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| Title | CHARCOAL HEGA UNITS SUPPLY REQUIREMENTS |

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REVISIONS

This document has been revised in accordance with the following schedule:

| Rev. No. | Date approved | Nature of revision | Prepared |
|----------|----------------|--|----------------------------|
| 00 | 2015-06-04 | First issue | RF Pienaar JD Adendorff |
| 01 | See Title Page | This document was updated to align the requirements and number of HEGA Filters | TS Maage |

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1. PURPOSE

This document covers the supply requirements for the supply of CHARCOAL HEGA units, including SAMPLER HEGA units with built-in sample canisters.

2. SCOPE

This document specifies all technical requirements which define all deliverable items with regards to the procurement of the CHARCOAL HEGA UNITS for the ventilation systems K7, K8 and K9 of the SAFARI-1 research reactor.

Note: The terms charcoal and carbon are used interchangeably in this document, as both refer to activated carbon of botanical origin as specified in ASME AG-1-2009 section FF.

3. REFERENCES

| Reference Number | Document Number | Document Title |
|------------------|-----------------|--|
| [1] | ISO 9001:2015 | Quality Management Systems — Requirements |
| [2] | RR-PRG-0500 | Procedure for the control, generation and maintenance of documents |
| [3] | RR-PRG-1600 | Procedure for the collection, storage and maintenance of records |
| [4] | RO-OPR-3001(01) | Ventilation System Filter Replacement |

4. CODES AND STANDARDS

| Applicable Codes & Standards | Code/Standard | Revision | Applicable |
|------------------------------|---------------|------------|------------|
| ASTM | D 3803 | 1991 | Yes† |
| ASME | AG-1 | 1997, 2009 | Yes |
| ASME | N509 | 2002 | Yes |

† This standard applies to testing of radioiodine adsorbent samples. In this context, the supplier shall be responsible to manage the technical interface with testing laboratories, ensuring that samples can be analysed in their supplied form without a need for repackaging. In addition, each batch of adsorbent shall be subject to testing according to this method.

5. HARDWARE

| No. | Deliverable | Deliverable description | Category |
|------|---------------------|--|----------|
| R501 | Charcoal HEGA Units | <ul style="list-style-type: none">The HEGA units/cells shall conform to ASME AG-1-2009 Section FD (Type II Adsorbers)The adsorbent shall conform to ASME AG-1-2009 Section FF (Adsorbent Media)Cell dimensions: Depth: 292 mm; Height and Width: 608 mmCharcoal bed depth (thickness): 50.8 mm (2") minimumQuantities are listed in Appendix C | Hardware |

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6. VERIFICATION

| No. | Deliverable | Deliverable description | Category |
|------|--|---|-----------------|
| R601 | The Supplier shall provide Test Certificates for charcoal testing according to ASME AG-1-2009 Section FF | The Test Certificates shall address: <ul style="list-style-type: none">Article FF-5100 – Physical testingArticle FF-5200 – Radioactive testing | Electronic copy |

7. INSTALLATION, COMMISSIONING AND OPERATIONS

| No. | Deliverable | Deliverable description | Category |
|------|--|---|-----------------|
| R701 | The Supplier shall provide instructions for installation, maintenance and operation. | The instructions shall cover the following: <ul style="list-style-type: none">Installing HEGA units correctlyAchieving maximum efficiency and longevity in operation of the HEGA unitsRoutine and corrective maintenance (if required)Sampling | Electronic copy |

8. MAINTENANCE AND SPARE PARTS

| No. | Deliverable | Deliverable description | Category |
|------|--|--|----------|
| R801 | The Supplier shall include spares and consumable items necessary to operate and maintain HEGA units. | <ul style="list-style-type: none">Replaceable seal kits (if required)Special tools (if required)Plugs to seal off sample flow pathOther to be recommended | Hardware |

9. PACKING, TRANSPORT AND DELIVERY

| No. | Deliverable | Deliverable description | Category |
|------|---------------------------------|---|---------------|
| R901 | Identification and traceability | <ul style="list-style-type: none">Systems, assemblies and components shall be delivered accompanied by a packing list and a configuration assembly list indicating serial numbers of all systems, assemblies and components.The Supplier shall ensure that each shipment crate or carton is clearly marked indicating the contents, name of Supplier, order number, handling instructions, total number of crates or cartons in the shipment and the number of the particular crate or carton in the shipment. | |
| R902 | Delivery Place | The Purchaser's premises. | |
| R903 | Delivery date: | To be negotiated. | |
| R904 | Purchaser's responsibility | Carriage paid to (CPT) according to INCO Terms. | |
| R905 | Data pack | The Supplier shall compile a data pack containing all product records, certificates, procedures etc. | Hard copy and |

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| No. | Deliverable | Deliverable description | Category |
|-----|-------------|-------------------------|-----------------|
| | | | Electronic copy |

