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Title - Sujet RFI for Seismic Equipment	
Solicitation No. - N° de l'invitation 23240-160715/A	**Date** 2015-11-26
Client Reference No. - N° de référence du client 23240-160715	**GETS Ref. No. - N° de réf. de SEAG** PW-$$PV-915-68469
File No. - N° de dossier pv915.23240-160715	**CCC No./N° CCC - FMS No./N° VME**
Solicitation Closes - L'invitation prend fin **at - à 02:00 PM** **on - le 2015-12-15**	**Time Zone** **Fuseau horaire** Eastern Standard Time EST
F.O.B. - F.A.B. **Plant-Usine:** ☐ **Destination:** ☐ **Other-Autre:** ☐	
Address Enquiries to: - Adresser toutes questions à: Gosselin, Monique	**Buyer Id - Id de l'acheteur** pv915
Telephone No. - N° de téléphone (819) 956-3803 ( )	**FAX No. - N° de FAX** (819) 956-3814
Destination - of Goods, Services, and Construction: **Destination - des biens, services et construction:** DEPARTMENT OF NATURAL RESOURCES . 580 BOOTH ST OTTAWA Ontario K1A0E4 Canada	

Instructions: See Herein

Instructions: Voir aux présentes

Delivery Required - Livraison exigée See Herein	**Delivery Offered - Livraison proposée**
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Name and title of person authorized to sign on behalf of Vendor/Firm (type or print) **Nom et titre de la personne autorisée à signer au nom du fournisseur/ de l'entrepreneur (taper ou écrire en caractères d'imprimerie)** **Signature** **Date**	

Canada

Request for Information regarding Seismological Equipment

For

Public Works and Government Services Canada on behalf of the Department of Natural Resources Canada

TABLE OF CONTENTS

Request for Information regarding Seismological Equipment

For

Public Works and Government Services Canada on behalf of the Department of Natural Resources Canada

1 Background of this Request for Information (RFI)

Public Works and Government Services Canada (PWGSC) on behalf of the Department of Natural Resources Canada (NRCan) intends to establish an interest including price and availability from industry for the provision of seismological equipment and support system for the renewal of Canada's national earthquake monitoring network. Interested suppliers are asked to comment upon both the proposed specification and the list of questions.

2 Purpose of this RFI

The purpose of this RFI is to provide industry with an early opportunity to comment on NRCan's requirement for seismological equipment.

This feedback will assist Canada in ensuring that its requirements are in line with industry standards.

3 Nature of RFI

This is not a bid solicitation. This RFI will not result in the award of any contract. As a result, potential suppliers of any goods or services described in this RFI should not reserve stock or facilities, nor allocate resources, as a result of any information contained in this RFI. Nor will this RFI result in the creation of any source list. Therefore, whether or not any potential supplier responds to this RFI will not preclude that supplier from participating in any future procurement. Also, the procurement of any of the goods and services described in this RFI will not necessarily follow this RFI. This RFI is simply intended to solicit feedback from industry with respect to the matters described in this RFI.

4 Contents of this RFI

This RFI contains Annex A – Requirements, Annex B – Questions to Industry for which PWGSC and NRCan are seeking feedback from industry, and Annex C - Acronyms and Definitions.

5 Nature and Format of Responses Requested

Respondents are requested to provide their responses to the questions and include any suggestions that could help to improve NRCan's requirement for seismological equipment. Respondents should explain any assumptions they make in their responses.

6 Response Costs

Canada will not reimburse any respondent for expenses incurred in responding to this RFI.

7 Treatment of Responses

(a) **Use of Responses**: Responses will not be formally evaluated. However, the responses received may be used by Canada to develop or modify procurement strategies. Canada will review all responses received by the RFI closing date. Canada may, in its discretion, review responses received after the RFI closing date.

(b) **Review Team**: A review team composed of representatives of the Client (where applicable) and other relevant stakeholders will review the responses. Canada reserves the right to hire any independent consultant, or use any Government resources that it considers necessary to review any response. Not all members of the review team will necessarily review all responses.

(c) **Confidentiality**: Respondents should mark any portions of their response that they consider proprietary or confidential. Canada will handle the responses in accordance with the *Access to Information Act*.

(d) **Follow-up Activity**: Canada may, at its discretion, meet with respondents who indicate in their responses that they wish to participate in a follow-up meeting. Such follow-up activity, if conducted, may include, but is not limited to, individual meetings and/or conferences. Canada may, in its discretion, contact any respondents to follow up with additional questions or for clarification of any aspect of a response.

8 Format of Responses

(a) **Cover Page**: If the response includes multiple volumes, respondents are requested to indicate on the front cover page of each volume the title of the response, the RFI number, the volume number and the full legal name of the respondent.

(b) **Title Page**: The first page of each volume of the response, after the cover page, should be the title page, which should contain:

(i) the title of the respondent's response and the volume number;
(ii) the name and address of the respondent;
(iii) the name, address and telephone number of the respondent's contact;
(iv) the date; and
(v) the RFI number.

