ANNEX I ASSIGNMENT DESCRIPTION

Title of tender	**Seismic Campaign Feasibility phase Einstein Telescope EMR**
Document number	**P2.1_067_V1.0**

H1. Introduction

1.1. Introduction Project Einstein Telescope

The Einstein Telescope will be an advanced observatory for gravitational waves. The border region of the Netherlands, Belgium and Germany is in the picture as a possible location. This is because of its tranquility, stable soil, and strong ecosystem of knowledge institutions and high-tech companies.
Researchers, companies and governments in the Netherlands, Belgium and Germany are jointly exploring the possibilities. The ultimate goal is to build the Einstein Telescope in the Meuse-Rhine Euroregion. For more info see https://www.einsteintelescope.nl/en/.

1.2. Project Office ET

The Project Office ET, based in Maastricht, is carrying out a feasibility study, resulting in a contribution to the bid book, on the basis of which a final choice of location for the Einstein Telescope will be made. This phase includes activities within various disciplines (project management, contract management, technical management, environmental management, project control). The management of the project office is conducted jointly by the delegated principal on behalf of the director of Nikhef.

1.3. Scope

The goal of the proposed high resolution seismic measurements is to accurately assess the risks of and support the integrated subsurface evaluation of the potential Einstein Telescope site in the EMR-region. These seismic measurements augment an ongoing first borehole campaign, will inform a second borehole campaign and contribute to the construction of an integrated self-consistent 3D subsurface model (see 3.3. Geomodeling and GeoBIM integration – ET2SMEs) in a timely and cost-effective manner with the goal to understand plus mitigate the subsurface risks to an acceptable level for constructing and operating the Einstein Telescope.

The search area for a potential location for the Einstein Telescope is shown in Figure 1.

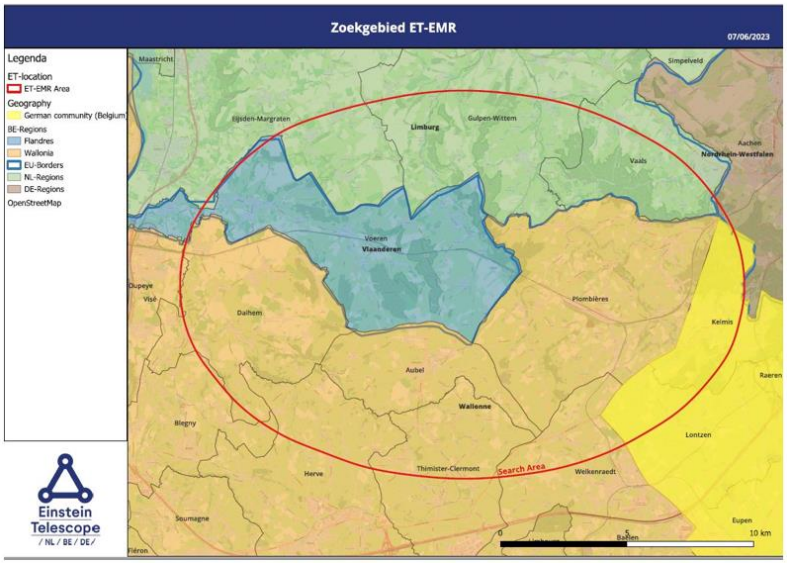

Figure 1: Search area for a potential location for the Einstein Telescope in the EMR-region.

The regional dip in the Cretaceous is shallow to minor (few degrees) to the North. Dipping in the Carboniferous and Devonian part of the section is assumed to be in different directions (preferentially NW and SE), possibly also with steep dipping angles (>> 20°). Faults are expected to intersect the rock sequence at different dip angles, possibly up to and above 60°. Due to the subsurface complexity the scope of the acquisition campaign contains a number of items, where some items ideally get carried out simultaneously, if safe operations can be ensured. The main technical elements are acquisition and processing of:

1. **Five high-resolution (20m vertical & 10m horizontal) 2D seismic tie lines** between envisioned corner points along the potential legs of the Einstein Telescope triangle. Connecting into up-to 7 with broad band seismometer and DAS-fiber instrumented wells. These lines will enable mapping the top of the unconformity, steep dipping (above 60°) strata and faults along the legs of the ET-triangle.
   The total 2D line length is estimated to be ~80-95 km. Possible lines are shown in Figure 2.
2. **Up-to seven high resolution DAS-VSP's** acquired simultaneously with item 1. in instrumented wells. Source points along the 2D lines of item 1, plus additional receiver points on a 2D grid around the observation well where possible, to obtain a very low-fold 3D DAS-VSP.

