Partial Contract concluded on the basis of a Framework Agreement signed on 12 October 2016 entitled:

Utilisation of foreign experience in the siting process for a deep geological repository for radioactive waste in the Czech Republic

between

CONTRACTING PARTIES

Client: **Česká republika – Správa úložišť radioaktivních odpadů**

Registered office: Dlážděná 6, 110 00 Praha 1, Czech Republic

Represented by: JUDr. Jan Prachař, Managing Director

ID: 66000769

Banking details:

Name of Bank: ČNB, Na Příkopě 28, Praha 1

Account No.: 35-64726011/0710

Not a payer of VAT

(hereinafter referred to as the "**Client**") and

Name of company: **Posiva Oy (lead party) in a consortium with Saanio & Riekkola Oy (from 31 August 2018 onwards, the company name is A-Insinöörit Civil Oy)**

Registered office: Olkiluoto, FI- 27160 Eurajoki, Finland

Represented by: Janne Mokka

ID: 1029258-8,

Tax ID: FI10292588,

Banking details:

Name of Bank: Nordea (NDEAFIHH)

Account No.: FI 281660 3001 1003 98

(hereinafter referred to as the "**Supplier**")

(hereinafter both referred to as the "**Contractual Parties**"

The Contractual Parties hereby conclude the following Partial Contract (PC) in accordance with the provisions of Article 5 and in the format of Annex No. 4 of the Framework Agreement.

Utilisation of foreign experience in the siting process for a deep geological repository for radioactive waste in the Czech Republic

Name of the Partial Contract:	**Utilisation of POSIVA experience in the Application of the Posiva Flow Log (PFL) system at the Bukov URF**; a tool for the detection of groundwater flows in bedrock.
Area of Services:	iv. the assessment and/or development of specific site characterisation methods
ID of Services:	2016-120-021

	Function	Name	Date	Signature
Client approved for chapter 1	Project Manager	Xxxxx xxxxxxxx	30.9.2021	
Compiled by	Project Manager of the Partial Contract	Xxxxx xxxxx	30.9.2021	
Partial Contract approved by the Client	Managing Director	Jan Prachař	30.9.2021	
Supplier approved - project manager	Project Manager	Xxxxxxx xxxxx	8.10.2021	
Supplier approved - manager of the partial contract	Project Manager of the Partial Contract	Xxxx xxxxxxxxxx	6.10.2021	
Partial Contract approved by the Supplier	Sales Director, Posiva Oy	Mika Pohjonen	5.10.2021	
	Vice President, A-Insinöörit Civil Oy AINS	Xxxx xxxxxx	20.10.2021	
	Managing Director, Posiva Solutions Oy	Mika Pohjonen	5.10.2021	

Note: This Partial Contract (PC) has been concluded in compliance with the conditions of a Framework Agreement (FA) signed on 12 October 2016 entitled: “Utilisation of foreign experience in the siting process for a deep geological repository for radioactive waste in the Czech Republic”.

1 CLIENT’S ASSIGNMENT

1.1 Requirements concerning the scope and technical specifications

The aim of this Partial Contract is the application of the Posiva Flow Log (PFL) system in selected boreholes at the Bukov URF site. The facility is located at a depth of 550 metres below the earth’s surface and serves as a test site for the Radioactive Waste Repository Authority (SURAO) with respect to the assessment of the behaviour of the rock environment and building materials at a depth corresponding to that anticipated for the future deep geological repository for spent nuclear fuel and radioactive waste. The underground facility is located in the village of Bukov in the Žďár nad Sázavou district, Vysočina region, Czech Republic. As with similar facilities of its type, it makes use of a pre-existing underground mine infrastructure, namely the former Rožná I uranium mine. The underground areas of the URF are located on the 12th level close to the B-1 shaft.

This PC consists of the testing and application of the PFL measurement methodology in the underground complex of the Bukov URF in two or three boreholes. The first step will comprise the selection of suitable boreholes for the taking of the measurements. One of the key factors concerning the selection of the boreholes concerns the inclinations thereof, since differing inclinations affect the conducting of the measurement process. Since upward and downward inclined boreholes require slightly different approaches, it is beneficial to take measurements in both borehole types. The technical work plan will be prepared prior to the actual conducting of the research work. The plan will include a description of the preparation phases such as the transportation of the measurement equipment to the site, a description of the measurements to be taken, the data collection process (including the definition of the borehole data that will be acquired during the testing phase) and the evaluation of the data, and the reporting process. Following the taking of the PFL measurements, two of the detected water flow fractures will be selected for the collection of water samples. The samples will be extracted using a doublepacker that will serve for the isolation of the target fractures; a water pipe will be used to transport the water from the boreholes. The water samples will be collected in the form of pressurised samples so as to ensure that potential gases remain within the samples. The water samples will subsequently be handed over at the measurement site and SURAO will be responsible for the subsequent analysis and testing of the samples. All the data gathered during the research work phase will be stored in SURAO’s borehole information system (BORIS), which was established as part of PC 09.