(c) **Numbering System**: Respondents are requested to prepare their response using a numbering system corresponding to the one in this RFI. All references to descriptive material, technical manuals and brochures included as part of the response should be referenced accordingly.

(d) **Number of Copies**: Respondents are requested to submit one softcopy in either Microsoft Word or Adobe PDF.

(e) **Response Confidentiality**: Respondents are requested to clearly identify those portions of their response that are proprietary to the Responder. The confidentiality of each Responders response will be maintained. However, due to the nature of the RFI activity, Responders must be aware that aspects of their response may be used as a basis for developing documents.

9 Enquiries

Because this is not a bid solicitation, Canada will not necessarily respond to enquiries in writing or by circulating answers to all potential suppliers. However, respondents with questions regarding this RFI may direct their enquiries to:

Contracting Authority: Monique Gosselin
E-mail Address: monique.gosselin@tpsgc-pwgsc.gc.ca
Telephone: (819) 956-3803
Facsimile: (819) 956-3814

10 Submission of Responses

(a) **Time and Place for Submission of Responses**: Responses must be submitted only to the PWGSC Bid Receiving Unit by the date, time and place indicated on page 1 of this RFI.

(b) **Responsibility for Timely Delivery**: Each respondent is solely responsible for ensuring its response is delivered on time to the correct location.

(c) **Identification of Response**: Each respondent should ensure that its name and return address, the RFI number and the closing date appear legibly on the outside of the response.

ANNEX A

REQUIREMENTS

NRCAN on behalf of the Canadian Hazard Information Service (CHIS) has a requirement for the renewal of the instrumentation and related software support infrastructure for the Canadian National Seismograph Network (CNSN). The CNSN is a monitoring system used for the detection and measurement of earthquakes and other seismic disturbances in Canada and abroad. The network consists of about 150 monitoring stations having a mixture of weak motion and strong motion sensors, digitizers, communications equipment and site infrastructure. These are positioned in diverse locations across the country from isolated stations in the arctic, to those in mountainous regions, to stations in densely populated urban centres. To record and analyse the acquired data CHIS operates two redundant data centres (one in Ottawa, Ontario, the other in Sidney, British Columbia). Further details on the current network may be found at http://www.earthquakescanada.nrcan.gc.ca/.

The network last received a major renewal of equipment in the 1990's. It is now close to end of life.

INTRODUCTION

NRCan seeks the supply of the following items as part of this potential procurement:

- Seismometers, Accelerometers, Digitizers, Accessories, and Data Centre Acquisition Software where the software has sufficient licensing to run in parallel at multiple data centres to acquire all data for up to 500 stations
- Warranty on equipment for a period of three years following delivery. Warranty on data centre software for a period of three years following installation. Support, i.e. parts, repairs and software updates, in particular software and instrument firmware updates for IT security and stability, for all items ordered for a minimum of ten years following issuance of any resulting contract
- Documentation for all components of the system (sensors, digitizers, and related software) , describing use, requirements for associated systems, and configuration
- All sensors and digitizers with calibration and test documentation as appropriate
- Training
- An optional requirement for additional deliveries for the items above.
- NRCan may also require as an optional item, a compatible low power satellite station to be used with the equipment.

GENERAL

To facilate the the technical evaluation, for any resulting RFP, NRCan may request the following:

- Internal and/or independent test data to substantiate claimed specifications;
- samples of equipment for testing;

- demonstration of bidders' the ability to deliver a project of this size and complexity within the last five years; and
- client's contact information for at least three previous projects of similar scope based on size and complexity.

REQUIREMENTS

1 Mandatory Requirements

1.1 Seismometers

1.1.1 Type: Sensor must be a triaxial, broadband, velocity seismometer with vertical, north and east component outputs and force-balance feedback design.

1.1.2 Enclosure: Sensor must be packaged separate from digitizer, i.e. no integrated seismometer and digitizer.

1.1.3 Format: Both surface vault sensors and posthole sensors must be available.

1.1.4 Output range: Sensor must have an output setting of 40 Vpp differential.

1.1.5 Sensitivity: Sensor must have a sensitivity of at least 1000 V/m/s.

1.1.6 Dynamic range: Sensor must have a dynamic range of at least 135 dB. Seismometer must have a clip level at least 10 dB above the self-noise level of the accelerometer described in section 1.2.

1.1.7 Bandwidth: Sensor bandwidth must be flat to velocity from 120 s to 50 Hz or better.

1.1.8 Sensor self-noise: Sensor self-noise must be below USGS NLNM from 30 s - 10 Hz on all three components.

1.1.9 Control: Must allow local and remote control of sensor on all three channels including mass lock & unlock (if necessary), mass centre and calibration.

1.1.10 Physical size: Sensor dimensions must be no larger than 35 cm high and 25 cm in diameter for surface vault sensors and 61 cm high and 15 cm in diameter for posthole sensors.

