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# SOLICITATION AMENDMENT
# MODIFICATION DE L'INVITATION

The referenced document is hereby revised; unless otherwise indicated, all other terms and conditions of the Solicitation remain the same.

Ce document est par la présente révisé; sauf indication contraire, les modalités de l'invitation demeurent les mêmes.

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| **Title - Sujet**<br>Radar Equipment replacement at CCG | |
| **Solicitation No. - N° de l'invitation**<br>F7048-160039/B | **Amendment No. - N° modif.**<br>003 |
| **Client Reference No. - N° de référence du client**<br>F7048-160039 | **Date**<br>2018-01-24 |
| **GETS Reference No. - N° de référence de SEAG**<br>PW-$$QF-117-26550 | |
| **File No. - N° de dossier**<br>117qf.F7048-160039 | **CCC No./N° CCC - FMS No./N° VME** |
| **Solicitation Closes - L'invitation prend fin**<br>**at - à 02:00 PM**<br>**on - le 2018-03-12** | **Time Zone**<br>**Fuseau horaire**<br>Eastern Standard Time EST |
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| F7048-160039 | 117qf. F7048-160039 | |

**Solicitation Amendment # 003 is raised to:**

**1) Extend the solicitation closing period until 12 March 2018.**

**2) At Annex D – Radar Extractor/Tracker - Technical Statement of Requirements**

**Delete:** In its entirety.

**Insert:** See attached.

*Note:* Changes were made to the following sections throughout the TSOR:

- 4 Applicable Documentation - 4.1.1 para 4.
- 7.1.2
- 7.4.1
- 7.4.3
- 5 List of Acronyms and Initialisms

**All other terms and conditions remain unchanged.**

Fisheries and Oceans Canada | Pêches et Océans Canada

Canadian Coast Guard | Garde côtière canadienne

F7048-160039 - ANNEX D

# Radar Extractor/Tracker


## Canadian Coast Guard

## Technical Statement of Requirements

Canada

## Copyright



## Trademarks

# Document Control

# 1 DOCUMENT MANAGEMENT

## 1.1 AUTHORITY

1.1.1 This document is issued by the Director General Integrated Technical Services (ITS), Canadian Coast Guard (CCG) National Technical Authority under the authority of the Deputy Minister Fisheries and Oceans and the Commissioner of the CCG, hereinafter known as "Canada".

## 1.2 RESPONSIBILITY

1.2.1 The Technical Authority (TA) for the National Radar Replacement Project, who resides in Electronics and Informatics (E&I) is responsible for:

- creation and promulgation of the document; and
- identification of an Office of Primary Interest (OPI) who is responsible for the coordination and the content of the document.

1.2.2 The OPI is responsible for:

- validity and accuracy of the content;
- availability of this information;
- update(s) as needed;
- periodic revision; and
- follow-up of all requests, comments and/or suggestions received to the originator.

- .

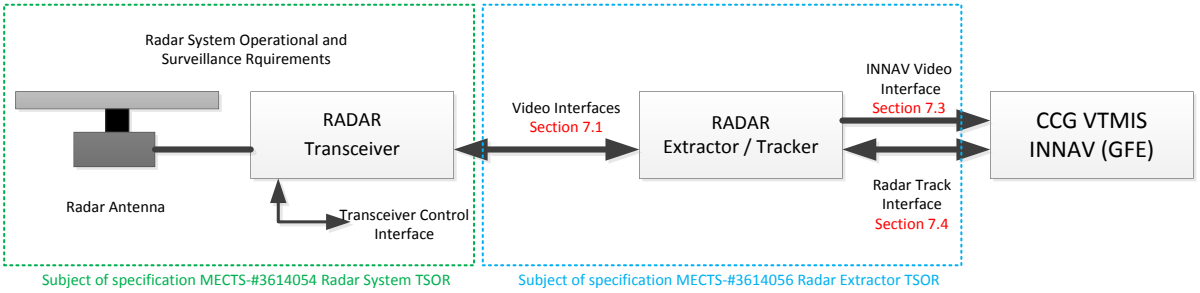
# 2 FOREWORD

## 2.1 PURPOSE

2.1.1 This document describes the technical requirements that shall be met as a fundamental part of the normal procurement process documentation. The contents of this specification, when included by reference in any contract, shall govern the acceptance of the system, through embodiment of the specification elements in performance tests.

