Specification

INS ENG S 15 108 Rev 1

TDP018 3578 PU PACKAGE

Manufacturing Review of the INS 3578 Package

Revision and Status		Prepared	Checked	Level	Approved
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For checking level information see INS document INS/SI/401/16

Revision Record

Revision	Clause	Detailed Descriptions of Revisions
0	-	First Issue
1	-	Issued for tender at this revision.
	3	Description of Stage 2 revised.
		Note added before 'For Stage 1' on page 7.
	6	1st paragraph reworded.
	7	Paragraph following specification table modified.
	8	1st sentence reworded.
	9	Delivery dates for Stages 1 and 2 clarified.

Contents

1 Background

INS has contracted with Doosan Babcock to manufacture 185 INS 3578 packages. The first 5 units are prototype[(1)] packages that are intended to prove the manufacturing route and hence provide 1 package for cold handling trials on plant and 4 packages for testing in line with IAEA SSR-6 regulations for Type B transport package designs (i.e. impact tests, followed by fire tests).

There have been a number of issues and delays during the manufacture of the first 5 packages and as a result, some reservations have been expressed as to whether the packages can be manufactured reliably, consistently and to specification for the required fleet of 180 units.

For all regulator approved Radioactive Material (RAM) transport package designs, the ability to manufacture the design intent must be clearly demonstrated in the selected manufacturer's deployed Quality Assurance processes and through compilation of appropriately detailed lifetime quality records for the packages.

Due to the concerns with respect to the INS3578 project performance to date and in order to ensure buy-in from all stakeholders, it is now considered important that a review of the 'manufacturability' of the package design is carried out by an independent, Suitably Qualified and Experienced Person(s) (SQEP) third party organisation. A separate independent review will audit the manufacturer's QA processes and their deployment on this project.

(1)In IAEA transport package parlance, it is common practice to term packages identified for regulatory testing as prototypes. However, it should be noted that these units are fully representative of the final product, so as to enable the tested 'prototype' design to be licensed for operational use.

2 The INS3578 – An Overview

The following description of the INS3578 should be read in conjunction with the technical documents identified in §7.

The INS3578 is a compact, primarily austenitic stainless steel package incorporating a thermosetting polymer material as neutron shielding. The design incorporates a core of precision machined steel vessels that are surrounded by polymer components and various thin wall, austenitic sheet structures. The package has an overall height of approximately 1.0m and a maximum external diameter of 0.425m. Unloaded, the tare mass is ~265kg and when loaded at maximum capacity, it has a gross mass of ~310kg. Due to the packages design intent, the 3578 incorporates a multiple water barrier (MWB) system. The MWB design philosophy is achieved via two independently testable austenitic stainless steel

containment vessels, the first (the Inner Containment Vessel, ICV) being secured within the second (Outer Containment Vessel, OCV) by means of a machined bayonet locking system. Each vessel lid is sealed against its body by two concentric elastomer o-rings, each possessing a testable interspace.

The ICV is manufactured from an austenitic stainless steel material and incorporates 8 radial bayonet features on its external diameter to secure it within the OCV. The ICV body is manufactured in 3 parts, which are subsequently welded together with full penetration, 100% volumetrically inspected welds. The lid of the ICV carries the primary containment seal and a second seal which enables testing of the containment boundary via the test point. During operations, the ICV lid is secured to the vessel body via a retaining ring with a M205 male thread and the complete ICV can be lifted by an integrated lid pintle. The ability to remove the ICV from the OCV and load it independently increases operational flexibility of the 3578 design.

The OCV uses the same construction material and is subjected to the same inspection regimes as the ICV, incorporating corresponding bayonet features on its internal diameter to engage and secure the ICV. The key difference between the vessels is in the attachment of the OCV lid, which utilises a more conventional bolting arrangement of 8 off, M10 bolts. As with the ICV component, the OCV lid carries the containment seals and a seal test point. It also incorporates neutron shielding within a sealed stainless steel fabrication that is welded to the main lid component's top surface. This structure includes a lift point for the lid and access penetrations to the lid bolt locations, the seal test point and a fusible plug, which avoids over-pressurisation of the lid neutron shielding cladding in the event of a thermal excursion.

The OCV body is the structural spine of the 3578 packaging, onto and around which neutron shielding, heat transfer fins and the packaging outer skin are attached. This shielding material (thermo-setting polymer) surrounds the OCV to an average thickness of 85mm. As this material potentially restricts heat flow from the ICV, each annular shielding section is sandwiched between stainless steel radial heat transfer fins, providing a conduction path from the OCV outer surface to the packaging's stainless steel skin. This double walled outer skin of the package (austenitic sheet) provides a sealed volume that surrounds the internal structures and as with the OCV lid shielding, a fusible plug provides pressure release in the event of a thermal accident. Within this double walled skin, a ceramic material provides thermal protection to the neutron shielding components. The outer skin incorporates a skirt at the upper edge of the packaging which protects the lid area and provides the packaging lifting feature. Following fixture and leak testing of the OCV lid, a security plate is placed over the OCV lid to prevent access to the lid securing bolt locations. External surfaces of the packaging have a paint treatment to improve decontamination and optimise heat transfer characteristics.