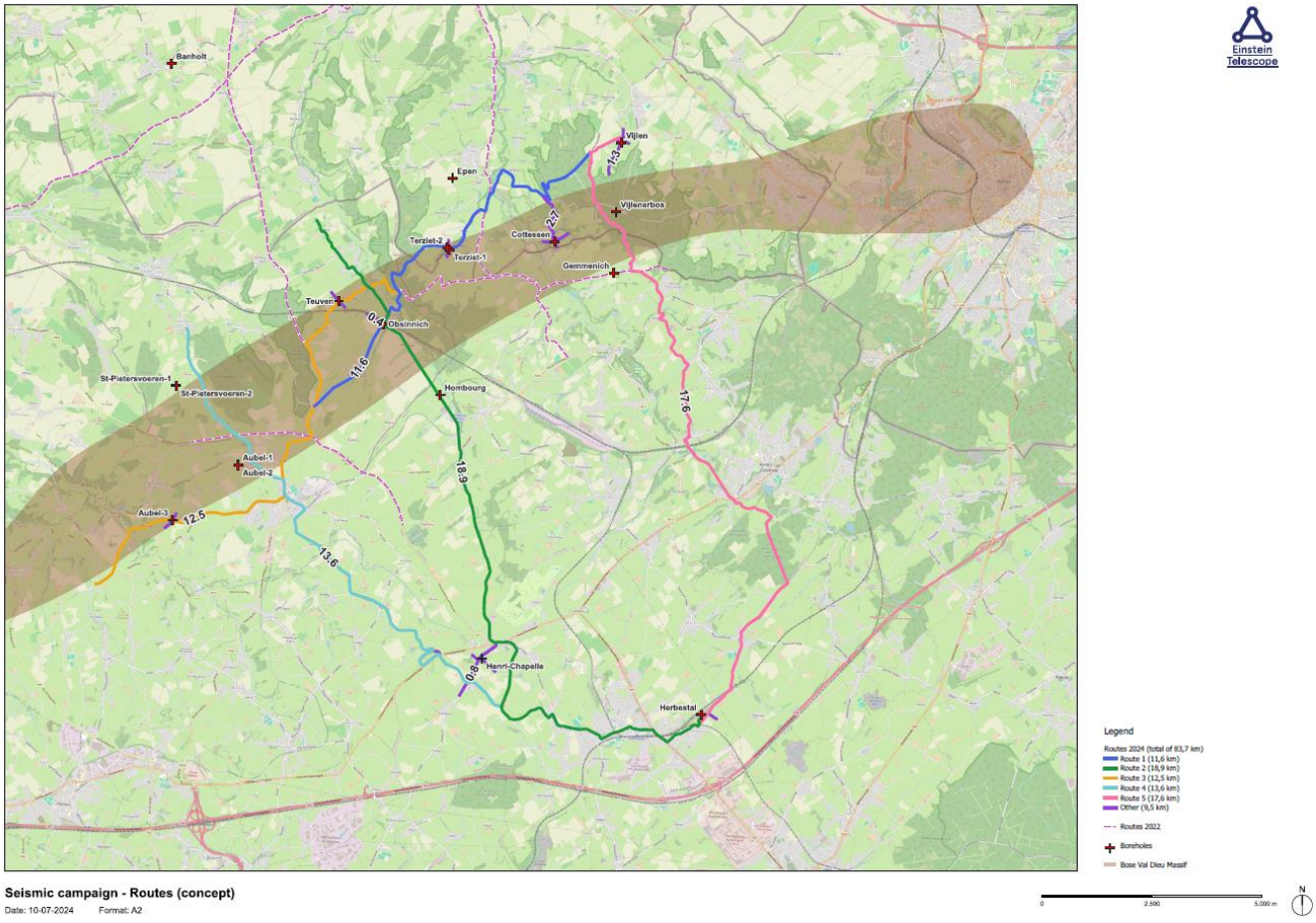

Figure 2: Potential routes for acquiring 2D lines connecting into 7 instrumented wells with a total length of ~80-95km.

