IV. Tender Book

1. Introduction

1.1 General framework

The management of natural hazards and associated risks means designing and implementing systems for monitoring the parameters characterizing an exceptional natural event, event able to produce a social and economic disaster.

The present project, acronym MARINEGEOHAZARD wishes to design, purchase and implement a early warning system in case of exceptional events produced by natural hazards in the Black Sea with effects in the cross-border area Romania-Bulgaria and has as beneficiaries the National Research-Development Institute for Marine Geology and Geo-ecology – GeoEcoMar – Lead partner, the Geology Institute of the Bulgarian science Academy (GI-BAS) – Partner 2, The Oceanology Institute of the Bulgarian Science Academy (GI-BAS) – Partner 3 and the National Research Development Institute for Earth Physics (INFP) – Partner 4.

The early warning system will offer the necessary support in all emergency situation management stages, by supplying continuously the information on which the decisions are based.

1.2 Objectives of the project

The main objective of the project MARINEGEOHAZARD is implementing an integrated early warning system, accompanied by a common decision support instrument and increase of the regional technical capacity, for the appropriate detection, assessment, forecast and fast notification of risk related to natural marine geo-hazards for the cross-border area Romania-Bulgaria at the Black Sea.

The component offered by the project has been conceived to cover three main objectives:

- Establishing a common regional system for early warning
- A common decision instrument for intervention
- The protection of local communities, of the environment and of the goods in the cross-border area, related to the consequence of natural marine geo-hazards.

According to the Contracting Plan in the financing contract, the parties forming the common regional system for early warning are grouped as follows:

a) Network of automatic marine gauge stations, with real time communication - Network (EUXINUS) - BATCH 1 of Contracting Plan

b) Coastal network for seismic monitoring - BATCH 2 of Contracting Plan

c) Ocean Bottom Seismometers (OBS) and Marine Seismic Acqusition System - BATCH 3 of Contracting Plan

d) Online Geodynamic Network (GeoPontica) – BATCH 4 of Contracting Plan

e) Network of mechanical extensometers and Strong Motion Seismometers - BATCH 5 of Contracting Plan

f) Assistance for Adapting and Implementing Software for Management Solution for the Assesment of the Consequences Marine Geohazards, including software: No. 6 of Contracting Plan

The present purchase procedure has as objective purchasing and implementing an integrated early warning system for “detection, estimatation, forecastating and fast notification of the natural marine hazards” in the “Romanian-Bulgarian cross-border of the Black Sea”.

The present purchase procedure is the second organized in the project and has as objective purchasing “specialized parts” of the Integrated Early Warning System – IEWS.

As defined in the project, the system is conceived as an integrated approach from the technical and methodological points of view, as well as in the view of a system that must function as a whole, in two neighbouring countries (Romania and Bulgaria).

The reasons mentioned above lead to the idea that the grant procedure must be organized so that the system will be totally integrated (from the methodological point of view, but also between the two countries), operational and tested when the agreements resulting after the tender will be concluded.

The possible participants to the tender must prepare the bids so that the specialized parts are organized, connected and integrated in a sole operational system, and consider the complicated commercial aspects, specific for a project integrating heterogeneous equipment, real-time recording equipment, meant for more beneficiaries.

The approach that will be further described aims that the bids declared winners will be technically and commercially according to the objectives, the financial framework in which the project is performed and in conformation to all terms - delivery, installation and testing period for the systems.

The tender will be performed for the project “Set-up and implementation of key-core components of a regional early-warning system for marine geo-hazards of risk to the Romanian-Bulgarian Black-Sea coastal area”, and has as objective to contract two “turnkey systems”, functional and operational, as structured in the “Contracting Plan” of the project.

The product batches, as defined in the Contracting Plan of the Project are kept entirely at the assignment level in the budget of the project.

The first “turnkey system” can be tendered only as a package formed of the Batches 1, 2, 5 and point 6 of the “Contracting Plan”, but will include all necessary adjustments so that Batch 4, already assigned in the first tender of the project – to be completely integrated in the Integrated Early Warning System – IEWS, so that the system will be operational, tested and accepted by the beneficiaries. This first turnkey system for which the grant procedure is organized will be hereinafter referred to as “**Turnkey System – Package I”.**

The second “turnkey system”, hereinafter referred to as “**Turnkey System – Package II”** is Batch 3 of the Contracting Plan. This is a “support system” for the main component (Turnkey System – Package I) of IEWS and can operate independently of it, the connection of the two turnkey systems being “off-line”.

Considering that the two turnkey systems supposes equipment delivery, but also installing them in locations (at sea or on land) indicated by the beneficiaries, we mention the following:

- the beneficiaries will ensure together the ship transportation and handling facilities necessary for installing, testing and commissioning the equipment that will be positioned at sea;
- the beneficiaries will supply the locations where the equipment will be installed, as well as all other necessary permits and approvals for installing them;

- the beneficiaries will provide the electric energy supply of those locations, as well as the security of the installed equipment;
- in case the two coordination centres, located in Constanţa (Romania) and Varna (Bulgaria), where communication equipment and hardware and software programs for obtaining data from all sensors and equipment composing Package I will be installed, the beneficiaries will ensure locations to install the communication equipment and the Internet broadband access (for the connection of the two centres);
- the tenderers will detail according to component parts, according to Table no. IV.1 The technical and commercial terms (the configuration of the equipment, process, delivery, installing and commissioning conditions) according to the tendered turnkey systems (Turnkey System – Package I and Turnkey System – Package II). In Table no. IV.1 the related budget grants for the four project partners and the division of the systems on parts, composing the two tendered packages, are mentioned;
- The financial offers for the parts meant for each beneficiary will have to fit in the budget assigned for each partner in the project. Considering the complexity of the tendered system, the contracting authority requires that within 30 days from signing the contract the winners/winner of the two system supplies to the beneficiary the technical performance projects. These must present in detail the configuration of the system, the manner in which the parts will be integrated in functional systems, as well as the manner in which the installation and testing of these systems will be performed. The performance by the suppliers and the approval by the beneficiaries of the two technical performance projects will be the basis for performing the first payment in the supplying agreements (after paying the advance of 10% of the value of the contract).