1.1.11 Weight: Sensor weight must be no more than 15 kg for surface vault sensors and 20 kg for posthole sensors.

1.1.12 Enclosure ingress protection: Sensor must be suitable for permanent outdoor deployment and have ingress protection rating of IP67 or better for surface vault seismometers and IP68 or better for posthole seismometers.

1.1.13 Temperature range: Sensor must have an in-specification operating temperature range of -20 C to 50 C or better.

1.1.14 Accessories: The sensor must include an appropriate cable to connect it to the digitizer.

1.1.15 Levelling: Sensor must be supplied with levelling devices, e.g. adjustable feet, self-levelling, etc.

1.1.16 Level indicators: Surface vault sensors must either provide a bubble level or the top of the case must be flat and level relative to sensor axes.

1.1.17 Orientation indicator: Sensor must have indicator for the direction of the north or east axis on at least one side or the top.

1.1.18 Lifetime: Sensor must be designed for at least a ten year life and must have a MTBF of at least 50 years.

1.2 Accelerometers

1.2.1 Type: Sensor must be a triaxial, broadband, force-balance accelerometer with vertical, north and east component outputs.

1.2.2 Enclosure: Separate packaging from digitizer, i.e. no integrated accelerometer and digitizer.

1.2.3 Format: Surface vault sensors must be available.

1.2.4 Full scale range: Sensor must have a full scale range of +/- 4g.

1.2.5 Dynamic range: Sensor must have a dynamic range of at least 145 dB. Accelerometer must have a self-noise level at least 10 dB below the clip level of the seismometer described in section 1.1.

1.2.6 Bandwidth: Sensor bandwidth must be flat to acceleration from DC to 200 Hz or better.

1.2.7 Sensor self-noise: Sensor self-noise must be below USGS NHNM from 10 s - 100 Hz on all three components.

1.2.8 Control: Must allow local and remote control of sensor on all three channels including offset zeroing and calibration.

1.2.9 Physical size: Surface vault sensor dimensions must be no larger than 10 cm by 20 cm by 20 cm.

1.2.10 Weight: Sensor weight must be no more than 3 kg.

1.2.11 Enclosure ingress protection: Sensor must be suitable for permanent outdoor deployment and have ingress protection rating of IP67 or better.

1.2.12 Temperature range: Sensor must have an in-specification operating temperature range of -20 C to 50 C or better.

1.2.13 Accessories: The sensor must include an appropriate cable to connect it to the digitizer.

1.2.14 Levelling: Sensor must be supplied with levelling devices, e.g. adjustable feet, self-levelling, etc.

1.2.15 Level indicators: Surface vault sensors must either provide a bubble level or the top of the case must be flat and level relative to sensor axes.

1.2.16 Anchoring: Surface vault sensor must have an anchoring device to prevent movement.

1.2.17 Orientation indicator: Sensor must have indicator for the direction of the north or east axis on at least one side or the top.

1.2.18 Lifetime: Sensor must be designed for at least a ten year life and must have a MTBF of at least 50 years.

1.3 Digitizers

1.3.1 Digitizer type: Digitizer must be a broadband, seismic digitizer with one 24 bit or greater ADC per channel.

1.3.2 Number of channels: Both six channel and three channel digitizers must be available.

1.3.3 Input range: Digitizer must have an input setting of 40 Vpp differential.

1.3.4 Gain settings: Must have appropriate gain settings in order to capture the full scale of the sensor at the maximum possible resolution. For example, if a 40 Vpp seismometer is connected to channels 1-3 and a 10 Vpp accelerometer is connected to channels 4-6, then channels 1-3 must be able to be configured to a gain of 1 and channels 4-6 must be able to be configured to a gain of 4.

1.3.5 Dynamic range: Digitizer must have a dynamic range of at least 135 dB at 100 sps.

1.3.6 Digitizer self-noise: Digitizer self-noise must be well below the USGS NLNM.

1.3.7 Timing accuracy: Data sample timing accuracy must be better than 100 µs with the GPS always on.

1.3.8 Sampling Simultaneity: Samples must be taken simultaneously on all channels within +/-5 µs of the mean sampling time.

1.3.9 Sample rates: Sample rate must be user selectable per group of three channels and include settings of at least 20, 40, 100 and 200 sps.

1.3.10 Monitoring: Must be able to monitor and check the status of the digitizer (and all attached sensors) both locally (on-site) and remotely (by communications link). See “State-of-Health data” below for the types of SOH data.

1.3.11 Monitoring method: Monitoring must be via a web browser, and/or a webservices interface, and/or via a Linux-based Application Programming Interface (API), and/or via a Linux-based program or command line interface (CLI). Programs, APIs and CLIs that must run on other computing platforms, including Microsoft Windows are not acceptable.

1.3.12 Configuration, command and control: Must be able to configure, command and control the digitizer (and all attached sensors) both locally and remotely. Command includes locking, unlocking and centering masses, and zeroing offsets. Control includes the ability to restart/reset the digitizer.