In the scope for the above-mentioned activities are also:

1. Environmental assessment,
2. UXO location and clearance,
3. (Line-) Scouting
4. Identifying any necessary permits and the license and, if permits/notifications are required, the license preparation in coordination with the competent authorities in the EMT-region,
5. Traffic control,

which are to be carried out in collaboration and consultation with the client. Details are given in paragraph 4.

1.4. Locations of instrumented wells

Locations of the instrumented wells to be tied into the 2D/3D surveys.

FID	Name	NITG_NR	Country	TD_m	X_ETRS89	Y_ETRS89	Finalisation	
1	Terziet-2	B62D1113	NL	260.49	3721187.748	2674143.164	Seismometer	
2	Cottessen	B62D1181	NL	251	3723550.022	2674278.813	Seismometer	DAS
3	Banholt	B62C1327	NL	252	3715143.087	2678180.884	Seismometer	
4	Teuven	B62C1340	BE	299.9	3718807.393	2672976.368	Seismometer	DAS
5	Obsinnich	B62D1192	BE	280.2	3719788.5	2672468.023	Seismometer	DAS
6	Vijlen	B62D1194	NL	TBD	3725008.043	2676444.636	Seismometer	DAS
7	Henri-Chapelle	BBEL0650	BE	TBD	3721932.691	2664659.035	Seismometer	DAS
8	Aubel-3	B62C1341	BE	404.5	3715172.4	2668162.419	Seismometer	DAS
9	Herbesthal		BE	TBD	3726750.886	2663907.867	Seismometer	DAS

1.5. Health, safety, security & environment

The contractor is responsible for the safety, health and resulting certification of its company and its employees. The employer must take the necessary measures according to the European Agency for Safety and Health at Work and the local safety and health regulations (e.g. is compliant with ISO 9001 in quality management; ISO 14001 in environmental management; ISO 45001 in occupational health and safety and aligned with IOGP 432??). Impact on the local communities and environment should be limited to what is necessary to acquire the data safely. Country-specific regulations must be respected, e.g. with respect to the peak force in case of a vibroseis source. Further, the material used must be environmentally friendly and must be removed after the work e.g., the equipment used must be as far as possible noise-insulated and oiled with rapidly biodegradable lubricants.

1.6. Equipment

All materials and equipment used shall be regularly tested and inspected and maintained in good condition in accordance with safety regulations.

All used seismic sources, sensors and recording equipment must be calibrated and the relevant calibrations to demonstrate that they are working within the manufacturer's specifications have to be submitted to the client on site (on request). Calibrations must be attached to the measurement report for documentation purposes.

1.7. Timing

Seismic acquisition campaign takes place in Q4-2024 or in Q1-2025.

The seismic processing is to be done within four months after the end of the seismic acquisition, but not later than July 31st, 2025. Subject to this period also being suitable from an ecological perspective and not encountering excessive risks from an ecological point of view.

2. Technical Framework

2.1. Geodetic reference

Geodetic reference system to be used for all final deliverables is EVRS2019.

2.2. Known seismic imaging challenges as basis for planning the seismic acquisition:

While it is difficult to achieve, for the near-surface image (0-400m depth below surface) a lateral resolution of ~10m and a vertical resolution of ~20m or better are needed to facilitate the construction of an integrated self-consistent 3D subsurface model. This goal translates directly into the bandwidth requirements of the source and spatial sampling requirements for the source and receiver locations.