A 3D CAD image of the INS3578 package is provided overleaf.

Figure 1: CAD image of the INS3578

3 Review Objectives

The objective of this independent review is to be considered as a 2 stage process, described as follows:

Stage 1:

To provide an objective, fully independent view as to whether the package design, as described in the technical documents identified in §7, can be manufactured and certified reliably, consistently and at reasonable(2) cost for a fleet of 180 packages. A view on whether adequate quality records, as specified in the technical documents, can be produced concurrent with manufacturing processes and the associated industry standard inspection regimes is also required.

(2)assumes package build can be achieved via deployment of well understood / commonly used manufacturing processes / practices.

Stage 2:

In parallel to Stage 1, (and therefore assuming that the Stage 1 findings are substantially positive) provide an objective view on whether Doosan Babcock and its key subcontractors

have the capability (i.e. adequate manufacturing and inspection processes, tooling, jigs and fixtures and SQEP personnel) of manufacturing and certifying a fleet of 180 packages reliably, consistently and demonstrably in line with the technical documentation provided to them. Another way of expressing this could be "are the manufacturing methods at Doosan Babcock and key subcontractors adequate to produce the INS3578 design on a consistent basis?"

The review conclusions, formalised in a report [(3)] produced by the contracted agency, shall provide the following information, with suitable under-pinning statements;

[(3)] if separate agencies are selected for Stages 1 and 2, each will obviously need to produce an individual report.

For Stage 1:

i) Yes (i.e. the design can be manufactured as is specified in the technical documents provided in §7)
ii) Yes (i.e. subject to implementing specific, but limited, changes in the technical documents), or
iii) No (the design as presented in the technical documents provided in §7 cannot be manufactured without substantial changes in the design as presented, due to stated requirements that either cannot be manufactured at all or not without significant expense due to protracted R&D requirements, e.g. deployment of novel manufacturing / inspection processes, etc.

The contracted agency as an expert in 'design for manufacture' should also look to suggest, as required, recommendations to improve INS's processes that are not directly relevant to the two objectives, but which would benefit INS in terms of continuous improvement.

For Stage 2:

i) Yes (i.e. with appropriate Quality Assurance systems, the contractor and its sub-contractors demonstrate the technical capability to satisfy the design intent in the manufactured product)
ii) Yes (subject to implementing specific recommendations), or
iii) No (neither the contractor and/or its sub-contractors display the required technical capability to be able to ensure the design intent is satisfied)

The results of the reviews will be provided firstly to INS management, and subsequently to stakeholders, via INS.

NOTE: This is not intended to be a design review, nor is it an opportunity for 'preferential' engineering. The key questions are (a) whether the current design could be built by any SQEP manufacturer and (b) if the identified Doosan Babcock plant is considered to satisfy this criterion. Suggestions for improvement to aid manufacturing can be made, but at this

stage of the project need to be relatively minor and within the design intent. Significant changes should only be proposed if it is considered the design cannot be manufactured without making those changes.

4 Requirements of the Contracted Agency

1) A sound mechanical engineering background, not necessarily in RAM transport, but ideally with a strong background in nuclear equipment design/manufacture or a similar i.e. highly regulated industry. A particular requirement is a proven track record of a wide ranging knowledge and experience of modern manufacturing processes deployed on high integrity stainless steels assemblies' e.g. machining, fabrication metal forming and welding, etc. thereof.

2) At present, the manufacturing route incorporates cold spinning on the thin-walled components. Knowledge of this process and its strengths / weaknesses is therefore essential either in-house or via suitable external support. However, the contracted agency should also suggest other processes that could achieve the same design intent for these components, in an economic manner, for the fleet number stated.

3) A good 'first hand' working knowledge of Quality Assurance (QA) processes and the level of inspection control required in the highly regulated nuclear industry, including the need for full, accurate and 'concurrent with manufacture' compilation of Lifetime Quality Records. (The continuous production and collation of LTQRs for a fleet of 180 packages is identified as a significant challenge).

4) Demonstrable experience in supply chain, contract and project management.

5 Parties subject to review

During Stage 1, which is considered to be a desktop study to be completed primarily at the contracted agencies site, any questions should be directed to:

Tom Addison, INS3578 Technical Project Manager, INS. Phone 01925 802651

Ian Grainey, INS3578 Engineering Lead, INS. Phone 01925 832881

This stage may involve an opening up meeting with INS at the contracted agencies discretion.

During Stage 2, questions and site visit arrangements should be coordinated through:

Tom Addison, INS3578 Technical Project Manager, INS. Phone 01925 802651

Doosan Babcock are utilising a number of subcontractors to produce the INS3578. The following subcontractors are also to be assessed as part of the Stage 2 assessment: Dukinfield Metal Spinners, Clydeview Engineering, Mellish Engineering. Doosan Babcock, via Tom Addison, will provide contact details for these sub-contractors.

INS will ensure that arrangements are in place with the parties stated under the Stage 2 assessment to provide adequate access to sites and personnel as required. However, the contracted agency is required to identify which resources and personnel need to be presented to ensure the stated objectives can be achieved.