10. QUALITY

| No. | Deliverable | Deliverable description | Category |
|-------|---|---|-----------------|
| R1001 | The Supplier shall follow an established and maintained Quality Management System as part of an Integrated Management System based on ISO 9001 and nuclear quality assurance system requirements. | <ul style="list-style-type: none">The Supplier shall have a Quality Management System that complies with a nuclear industry accepted Quality Assurance System, for example ISO9001.The preferred Supplier must provide all necessary documentation required upon request to be registered as an approved supplier through the registration process. | Electronic copy |
| R1002 | The Supplier shall prepare a Quality Plan for this scope of supply. | | Document |
| R1003 | The Supplier shall register, manage and control all documentation and records (including reports, notifications, meeting minutes, certificates and plans). | <ul style="list-style-type: none">Uniquely identified, managed and controlled documentation.The Purchaser may conduct Configuration Management assessments throughout the design lifecycle of the system. | Work |
| R1004 | Non-Conformances | <ul style="list-style-type: none">All non-conformances shall be reported to the Project Manager/System Engineer for assessment and approval if necessary. Supplier or sub-suppliers non-conformance reports shall include supplier-recommended disposition (e.g. non-standard repair, approved/qualified repair, rework or use-as-is) and technical justification. Where the supplier's recommendation is to reject and/or remanufacture the item from scratch, the non-conformance need not be reported.The following shall be regarded as a non-conformance:<ul style="list-style-type: none">Deviation from a technical, QHSE or material requirements;Deviation from a requirement in an approved supplier document;When a problem/mistake cannot be corrected by continuation of the original manufacturing process. A problem/mistake shall be reported on a NCR and the decision to correct shall be done on a deviation authorisation issued by the purchaser. | |

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11. GENERAL

| No. | Deliverable | Deliverable description | Category |
|-------|-----------------|--|----------|
| R1101 | Right of access | Subject to applicable law, the Purchaser will have right of access to the Supplier's and any sub-contractor's facilities, premises and records for surveillance/inspection, for purposes of Supplier Qualification under the SAFARI-1 QMS. | |

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APPENDIX A: STANDARD HEGA CARBON ADSORBER CELL DATA SHEET

| | | | | | | | | | | |
|---------------------------|---------|-----|-----|----------|-------------------------------|--|------|---------------------------------|-----------|---------|
| HEGA Carbon Adsorber Cell | | | | | RR Doc No | RR-PUR-0018 | | | | |
| | | | | | CMS No | 113416 | | | | |
| Revision history | | | | | SBS No | 1.6.5.7-9 | | | | |
| Rev | Date | By | Chk | Approved | Description | | | | | |
| 00 | 25/5/15 | JDA | WV | | Standard HEGA carbon | | | | | |
| 01 | 11/9/25 | SM | | | adsorber cell to fit SAFARI-1 | | | | | |
| | | | | | K9 | | | | | |
| Project name | | | | | | | | | | |
| Project number | | | | | | | | | | |
| Category | | | | | Line | Description | | Data | | |
| GENERAL | | | | | 1 | Equipment tag no | | N/A | | |
| | | | | | 2 | Functional description | | Contain radioiodine release | | |
| | | | | | 3 | Area hazard classification | | Controlled radiological area | | |
| | | | | | 4 | P&ID number | | NSRR-SAFARI-1-U-P&ID-0031,35,36 | | |
| | | | | | 5 | Service | | Ventilation air | | |
| PROCESS DATA | | | | | 6 | Gas/vapour composition | | Air | | |
| | | | | | 7 | Molecular weight | | 28.8 g/mol | | |
| | | | | | 8 | Specific gravity | | 1.02 kg/m3 | | |
| | | | | | 9 | | Unit | Minimum | Normal | Maximum |
| | | | | | 10 | Flow rate | m3/h | 400 | 1200 | 1715 |
| | | | | | 11 | Temperature | °C | 0 | 25 | 80 |
| | | | | | 12 | Pressure at inlet | kPa | | 88.0 | |
| | | | | | 13 | Pressure drop | kPa | 0 | 0.03-0.09 | 0.25 |
| | | | | | 14 | Efficiency (CH3I) | % | 99 | N/A | N/A |
| DESIGN DATA | | | | | 15 | Type | | Type II carbon cell adsorber | | |
| | | | | | 16 | Width | | 608 mm | | |
| | | | | | 17 | Height | | 608 mm | | |
| | | | | | 18 | Depth | | 292 mm | | |
| | | | | | 19 | Additional options | | Carbon layer 50.8 mm (2") min. | | |
| | | | | | 20 | | | | | |
| MATERIALS | | | | | 21 | Frame | | 304L | | |
| | | | | | 22 | Internals | | Nuclear grade activated carbon | | |
| | | | | | 23 | Surface finish | | N/A | | |
| SPECIAL REQUIREMENTS | | | | | 24 | Markings | | As per ASME N509 | | |
| | | | | | 25 | Operating life | | 4 years | | |
| STANDARDS | | | | | 26 | ASME | | N509-2002 | | |
| | | | | | 27 | ASME | | AG-1-2009 | | |
| | | | | | 28 | | | | | |
| NOTES | | | | | 29 | Carbon batch number to be stamped on every cell. | | | | |
| | | | | | 30 | Date packed to be stamped on every cell. | | | | |
| | | | | | 31 | QA Test certificate to accompany every shipment. | | | | |
| | | | | | 32 | Sampler HEGA cells to accompany every standard HEGA order. | | | | |