1.3.13 Configuration, command and control method: Configuration, command and control must be via a web browser, and/or a webservices interface, and/or via a Linux-based API, and/or via a Linux-based program or CLI. Programs, APIs and CLIs that must run on other computing platforms, including Microsoft Windows are not acceptable.

1.3.14 Sensor calibration: The digitizer must be able to send calibration signals to all channels of all sensors. Calibration must be able to be initiated both locally and remotely.

1.3.15 Sensor calibration method: Sensor calibration must be via a web browser, and/or a webservices interface, and/or via a Linux-based API, and/or via a Linux-based program or CLI. Programs, APIs and CLIs that must run on other computing platforms, including Microsoft Windows are not acceptable.

1.3.16 Calibration type: Sensor calibration type must include sine wave, step function and one or more broadband calibration options, such as Pseudo-Random Binary or white noise.

1.3.17 Power to sensors: The digitizer must provide appropriate power to two connected sensors – typically one seismometer and one accelerometer.

1.3.18 Power: The digitizer and any required auxiliary devices (e.g. for timing (GPS antenna), local data storage, real-time data telemetry, etc.) must take no more than 12 Watts of power at 12 VDC, when a) connected to one three channel broadband seismometer and one three channel accelerometer, and b) sampling at 100 sps, and c) with the GPS always running, and d) buffering to local storage and streaming continuous data via an IP communications link.

1.3.19 Physical size: Digitizer and any required auxiliary devices altogether must be no larger than 45 cm by 20 cm by 20 cm.

1.3.20 Weight: Digitizer and any required auxiliary devices altogether must weigh no more than 10 kg.

1.3.21 Enclosure ingress protection: Digitizer and any required auxiliary devices must be suitable for permanent outdoor deployment and have ingress protection rating of IP67 or better.

1.3.22 Temperature range: Digitizer and any auxiliary devices must have an in-specification operating temperature range of -20 C to 50 C.

1.3.23 Accessories: The digitizers must include GPS antennas and cables.

1.3.24 Ethernet interface: Digitizer or auxiliary device must have at least one Ethernet network interface to be used for data communication with distant data centres.

1.3.25 Communications protocol: Data communications must use IP protocols.

1.3.26 Telecommunications services: Data communications must work with the following communication services: cell modems, satellite links, DSL and cable ISPs, IP radios, Wi-Fi and frame relay links.

1.3.27 Data recording: Digitizer must provide complete and continuous digital recording of data from sensors.

1.3.28 Data compression: Data recorded from digitizer must be compressed for storage and transmission using a lossless compression algorithm. Data compression must be at least 50% under typical conditions.

1.3.29 Local storage: Digitizer or auxiliary device must provide a local, non-volatile storage buffer of at least 28 days in duration, assuming six channels at 100 sps and 50% data compression.

1.3.30 Data telemetry: Digitizer or auxiliary device must provide continuous (and, if supported, triggered), real-time data transmission to distant data centres via the Ethernet port.

1.3.31 Local storage and remote data telemetry: Continuous (and, if supported, triggered) data must be simultaneously available for local storage and telemetry via the Ethernet interface.

1.3.32 Data latency: Data telemetry must have low latency and send data packets within one second of data recording.

1.3.33 Packet size: Data packets must contain no more than three seconds of data for any channel in order to maintain low data latencies.

1.3.34 Multiple data centres: Simultaneous data telemetry to multiple data centres must be supported.

1.3.35 Data telemetry protocol: A data telemetry protocol is used to control and manage the streaming of data between multiple sites. The digitizer or auxiliary device must support a data telemetry protocol suitable for real-time data transmission, i.e. file transfer is not acceptable.

1.3.36 Data retransmission: The data telemetry protocol must support real-time requesting and retransmission of missed data. If real-time, streaming data is not received at the data centre (e.g. due to communications outage), the missed data must be able to be requested and resent. The digitizer or auxiliary device must support the real-time retransmission of any data that is up to 24 hours old, or better.

1.3.37 File access: The digitizer or auxiliary device must support local and remote extraction of any portion of the local storage buffer into miniSEED format files via http, https, rsync, scp or ftp file transfer.

1.3.38 Channel naming: It is mandatory that the digitizer must identify the data stream from each channel by either:

a) Using a naming convention that includes a two-character (SEED) network code, a five-character station code, a two-character location code, and a three-character (SEED) channel code.

b) Using an identifier that gets associated with the naming convention in a) above when the data is received at the data centre, i.e. an id-to-name mapping.

1.3.39 SOH data: The digitizer must be able to provide State-of-Health (SOH) information for the following attributes: system status (e.g. okay, attention needed), supply voltage, mass positions, clock status.

1.3.40 SOH access: All SOH data should be accessible locally and remotely via the digitizer monitoring method mentioned above.

1.3.41 Lifetime: Sensor must be designed for at least a ten year life and must have a MTBF of at least 50 years.

1.4 Data Centre Acquisition Software

NRCan currently uses Antelope software from BRTT for both data acquisition and processing. In addition, NRCan currently uses SeisComP3 for data acquisition in a limited role. NRCan plans to continue to use Antelope for data processing. NRCan prefers to use Antelope for data acquisition. NRCan may continue to use SeisComP3 for data acquisition. NRCan only supports software that runs on Intel/AMD X86 computers running Linux (CentOS 6 or higher).