## 2.2 SCOPE

2.2.1 This Technical Statement of Requirements (TSOR) establishes the technical requirements for the Radar Extractor/Tracker and its interfaces. The high-level diagram below explains how the CCG radar procurement specifications are related to the overall project and which section refers to the identified component.




# 3 INTRODUCTION

## 3.1 REQUIREMENTS

3.1.1 Canada has a requirement to replace Radar System Equipment including its Radar Extractor/Trackers at its Marine Communications and Traffic Services (MCTS) radar sites. The Radar Extractor/Trackers to be supplied must interface, and be compatible, with recently acquired solid-state radar transceivers located at Prince Rupert.

3.1.2 The new Extractor/Trackers will be replacing existing extractors that are currently in use. The new Radar Extractor/Trackers must interface with and provide radar data to the CCG

Vessel Traffic Information Management System (VTMIS), called Information System on Marine Navigation (INNAV).

3.1.3 In support of these goals, this specification defines the essential characteristics that are required for the new Radar Extractor/Trackers.

3.1.4 For the purposes of this TSOR, the new Radar Extractor/Trackers will be known as the "Extractors".

## 3.2 EXISTING RADAR SYSTEMS

3.2.1 The existing Radar Transceiver equipment is a mix of makes and models of 25 or 50 kW, magnetron based, pulse-type radars, which date as far back as 1989 and as recently as 2004/2005. The majority of radar transceivers are Terma Scanter 2001, 25 kW radar transceivers. There is also a number of Raytheon Pathfinder R50, 50 kW radar transceivers and Canadian Marconi Corporation CMR-91, 25 kW radar transceivers in use. There are three (3) new sites in Western Region utilizing Terma Scanter 5202 (200 W) and 5102 (50 W) solid-state radar transceivers to which the new Extractors must be interfaced.

# 4 APPLICABLE DOCUMENTATION

## 4.1 SPECIFICATION AND PRECEDENCE

4.1.1 The following documents are applicable to this specification. In the case of a conflict between the wording elsewhere in this specification and the applicable documents, the CCG specification wording shall take precedence.

1. Radar Equipment Replacements Statement of Work (SOW), EKME# 3468591.
2. IALA Guideline 1111, Edition 1, May 2015, on "Preparation of Operational and Technical Performance Requirements for VTS Systems" This document is available at: http://www.iala-aism.org/products/publications/category.html?category=c13896403bc3beca86ad0a2a76032055
3. IALA Recommendation V-125 in "The use and presentation of symbology at a VTS Centre (including AIS)", Edition 3, June 2012. This document is available at: http://www.iala-aism.org/product/use-and-presentation-of-symbology-at-a-vts-centre-including-ais-125/
4. IALA Recommendation V-145 on "the Inter-VTS Exchange Format (IVEF) Service", Edition 1, June 2011. This document is available at: http://www.iala-aism.org/product/inter-vts-exchange-format-service-145/
5. Department of Defence – MIL-HDBK-217F, "Reliability Prediction of Electronic Equipment". This document is available at: http://www.sre.org/pubs/Mil-Hdbk-217F.pdf
6. Electrical Safety Authority – Electrical Product Approval Requirements. This document is available at: https://www.esasafe.com/assets/files/esasafe/pdf/Electrical_Product_Safety/ESA-ProductApprovalCard-Final-web.pdf

# 5 LIST OF ACRONYMS AND INITIALISMS

| | |
|---|---|
| ACP | Azimuth Change Pulse |
| AtoN | Aids to Navigation |
| BIST | Built-In Self-Test |
| C | Celsius |
| CCG | Canadian Coast Guard |
| CFAR | Constant False Alarm Rate |
| COTS | Commercial Off the Shelf |
| DC | Direct Current |
| DFO | Department of Fisheries and Oceans Canada |
| E&I | Electronics & Informatics |
| ESA | Electrical Safety Authority |
| IALA | International Association of Marine Aids to Navigation and Lighthouse Authorities |
| ID | Identification |
| INNAV | Information System on Marine Navigation |
| IP | Internet Protocol |
| ITS | Integrated Technical Services |
| IVEF | Inter-VTS Exchange Format |
| kn | knots |
| kW | kilowatt |
| Mbps | Megabits per second |
| MCTS | Marine Communications and Traffic Services |
| MIB | Management Information Base |
| MTBF | Mean Time Between Failure |
| MTTR | Mean Time to Repair |
| NAS | Network-Attached Storage |
| OPI | Office of Primary Interest |
| $P_D$ | Probability of Detection |
| $P_{FA}$ | Probability of False Alarm |
| RMS | Root Mean Square |
| SNMP | Simple Network Management Protocol |