2. Specific information

Various business entities have the right to associate in order to submit a common bid, without have the obligation to formally certify their association

The association contract will mention that all associates take their collective and solidary responsibility for the performance of the contract, that the leader of the association is authorized to undertake and receive instructions in the name of all

associates and is liable for himself and in the name of the association for the performance of the contract.

Also, the association contract will stipulate that all associates in the association have to remain in the association for the whole duration of the contract.

In case the common bid will be declared winning, the association will be certified and presented to the contracting authority before the date of execution of the contract-.
In case the bid is submitted by an association, each tenderer (including the leader) will submit form no. 4 “General information” and form no. 7 “Statement regarding the quality of participant to the procedure.

The winning tenderer will conclude the supply contract with each partner/beneficiary in part according to Table IV.1.

The winning tenderer has the obligation to conclude the supply contract according to Form no. 19 “Supply contract model”.

The economic and financial capacity of the tenderer can be sustained also by another person in order to perform and contract.

In case the tenderer proves its economic and financial situation invoking also the support granted by another person, then he has the obligation to prove the support he benefits from by presenting a firm commitment of that person, conclude d in authentic form, with which that person confirm providing to the tenderer the mentioned financial resources.

In case a group of business entities submits a common bid, the economic and financial situation is proved by considering the resources of all members of the group.

The grant of the advance payment of 10% of the value of the supply contract is made only based on an advance return performance bond.

In case there are offers on the fist place that have the same value, the tiebrake is made by the Contracting Authorithy that will ask for a new offer in a sealed envelope.

The bids will have annexed printed leaflets for each equipment included in the bid.

The contractor will install the equipment according to the specifications of the producer.

The equipment shall be installed according to the performance standards for measuring meteorological and physical and chemical parameters; especially the standard decisions for positioning the detection sensors will be carefully complied with.

The supplier will perform any necessary visit on the spot to prove that the space is appropriate before beginning the installation.

After the installation and commissioning of the equipment and related software packages, the Supplier will perform for each location and for each equipment on the spot training for operation and maintenance. The training must be supplied by the equipment producer, or by a qualified representative recommended by the equipment producer.

The supplier will present together with the bid a detailed training proposal appropriate for the needs of the beneficiaries. Before commissioning the equipment, the detailed training plan will be presented in advance to the beneficiary for approval.

The beneficiary will provide specialized staff to be trained for future operation and maintenance of the purchased equipment.

"Turnkey System - Package I"

Batch 1

Network of automatic marine gauge stations, with real time communication - Network "EUXINUS" (3.14 – 1 of Contracting Plan)
Description: The main objective of the EUXINUS Network is to provide critical data (as movement of the sea bottom due to earthquakes and typical tsunamis waves) for tsunamis generation and propagation in order to protect the two countries (Bulgaria and Romania) against such phenomenon. The second major objective of the network is to provide long time series of physical and bio-chemical data regarding the properties of air and water masses. The future development of the project has support from GOOS – Global Ocean Observing System. The network will have 5 stations of which 3 will be installed on the Romanian part and 2 on the Bulgarian site. The real-time, automatic deep-sea gauge will have two modules: *sea stations* and *on-shore coordination centers (one center for each country)*. The coordinating centers will collect, centralize, store, process and analyze data from all sensors and networks deployed in the framework of this project. These two centers will receive also near real-time processed information regarding the earthquake occurrences in the area of Black Sea basin. These kind of data should come from Bulgarian and Romanian organizations in charge at national level with earthquake monitoring. *Sea-station modules, five systems,* from which 3 with automatic meteorological station; wave characterization; bidirectional communication; water sensors (physical and bio-chemical sensors); water-bottom pressure sensor. The real-time deep-sea gauge consists of an integrated multi-parameter system that will be mounted on two depth levels. They will provide data on physical-chemical and biological marine environment. Each station will have two levels of measurement, arranged as follows: 1) surface level 2) bottom level The systems will provide data on physical, chemical and biological characteristics of the marine environment. For each level of measurement there will be installed a data logger module able to integrate measuring sensors. *Surface level, sensors:* Oxygen, Temperature, Conductivity (and derived parameter salinity), Turbidity, Pressure, Chlorophyll, Doppler Current Sensor; Bottom level*:* Temperature, Conductivity (and derived parameter salinity), Pressure, Doppler Current Sensor; Turbidity The system shall be capable to perform its functions in a continuous manner without the need of any manual intervention. The system has to be remote configurable and checked via radio link and internet (via satellite). The communication between the deep sea gauges and the inland data processing facilities shall be bi-directional. All sensors have to be accompanied by calibration certificates; calibration and mainteneance intervals has to be clearly specified.
Sea-station modules **Quantity: 5 systems (3 in Romania, 2 in Bulgaria)** ***Surface buoys:*** - Spar buoy design for minimized mooring load, extended free of service intervals - Easily maintainable, steel construction preferred

- Compartmentalized
- Corrosion protected, Primer+ 2 layers of epoxy or PUR paint
- Submerged part coated with antifouling
- Solar powered, properly designed to charge the battery packs
- Internal rechargeable battery properly designed for powering the system
- Power management, all subsystems (communication, lights, radar reflector, instruments)
- switchable via communication link, protected with programmable electronic fuses
- LED navigation light, ambient light sensor, fully programmable, min 5mi normalized visual pickup distance
- Active radar reflector (X-band)
- Low system power consumption
- Internal Hydrogen converter and sensor for eliminating potentially generated hydrogen from battery charging process
- External Configuration connector
- Suitable for single point (deep water) and two point moorings (shallow water)
- Buoy pressure rated to 1000 kPa, continuously (submerging in bad weather, vessel collision, during deployment when dropping the anchor)
- Leakage detector + alert

Buoy: satellite telemetry and system for power management:

Alternative satellite, UHF radio and/or GMS/UMTS telemetry with power management.