The price estimation has been calculated based on the assumption of the study of three boreholes (both upward and downward inclinations) with a total length of 400 m. The selection of the boreholes will be conducted following a visit to the Bukov URF site. The visit to the site will be conducted well in advance of the planned measurement phase in order to have sufficient time in which to make the necessary preparations.

Parameters of the boreholes:

Number of boreholes: 2 or 3 boreholes

Total combined length of the boreholes: 400 m

Inclinations: Upward and downward inclinations; the minimum inclinations either up or down will be 3º

Diameter: NQ = 76 mm

Locality: Bukov URF, level 12,

Note:

Should any objective factors arise that prevent the execution of the work, the measurement programme will not be realised. Moreover, all the fieldwork is planned in the underground complex of the Bukov URF, concerning which special rules are in place concerning both entry and the conducting of research work.

The Partial Contract includes the following work packages (WP):

WP 1: Visit to the Bukov URF

A visit to the research site will be required before the final fieldwork plan (part of WP2) can be prepared. In addition, it is possible that the budget will have to be revised following the visit since it is not possible at this stage to take into account all the aspects that the research at the site will involve.

The visit was planned in the context of PC11 (a separate plan).

WP 2: Preparation of the technical research work

The technical research work plan includes a description of the measurement process, the data to be obtained and the evaluation thereof, the preparation of a database and the transport of the PFL system to the site. The plan shall also include information on the detailed time schedule of the research work and information on the limits and requirements for the preparation of the site (i.e. with concern to the electricity supply, the technical water, the duration of the measurement process etc.). It should be noted that all the fieldwork is planned in the underground complex and the research work must respect the strict operational rules and restrictions set by mining legislation and by the operator of the mine. SURAO will provide full cooperation in this respect.

WP 3: Technical research work

PFL measurements: In-situ hydrogeological testing employing boreholes at the Bukov URF using the PFL flow measurement system including the measurement of the pressure, electrical conductivity and temperature of the borehole water and the single point resistance of the borehole walls. The measurements shall be taken under two pressure conditions aimed at obtaining data for the evaluation of the transmissivity and hydraulic heads of the fractures. The basic results will be similar to those from the taking of PFL measurements at ground level.

Water sample collection: The collection of water samples from the two selected fractures will be conducted using doublepacker equipment. The setup of the doublepacker system will be planned and prepared based on the PFL results following the taking of the PFL measurements. The duration of the water sampling process will depend on the flow rate of the selected fractures; therefore, the selection of the fractures should take into account the requirement for the collection of enough water during one night. A flow of 1000 ml/h is sufficient to satisfy this requirement. The work shall include the installation of the required equipment in the boreholes and the extraction of the water samples from the doublepacker intervals; the work shall not include the laboratory analysis.

This work package will include the hydrogeological testing of boreholes selected during the preparation stage of WP1 by SÚRAO and the Supplier. The testing programme will focus on the specific hydrogeological conditions of the boreholes and the collection of data on the hydraulic parameters of the rock mass.

WP 4: Data evaluation

This work package includes the compilation of final reports that shall provide descriptions of all the new data obtained and the evaluation thereof. The reports will also include recommendations concerning the application of the methodology and the advantages and disadvantages of the use of the PFL system at this site, as well as proposals for the modification of the PFL system for the purposes of geological characterisation work during the ongoing Czech DGR site selection process. The work will also include the transfer of the knowledge gained to the respective SÚRAO databases.

The Client nominates the following person as the Project Manager for the Partial Contract (PC): Mr. xxxxx xxxxx, e-mail: xxxxxxxxxxxxThe Supplier will communicate directly with this person, with correspondence copied on all occasions to Mr. xxxxx xxxxxxxx, e-mail: xxxxxxxxxxxxxxxxx.

The Client requires the Supplier to nominate those PC participants that will be financed from this Partial Contract.

Changes of persons nominated either by the Client or the Supplier are permitted without the requirement for amending the PC. In case of a change of Project Manager either on the side of the Client or the Supplier, the Project Manager of the one party shall be required to notify his/her counterpart of the other party in writing of the change.

1.2 Required Services deadlines

Definition of the T0: the date of publication of this Partial Contract according to Section 6(1) of the Act No. 340/2015 Coll, on the Register of Contracts.