| | |
|---|---|
| SOG | Speed Over Ground |
| SOW | Statement of Work |
| TA | Technical Authority |
| TSOR | Technical Statement of Requirements |
| USB | Universal Serial Bus |
| VGA | Video Graphics Array |
| VTMIS | Vessel Traffic Management Information System |
| VTS | Vessel Traffic Services |
| W | Watt |

# 6 EXTRACTOR PERFORMANCE AND FUNCTIONALITY

## 6.1 PLOTS, FRAGMENTS, AND TARGETS

6.1.1 It should be noted that the text below uses the term "plot" to define extractor performance requirements. CCG defines a plot to be equivalent to a fragment (i.e., the smallest video unit handled by the Extractor). A target may be composed of multiple plots or fragments which are also referred to as plot aggregates.

## 6.2 GENERAL FEATURES

6.2.1 The performance of the Extractor must not be the limiting factor for the whole radar system. In other words, the Extractor must be capable of processing all information contained in the transceiver raw video feed without imposing limits as to the amount of information that can be processed. The Extractor must process plots, fragments of plots, coast line reflection, waves and ice simultaneously if the Extractor is configured to do so, and the transceiver capacity and configuration allows for such targets to be detected.

6.2.2 The Extractors must be available as separate units to interface with existing Terma Scanter 5202 (200 W) and 5102 (50 W) solid-state radar transceivers at Mt. Hays, Dundas Island, and Ridley Island.

## 6.3 MODULAR DESIGN

6.3.1 The Extractor must use modular design in both the hardware and software. Hardware must consist of Commercial Off the Shelf (COTS) hardware modules.

## 6.4 DISPLAY AND CONFIGURATION

6.4.1 The Extractor must have connectors for a VGA display and USB keyboard to allow local radar control and Extractor setup.

6.4.2 Extractor setup and configuration must also be available remotely through the network Ethernet interface.

## 6.5 GEOGRAPHICAL PROCESSING

6.5.1 Track handover from one Extractor's coverage zone to another Extractor's coverage zone, where overlapping coverage exists, is carried out by INNAV.

6.5.2 The Extractor must be able to generate the following:

- detailed land masks,
- clutter mapping,
- auto/manual acquisition areas,
- shadow areas,
- littoral masks,

- video generation masks, and
- object masks and handover masks.

## 6.6 BUILT-IN SELF-TEST

6.6.1 The Extractor must have Built-In Self-Test (BIST) capability for internal diagnostics, error warnings and remote control, as a minimum.

6.6.2 The BIST must be configurable to run automatically, autonomously and at regular time intervals.

6.6.3 The BIST results must be available using Simple Network Management Protocol (SNMP) v3 over an Ethernet interface. The Management Information Base (MIB) information file must be provided to interface the radar BIST SNMP output to the CCG support management console.

## 6.7 RELIABILITY AND MAINTAINABILITY

6.7.1 Mean Time Between Failure (MTBF)

The Extractor must have an MTBF of: ≥ 35,000 hours

a) The Contractor must provide an explanation, (such as; empirical failure data, stress analysis, reliability test data, prediction calculation), of how their MTBF values were determined. (Note: MTBF calculations must be in accordance with MIL-HDBK-217F.)

b) For explanations based on empirical data, the Contractor must state the number of units used in the calculation, the number of hours of reliable service, the number of different types of failures recorded, the total number of failures, and any other information that can be used to evaluate the reliability claim of the equipment being offered.

6.7.2 Mean Time to Repair (MTTR)

The Extractor must have an MTTR of: ≤ 1 hour

6.7.3 Rack Mountable

The Extractor must be capable of being mounted in a standard 19” equipment rack.

6.7.4 Redundancy

The Extractor must have built-in redundancy of major or critical units, e.g., power supplies. The Extractor must also be capable of being configured for redundancy in active/standby configuration.