Further, imaging the target level of the Einstein Telescope below the Devonian–Carboniferous unconformity at a depth of ~+/- 50m (EVRS2019) including the steep dipping faults and strata is challenging because of:

1. the existence of a mainly horizontal high velocity contrast between ~20-100m below surface, where the velocity of a layer consisting of soft & loose material (e.g. wet sands or soft shales) increases from ~1500m/s to ~3500-4500m/s of a "hard-rock" layer. Since this reduces the incident angle below the Devonian–Carboniferous unconformity significantly, seismic reflection imaging below that contrast is difficult.
2. the Ground roll caused by the seismic source can be very strong.
3. shear waves that get generated at the various strong velocity contrasts.
4. scattering of the wavefield in the near surface, potentially caused by boulders, etc.
5. a high intrinsic absorption in the near surface layer.

Based on the results of the 2022 acquisition campaign it can be concluded that the geological complexity described above leads to a low signal-to-noise ratio that noticeably hampers the seismic processing and the imaging below the unconformity.

2.3. Implications of the imaging challenges to be considered in the acquisition design

The experience from the 2022 campaign shows that it will be essential to:

1. minimize the generation of noise
    - In the 2022 campaign it was observed that using three vibroseis trucks simultaneously at a single source point created interfering noise that hardly could be attenuated in processing mainly due to an insufficient receiver sampling of 10m.
2. sample complete wavefield, i.e. the noise, the refraction and the reflection signal sufficiently.
    - Tests in the 2022 campaign showed that likely a receiver and source spacing below 5m is required (at least for the 2D lines), considering the resolution needs.
    - Nodal acquisition without any receiver group forming in the field might enable sampling needs.
    - The offset is to be chosen such that dipping events of ~30deg can be imaged to an depth of ~800m below sea-level EVRS2019 with the goal to understand the geological structure below the target level of the Einstein Telescope.
    - The receiver line has to be extended such that a full multiplicity is reached at the first source point.
    - Acquisition tests could be included in the work proposal for 2024/2025 campaign
3. enable less conventional processing steps like
    - Surface wave inversion (SWAMI or similar)
    - A type of (Full)-waveform inversion that focuses on refractions and surface waves.
    - A very detailed static refraction static model or near-surface velocity model in depth will likely be needed to achieve the imaging goals.
        - To resolve the shallow low velocity weathering layer special measurements might have to be included in the proposal.
4. use a "broadband" source. The frequency range suggested to be between [2, 80] or wider, to achieve the aspired resolution. After processing the reflection data (i.e. the signal) are expected to have a flat amplitude spectrum for most of the frequency range of the source.

Results from the previous seismic acquisition campaign and well-logs can be shared with the Contractor during the detailed acquisition design.

2.4. Source tests

Prior to data acquisition, the Contractor shall perform seismic source (e.g. falling weight, vibroseis, explosives,) and if needed receiver spacing tests to assess the following:

1. The ability of the signal source to generate a broadband signal between [1, 80] Hz
2. The frequency content returned from the shallow sediments
3. The sampling of the primary signal and the coherent noise is sufficient. Thus, an acceptable signal-to-noise ratio will be obtained through the appropriate sampling of the noise (and signal). This is to be verified with "infield" processing (in the source and receiver domain) by applying standard noise suppression techniques (e.g. t-p, f-k filtering, decon, de-spike,…).

And for vibroseis acquisition:

4. Correlation performance at high frequencies (linearity and harmonics)
    a. Comparison between signal at the baseplate and the nominal sweep
5. Total energy injected: different sweeps, different number of sweeps to be stacked, different frequency ranges starting from [1, 80] Hz.
    a. Vibroseis test parameters include for:
        i. sweep duration
        ii. listening time
        iii. number of sweeps to be (diversity) stacked
        iv. frequency content
        v. sweep type (linear, logarithmic, special designed, random)
        vi. peak force level
6. Based on the results of the sweep tests, the sweep duration, listening time and frequency range shall be adjusted so that a broadband signal with a balanced amplitude-frequency spectrum can be injected to increase image resolution at the depth of ~+/- 50m (EVRS2019).
7. The results of the sweep tests are used to select sweep and source and configurations that are optimized in terms of energy/resolution ratio for the target. The final source configurations are intended to be adopted for the entire seismic campaign.