1.4.1 Data acquisition modules: At the data centres, station waveform and SOH data must be acquired directly by Antelope data acquisition modules (e.g. q3302orb), or directly by SeisComP3 data acquisition modules, or directly by proprietary acquisition software supplied by the bidder.

1.4.2 Data acquisition software requirements: All data acquisition software (whether Antelope, SeisComP3 or proprietary) must support all real-time data telemetry requirements listed in the digitizer section above. For example, waveform and SOH data telemetry to multiple data centres, real-time retransmission of missed data, channel naming requirements, etc.

1.4.3 Data transfer to Antelope software: If proprietary or SeisComP3 software is required for data acquisition, all station waveform and SOH data must be forwarded in real-time to Antelope software with minimal data delay (typically less than one second) and maximal completeness (i.e. must support data retransmission mechanism for missed data).

1.4.4 Data extraction from proprietary software: If proprietary software is required for data acquisition, it must provide the capability to automatically and routinely extract all data in miniSEED format files, one file per channel per day.

1.4.5 Monitoring of data acquisition system: Monitoring software must be provided. Monitoring software must provide the ability to monitor the data acquisition software performance, station state-of-health, and data acquisition performance (e.g. station data availability, data latency, etc.). If necessary, the monitoring functionality can be provided directly by the data acquisition software via http or https web access.

1.4.6 Software watchdogs: All continuously running software must be started automatically at computer boot up and be automatically restarted in case of a software crash.

1.4.7 Computer platform: Any data centre software provided must be able to run on existing NRCan computers (i.e. CentOS Linux 6 or higher on X86).

1.4.8 Multiple data centres: Any required data centre software must run simultaneously at multiple data centres.

1.4.9 Software licensing: Any data centre software provided must have sufficient licensing to run in parallel at multiple data centres to acquire all data for up to 500 stations.

1.4.10 Installation and Configuration: Any required data centre software must be installed and configured to the satisfaction of NRCan on government supplied computers at multiple data centres.

1.4.11 If access is required to government computers and networks in order to install, configure, support, and maintain the system, then the bidder must acquire appropriate government security clearances.

1.5 Warranty, Support, Traning, Documentation

1.5.1 Equipment must be warranted for defects in materials and workmanship for a period of three years following delivery.

1.5.2 All software shall be warranted for defects in materials and workmanship for a period of three years following installation. In addition, any standard updates will be provided within this time period.

1.5.3 The bidder must guarantee that it will provide support, i.e. parts, repairs, and software updates, in particular software and instrument firmware updates for IT security and stability, for all items ordered for a minimum of ten years following issuance of contract.

1.5.4 The bidder must provide on-site training in Ottawa for station equipment on its installation, configuration, and use.

1.5.5 The bidder must provide on-site training in Ottawa for data centre software on its installation, configuration, and use.

1.5.6 All components of the system (sensors, digitizers, and related software) must be provided with appropriate documentation describing use, requirements for associated systems, and configuration

1.5.7 All sensors and digitizers must be provided with calibration and test documentation as appropriate.

1.6 Delivery Schedule

Equipment and software must be received by NRCan within the first year of any resulting contract. No equipment and software can be delivered before April 1st 2016, and all must be received by March 31st 2017. Equipment and software must be delivered in three batches according to following table. Note, warranty periods will not start before the batch delivery dates.

	Required Delivery Dates – delivery must be within +/-10 days of target date.			
Item	30 days after contract award	90 days after contract award	March 15th, 2017	Total units delivered
Seismometers†	20	30	110	160
Accelerometers†	20	30	110	160
Digitizers*	30	30	140	200
Data Centre Acquisition Software (if required)	Licences for multiple data centres			Licences for multiple data centres

† A combination of vault and posthole sensors will be ordered. The exact number of each type will be determined at time of contract issuance (depending on operational requirements and the relative pricing received in response to the RFP).

* The exact number of three vs six channel digitizers will be determined at time of contract issuance (depending on operational requirements and the relative pricing received in response to the RFP).

2 POINT RATED REQUIREMENTS

The exact point rating scheme will not be identified until the RFP is issued. It is expected that a total of 30 points will be given to requirements in sections 2.1 to 2.4 (Seismometers, Accelerometers, Digitizer and Data Centre Acquisition Software; and that a total of 30 points will be given to requirements in section **Error! Reference source not found.** (Bidders Experience); and that 40 points will be awarded based on cost (with lowest cost compliant bid receiving up to 40 points and other bids getting less points).

2.1 Seismometers

2.1.1 Mass locking: Sensor should require no mass locking for safe transport.

Maximum points awarded if no mass locking required

No points awarded if mass locking required.

2.1.2 Instrument information: Should allow local and remote querying of sensor to retrieve manufacturer information including no less than the instrument manufacturer, type, model, serial number and status.