- Satellite telemetry
    - Iridium satellite communication, preferably RUDICS operation mode
    - Quadrifilarhelix antenna
    - Min 2400bd data bandwith
    - Preferably router based not connection or message based operation mode
- Radio Link
    - UHF or VHF telemetry,
    - Up to 5W transmit power
    - Min 9600 bitd data rate
    - Configurable to 12.5kHz or 25 kHz channel bandwith
    - Mast integrated antenna
- GSM/UMTS Link
    - Mast integrated antenna
- Optional HF-Link
- GPS receiver with out of position alert via radio/satllite link
- Data logger that has to store all forwarded data + engineering parameters
- Multi channel peak power tracking solar charger
- Power metering for all subsystems and solar panels + batteries
- Fully integrated communication (remote management, system diagnosis, configuration and data access) with all subsystems (Data logger, power manager, navigation light, sensors, acoustic telemetry, subsea nodes)
- Access to realtime sensor data and system engineering parameters available in the XML format at the land station

Acoustic telemetry

- Optionally fully redundant (1 system active, 1 in standby, automatic failover)
- High reliability system
- Selectable modulation, coding scheme
- Automatic retransmission of damaged data packets

- Packet based communication
- Energy efficient
- Carrier band >40kHz for shallow water
- Carrier band >18kHz, <30kHz for deep water application
- Transducers at 5m depth
- Directivity -3dB @+/-35°
- Max. source level min. 195dB ref 1µPa@1m
- Multi node communication capable
- Surface telemetry integrated into buoy (no external cables)
- Communication with tsunameter lander, and level 2/3 sensors / optionally marine seismic
- Lander (device to reach the sea bottom)

Buoy Sensor systems:

Buoy integrated:

- Automatic weather station (for three buouys, 2 in Romania and 1 in Bulgaria)
    - Ultrasonic wind speed and direction
    - Temperature
    - Pressure
    - Relative Humidity,
    - Installed 4m above water line
    - Submergible
- Electronic compass with tilt compensation (Accuracy +/-2°)

Submarine Sensors:

- Level 1 at 5m, buoy integrated)
- Level 1 (0-10m) marine sensors integrated into buoy bottom (@5m depth) without external cabling
    - Doppler current sensor,
        - Minimum average speed accuracy +/-1.5mm/s, +/-1% of reading
    - Oxygen Sensor
        - Optical measurement principle
        - Temperature compensated
        - Long term stable
        - Range 0-16 mg/l
        - Response time (63%) <25s
        - Accuracy +/-200µg/l
        - Range 0-16 mg/l
    - Water temperature Sensor
        - -4 to 36°C
        - Min. accuracy +/-0.03%
    - Conductivity Sensor
        - Inductive measurement principle
        - Range: 0 - 7.5S/m (0 - 75mS/cm)
        - Resolution: 0.0002S/m (0.002mS/cm)
        - Accuracy: ±0.0018S/m (±0.018mS/cm)
    - Turbidity
        - Range 0 to 500FTU
        - Resolution 0.1FTU
        - Accuracy +/-2%

- Water pressure
  - Range 0-300m
  - Resolution 0.0001%
  - Accuracy 0.04%
- Chlorophyll sensor
  - Range 0-500µg/l
  - Resolution 0.1µg/l
  - Accuracy: Linearity 0.99R^2 for serial dilution of Rhodamine WT

- Level 2: bottom marine sensors
  - (Doppler) 3D Current sensor
    - Min. Average speed accuracy +/-1.5mm/s, +/-1% of reading
  - Pressure Sensor
    - Range 0-2200m
    - Resolution 0.001%
  - Water temperature Sensor
    - -4 to 36°C
    - Min. accuracy +/-0.03%
  - Conductivity Sensor
    - Inductive measurement principle
    - Range: 0 - 7.5S/m (0 - 75mS/cm)
    - Resolution: 0.0002S/m (0.002mS/cm)
    - Accuracy: ±0.0018S/m (±0.018mS/cm)

Mooring of the buoys:

In case of Shallow water (<40m):

- 2-point mooring
  - 1 string elastic rubber cord
  - 1 string Dyneema 16mm

In case of deep water (>50m)

- Swivel (titanium, 50kN SWL)
- S-slope mooring
- Hot zinc dipped heavy chain 22mm. 25m below buoy
- Dyneema rope 50m/14mm with floatation spheres (15x 11» Nokalon, 85N buoyancy
- 600m depth rating)

- Dyneema SK75 rope segments with stainless steel thimbles (12mm, 500m, 200m, 50m segments to seafloor)
- Zinc hot dipped shackles, working load >30kN
- 5xsyntactic foam floatation spheres, 18'', rated to 3000m, >180N lift / sphere
- Acoustic release with deck controller, 25kN SWL
- Anchor to be supplied by customer

The above technical specifications regarding mooring, are general; the system integrator should provide the information regarding the maximum sea state at which the system is operational and kept in place.

Tsunameter:

- Seafloor lander with syntactic foam floatation, one single system housing with sensors, system controller, telemetry, power supply, release and recovery beacon.