Nikhef welcomes suggestions from the Contractor with respect to the acquisition design and is open to innovative ideas and carrying out the required experiments in close collaboration with the Contractor. Based on the current understanding Nikhef envisions following acquisition parameter, which are only to be taken as a suggestion and recommendations to optimize them to increase the effectiveness or reduce cost will be welcome:

2.4.1. Potential seismic acquisition parameters of the 2D lines and DAS-VSP's

2D line parameters:

- Crooked line acquisition
- Maximum offset: 1200m
- Split-spread acquisition: +/- 1200m
- Full multiplicity at first source-point and last source point
- Source point spacing: 4m or less
- Receiver point spacing: 4m or less

2D grid/3Dpatch geophone grid parameters for DAS-VSP (well-depth ~250-400m)

- Cross-spread based
- Symmetric in-line and crossline source spacing: 10m
- Symmetric in-line and crossline receiver spacing: 10m

Source characteristics

- Broad band source ~1-120Hz
- Single source at a source point
- For vibroseis
    - Minimum source strength: 1200N
    - Sweeps per source point: 3

    - Sweep designed to enhance low frequencies
        - Sweep duration: 16s
        - Listening time: 4s

Receiver characteristics

- Single receiver nodes (wired or wireless)
- MEMS based
- 1C (3C would be great) sensor
- Sampling: 1ms

3. Seismic processing

The contractor is encouraged to include the seismic processing of the acquired data (2D lines, 2D DAS-VSP's, small 3D's, 3D DAS-VSP's) in the proposal. In the proposal a detailed processing sequence should be given by the Contractor. Depending on the processing proposal of the Contractor, Nikhef might decide to only award the seismic acquisition.

3.1. Processing strategy for active source seismic acquisition

Since the geology is complex and the processing flows for the respective data have to be carefully designed. Based on the current experience Nikhef gives the (kinematic) imaging of reflectors a higher priority in comparison to retaining reliable reflection amplitudes. This means that some primary reflection amplitude can be sacrificed, if the image the overall image is improved. Nikhef is open to new innovative workflow that are suggested by the contractor and expects a close collaboration with the Contractor during the processing.

Currently, a high-end processing flow that can utilize the improved sampling of the wavefield is anticipated by Nikhef and thus where possible, the processing strategy is expected to be deterministic and model driven and only data adaptive where needed, e.g.:

- Creating a noise model (ground-roll, shear-wave, multiples,…) of the targeted noise and then subtracting it from the original data
    - This might have to include a de-aliasing the data for the considered frequency range
- Wave-equation based, e.g.:
    - Modelling the ground-roll
    - Modelling the first arrivals
        - Creating a near surface velocity model to estimate the statics or in case of depth imaging replacing the refraction static.
    - Modelling of scattering effects
    - Waveform inversion to obtain the velocity model
    - Pre-stack depth imaging
- Spatial resolution should be maximized within the limits of the acquisition parameters.

3.2. Data delivery and final products for active source seismic acquisition

All data and information required to acquire and reproduce the processing results need to be provided to Nikhef. This includes, but is not limited to:

- Raw data as acquired (pre-correlation) in SEG-D format
- Raw navigation data in UKOOA P1/90 format or where applicable P6/11
- Final navigation data in UKOOA P1/90 format or where applicable P6/11
- Fully idented correlated vibroseis recording ("shots") before and after summation of the sweeps in SEG-Y
- Multiplicity maps before and after trace editing
- Refraction time picks for the statics derivation
- Refraction & residual statics in trace header and as ascii file
- Near-surface velocity model used to estimate the refraction statics
- Results after intermediate processing steps
    - Denoising in the source point domain
    - Denoising in the receiver domain
    - Multiple suppression

- Velocity fields used for stacking and pre-stack (time and depth) imaging in ascii and SEG-Y format
- Common mid-gathers as used as input to the pre-stack imaging
- QC -stacks at needed
- Common image gathers (pre-stack time or depth gathers) without post-processing
- Common image gathers (pre-stack time or depth gathers) after post-processing
- Applied mute functions
- The filter responses of the applied filters that are used throughout the processing to produce the final processing results.
- Stacking velocity field in ascii and SEG-Y format
- Pre-stack migration velocity field in ascii and SEG-Y format

4. Non-technical Framework

4.1. Permitting and line-scouting

The selected Contractor will have to apply for the operating plan permit and any required nature conservation permits for seismic work on behalf of the Nikhef with the respective authority/authorities in the Netherlands, Flanders and Wallonia.