No points awarded if no instrument information available via query

Points awarded for each type of information availabe, up to a maximum number of points

2.1.3 Insulation: Surface vault sensors should be provided with close-fitting insulation to reduce thermal instability.

Maximum points awarded if close-fitting insulation provided

No points awarded if no close-fitting insulation provided

2.2 Accelerometers

2.2.1 Posthole format: Posthole accelerometers should be provided. Sensor dimensions must be no larger than 51 cm high and 10 cm in diameter. Sensor must be suitable for permanent outdoor deployment and have ingress protection rating IP68 or better.

Maximum points awarded if posthole accelerometers available

No points awarded if no posthole accelerometers available

2.2.2 Output range: Sensor should have an output setting of 40 Vpp differential.

Maximum points awarded if accelerometer has requested output range

No points awarded if accelerometer does not have requested output range

2.2.3 Instrument information: Should allow local and remote querying of sensor to retrieve manufacturer information including no less than the instrument manufacturer, type, model, serial number and status.

No points awarded if no instrument information available via query

Points awarded for each type of information availabe, up to a maximum number of points.

2.3 Digitizers

2.3.1 Multiple sample rates: Digitizer should be able to simultaneously record channels at different sample rates. For example, stream weak motion data at 40 sps and record locally at 100 sps, or stream strong motion data at 100 and send triggered data at 200 sps.

Half points awarded if channels can be recorded at multiple sample rates.

Half points awarded if different channels can be recorded at different sample rates.

2.3.2 Monitoring method preference: Preferences for monitoring methods are rated in the following order: web browser, webservices interface, Linux-based API, Linux-based program or CLI.

Point values are rated based the preference rating; i.e. web browser = maximum points; Linux-based API = minimum points, Linux-based program or CLI = no points.

2.3.3 Instrument information: Via the monitoring method, should be able to remotely query the digitizer AND all attached sensors to retrieve the manufacturer information including not less than the instrument manufacturer, type, model and serial number.

No points awarded if no instrument information available via query

Points award for each type of information availabe and each type of instrument accessible, up to a maximum number of points

2.3.4 Configuration, command and control method preference: Preferences for configuration, command and control methods are rated in the following order: web browser, webservices interface, Linux-based API, Linux-based program or CLI.

Point values are rated based the preference rating; i.e. web browser = maximum points; Linux-based API = minimum points, Linux-based program or CLI = no points.

2.3.5 Sensor calibration method preference: Preferences for sensor calibration methods are rated in the following order: web browser, webservices interface, Linux-based API, Linux-based program or CLI.

Point values are rated based the preference rating; i.e. web browser = maximum points; Linux-based API = minimum points, Linux-based program or CLI = no points.

2.3.6 Triggered data: In addition to continuous data recording, triggered data segments should be supported. Data segments should be triggered off external inputs, STA/LTA ratios or pre-set levels.

No points awarded if triggered data not supported

One third of maximum points awarded for each of the three trigger methods supported.

2.3.7 Reduced packet size: The digitizer should be configurable so that data packets contain no more than one second of data for any channel, in order to maintain very low data latencies suitable for earthquake early warning systems.

Maximum points awarded if one second (or less) packets supported

No points awarded if one second (or less) packets not supported

2.3.8 Telemetry bandwidth: Data telemetry should require no more than 20 kilobits per second for 6 channels sampled at 100 sps being sent to two data centres, assuming 50% compression, a packet size of no more than three seconds, and no retransmission needed.

Maximum points awarded if bandwidth less than 20 kilobits per second.

No points awarded if bandwidth greater than 30 kilobits per second

Bandwidth between 20 and 30 kilobits per second awarded points on a sliding scale.

2.3.9 Maximum retransmission: The digitizer or auxiliary device and the data telemetry protocol should support the real-time retransmission of ANY data in the local storage buffer, i.e. 14 days of data.

Maximum points awarded if support for real-time retransmission of entire local buffer

No points awarded if no support for real-time retransmission of entire local buffer

2.3.10 Data order: In normal operations (i.e. no missed data), data should be sent in time order. After a communications outage and retransmitting missed data, current (data from last five minutes) real-time data should be sent before older missed data, which in turn should be sent before newer missed data.

Maximum points awarded if requested ordering supported

No points awarded if requested ordering not supported

2.3.11 Throttling: The digitizer or auxiliary device should support data throughput throttling for problematic or low-bandwidth communication links.

Maximum points awarded if data throughput throttling supported

No points awarded if data throughput throttling not supported

2.3.12 Auxiliary channels: Digitizer should include one or more auxiliary analog channels sampled at least 1 sps and with 10 bits of resolution.

Maximum points awarded if two or more auxiliary analog channels supported

Half points awarded if one auxiliary analog channels supported

No points awarded if no auxiliary analog channels supported

2.3.13 Optional SOH data: The digitizer should be able to provide State-of-Health (SOH) information for the following attributes: temperature, complete power status (current, voltages, recent min/max), complete clock status including number of GPS satellites, complete sensor status, digital inputs status (e.g. vault/authbox door open/closed).