- Compact form factor
- Continuous operation for >2 years (1 event triggered monthly, cancelled after 15 min)
- Corrosion proof design, min 5 years warranty against corrosion
- Pressure sensor
    - Thermal compensation-2°C to 40°C
    - Operation depth rated to >2000m
    - Output Pressure [Pa], Temperature [°C]
    - 15 sec pressure sampling interval
    - Accuracy better than 0.01% FS
    - Resolution better than 10Pa
- Integrated low power data logger, up to 128GB flash (SDHC)
    - Precision real time clock (precision better 1ppm)
    - 10 channels
    - Up to 10 serial ports (RS232/422)
- Tsunami detection according to proven DART algorithm
- Full Remote management/ access via surface telemetry
    - Cancellation of false alerts
    - Reading of recorded data (averaged and 15s)
    - Reconfiguration of detection parameters (threshold etc) and transmission intervals
    - Reading of engineering parameters
    - Operation modes:
        - Standard operation mode with transmission of pressure history (15 min averaged data) every 6 hours
        - Alert mode, after triggering of tsunami algorithm, immediate transmission of current pressure data and event characteristics, following continuous
        - transmission with 15s pressure data every 1 minute (or according to specification) until cancellation or 4 hours
        - Time from triggering to message available at land station <30s

- Acoustic telemetry to surface buoy (range 4000m, buoy within 50° cone)
- Integrated acoustic release 5kN SWL
- Refillable battery container for standard LR20 cells (Alkaline or Lithium)
- Syntactic foam flotation rated to 3000m
- System rated to >3000m deployment depth
- Recovery beacon
    - Strobe
    - Satellite GPS position transmission upon surfacing or radio beacon
- Interface for up to 2 external sensors
- Tilt sensor
- Interface for up to 2 external sensors

Training will be provided for operation and maintenance of all components; proper technical documentation will be delivered for operation and maintenance.

Batch 2

1. Coastal Network of Seismic Monitoring

Description:
The network comprises a total of 3 systems which will be installed on the Romanian site.

Quantity: 3 systems in Romania

Marine part:
Consisting of the following main components:

- Three (radar and 2x pressure) different water level sensors data form (0-5V), digital sampling rate 1 min connection to a data logger
- Radar tide gauge sensor data form (0-5V), RS485 sampling rate 1 min
- Two pressure sensors with titanium housing
- To eliminate errors due to atmospheric air pressure fluctuations the pressure probe cable have to be equipped with a pressure equalization capillary tube in the cable, which provides the current ambient air pressure as a reference.
- Tide Gauge data logger with internal storage capability and GTS functionality
- Computer system to manage all components and data storage
- GPS to distinguish between vertical land movement signals and sea level measurements
- Receiver: Geodetic GNSS Receiver (GPS & GLONASS) with sampling rate 1 Hz (and a down sampling to 30 sec) with geodetic antenna
- Meteorological compact sensor or similar to measure air pressure, air temperature, relative humidity, wind speed, wind direction and rainfall
- Communication system connections to GTS/Meteosat transmitter satellite network link
- The data have to be transmitted on fixed intervals (e.g. 15 minutes) on a specified time on a regional channel
- Antenna are Crossed-Yagi antenna and satellite antenna
- Power supply unit: two batteries with 255 Ah powered by the local electric network
- Battery management system connection to external devices for power supply. The devices/channels can be manually or automatically controlled and switched ON and OFF (e.g. voltage dependent)
- The battery manager have to monitor the power (voltage) and powers down the 12V DC-output channels

Seismicity:

- Seismometer, 3 Component, 120 Secs to 50Hz
- Accelerometer, Triaxial, Sealed, Low Noise, Hi-Res
- Recorder, 6 Channel
- GPS Receiver/Clock
- Disk, Flash Memory, 2GB, CF Type, -20C to 60C
- Reader, CF I/II/III, External, USB, 2 Slot
- Assembly, PCB, Sensor Control Board
- Software and Data Utilities
- Maxim Input Range 40Vpp
- Selectable amplification on each channel: 1,20
- Filtering Linear or Minimum Phase FIR.
- Sampling rate 200, 100, 50, 40, 20, 10, 1
- Time Base Precision TCXO, locked to GPS

- Telemetry Full Duplex, efficient positive
- Communication UDP/IP or Ethernet.
- Temperature Fully specified -20 to +45C
- Sensor Control Calibrate step, sine, or random.
- Re-center, on-command
- Continuous information about Data, Temperature, DC Voltage, GPS status, Sensor position
- Serial ports with maximum speed of 115kbaud
- Reduced power consumption<1 W
- Each seismological system will be installed in a modular cabin of 150x150x240 cm size, construction made from fiberglass, multilayer type, with rigid polyurethane foam which ensure phonic and thermal isolation; the door is fully made of aluminum. The floor is made of agglomerated wood plate protected with a polyester layer or simple oriented strand board, mounted on a metal frame.

The whole system has to work independently and have to store all relevant data on the Flash Drive storage. Data have to be transmitted regularly to the Warning Centre. For redundancy the data partition on the local computer have to be saved as a backup regularly. Download of the Tide Gauge data from the last 24 days have to be possible. The Tide Gauge data have to be transmitted additionally every 15 minutes via GTS/Meteosat.

2. Coastal gauge

Description:
The station will be installed on the Romanian site at a water depth between 12 and 20 m. The system will be provided with the specialized software. The communication between the coastal gauges and onshore centers shall be bidirectional. The software package will include calibration modules. The calibration of the measuring devices placed on the coastal gauges must be possible remotely from the onshore centers.
The coastal gauge system is supposed to be a system installed on a fixed data pole, either with a foundation or on an anchoring system.

Quantity: 1 system in Romania

Satellite telemetry and system/power management

Alternative satellite, UHF radio and/or GMS/UMTS telemetry with power management.