## 6.8 VIDEO PROCESSING

6.8.1 The Extractor must be capable of being configured to record raw video received from the Transceiver Video Interface, plots and track data to Network-attached storage (NAS) and/or local disk.

6.8.2 The Extractor must be capable of supporting frequency diversity.

6.8.3 The Extractor must maximize the signal-to-noise and signal-to-clutter ratio using such techniques as: Constant False Alarm Rate (CFAR), geographical masks, sweep integration, scan-to-scan correlation, and Sensitivity Time Constraints.

6.8.4 Target Representation

The Extractor must reproduce the approximate shape of the radar target showing the outline and geometrical centre of the target.

## 6.9 PLOT EXTRACTION

6.9.1 Plot extraction from the video feed received on the Transceiver Video Interface must be automatic. The plot extraction process must handle the minimum number of plots per rotation as shown in Table 6-1 below.

## 6.10 TRACK INITIATION

6.10.1 The extractor must be able to be configured to initiate tracks automatically or manually, based on configured geographical zones in its configuration.

6.10.2 In **automatic track initiation modes**, all plot aggregates in a scan must be considered potential targets. Some of the plot aggregates will be associated with previously established tracks, with the remaining plots aggregates considered as candidates for new tracks, i.e., tentative tracks.

6.10.3 Tentative tracks must become confirmed tracks if plot aggregates from consecutive scans "fit into the picture" within reasonable physical manoeuvrability limits. Otherwise the tentative tracks must be discarded.

6.10.4 The tracking system must be able to handle the tentative tracks, as detailed in Table 6-1. The tracking system must initiate tracks and subsequently confirm tracks under certain conditions of Probability of Detection ($P_D$) and Probability of False Alarm ($P_{FA}$).

6.10.5 It must also be possible to initiate a track manually from the CCG VTMIS using the RADAR Track Interface. In manual track initiation, a plot aggregate on the VTMIS display is selected by the operator using a graphical tool. When selected, this plot aggregate should form the starting point for a tentative track which eventually should be confirmed or discarded, as in the automatic case described above.

## 6.11 MAINTAINING TRACKS

6.11.1 If automatically or manually created tentative tracks persist over a certain length of time, the tracks must be promoted to confirmed tracks. Confirmed tracks shall be provided on the RADAR Track Interface to the CCG VTMIS. The tracking system must be capable of

handling the number of confirmed tracks specified in Table 6-1 and to maintain tracks until the track termination criteria is reached.

## 6.12 TRACK TERMINATION

6.12.1 A confirmed track must be terminated if:

a) it moves outside the extractor configured maximum range;

b) it moves into an extractor configured defined non-tracking area;

c) the quality of the track falls below a predefined minimum configured in the extractor; or

d) the track cannot be updated with new plots over a certain length of time configured in the extractor.

## 6.13 PLOT EXTRACTION AND TRACKING PERFORMANCE

6.13.1 The requirements in respect of plot extraction and tracking are defined by the individual MCTS authority, on the basis of local conditions, number of radar sensors in a system and other considerations.

6.13.2 The Extractor performance must meet the guidelines in IALA Guideline 1111 “Preparation of Operational and Technical Performance Requirements for VTS Systems,” as shown in Table 6-1 below.

**Table 6-1 System Tracking Performance Parameters[1]**

| Parameter | | Requirement |
|---|---|---|
| Number of plots per antenna rotation[2] | | ≥ 1000 |
| Number of confirmed tracks | | ≥ 500 |
| Time for initiation of a tentative track | | < 1 min |
| Time for classification as a confirmed track. | | < 2 min |
| Time from data loss to automatic track termination. | | ≥ 60 sec. |
| Speed of tracked surface objects | | ≤ 70 kn |
| Turn rate of tracked surface objects[3] | | ≤ 20°/sec with a SOG of ≤ 5 kn |
| Transversal acceleration of tracked objects[3] | | ≤ 5 m/s$^2$ with a SOG of > 5kn |
| Accuracy of track position | Range (relative to sensor location) | 10 m. |
| | Bearing (relative to sensor location) | ≤ 0.5° |
| Accuracy of track speed and direction | Speed over Ground | ≤ 1 kn |
| | Course over Ground | ≤ 2° |

**Note 1:** Based on IALA Guideline 1111, "Preparation of Operational and Technical Performance Requirements for VTS Systems," Table 21 (Typical System Tracking Performance) and Table 22 (Single Radar Sensor - Tracking Performance Parameters)

**Note 2:** Dependent upon area covered, traffic density and smallest size of objects to be tracked.

**Note 3:** The transversal acceleration – Speed Over Ground (SOG) turn rate, thus for slow moving targets, the turn rate is the limitation, whereas the transversal acceleration is the limitation for fast targets.

