Title: **Ruggedised Ultrasonic Horn DRAFT**

1. **Introduction**

This specification is in its first draft and has been released with the request for information (RFI) to help interested suppliers to understand the requirements of the National Nuclear Laboratory and to self-evaluate whether this service requirement is something which they are able to provide. If you have any feedback regarding the specification, please send this to [Emma.Kirkpatrick@UKNNL.com](mailto:Emma.Kirkpatrick@UKNNL.com)

NNL require a ruggedised ultrasonic horn, associated power supply/control system and associated documentation to be supplied to meet the requirements of this specification.

The supplier shall check and satisfy themselves that all information provided by NNL is complete to support their supply of materials, manufacture, assembly, inspection, testing at their works, works test documentation, packing, and delivery. Where supporting documentation is referenced, but not supplied, it is the supplier’s responsibility to request the information required.

It is the supplier’s responsibility to ensure that the scope of supply is legally compliant with all relevant Legislation, Directives, Regulations, Codes and Standards. The supplier shall advise on any of the above that are not stated within this specification.

The following descending order of precedence shall prevail for specifications and standards applicable to the contractor’s scope of supply:

* UK / EU Directives, Regulations & Legislation
* This Specification
* Relevant Design Codes and Standards

Notwithstanding the above, it is the supplier’s responsibility to contact NNL to secure a formal, written, resolution of any conflict between the requirements stated within the above referenced documents and any of those defined within this technical specification.

To ensure expediency of supply, value for money, and reliability, it is the preference of NNL to use Commercial Off-The-Shelf (COTS) equipment, followed by Modified Off-The-Shelf (MOTS) equipment, and then only if necessary bespoke designs. These aspects shall form part of any proposal for supply.

NNL will use their experience within the nuclear industry, with client facilities and through the expertise of their staff, to develop a deployment system for the above equipment. The overall system will consist of the equipment stated above interfacing with that to be designed/supplied by NNL. The nature of the interface shall be developed, for a common goal, between the two parties.

* 1. Scope of Supply

NNL require a system to be designed, manufactured and supplied to fulfil the duties described within this specification. To this end, it is envisaged that the following shall be supplied as a minimum:

1. Design and supply of a Ruggedised Ultrasonic Transducer system
2. Design and supply of a single compatibility Ultrasonic Horn
3. Design and supply of a compatible Control/Power Supply system
4. Ancillaries items and cabling as required to connect associated components
5. Documentation relevant to the supply and operation of the system, including any software source code.
   1. Environment

The ultrasonic transducer and horn assembly, plus connecting cables shall be designed to operate fully submerged in the following fluids:

* Up to 6M nitric acid
* 1M Sodium Hydroxide
* Water, pH
* The temperature of any fluid could be between 10°C to 60°C

The ultrasonic transducer and horn assembly shall be designed to operate in an ionising radiation environment of 2Sv/hr

* 1. Physical

Deployment of the ruggedised ultrasonic horn system will be through existing or purpose made access points. Using experience, NNL have determined that a 75mm diameter aperture is the upper limit and as such the envelope of the ultrasonic horn system, including interface to deployment pole and electrical connections shall be design to fit through whilst attached to the deployment pole.

In order for the system to be manoeuvred on the end of a relatively long deployment pole (possible up to 3m), the maximum length of the unit shall be limited.

* + 1. Dimensions

The following dimension dictate the limits that the supplier shall adhere to:

• The Maximum diameter for the ruggedised transducer, horn and connections to the deployment pole and cables shall be fall with a cylinder no greater than 70mm diameter.

• Maximum length shall be 400mm (from end of the horn to the end of attachment to deployment pole)

* + 1. Shape

To minimise the potential for the deployed system to snag and present recovery problems upon withdrawal, the shape, including electrical connections, shall be designed to avoid features which could snag, e.g. steps or sudden changes in shape or diameter

* + 1. Weight

The weight of the Ultrasonic Transducer/Horn assembly shall be minimised to remain suitable for manual deployment.

The maximum weight of the transducer / horn assembly shall not exceed 5kg.

* + 1. Robustness

The environment in which the ultrasonic horn is to be deployed will result in inadvertent physical impacts with associated plant and equipment, either in trying to pass the system through relatively small apertures, or due to difficulties in manoeuvring a long pole, to which it is attached.

The Transducer and horn assembly shall therefore be ruggedised to be resilient to these contacts and impacts.

The transducer and horn assembly shall be demonstrated by test to remain operational following an equivalent drop impact, in any direction, from a heigh of 0.3m on to a metal surface.

* 1. Materials

Materials shall be selected for compatibility with the environment described in section 1.2.

To ensure an acceptable operating life, the consumable Horn element of the system shall be manufactured from materials best suited, this would probably be Titanium

* 1. Performance Specification

NNL have limited experience in the specification of ultrasonic cleaning, mobilisation equipment and would seek to work with the supplier to determine the optimal specification. For the purposes of initial design, the transducer shall be assumed as follows:

• Power – 750W

• Operating Frequency – 20kHz

The transducer shall be designed for continuous operation. If this determined to be not practicable, the supplier’s proposal shall identify any operating constraints or limits.

It is recognised that heat will be generated within the Ultrasonic transducer during operations. As such the system shall be designed with sufficient cooling to permit continuous operation.

The shape of the horn shall be developed in conjunction with NNL to ensure that the most appropriate shape is provided.

The ultrasonic transducer and horn shall be designed so that it can be replaced, either due to wear, optimisation of shape/profile or damage.

* 1. Interfaces

Mechanical connection between the transducer and the deployment pole

Affixing the associated electrical cabling to the deployment pole

* 1. Electrical

Cable length ~6m

Cable specification – resistant to reasonable damage, need for electrical shielding, 230v, 50Hz. 13A supply

Position/quantity of connections, i.e. transducer plug directly in to power supply to intermediate lead.

Permanent connection – potted to UT

Sealing – IP rating of other connectors

* 1. Life

The ruggedised ultrasonic transducer and horn system shall be designed to operate for an operating life of no less than 24 months.

The power supply / control system shall be design for a minimum operating life of 5 years.

Where the presence of ionising radiation may have a limiting effect on transducer life, the supplier shall advise on capability

* 1. Standards and Regulations

The Ultrasonic Horn and Associated Systems shall be compliant with all applicable regulations, which may include but not limited to:

* Low Voltage Directive
* Electromagnetic Compatibility Regulations

Residual risks related to the scope of supply shall be identified to NNL via risk assessment or ‘Instruction for Use’ supplied with the equipment.

Where relevant directives exist, the system shall be CE/UKCA marked.

2. Design Review

The supplier shall allow for a formal design review with NNL prior to manufacture or purchase or materials & components. This review shall cover any drawings and documentation supplied as part of the proposal and will confirm what shall be included as part of the delivery. NNL acceptance of the design shall be required before commencement of manufacture.

3. Testing

The supplier shall be required to undertake functional testing of the unit. A testing procedure shall be agreed with NNL prior to the commencement any tests.

NNL shall be given the opportunity to attend tests at the supplier’s work should they wish to do so.

4. Quality

The ruggedised ultrasonic horn system shall be supplied to Quality Grade 3, in accordance with the NNL document IMS-CQR-03

Lifetime quality records shall be compiled during manufacture, inspection, assembly and testing, and provided to NNL in line with document IMS\_CQR\_03.

5. Warranty

The supplier shall provide a 12-month warranty from date of delivery to NNL, subject to operation in an inactive environment.