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APPENDIX B: SAMPLER HEGA CARBON ADSORBER CELL DATA SHEET

| | | | | | | | | | | |
|-----------------------------------|--------------------|-----|------------------------------------|----------|--|--|------|--|-----------|---------|
| Sampler HEGA Carbon Adsorber Cell | | | | | RR Doc No | RR-PUR-0018 | | | | |
| | | | | | CMS No | 113416 | | | | |
| Revision history | | | | | SBS No | 1.6.5.7-9 | | | | |
| Rev | Date | By | Chk | Approved | Description | | | | | |
| 00 | 25/5/15 | JDA | WV | | Sampler HEGA carbon adsorber cell to fit SAFARI-1 K9 | | | | | |
| 01 | 11/9/25 | SM | | | | | | | | |
| | | | | | | | | | | |
| Project name | | | | | | | | | | |
| Project number | | | | | | | | | | |
| Category | | | | | Line | Description | | Data | | |
| GENERAL | | | | | 1 | Equipment tag no | | N/A | | |
| | | | | | 2 | Functional description | | Contain radioiodine release Provide 4x annual samples | | |
| | | | | | 3 | Area hazard classification | | Controlled radiological area | | |
| | | | | | 4 | P&ID number | | NSRR-SAFARI-1-U-P&ID-0031,35,36 | | |
| | | | | | 5 | Service | | Ventilation air | | |
| PROCESS DATA | | | | | 6 | Gas/vapour composition | | Air | | |
| | | | | | 7 | Molecular weight | | 28.8 g/mol | | |
| | | | | | 8 | Specific gravity | | 1.02 kg/m3 | | |
| | | | | | 9 | | Unit | Minimum | Normal | Maximum |
| | | | | | 10 | Flow rate | m3/h | 400 | 1200 | 1715 |
| | | | | | 11 | Temperature | °C | 0 | 25 | 80 |
| | | | | | 12 | Pressure at inlet | kPa | | 88.0 | |
| | | | | | 13 | Pressure drop | kPa | 0 | 0.03-0.09 | 0.25 |
| | | | | | 14 | Efficiency (Mel) | % | 99 | N/A | N/A |
| | | | | | DESIGN DATA | | | | | 15 |
| 16 | Width | | 608 mm | | | | | | | |
| 17 | Height | | 608 mm | | | | | | | |
| 18 | Depth | | 292 mm | | | | | | | |
| 19 | Additional options | | Carbon layer 50.8 mm (2") minimum | | | | | | | |
| 20 | Sample canisters | | 4x per cell; 50.8 mm (2") diameter | | | | | | | |
| MATERIALS | | | | | 21 | Frame | | 304L | | |
| | | | | | 22 | Internals | | Nuclear grade activated carbon | | |
| | | | | | 23 | Surface finish | | N/A | | |
| SPECIAL REQUIREMENTS | | | | | 24 | Markings | | As per ASME N509 | | |
| | | | | | 25 | Operating life | | 4 years | | |
| STANDARDS | | | | | 26 | ASME | | N509-2002 | | |
| | | | | | 27 | ASME | | AG-1-2009 | | |
| | | | | | 28 | ASTM | | D 3803-91 | | |
| NOTES | | | | | 29 | Sample canisters shall be in acceptable configuration for analysis at accredited laboratories. | | | | |
| | | | | | 30 | Sample canister flow path shall be sealed off after sample retrieval. Supplier shall provide plug/sealing-off mechanism. | | | | |

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APPENDIX C: HEGA CARBON ADSORBER CELL QUANTITIES

| Item Description | Qty: K7 | Qty: K8 | Qty: K9 |
|--|------------|------------|------------|
| Type 1: Standard HEGA Carbon Adsorber Cell with 50.8 mm (2") charcoal (see Appendix A) | 0 | 0 | 10 |
| Type 2: Sampler HEGA Carbon Adsorber Cell with 50.8 mm (2") charcoal, and 4x integral 50.8 mm (2") sample canisters (see Appendix B) | 0 | 0 | 4 |