- Satellite telemetry
    - Iridium satellite communication, preferably RUDICS operation mode
    - Quadrifilarhelix antenna
    - Minimum 2400bd data bandwidth
    - Preferably router based not connection or message based operation mode
- Radio Link
    - UHF or VHF telemetry,
    - Up to 5W transmit power
    - Min 9600 bitd data rate
    - Configurable to 12.5kHz or 25 kHz channel bandwidth
    - Mast integrated antenna
- GSM/UMTS Link
    - Mast integrated antenna

- Optional HF-Link
- GPS receiver for out of position alert via radio/satellite link
- Data logger storing all forwarded data + engineering parameters
- Multi channel peak power tracking solar charger
- Power metering for all subsystems and solar panels + batteries
- Fully integrated communication (remote management, system diagnosis, configuration and data access) with all subsystems (Data logger, power manager, navigation light, sensors, acoustic telemetry, submerged nodes)
- Access to real time sensor data and system engineering parameters available in the XML format at the land station

Sensors:

- Navigation light
- Corrosion proof, low maintenance enclosure (IP68m, depth of immersion min 10m)
- Automatic weather station
    - Ultrasonic wind speed and direction
    - Temperature
    - Pressure
    - Relative Humidity,
    - Installed above water line (approx. 2-4 m)
    - Submersible
- Wave Sensor:
    - Wave height & direction
    - Tide level

Additional sensors mounted at 5m water depth

- Doppler current sensor,
    - Min. Average speed accuracy +/-1.5mm/s, +/-1% of reading
- Oxygen Sensor
    - Optical measurement principle
    - Temperature compensated
    - Long term stable
    - Range 0-16 mg/l
    - Response time (63%) <25s
    - Accuracy +/-200µg/l
    - Range 0-16 mg/l
- Water temperature Sensor
    - -4 to 36°C
    - Min. accuracy +/-0.03%
- Conductivity Sensor
    - Inductive measurement principle
    - Range: 0 - 7.5S/m (0 - 75mS/cm)
    - Resolution: 0.0002S/m (0.002mS/cm)
    - Accuracy: ±0.0018S/m (±0.018mS/cm)
- Turbidity
    - Range 0 too 500FTU
    - Resolution 0.1FTU
    - Accuracy +/-2%
- Water pressure

- Range 0-300m
- Resolution 0.0001%
- Accuracy 0.04%

- Chlorophyl sensor
  - Range 0-500µg/l
  - Resolution 0.1µg/l
  - Accuracy: linearity 0.99R^2 for serial dilution of Rhodamine WT

3. Coordination Centers, data processing computers and information presentation systems (hardware and software)
Quantities: 2 systems (1 Center in Romania, 1 Center in Bulgaria)

Description:
The Coordination Centers are located at the GeoEcoMar in Constanta branch and in Varna, in IO-BAS headquarters and their main task are automatic operation of the stations for tsunami detection, the measurements of the waves; elaboration and transmission of the tsunami alarm notification to the decision-makers. The centers will also receive and store of all real time or near-real time data originating from all equipments installed in the framework of the MARINEGEOHAZARD project but also from Bulgarian and Romanian organizations in charge with earthquake monitoring. The centers will have the main and ancillary infrastructure and logistics, including necessary software, needed to integrate and process the multidisciplinary information underlying the tsunami notification. The coordination centers will operate continuously (24 hour / 7 days). All the above mentioned hardware and software has to be provided by the System Integrator (Consortium) that made the offer.
The two Coordination Centers has to be bidirectional interlinked at the level of processed information regarding earthquake events and their relevant parameters for possible tsunamis generation and propagation. The System Integrator has to explicitly present the hardware and sofware configuration of the Coordination Centers, according with the specifications of proposed sensors and instruments. A general scheme of such configuration is presented below.

Each Coordination Center will have:
- System for Seismic Acquisition Station
- System for data coming from Tide Gauge and Buoy Stations
- System for data coming from Geodynamic Stations
- System for simulation of tsunamis generation, propagation and inundation (details in lot 6)
- Data link between the Romanian and Bulgarian Coordination Centres and all equipments installed onshore and offshore in the framework of this project
- Data link with national organizations in charge with earthquake monitoring

All systems have to be redundant in terms of power and operational capabilities.

The System Integrator has to install, configure, interconnect and test all the systems that are delivered to the Coordination Centers. A proper scheme of training will be proposed to be delivered at each place. The trainings will cover aspects of installation, configuration, operation and maintenance (hardware and software) for all systems.
Proper documentation will be provided for:
- installation
- configuration
- operation
- maintenance

Batch 5 – Network of Mechanical Extensometers and Strong Motion Seismometers

1. Strong motion seismometers

Description:
The strong motion seismic network is intended to be located on land. The locations of the stations will be selected on the basis of low noise level, good geometry coverage and near distances to the main seismic sources in the region. The aim of the network is to provide reliable information about the strong seismic motions generated by local sources and to serve engineering purposes. The integration with the marine stations can provide the seismic trigger level of warnings about the population and infrastructure.
Quantity: 5 systems

Main components:
- sensor
- data-logger
- power system
- trigger and communication
- enclosure

Technical details

Sensor
- Components: Tri-axial
- Type: Force-Balance Electro-mechanical
- Bandwidth 0 – 200 Hz
- Dynamic Range 155 dB+
- Full-Scale Range +/- 2G & +/- 4G user selectable

Data-logger
- Number of Channels: 4
- Resolution: 24 bits
- Sampling Rates: 1 to 2,000 sps
- Communication Options: Ethernet TCP/IP, RS-232, FTP, SFTP
- Common Trigger: Via Internet
- Power Consumption: Less than 2 watt
- GPS: Internal built in GPS
- Memory: Solid State CF memory – minimum 4GB
- Output Data Format: MiniSEED, SAC, Matlab, ASCII, EVT
- Real-time Parameters Calculation: FFT & PSD
- Timing Accuracy: Under 1microsec

Power system
- Battery or AC operated 12 VDC, 35Ah minimum
- Autonomous Operation 12 hours minimum
- Solar panels – 12 V DC

Trigger and communication
- System Communication: Simultaneous acquisition & interrogation

- Acquisition modes: Continuous, Triggered, Time Windows
- Threshold Trigger: Selectable from 0.01% to 100% of full scale
- Additional Trigger: STA/LTA, Time Window

Enclosure

- Enclosure: Sensor & Data-logger in the same enclosure
- Enclosure Rating: IP67 Equivalent
- Environmental: RoHS Compliant
- Protection: Transient and EMI/RFI protection

Software: compatible with Antelope

Cable and connectors: All necessary cables and connections for a unitary functioning

Manuals and documentation: Service and maintenance manuals, installation and operation manuals, for each component (hardware and software). The manuals will be provided in English language, printed and on DVD support.