6 Specific issues to review

On receipt and review of the technical documentation listed in §7, the contracted agency (or agencies) is required to use its knowledge and experience to instigate and internally manage the review of stages 1, 2 or both.

Although the contractor has complete autonomy to progress this package of work as required to deliver the stated outcomes, the following specific issues are suggested for consideration:

Under Stage 1:

a) Machining tolerances in general for 3578 components
b) The welding of machined parts to fabrications and the avoidance of assembly tolerance issues due to weld shrinkage.
c) Appropriateness of cold spinning to produce the thin-walled components of the design, given the tolerance requirements of the final build.
d) The welding of components pre and post cold spinning.
e) The effect manufacturing processes may have on material properties e.g. spinning may cause work hardening, which could enhance UTS, but reduce ductility.
f) The repeatability and stated tolerance requirements of precision machined parts e.g. seal grooves.
g) The repeatability and accuracy of the overall build, given it is a combination of precision machined components and sheet metal fabrication.

Under Stage 2:

h) DB/subcontractor capabilities of maintaining stainless steel free from carbon contamination.
i) DB/subcontractor capabilities of welding machined parts to avoid problems of out of tolerance shrinkage.
j) Are the DB/subcontractor manufacturing process steps suitable, i.e. could the DB/subcontractor process steps compromise component properties?
k) Evidence of DB/subcontractor experience of the UK nuclear industry requirements regards stringent quality control and recording thereof.

7 Information provided to the Reviewer

For the stage 1 assessment, the technical documentation that was provided to the manufacturer at contract placement is as follows:

INS Detail Drawings:

Drawing Number	*Mod*	*Description:*
0 INS 000069	J	3578 Package Exploded View
0 INS000072	D	INS3578 Package - Drum details sheet 2
0 INS 000075	J	INS3578 Package - General arrangement
0 INS 000076	J	INS3578 Package - Drum/outer containment vessel Sub-assembly sheet 1
0 INS 000077	J	INS3578 Package - Drum/outer containment vessel Sub-assembly sheet 2
0 INS 000078	G	INS3578 Package - Lid sub-assembly & details
0 INS 000079	G	INS3578 Package - Security Locking Plate sub-assembly and details
1 INS 000080	G	INS3578 Package - Inner containment vessel details
0 INS 000082	G	INS3578 Package - Gasket , Lid Bolt, Interspace Test Point & Fusible Plug details
1 INS 000083	H	INS3578 Package - Drum Heat Transfer Fins, Locking Bar , Wedge Strip & Alignment Pin - details
0 INS 000084	J	INS3578 Package - Drum details sheet 1
0 INS 000085	H	INS3578 Package - Outer Containment vessel details.
0 INS 000086	K	INS3578 Package - Drum/outer CV/lid CLP-NS details
0 0NS 000087	F	INS3578 Package - Painting details

INS Specifications:

Specification Ident	Rev	*Description:*
INS/ENG/S/13/005	6	Manufacturing specification - INS3578 Transport Package
INS/ENG/S/13/006	4	Manufacturing specification - Bolts, Plugs and Seals

For the stage 2 assessment, the contracted agency shall be supplied with the same information pack as above and shall liaise with the manufacturer via the INS contact given in section 5 and, through review of appropriate documentation, site visits and discussions, satisfy itself that stage 2 of the objective can be met.

8 Deliverables

The contracted agency (or agencies) shall provide a fully detailed report(s) that has been processed through its companies QA system and delivered to INS as per the agreed contract dates (see §9).

The final report(s) shall incorporate an Executive Summary, capturing the main project findings of Stages 1 and 2. If the same contractor is selected to complete Stage 1 and 2, this single report will also provide the detail findings / conclusions for each stage separately, in line with the stated objectives in §3. How this information is presented is at the discretion of the contractor, but the report shall be clear, concise and provide suitable references/supporting evidence to statements as is deemed appropriate.

The final report(s) shall be submitted in the following formats;

1. Hard Copy – three certified colour copies.
2. Electronic Copy – in pdf format.

Evidence of author / checker 'SQEP'ness' shall also be incorporated into the delivered document(s).

9 Programme Requirements

It is the intention to place a contract for this work by w/c 13th July 2015 at the latest and earlier, if at all possible.

Given this stated start date, INS requires;

For Stage 1:

- Issue of a draft report 'for comment by INS' by w/c 24th August 2015 (i.e. 6 weeks following contract placement). Then, subsequent to comments by INS (4);

- Issue of the final report by w/c 7th September 2015 (2 weeks after issue of the draft).

Similarly, for Stage 2:

- Issue of a draft report 'for comment by INS' by w/c 24th August 2015 (i.e. 6 weeks following contract placement). Then, subsequent to comments by INS (4);

- Issue of the final report by w/c 7th September 2015 (2 weeks after issue of the draft).

(4) It should be assumed that INS shall spend no more than 2 full working days reviewing the draft reports.

Any issues with meeting the above dates should be clearly indicated in the tender package. It may be the case that tenderers submit for individual stages, or both. In all cases, it should be clearly evident in the submission which stage(s) is being pursued and individual stage costs are required for all submissions.