No points awarded if no SOH information available

Points award for each type of SOH information availabe, up to a maximum number of points

2.3.14 SOH data telemetry: SOH data should be transmitted in real-time via telemetry to multiple data centres. The frequency of SOH sampling should be user configurable and from once per minute to once per 6 hours.

Maximum points awarded if SOH data transmitted in real-time at configurable interval

Half points awarded if SOH data transmitted in real-time at fixed interval

No points awarded if no SOH data transmitted in real-time

2.3.15 Event processing: Digitizer should support the creation of triggered data products such as PGA/PGV/PGD event alerts. Triggered data products should be transmitted in real-time via telemetry to multiple data centres.

Maximum points awarded if triggered data products supported AND sent in real-time

Half points awarded if triggered data products supported but NOT sent in real-time

No points awarded if triggered data products not supported

2.3.16 Firmware upgrades: The digitizer should support remote firmware upgrades. In addition, safe upgrades should be supported such that the digitizer will automatically revert to the last viable firmware version if an upgrade fails to work properly.

Maximum points awarded if remote firmware upgrade AND automatic reversion supported

Half points awarded if remote firmware upgrade supported but automatic reversion NOT supported

No points awarded if remote firmware upgrade not supported

2.4 Data Centre Acquisition Software

NRCan currently uses Antelope software from BRTT for both data acquisition and processing. In addition, NRCan currently uses SeisComP3 for data acquisition in a limited role. NRCan plans to continue to use Antelope for data processing. NRCan prefers to use Antelope for data acquisition. NRCan may continue to use SeisComP3 for data acquisition. NRCan only supports software that runs on Intel/AMD X86 computers running Linux (CentOS 6 or higher).

2.4.1 Data acquisition software preference: At the data centres, station waveform and SOH data should be acquired directly by Antelope data acquisition modules. NRCan strongly suggests that the bidder develop a robust Antelope data acquisition module for their digitizer, if not already available. If an Antelope data acquisition module is not available, station waveform and SOH data should be acquired directly by robust SeisComP3 data acquisition modules.

Maximum points awarded if robust Antelope data acquisition module available and supported

One third points awarded if robust SeisComP3 data acquisition module available and supported

No points awarded if Antelope and SeisComP3 data acquisition modules not available

2.4.2 Reporting on data acquisition system: Reporting software should be provided. Reporting software should provide performance information and statistics on the data acquisition software performance, station state-of-health, and data acquisition performance (e.g. station data availability, data latency, etc.). Reporting software should generate reports with user-selectable granularity (e.g. all stations, one station or one channels) for user selectable report periods. User configurable reports must be able to generate reports on overall data availability, station and channel data availability, data latency and other key performance metrics. For example daily report of data availability for all stations. If necessary, the reporting functionality can be provided directly by the data acquisition software via http or https web access.

Up to half points awarded for reporting multiple metrics

Up to half points awarded for user configurable reports

No points awarded if reporting software not available

2.5 Bidders Experience

2.5.1 The bidder's quality management system will be evaluated

Up to maximum points awarded based on review of quality management system

2.5.2 The bidder's reputation will be evaluated.

Up to one half points awarded for reference checks of client with project of similar scope based on size and complexity completed within the last five years

Up to one half points awarded for reference checks of two different clients with projects of similar scope based on size and complexity completed within the last ten years

Reference checks will include questions regarding manufacturer (and their products and software) reliability, quality, service, throughness, promptness, ability to deliver on time, etc.

3 OPTIONAL REQUIREMENTS

3.1 Optional Order for Extra Units

Canada may, at its discretion, order extra units of seismometers, accelerometers, and digitizers in each of the four years following contract award. Delivery of the extra units will be required within 90 days of the option being exercised. The option may be exercised in lots of various sizes up to the total estimated quantities indicated.

Item	Estimated Quantities
Seismometers†	50
Accelerometers†	50
Digitizers*	70

† A combination of vault and posthole sensors will be ordered. The exact number of each type will be determined at time of contract issuance (depending on operational requirements and the relative pricing received in response to the RFP).

* The exact number of three vs six channel digitizers will be determined at time of contract issuance (depending on operational requirements and the relative pricing received in response to the RFP).

3.2 Optional Order for Low Power Satellite Transmisison Option

Canada may, at its discretion, order low power satellite transmission options, if available and appropriate. Delivery of these options will be required within 90 days of the option being exercised. The option may be exercised in lots of various sizes in each of the three years following contract award for a total of up to 50 units.

3.3 Other Optional Items

Suppliers are encouraged to list, describe and price any other available options that may be relevant to this project. This may include hardware and software options for use at stations or data centres.

3.4 Other Optional Services

Suppliers are encouraged to list, describe and price any other available services that may be relevant to this project, e.g. installation or configuration of required or optional items. This may include field or data centre services.

ANNEX B
QUESTIONS TO INDUSTRY

Interested suppliers are asked to comment upon the following items:

1) Comment on any aspect of the proposed specification.