WP1+3	T0+7 Months
– Output: Technical plan of the investigation work (memo), database, hydrogeological testing	

WP 4: Final report that provides a description of the work, data evaluation and database	T0+10 Months

1.3 Estimated labour intensity and/or limitations thereto

The Client estimates that the work involved in the PC will amount to 770 hours.

Point in the PC	Activities	Estimated labour intensity [hours]
WP1	Visit to the Bukov URF. Two persons. (Including preparations)	80
WP 2	Preparation of the technical work	160
WP 3	Technical work (PFL 80h/borehole, 32h for the water sampling (incl. travelling of 48h))	320
WP 4	Data evaluation	160
WP 1-4	Project management	50

The hourly estimation has been calculated assuming the research of three 135 m-long boreholes. One borehole shall be upward inclined and two boreholes downward inclined.

1.4 Specific requirements concerning the organisation of the Services

The Supplier shall propose the location and timing of those meetings with the Client's experts deemed necessary for the fulfilment of the objectives of the Partial Contract. Communication via telephone, email and videoconferencing will be acceptable provided the security of the information disclosed is ensured.

2 CONFIRMATION/MODIFICATION OF THE ASSIGNMENT OF SERVICES BY THE SUPPLIER

2.1 Scope of the Services and technical specification

The PFL DIFF measurement system is used to determine both the locations of water conductive fractures in boreholes and the hydraulic conductivity of borehole sections and fractures.

The method locates water flow fractures that intersect monitored boreholes. The flow measurements are taken under two differing pressure conditions in order to obtain data for the evaluation of the transmissivity and the hydraulic head. In addition, the method is able to identify suitable borehole sections/fractures for subsequent water sampling purposes.

The PFL probe is lowered to the bottom of vertical boreholes using weights attached below the probe. In boreholes with inclinations of less than 50º, the probe has to be pushed to the bottom of the borehole. With respect to 135 m-long boreholes, a push rod rig will be required to push the probe to the desired location.

The measurement programme and the various phases of the fieldwork for both types of borehole is as follows:

1. Dummy logging for the borehole stability/risk evaluation. If more than four dummy runs are needed, the Client shall be informed and the continuation of the dummy runs discussed. Dummy probing resembles the moving of the PFL probe in the borehole and cannot be replaced by other probing methods.

2. Flow logging under low borehole pressure conditions. If the borehole is downward inclined, the borehole may be open; however, in the case of upward inclined boreholes, the borehole needs to be filled with water and must be closed with a sealing mechanism during the measurement process so as to ensure that the borehole remains filled with water. The section length is L=0.5 m and the increment (step) length is dL=0.1 m. The probe is lowered to the bottom of the borehole (or pushed depending on the inclination). During the automatic measurement process, the probe is moved in distance increments between the measurement points and is stationary during the flow measurement process. Since the section length is longer than the increment length, the flow from a single fracture is measured more than once.

   Measured parameters:

   - Flow (mL/h)
   - Single point resistance (SPR)
   - Water level in the boreholes and the pressure
   - Air pressure
   - Electrical conductivity (EC) and the temperature of the water

   The measurements indicate the location of flow fractures at a resolution equal to the incremental distance.

3. Flow logging under high borehole pressure conditions. The borehole is closed using a sealing mechanism and the pressure in the borehole verified. The borehole pressure must be set at least 12 hours before the measurement process commences in order to attain stable pressure conditions following the setting of the pressure level. The pressure depends on the borehole conditions (e.g. the content of the water flow is high enough so as to ensure the pressure elevation in the borehole).

4. The collection of water samples from the two selected fractures will be conducted using a doublepacker system installed in the borehole. The exact setup of the doublepacker will be decided following the obtaining of PFL results from the boreholes.

All the flow logging measurements include the measurement of the single point resistance of the bedrock, the results of which are then used for the matching of the depths between the measurement runs. Since the flow measurements are taken under two differing pressure conditions, the hydraulic conductivity of the detected fractures can be calculated. All the fractures between two consecutive measurement points are treated as a single fracture in terms of the processing of the measurement results.

The control of the borehole pressure in tunnel boreholes requires a pump that serves to maintain stable pressure conditions. Depending on the borehole conditions, it might be required that water be pumped into the borehole, in which case the pumped water enters some of the fractures. SÚRAO acknowledges this factor and shall take into consideration when selecting the test boreholes that pumped water may enter the bedrock fractures. Thus, water must be available at the site for the pump. The water can be supplied using a water line or a water tank. The required amount of water depends on the borehole conditions (i.e. how much water needs to be pumped into the borehole in order to ensure a reasonable pressure elevation); therefore, a supply via a water line is the preferred option.