Spare parts and warranty:

Spare part kits (as of the best knowledge of supplier) corresponding to the GNSS configuration, for a minimum of 2 years.

Systems warranty : 1 year minimum

Place of installation: Bulgaria

On-site training

Installation and testing; Training for the operators for a minimum of 3 days.

2. Extensometers

Description:

Mechanical extensometer designed for installation on narrow cracks (crack gauging) to monitor relative micro-displacements between both walls of the crack. It measures the displacements in three dimensions (*x*, *y* and *z*) – displacement vector in two perpendicular planes (horizontal and vertical) and angular deviation (rotation). The measurement works on the principle of Moiré optical effect of two optical grids. Their interference pattern changes when two transparent plates move (Košťák 1977, 1991). The advantages of this purely opto-mechanical instrument are: it completely avoids the use of electrical transmission means and furnishes good performances under severe outdoor conditions, and it has a long-term stability.

Data are generally taken once a month or bimonthly and long-term monitoring is preferable. Temperature of the monitoring site is also taken into account for eventual temperature influence on the instruments especially for surface outcrops. The gauge is used for regular monitoring of slow displacements along active faults, landslide fissures and rock deformations.

Quantity: 5 systems

Main components

Extensometer

Technical details

Measures:

- Displacements in all three directions (x, y, z)
- Displacement vector in two perpendicular planes: horizontal and vertical
- Angular deviation (rotation)

Sensitivity of the instrument is 0.05-0.0125 mm in all three space co-ordinates and 3.2×10^{-4}rad in angular deviations.

Other components

- 2 holders, with a maximum length of a single tube holder of 1 m, diameter minimum 40 mm
- screw for spherical heads fixing

- spherical heads screws with spherical pads
- mounting separator
- spherical heads
- mounting bars – displacements indicators
- side screws
- grid centering screws
- circular grids
- linear grids – rotation indicators
- grid clamps
- leaf
- spiral thermometer
- box
- lock

Manuals and documentation

Service and maintenance manuals, installation and operation manuals, for each component. The manuals will be provided in English language, printed or on DVD support.

Spare parts and consumables

Spare part kits (as of the best knowledge of supplier) corresponding to the extensometer configuration, for a minimum of 2 years.

Place of installation

Bulgaria

On-site training

Installation and testing.

Training for the operators for a minimum of 3 days.

Point 6 of Contracting Plan

Assistance for adaptation and implementation of marine geohazard consequence assessment software package, including software itself

Software:

The software package has to have as main characteristic the ability to simulate tsunami waves generation due to potential sources in the area of Black Sea basin, the propagation of tsunami waves and also to assess the inundation (without roughness of the coastal areas) of Bulgarian-Romanian coastal areas. This capability of the software package is the core of the whole project that has to function as an early warning system. In order the software to properly respond to this function, it has:

- to receive and store in a relational Database Management System the necessary data for running the simulation scenario both offline and near real time, regarding the generation and propagation of tsunami waves in the Black Sea, and consequent inundation of Romanian and Bulgarian coasts; the static data (for the Digital Elevation Model – DTM of the sea bottom and coastal land area) will be provided by the four partners in this project; the dynamic data will come as information streams from onshore and offshore sensors installed in the framework of this projects, sensors and ancillary equipments, including acquisition and data transmission software that are parts of the tendered package; the processed near real time seismological data stream will come from the Romanian and Bulgarian partners in the project, partners that are responsible at their national level with earthquake monitoring;
- to receive and store ancillary information (data coming from installed sensors in the

framework of this project), as meteo data;
- to provide basic GIS functionalities, mainly the ability to produce inundation maps in generally accepted standard GIS formats (e.g. raster or vector format: as geotif or shape files).

The assistance for adaptation and implementation of the above described software package is seen as a tuning process of a similar software package that the tenderer implemented, tested and put in operation in an Early Warning System (requested as prior experience).
A number of three licenses for each Coordination Centers have to be granted.

Training:
Training has to be provided at both Coordination Centers (in Romania and Bulgaria). The personnel which will operate the centers have to be trained for:

- basic understanding of tsunami waves generation, propagation and coastal inundation processes;
- data gathering from sensor and designated providers (national seismological monitoring organizations);
- construction of onshore and offshore DTMs;
- running and validation of tsunami generation, propagation and inundation scenarios

"Turnkey System - Package II"