The selected Contractor shall draw up an operating plan in cooperation with Nikhef. The Contractor shall take care of general permits prior to the work and obtaining other permissions for the use of public properties or private properties during the execution of the seismic survey, e.g. water authorities, road traffic offices. The contractor conducts a nature assessment/ecological study for the traces and their immediate surroundings to identify any points of concern and obstacles from a nature and environmental point of view and prepares any required permits. The contractor shall also arrange for unexploded ordnance surveys to identify whether the intended routes are suitable for active seismicity from a safety perspective along the entire routes. As such, routes shall be adjusted by mutual agreement.
The Contractor can involve an external, separately commissioned, company and that shall take care of the permitting (authorities, commercial companies, private persons). The Contractor is obliged to provide all information required during the preparation of the operating plan and/or the permitting procedure to the externally commissioned company immediately after the contract has been awarded. This includes, but is not limited to e.g.:

- Technology and equipment used and their technical data, e.g.: Noise level;
- Environmental compatibility of the technology and equipment used;
- Personnel used, general occupational health and safety and occupational safety specifications of the Contractor;
- Work permit for seismic data acquisition in the Netherlands, Wallonia and Flanders (if required);
- Use of radio communication during canvassing or aspects concerning traffic and traffic safety.

In order to determine the exact routes of the seismic lines, site visits are to be carried out with Nikhef. Subsequently, in collaboration with Nikhef the Contractor shall generate a detailed plan of the routes (incl. source and receiver points) with corresponding coverage calculations. Once contracted, the aim is to firm-up the intended routes as soon as possible so that the ecological and unexploded ordnance surveys can be picked up as soon as possible. Compliance with safety distances to vibration-sensitive buildings, listed buildings, bridges, pipelines, power lines, water lines, etc. as well as DIN 4150 must be taken into account. In built-up areas as well as on all other sensitive objects, real-time vibration measurements must be carried out according to DIN 4150. To avoid exceeding the limit values, the force of vibrator(s) may have to be reduced. If the limit values are still exceeded, the source point is omitted.

Before and during the data acquisition, documentation of the condition of the roads, buildings and other above-ground structures must take place. The condition of roads, buildings and other structures before data acquisition shall be documented by the Contractor by means of photos and/or videos. During the data acquisition (vibrations at the source points), the Contractor shall ensure documentation of roads, buildings and other structures by means of photos and/or videos. This documentation must take place both closely before and closely after the signal release and made be available on request to Nikhef online with a map display within 72 hours. The data from the documentation (photos, videos, etc.) must be handed over to Nikhef after finalizing the acquisition report.

The actual source and receiver positions (longitude, latitude, altitude) used in this seismic campaign are to be accurately measured (error to be less than 0.5m), so that they can be used in the seismic processing.

It is important that there is good communication between the Nikhef, Nikhef's field representative, the Contractor and the residents along the routes on which the data acquisition takes place before, during and after the data acquisition.

4.2. Traffic and road safety

The Contractor must directly take care of the regulations and specifications regarding traffic safety, barriers and road use for data acquisition. For this purpose, the Contractor must comply with the permit for the implementation of traffic measures. The processing time for a permit is at least 8 weeks and for a permit for temporary measures 6 weeks. The traffic measures within the scope of the works must be carried out in the Netherlands in accordance with the latest CROW guidelines "Werk in Uitvoering (WIU) 96a and 96b". In addition, the Contractor must apply to the municipalities in the Netherlands for permits for road works on the basis of the Local Act (APV). In the Netherlands, this concerns the province of Limburg (Netherlands) and the municipalities of Gulpen-Wittem and Eijsden-Margraten.
For data acquisition in Belgium and Flanders, similar guidelines and regulations must be observed, and permits must be obtained by the Contractor from the respective provinces of Liège (Wallonia) and Belgian Limburg (Flanders) and municipalities Voeren (Belgian Limburg), Plombières, Welkenraedt, Aubel and Lontzen (all Wallonia).