2) Could the supplier meet all requirements and supply a compliant bid during any potential RFP. Could the supplier meet the delivery schedule identified in section 1.6 of ANNEX A

3) If the delivery schedule cannot be met, how much lead time is required for each delivery batch?

4) Provide list price information for the data centre acquisition software, sensors (both vault and posthole variants), digitizers, cables and accessories (if a separate line item).

5) Provide a description of the Quality Management System in use by the supplier. Provide evidence of any formal certifications held (e.g. ISO 9000), if any.

6) Government rules require any companies and staff needing access to government networks and computers to have proper security clearances. Interested suppliers are asked if they would need remote or local access to government networks and computers in order to install, configure and maintain any necessary data centre acquisition software. In other words, is it necessary and/or recommended for the supplier to install and configure the software, or is it easy enough for NRCan to install and configure? Interested suppliers are asked if they would be willing to, and likely to be able to gain proper security clearances?

7) Describe what is delivered with each type of unit: Seismometer, Accelerometer, Digitizer, Accessories, and Data Centre Acquisition Software. I.e. what comes in the box?

8) Describe, and if applicable provide supporting documentation for, the data telemetry protocol to send data and to request and retransmit missed data. Describe how missed data would be requested by the data centre acquisition software and retransmitted by the digitizer after a long communications outage (>4 hours), as well as during on-going intermittent outages (e.g. frequent 5 minute outages). Which data will be sent first – the oldest data or the newest data? Will all the data be retransmitted via the real-time data telemetry protocol, or will some data have to be recovered by remotely copying files from the digitizer? How many attempts can the data centre acquisition software make (i.e. how many retransmit requests) to recover data that is still missing – one, two, multiple, endless? How long does the data telemetry protocol allow the data centre acquisition software to continue trying to recover missed data – minutes, hours, days, weeks?

9) Describe the protocols that exist for the extraction of SOH information from the instruments. Describe any ancillary software which can be used to display, manage, and store SOH information including provision of automated alerts (if any). Provide a list of information items which may be extracted from the instruments. Is this information available as part of the data stream or is an additional hardware interface (e.g. RS-232) required.

10) How long is the SOH information stored in local buffers, and may it be retrieved after the fact?

11) Provide the maximum supported length of seismometer and GPS antenna cables.

12) Provide the maximum depth that a posthole sensor may be installed.

13) Provide any information on any borehole sensors that may available as an option. From a supplier's perspective, describe the pros and cons of surface vault sensors versus posthole sensors versus borehole sensors.

14) Describe any auxiliary analogue/digital inputs and/or outputs for sensing and control functions contained within the sensors or digitizers.

15) Describe any electrical surge protection supported on sensors and digitizers.

16) What is the minimum number of satellites needed to lock the digitizer clock to accurate GPS time? What is the minimum number of satellites needed to maintain a lock of the digitizer clock to accurate GPS time? Does the digitizer begin digitizing and recording data before its clock is locked to GPS? Does the digitizer continue to digitize and record data when GPS lock has been lost? Describe the clock precision and drift of the digitizer if the GPS timing was lost (e.g. damaged GPS antenna or cut GPS cable). How long would the digitizer timing maintain a clock accuracy of 100 μs or better?

17) Describe possible support services and timelines.

18) Provide a description of any training that may be offered.

19) Provide a description of any other services that the supplier may be able to offer. E.g. installation or configuration services in the field or at the data centre.

20) Provide information regarding low power satellite data transmission options which are compatible with the system and which the bidder may consider offering. What is the power requirement for such a system? What satellite data exchange providers are compatible with the bidder's satellite option? If available provide sample pricing for data communications (per month, per MB as available). Provide environmental specifications for supplementary satellite equipment.

21) How do you define and calculate the design life of your products? How do you calculate your MTBF values?

22) Is the instrument self noise of your sensors comparable on all channels, or is the vertical channel different than the horizontal channels?

ANNEX C
ACRONYMS AND DEFINITIONS

API	Application Programming Interface
CHIS	Canadian Hazard Information Service
CLI	Command Line Interface
CNSN	Canadian National Seismograph Network
GSC	Geological Survey of Canada
GFE	Government Furnished Equipment
GPS	Global Positioning System
miniSEED	see http://ds.iris.edu/ds/nodes/dmc/data/formats/seed/
MTBF	Mean Time Between Failures
NLNM	New Low Noise Model
NHNM	New High Noise Model
NRCan	Natural Resources Canada
PGA	Peak Ground Acceleration
PGD	Peak Ground Displacement
PGV	Peak Ground Velocity
SEED	Standard for the Exchange of Earthquake Data see http://ds.iris.edu/ds/nodes/dmc/data/formats/seed/
Sensor	Unless otherwise indicated sensor means seismometer or accelerometer
SOH	State Of Health
sps	samples per second
USGS	United States Geological Survey
Vpp	Volts Peak to Peak
V/m/s	Volts per metre per second