Batch 3 - Ocean Bottom Seismometers (OBS) and Marine Seismic Acqusition System

1. Ocean Bottom Seismometers
Description: The Ocean Bottom Seismometers will be deployed on the sea floor in anoxic environment and will record seismic data generated by air guns and earthquakes. They will acquire information about the western part of Black Sea, including the deep-water zone. Information about the deeper sediments, including the upper crust will be analyzed in order to decipher the geological structures and to assess the marine hazards (tsunamis) and to better understand their causes. The system shall be capable to perform its functions in a continuous manner without the need of any manual intervention, in the conditions and the environment that are typical of the site of installation, and shall present both intrinsic and external redundancy. The system shall have automatic instrument error recovery capability to ensure a high availability of the whole. The Ocean Bottom Seismometers have to be operational in H_2S environment. **Quantity: 7 systems (5 in Romania and 2 in Bulgaria)** **Ocean bottom seismometers:** - Seafloor lander with syntactic foam floatation, one single system housing with sensors, system controller, telemetry, power supply, release and recovery beacon + geophone unit. - Corrosion proof design, minimum 5 years warranty against corrosion - Vibration decoupling of geophone unit from lander - Extended bandwidth geophones (e.g. LF-24, Low corner frequency 1Hz) - Gymbaled geophone unit with 3 octagonal geophones (low frequency, broadban, 3 component) with locking mechanism. - Compact form factor - Differential wideband hydrophone rated to min 2500m operating depth, - Optional pressure sensor (identical to tsunameter/including algorithms) - Seismic data logger • 4 channels • 24 bits • Minimum dynamic range: 110 dB • Programmable geophone amplifier (0, 6, 12, 24 dB) • Programmable hydrophone amplifier (0 - 48 dB) • Active geophone supply • Gymbaling control • Programmable low pass filter • Programmable high pass filter • Standard time base precision better than 1ppm/6 months (86ms/day), • Optional time base with precision/aging 0.5 ppb/6 months (43 µs/day) • Continuous operation (depending of sampling rate) for up to 6 months

- Recording capacity up to 4TB (flash based)
- Self calibration & test DAC
- Interface for 2 additional external sensors (RS232/422)
- Tilt sensor

- Acoustic surface telemetry (range 4000 m, buoy within 50° cone)
- Integrated acoustic release 5 kN SWL
- Refillable battery container for standard LR20 cells (Alkaline or Lithium)
- Syntactic foam flotation rated to 3000m
- System rated to >3000m deployment depth
- Recovery beacon
  - Strobe
  - Satellite GPS position transmission upon surfacing or radio beacon
- Interface for up to 2 external sensors

2 . Marine seismic acquisition system

Description:
The aim of the seismic data acquisition system is to deliver information regarding the western part of Black Sea, including the deep-water zone. The measurements will focus on the sedimentary formations, allowing the deciphering of the shallow geological structures. A seismic system will be used for these studies, consisting from two components: acquisition (streamer, air guns, air compressor, acquisition software) and processing (processing software). The mapping of the geological formations from the western part of Black Sea, but not only, will be done using seismic reflection methods.

Quantity: 1 system in Romania

This sub-lot is understood as a support tool for the early warning system in order to evaluate the stability of the submarine continental slope, but also the proper offshore seismicity.
Marine seismic acquisition system – MSAS
The MSAS has to be a turn-key solution for a 2D marine multichannel reflection seismic system, including training and put in operation of the system
The system has to have at least 96 channels to allow proper recording at least for two seconds two way travel time (some more that 2000 m penetration of the sediment pile) and to allow proper quality control of acquired data.
The system has to be complete and provided as turn-key solution. A set of spare parts recommended by the system producer/integrator should be included. Minimum redundancy of the key components that make the MSAS has to be provided.

The structure of the system have to be (hardware, electronics and software) as follows:
- navigation sub-system:
  - proper hardware, electronics and software for planning, acquisition and transmission of navigation data
  - the system has to be able to provide proper positioning of the key components (streamer, seismic sources), sub-meter accuracy
  - to be well integrated with all other parts of the system (air-gun trigger control unit etc.)

- generation of the seismic signal (seismic sources, compressor(s), ancillary equipment, including small hydraulic arm for air gun handling:

- seismic sources, preferably controlled bubble air guns (GI type), 2 pieces, able to provide proper penetration in a typical marine environment at least for about 2000 m of sediment pile
- the integration of the system that generates the seismic signal and the streamer offered should assure at least 30 CMP fold
- the air guns and compressor should be accompanied with a proper set of workshop tools and spare parts for one year functioning and maintenance
- the air guns has to be accompanied by a well designed frame for air guns assemble and a system for the deployment/recovery of the air guns array (a hydraulic arm/small crane)
- air pressure distribution system gauge, gun and triggering controller with checking functions for reliable signature and time synchronization
- better than 400,000 shot warranty for air guns

- Seismic streamer:
  - at least 96 channels digital streamer (preferably solid streamer), low noise
  - 12.5 m (preferably) group interval
  - Depth and position control system including ballasting system and weight, properly adjusted for the Black Sea specifics (water density)
  - Proper system for deployment and recovery
  - Streamer checking unit

- Seismic data acquisition system:
  - redundant client server system architecture
  - RAID architecture for data acquisition
  - high capacity of seismic data acquisition and archiving
  - able to manage auxiliary traces
  - allows real time and post acquisition QC of seismic data
  - includes maintenance unit for all active sub-systems
  - uses standard seismic format for data acquisition and archiving (SEG-D, and data exchange SEG-Y, etc)
  - fully compatible with a Ethernet network

Compressor:
- Compressor unit: with metal-based frame and 2 compressors
- Mean reference surface level at 7m distance: L/10=70 db/(A)
- Engine performance per compressor
  - at 150 bar – 2.0 m^3 per minute: 2175 psi-70,6 cu. ft./min.
  - at 200 bar (should be adjusted at safety feature)
- installed in container like structure
- Freshwater cooling with non-freeze liquid / re-cooling with sea-water
- Intake air via oil-bath air filter
- Water separator
- Safety valve at each air-end
- 1x Start-up air-bottle per compressor
- Flow pressure 150 bar,
- Lifting eyes on frame
- Input for seawater pump: 230V

A properly configured spare x86 PC (2 TB RAID HDD, with Red Hat OS) and 24” LCD

monitor will be provided.
The MSAS has to include all ancillary deck cables, controllers, units, hardware electronics and software, in order the system to be a turnkey solution for multichannel marine seismic acquisition.
Onsite training and sea trial has to be provided. The training has to be at least five days, regarding installation, configuration, operation and maintenance of all sub-systems and equipments.
Proper documentation has to be delivered for installation, configuration, operation and maintenance of all systems.
Minimum spare parts has to be supplied, according with the experience of the system integrator.