4.3. Quality control and project management

Quality control must be part of the daily operations and should take place as outline in the quality management system of the Contractor. This should include:

- Daily line checks
- Source parameter checks
- Geophone parameter checks
- Concise daily progress reports to Nikhef and the field representative of Nikhef.
- Updated schedules
- Data readout as soon as possible (depending on the acquisition system) after the measurement at one source point is complete
    - Checks that the signal-to-noise ratio is acceptable.
    - In case of a too low signal-to-noise ratio check if it is possible to repeat the source point
- Not more than 3% of "dead" (unusable) receiver traces
- Brute-stacks as soon as the data is available, this can be done in the field or at the premise of the Contractor

4.4 Planning

The contractor creates a week-to-week planning schedule for all requested activities in this tender.

5. Tables to be completed by the Bidder

Tables describing the various acquisition geometries (5.1), technical parameters for acquisition geometry scenarios (5.2) and bids (5.3) for the proposed acquisition geometries, the source parameters, especially for vibroseis acquisition (5.1), and technical parameters are given below.

The Bidder shall complete Tables 5.2 and 5.3 for the specified by Nikhef suggested scenario" in Table 5.1. In addition, the Bidder may propose a further acquisition geometry scenario (Suggestion A in Table 5.1). For this proposal, the corresponding column in Table 5.2 must be filled in.

Table 5.4 must be filled in. The total amount has to correspond with Price sheet item 2.1a.
Table 5.5 must be filled in. The total amount has to correspond with Price sheet item 2.1g.
Table 5.6 must be filled in. The total amounts have to correspond with Price sheet item 2.1b and 2.1h.
Table 5.7.1 must be filled in. The amounts have to correspond with Price sheet item 2.1c-d and 2.1i-j.
Table 5.7.2 must be filled in.
Table 5.8 must be filled in. The amounts have to correspond with Price sheet item 2.1e-f and 2.1k-l.

5.1. Acquisition geometry

This table describes the acquisition geometry suggested by Nikhef in terms of receiver distances and shot intervals for the shallow and deep target. The Bidder is invited to specify an additional acquisition geometrie (Suggestion A) based on his experience and the described 2D seismic in this tender. Suggestion A should be the preferred proposal of the Contractor.

Scenario	**Suggestion Nikhef**	**Bidder: Suggestion A**
geometrical Parameter		
Receiver interval [m]	4	
Source interval [m]	4	
Number of sources per source point (Type and number)	1	
Number of sweeps per source point and source (Type and number)	3	
Minimum source strength/(vibration) energy injection [N]	1200	
Maximum source strength/vibration energy injection [N]	7000	

5.2. Technical parameters for acquisition geometry scenarios

In this table, the Bidder is requested to provide technical parameters for the acquisition geometry scenarios defined in "5.1 Acquisition geometries".

Position	Acquisition geometry *Technical Parameters*	Suggestion Nikhef	Bidder: Suggestion A
1	*Recording sampling rate [ms]*	1	
2	*Spread length to one side of the SP [m]*	1200	
3	*Unaliased recording frequency [Hz]*	80	
4	*Maximum of signal source [N]*	7000	
5	*Number of geophones per receiver station*	1	
12	*Source points per day & per source*	200	
13	*Total length of acquisition [km]*	95	

5.3. Source vehicle (e.g. vibroseis truck) parameters

Parameter	Information provided by the bidder		
Type of if „fuel ", please specify the type of fuel if „Other" please specify	Fuel:	Electrical:	Other:
Sound level during driving [dB(A)] the vehicle both noise source power in dB(A) and noise levels in dB(A) up to 50 m from the vehicle dB(A)			
Sound level during injection of the signal [dB(A)] both noise source power in dB(A) and noise levels in dB(A) up to 50 m from the vehicle dB(A)]			
Total weight [kg] of system (vehicle and source)			
Dimensions [m]	Width:	Length:	Height:
Stage classes: *Combustion engines of mobile tools are divided into so-called stage classes according to European standards. This indicates the limit values in g/kW of harmful substances that may leave the exhaust, such as soot particles/fine dust (PM), carbon monoxide (CO), hydrocarbons (HC) and nitrogen oxide (NOx).*			
Pollutant filter class			
Is an AdBlue system installed	Yes	No	

