your institution?			Yes X	NO ☐
	Range	procedure reference	Comments	

Pressure	0 – 600 bar 0-400 bar		Cylindrical pressure tank 900 mm x phi 200 mm oil filled. 9 electrical pin connector. Available at INFN-LNS Spherical pressure tank 6000 mm radius water filled. 9 electrical pin connector. Available at Shore Laboratory.
Temperature			
vibration			
…..			
SENSOR CALIBRATION			
Can you offer calibration facilities at your institution?			Yes ☐ NO ☐
	Range	procedure reference	Comments
Temperature			
Conductivity			
Pressure			
Oxygen			
Currentmeter			
OTHER COMPONENTS			
Are you planning to provide other devices/components for in-situ testing			Yes ☐ NO ☐
	Reference		
Bio fouling protection system			
Deep sea acoustic transmitter for calibration	Sea Surface and/or deep sea beacons developed and realized by INFN (see Test 3)		
TEST PROGRAM			
TEST 1 Description (5 lines)	We want to perform maintenance, connection/disconnection and recovery operations on ROV e.o. mateable connectors installed at the Test Site in different times (2005, 2006). Once recovered the mechanical and electrical status of ROV connectors will be studied. During the ROV dive structures made of different materials, installed in the site, will be recovered and studied.		
TEST 2 Description (5 lines)	Two different power and data transmission systems will be tested: the direct "shore-to-deep sea frame" link on TSN and the link on TSS. The latter is realised by the use of a deep sea Junction Box (see description of the infrastructure) installed in year 2006. This will allow also a test of the power and data transmission systems installed on the Junction Box.		
TEST 3 Description (5 lines)	We will perform real-time tests of acoustic sensors, installing a calibrated acoustic transducer on the ROV. The acoustic transmitter will be, in fact, linked to the GPS time with the aim of performing a time-and-amplitude calibration of hydrophones.		

Comments: The test will be performed in collaboration with INGV

DESCRIPTION OF THE INFRASTRUCTURE

The Eastern Sicily infrastructure consists of a shore laboratory, a 28 km long electro-optical (hereafter e.o.) cable connecting the shore lab to the deep-sea lab. The shore laboratory hosts the land termination of the cable, the on-shore data acquisition system and power supply for underwater instrumentation. The shore laboratory has also a radio link (maximum speed 56 Mbps) to LNS-INFN that allows link (100 Mbps/1Gbps) to the internet. The underwater cable is an umbilical underwater e.o. cable, armoured with an external steel wired layer, containing 10 optical single-mode fibres (standard ITU-T G-652) and 6 electrical conductors (4 mm^2 area). At about 20 km E from the shore, the cable is divided into two branches, roughly 5 km long each, that reach two different sites namely Test Site North (TSN, latitude 37°±30'810 N, longitude 015°±06'819 E depth 2100 m) and Test Site South (TSS, latitude 37°±30'008 N, longitude 015°±23'034 E, depth 2050 m). The TSN cable branch has 2 conductors and 4 fibres directly connected to shore. The TSS branch has 4 conductors and 6 fibres.

In January 2005 INFN and INGV performed a sea operation onboard the Pertinacia-Elettra C/L vessel to recover the underwater cable terminations TSN and TSS and to install, on them, two underwater frames. Each frame, made of grade 2 titanium, is equipped with a pair of e.o. connectors. The two frames were deployed on the seabed. The e.o. connectors are made to be handled by ROV to allow plugging and unplugging of underwater experimental apparatuses, avoiding further recovery operations of the main cable. During the same naval campaign two experimental apparatuses were deployed, plugged and put in operation. The seismic and environmental monitoring station Submarine Network 1 (SN1), designed and operated by the INGV (Istituto Nazionale di Geofisica e Vulcanologia) was connected to the TSN termination and the O*ν*DE (Ocean Noise Detection Experiment) station was deployed and connected to the TSS termination.

The NEMO Phase-1 project was realised in order to validate the technological solutions proposed by INFN for the construction of the so called *km^3 high energy neutrino detector*. NEMO Phase-1 consisted in the deployment and operation of prototypes of the critical elements of the km^3 detector: a junction box (JB) and a tower hosting optical sensors and data acquisition/transmission electronics. The JB provides connection between the main electro-optical cable and the detector structures. It has been designed to host and protect from the effects of corrosion and pressure, the opto-electronic boards dedicated to the distribution and the control of the power supply and digitized signals. The JB is working and is fully usable for deep-sea experiments. The JB offers optical several fibre links and power connection (380 VAC 3 phase, 3 kW in total) to several end users. Connections to end users are realised through four e.o. ROV mateable connectors.

The Eastern Sicily infrastructure includes underwater handling capability to manage experiments, such a capability consists of a deep-sea light-class ROV with 2 manipulators (SeaEye Cougar, 4000-m operative depth) and a deep-sea shuttle able to deploy and recover on the seafloor heavy systems (40 kN, the systems have to be equipped with a compatible mechanical interface).