Table IV.1

Object of the Contract	Beneficiary	Description	Value (Euro)	Delivery Place
Deep sea gauges: Batch 1 equipment and installation; Part of "Turnkey System– Package I"	Lead Partner	Part of Batch 1 that consists in 3 Sea-station modules, from which one with weather station; detailed description in the body of tender book	900 000	R/V Mare Nigrum, Constanta Port, Romania
Deep sea gauges: Batch 1 equipment and installation; Part of "Turnkey System– Package I"	Partner 3	Part of Batch 1 that consists in 2 Sea-station modules, from which one with weather station; detailed description in the body of tender book	714 000	R/V Mare Nigrum, Constanta Port, Romania
Coastal Network of Marine seismicity: Batch 2, Coastal gauge - equipment and installation; Part of "Turnkey System– Package I"	Lead Partner	Part of Batch 2 that consists in a coastal gauge in water depths between 12-20 m; detailed description in the body of tender book	97 000	Constanta, Romania
Coastal Network of Marine seismicity: Batch 2, IT System for Coordinating Center (Hardware and software); Part of "Turnkey System– Package I"	Lead Partner	Part of Batch 2 that consists in an IT system (harware and software) able to receive and store all incoming data from all installed sensors in the project; detailed description in the body of tender book		
Coastal Network of Marine seismicity: Batch 2, IT System for Coordinating Center (Hardware and software); Part of "Turnkey System– Package I"	Partner 2	Part of Batch 2 that consists in an IT system (harware and software) able to receive and store all incoming data from all installed sensors in the project; detailed description in the body of tender book	20 000	Varna, Bulgaria
Coastal Network of Marine seismicity: Batch 2, coastal real-time marine seismicity monitoring system - equipment and installation; Part of "Turnkey System– Package I"	Partner 4	Part of Batch 2 that consists in a coastal real-time marine seismicity monitoring system; detailed description in the body of tender book	280 000	Constanta, Romania

Object of the Contract	Beneficiary	Description	Value (Euro)	Delivery Place
Network of mechanical extensometers and strong motion monitoring: Batch 5 – equipment and installation; Part of "Turnkey System– Package I"	Partner 2	Part of Batch 5 that consists in 5 mechanical extensometers; detailed description in the body of tender book	15 000	Varna, Bulgaria
Network of mechanical extensometers and strong motion monitoring: Batch 5 – equipment and installation; Part of "Turnkey System– Package I"	Partner 3	Part of Batch 5 that consists in 5 strong motion seismometers; detailed description in the body of tender book	97 000	Varna, Bulgaria
Assistance for adaptation of an assessment software package, including software itself; Part of "Turnkey System– Package I"	Lead Partner	Defined as Batch 6 in the body of tender book; 2 packages of software	275 000	Constanta, Romania
"Turnkey System – Package I" – Grand TOTAL			**2 398 000**	

Object of the Contract	Beneficiary	Description	Value (Euro)	Delivery Place
Marine seismic acquisition system and bottom seismometers: Batch 3; "Turnkey System– Package II"	Lead Partner	Part of Batch 3 that consists in 5 ocean bottom seismometers; detailed description in the body of tender book	1 750 000	R/V Mare Nigrum, Constanta Port, Romania
Marine seismic acquisition system and bottom seismometers: Batch 3; "Turnkey System– Package II"	Lead Partner	Part of Batch 3 that consists in a marine seismic acquisition system; detailed description in the body of tender book		R/V Mare Nigrum, Constanta Port, Romania
Marine seismic acquisition system and bottom seismometers: Batch 3; "Turnkey System– Package II"	Partner 3	Part of Batch 3 that consists in 2 ocean bottom seismometers; detailed description in the body of tender book	119 000	Varna, Bulgaria
"Turnkey System– Package II" – Grand TOTAL			**1 869 000**	

Table IV.2 Locations for installation

Item	Batch	Country, station	Latitude	Longitude
Sea Station module	Batch 1 - Network of real-time deep-sea gauges (EUXINUS)	Romania, EUXRo01-1	44.40.00	31.04.00
Sea Station module	Batch 1 - Network of real-time deep-sea gauges (EUXINUS)	Romania, EUXRo02-2	44.09.00	31.03.50
Sea Station module	Batch 1 - Network of real-time deep-sea gauges (EUXINUS)	Romania, EUXRo03-3	43.54.44	30.35.47
Sea Station module	Batch 1 - Network of real-time deep-sea gauges (EUXINUS)	Bulgaria, EUXBg04-1	43.22.30	28.50.00
Sea Station module	Batch 1 - Network of real-time deep-sea gauges (EUXINUS)	Bulgaria, EUXBg05-1	42.58.00	28.28.10
Coastal real-time marine seismicity monitoring systems	Batch 2, 3 pcs	Romania	Sf. Gheorghe, Tulcea, Eforie, Mangalia, Constanta	
Coastal gauge	Batch 2, 1 piece	Romania	Mangalia	
Coordinating center	Batch 2	Romania	Constanta, Branch of GeoEcoMar	
Coordinating center	Batch 2	Bulgaria	IO-Bas Varna	
Strong motion seismometers	Batch 5, 5 pcs.	Bulgaria	Shabla; Balchik; Kaliakra; Kavarna; Varna	
Extensometers	Batch 5	Bulgaria, Kamen Bryag	43.26.00	28.32.15
Extensometers	Batch 5	Bulgaria, Kaliakra (Bolata Northern part)	43.23.30	28.28.10
Extensometers	Batch 5	Bulgaria, Kaliakra (Bolata Southern part)	43.22.55	28.28.10
Extensometers	Batch 5	Bulgaria, Kaliakra (Rusalka)	43.41.70	28.50.00
Extensometers	Batch 5	Bulgaria, Kamen Bryag	43.26.00	28.32.15