5.4. Cost estimates for acquisition "Nikhef Suggestion"

Position	Description	Unit	Price per unit [€]	Number	Total price [€]
1	Provision for operational plan preparation, timing estimates, etc.	per h or lump sum			
2	Provision for environmental impact assessment	per h or lump sum			
3	UXO location and clearance	per h or lump sum			
4	Permitting & line scouting	per h or lump sum			
5	Traffic control	per h or lump sum			
6	Mob/Demob	per h or lump sum			
7	Audit	per h or lump sum			
8	Receiver points with number of geophones from position 5 in table	Per Receiver point			
9	Low velocity line	Per line			
10	Parameter test	per h or lump sum			
11	Acquisition	Per source point			

5.5. Cost estimates for acquisition Contractor Suggestion A

Position	Description	Unit	Price per unit [€]	Number	Total price [€]
1	Provision for operational plan preparation, timing estimates, etc.	per h or lump sum			
2	Provision for environmental impact assessment	per h or lump sum			
3	UXO location and clearance	per h or lump sum			
4	Permitting & line scouting	per h or lump sum			
5	Traffic control	per h or lump sum			
6	Mob/Demob	per h or lump sum			
7	Audit	per h or lump sum			
8	Receiver points with number of geophones from position 5 in table	Per Receiver point			
9	Low velocity line	Per line			
10	Parameter test	per h or lump sum			
11	Acquisition	Per source point			

5.6. Cost and elapsed time estimates for the seismic processing of the 2D lines

In addition to providing the requested information the Contractor is asked to propose a processing sequence that can address the seismic imaging challenges given in paragraphs 2 and 3.

Position	Description	Unit	Price per unit [€]	Number	Total price [€]
1	Processing from data import to input for pre-stack time or depth migration	per km or lump sum			
2	Pre-stack time/depth-migration (including velocity model building)	per h or lump sum			
3	Elapsed time for processing 95 line km's.	Weeks	NA		NA

5.7. Cost estimate and technical specification for the DAS-VSP acquisition

The 2D or cross-spread based 3D DAS-VSP's are to be acquired in 7 instrumented wells using the installed DAS fiber optical cables when the acquisitions of the planned 2D lines are traversing those well. The gauge length should be below or equal to 10m. For the cross-spread based 3D DAS-VSP additional geophones on a 2D grid are envisioned.

5.7.1. 2D and 3D DAS-VSP related cost

Position	Description	Price per day [€]	Price for one DAS-VSP	Price for 7 DAS-VSP's. wells [€]
1	Mob/Demob of Interrogator			
2	Operator rate			
3	Interrogator rate			
4	Preparation work (e.g. connecting the DAS fibers)			

Position	Description	Number of additional receivers	Price for using additional receivers for one well	Price for using additional receivers at 6 wells to enable a 2D geophone patch
1	Additional receiver points for a 2D receiver grid for a 3D DAS-VSP			

5.7.2. Technical specifications for the interrogator:

Position	Description	
1	Interrogator model	
2	Minimum gauge length [m]	

5.8. Cost and elapsed time estimates for the seismic processing of DAS-VSP's

In addition to providing the requested information the Contractor is asked to provide a processing proposal for the acquired DAS-VSP's including a processing sequence that can address the seismic imaging challenges given in paragraphs 2 and 3.

Position	Description	Unit	Price per unit [€]	Number	Price for 7 DAS-VSP's [€]
1	Processing from data import to input for pre-stack time or depth migration	One DAS-VSP			
2	Pre-stack time/depth-migration	One DAS VSP			
3	Elapsed time for processing of 7 DAS-VSP's.	Weeks	NA		NA