6.13.3 Track Initiation and Track Maintenance

6.13.3.1 The radar $P_D$ must be adaptable to the role of MCTS and configurable in each extractor. The automatic track initiation and track maintenance is optimised accordingly. Based on preliminary modeling of the radar sites, the Canadian Coast Guard used a $P_D$ of 80% for all sites.

6.13.3.2 The Extractor must track with a 3 dB target to noise ratio.

6.13.3.3 Swapping of track identity may occur as a result of targets moving close together or even merging for a period of time, especially if targets are overtaking with small difference in speed and course. A simple method of manual correction must be available using the Radar Track Interface.

6.13.4 False Tracks

6.13.4.1 False tracks may appear as a result of noise, clutter (including wakes) and ghost echoes. However, the number must not be significant, if the required values given in Table 6-1, with an availability of 99.9 %, are respected.

6.13.4.2 The maximum number of false tracks allowed is dependent upon the role of the MCTS authority. False tracks must be avoided in safety critical areas and occasionally accepted in areas where surveillance and traffic monitoring is the priority.

6.13.4.3 There is a trade-off between the time for confirmation of tentative track and the number of false tracks. A longer confirmation time shall imply fewer false tracks and it must be possible to balance this trade-off in each extractor.

6.13.5 Track Loss

6.13.5.1 Track loss may occur as a result of $P_D < 1$ in combination with targets manoeuvring, especially in the vicinity of obstructions such as bridges.

6.13.5.2 A level generally accepted is that each MCTS Operator should correct up to one track loss per hour in all areas where the required values given in Table 6-1 are respected.

# 7 EXTRACTOR INTERFACES

## 7.1 VIDEO INTERFACES

7.1.1 The new Extractors must be capable of being interfaced with existing and new Radar transceivers through the Transceiver Video Interface. They must also interface and be compatible with the CCG VTMIS System (which supports the Radar display requirements) called INNAV through the RADAR Video Interface and the RADAR Track Interface.

7.1.2 The RADAR Video Interface must be based on the ASTERIX protocol standard.

## 7.2 TRANSCEIVER INTERFACE

7.2.1 To interface with the existing and new Radar systems, where applicable, the Extractor must meet the following specifications where applicable.

7.2.2 The new Extractor must be capable of being interfaced with existing Terma 5102 and 5202 located in the Prince Rupert area.

7.2.3 Digital Video Input

- Interface: Network IEEE 802.3 interface
- Number of Channels: two (2)
- Amplitude Resolution: ≥ 14-bits
- Format: Network raw video over Ethernet
- Data Rate: ≥ 40 Mbps

## 7.3 INNAV VIDEO INTERFACE

7.3.1 The Radar video information for INNAV must come from the Extractor. This information must consist of IP Network video (Streaming), using an Ethernet interface.

7.3.2 Digital Video Feed

- Format: Video must be carried using the ASTERIX protocol standard.
- Video Shape: Polygon or other to represent targets as close as possible to "raw video" quality. Documentation must be provided on the video shape used to allow INNAV to decode and integrate the video feed entirely with its native quality.
- Bandwidth: It must be possible to configure in the extractor the desired amount of bandwidth used by the RADAR Video Interface. The extractor must auto tune its RADAR Video Interface output quality to achieve the desired bandwidth.

- Video Range Resolution: up to equal to sampling resolution;
- Video Azimuth Resolution: up to equal to antenna resolution in units of 0.088° (4,096 ACPs)
- Video Amplitude: ≥ 8-bits
- Number of video levels ≥ 16

## 7.4 RADAR TRACK INTERFACE

7.4.1 The RADAR track information for INNAV must come from the Extractor using the Inter-VTS Exchange Format (IVEF) protocol standard over an Ethernet interface.