The equipment required for the taking of PFL measurements under tunnel conditions consists of a push rod rig and a PFL trailer, both of which have to be positioned in front of the borehole. The push rod rig is approx. 4 m long and the PFL trailer is 4.7 m long. Space is also required for working between the push rod rig and the trailer; therefore, the entire length of the equipment that needs to be set up in front of the borehole is approx. 10 m. The trailer must be transported into the tunnel in the upright position (length 4.7 m, height 2.0 m, width 1.95 m and weight 1000 kg). The transportation of the equipment to the Bukov URF from Finland will be arranged by a freight forwarding company using a truck; therefore, the trailer will need to be lifted off the truck using a fork lift truck at the Bukov URF site.

2.2 Fulfilment dates

It is not possible at the time of the submission of the offer to determine the commencement date for the fieldwork or the timing of the visit to the Bukov URF due to the covid epidemic situation. Furthermore, the continuation of the fieldwork even after it has commenced cannot be guaranteed since guidelines issued by the respective governments, authorities and companies are liable to change and may require the recalling of personnel from the site. Thus, the Supplier reserves the right to extend or cancel the performance of the contract in whole or in part should the coronavirus (COVID-19) situation lead to the introduction of travel restrictions by the authorities and/or the TVO group and/or the customer and/or by another party. The preliminary planned date for the visit to the Bukov URF is October 2021 and for the commencement of the fieldwork at the beginning of 2022.

2.3 Price of the Partial Contract

The price of the Partial Contract has been estimated as presented in the table below. The price estimation will be verified following the first visit to the Bukov URF site.

Visit to the Bukov URF prior to the fieldwork	15113,60€
Preparations	160h*153,02€/h=24483,20€
Fieldwork (PFL + water sampling)	272h*153,02€/h=41621,44€
Data processing and reporting	160h*153,02€/h=24483,20€
Travelling, daily allowances and accomodation	21044,96€

Equipment rental (PFL and push rod rig)	15days*2200€/day=33000€
Rental of water sample equipment	3000€
Equipment transportation	4000€
Project managemant	50h*153,02€/h=7651€
Total	**174397€**

2.4 Organisation of the Services

Name	Role/position	Knowledge areas relevant to this PC
Xxxxx xxxxxxxx	Adviser, Flow logging	PFL flow logging and equipment specialist
Xxxx xxxxxxxxxx	Adviser, Flow logging	Project manager, PFL flow logging and interpretation and reporting of the results.
Xxxxxx xxxxxxxxxx	Expert, Flow logging	PFL flow logging and reporting
Xxxxxxx xxxxx	Adviser	Project management of the FA

Table 2: Personnel hours by category

Category	Hours	%	Price/€
Cat 2	770	100	117825,40€

2.5 Risk identification

The taking of measurements in boreholes involves certain risks that cannot be fully avoided. These risks can be divided into at least two categories: the jamming of the equipment in the borehole and the loss of the measurement equipment and the failure to obtain representative measurement results due to the borehole conditions.

The dummy logging of the boreholes is conducted prior to the commencement of the taking of real measurements aimed at assessing the stability of the boreholes. Dummy logging also serves to clean the borehole wall of loose rocks. Nevertheless, the measurement probe may become stuck in the borehole even after a successful dummy logging run. If the measurement probe does become stuck in the borehole, the contractor is not responsible for the opening of the borehole.

The borehole conditions may affect the quality of the measurement results. Specific borehole conditions that may affect the quality of the measurement process are listed below; this is not an exhaustive list, and other factors may also affect the measurement quality.

- Rough borehole wall conditions may cause the rubber discs in the PFL probe to leak, which exerts a significant impact on the quality of the flow logging procedure.
- Gas bubbles issuing from a fracture may interfere with the flow logging process and lead to the recording of erroneous flow rate results.
- The tolerance between the probe and the borehole wall is very small; therefore, if the borehole profile is not sufficiently round, the rubber discs may leak or the probe may not be able to enter the borehole at all.
- If the borehole crosses fractures which have very high hydraulic conductivity, it may be impossible to create a sufficient drawdown via the pumping of water out of the borehole. This affects the interpretation of both the transmissivity and the hydraulic head of the fractures.

In addition to these risks, working under mine conditions involves risks that cannot be predicted beforehand. Therefore, it is important to visit the mine prior to the commencement of the fieldwork and to consider all the details that might affect working at the site.

3 CONCLUSION OF THE PARTIAL CONTRACT

The Supplier acknowledges that the Client is obliged to publish this Partial Contract pursuant to the Act No. 340/2015 Coll, on the Register of Contracts. This Partial Contract comes into force on the date it is signed by both Contractual Parties. This Partial Contract comes into effect by the date of its publication according to Section 6(1) of the Act No. 340/2015 Coll, on the Register of Contracts.