7.4.2 The new Extractors must provide an interface for INNAV with the following track control and feedback capabilities, (**Note:** Subject to the MCTS operational procedures, all of these functions might not be utilized.)

7.4.3 Track information

- Format: Track information must be carried using the IVEF protocol standard.
- Track information: Documentation must be provided on the track information, controls and feedback used by the extractor to allow INNAV to decode and integrate the track feed entirely with its native quality.

7.4.4 Tracker Controls

7.4.4.1 The RADAR Track interface must offer the following controls:

- Initialisation and acquire masks
- Acquire target
- Release target
- Auto Acquire (ON/OFF, min size, max speed (kn))
- Gain control
- Auto Tune Sensitivity Control
- Clutter Control
- Manual Tracks swap correction

7.4.5 Tracker Feedback

7.4.5.1 The RADAR Track interface must offer the following feedback:

- Mode: On/Off
- Acquire target status indicator
- Auto Tune Sensitivity level indicator

- Clutter Control level indicator
- Number of plots indicator
- Number of targets indicator
- Change of track ID notification
- Number of Aids to Navigation (AtoN) indicator (Optional)

## 7.5 RADAR VIDEO RECORDING INTERFACE

7.5.1 The Extractor must have an interface to enable the recording of raw video and track data to NAS and local disk in the same format as described in 7.3 and 7.4 respectively.

# 8 SAFETY, ENVIRONMENTAL AND APPROVAL OF EQUIPMENT

## 8.1 ELECTRICAL SAFETY

8.1.1 Safety Certification

8.1.1.1 In accordance with Paragraph 8.1.2.1 below, all Extractors must bear the appropriate certifying organization's mark at the time of delivery to Canada.

8.1.2 Electrical Safety Authority

8.1.2.1 The Electrical Safety Authority (ESA) recognizes certification bodies and field evaluation agencies, accredited by the Standards Council of Canada, to certify or evaluate electrical products or devices. Only equipment bearing a recognized mark or label is deemed to be approved for use in Canada. Information regarding recognized marks and labels approved for use in Canada can be found at:

https://www.esasafe.com/assets/files/esasafe/pdf/Electrical_Product_Safety/ESA-ProductApprovalCard-Final-web.pdf

8.1.3 Personnel Safety Requirements

8.1.3.1 The Extractor must incorporate the requirements specified above to provide for the safety of personnel engaged in installing, operating, and maintaining the equipment. It is recognized that equipment may include hazards. It is imperative that hazards be clearly identified and that measures are provided to protect personnel. In addition, the equipment must incorporate the following safety measures:

- Electrical: The Extractor must be designed to protect personnel from accidental contact with voltages in excess of 30 Volts, RMS or DC, during equipment operation.

- Ground Potential: The Extractor must be designed that all external parts, surfaces and shields are at ground potential during normal operation.

- Guards and Barriers: The Extractor contacts, terminals, and similar devices having voltages in excess of 70 Volts RMS or DC, with respect to ground, must have barrier guards to minimize accidental contact by personnel.

## 8.2 ENVIRONMENTAL CONDITIONS

8.2.1 Operational Temperature and Humidity

8.2.1.1 The Extractors must operate in a continuous unattended mode under the following sheltered environmental conditions:

a) Ambient Temperature: 0° C to +45° C
b) Relative Humidity: 95% maximum at 45° C (non-condensing)

8.2.2 Storage and Transportation

8.2.2.1 The Extractors must meet all technical and functional requirements following temporary storage or transportation under the following environmental conditions:

a) Ambient Temperature: -20° C to +60° C
b) Relative Humidity: 90% maximum (non-condensing)
c) Altitude: 0 to 8,000 m (non-operating)

## 8.3 AC POWER TRANSIENTS AND INTERRUPTIONS

8.3.1 Voltage Transients

8.3.1.1 The Extractors must be designed to withstand voltage transients of ±25% of nominal line voltage for a duration of 500 milliseconds.

8.3.2 Voltage Spikes

8.3.2.1 The Extractors must be designed to withstand voltage spikes of 1,000 Volts Peak for 10 µseconds.

8.3.3 AC Power Restoration

8.3.3.1 Upon AC power restoration, all the Extractors must return to their previous configurations and modes of operation, prior to any power interruption.