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| ONR Project assessment report  PR-01544 Renewal of Uranium Trioxide Industrial Fissile Package (Phase 2) – Project assessment report for GB/3573A/IF transport package design approval |



ONR Project assessment report

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# Executive summary

International Nuclear Services (INS) Ltd, trading as Nuclear Transport Solutions (NTS), has applied to the Office for Nuclear Regulation (ONR) for the approval of transport package design GB/3573A/IF ‘Uranium Trioxide Industrial Fissile Package’. This package design previously received regulatory approval in 2010 and the certificate of approval GB/3573A/IF-96 expired in 2015.

This report presents the basis of the regulatory decision by the ONR as Great Britain (GB) competent authority (CA) for the transport of Class 7 (radioactive material) dangerous goods.

The packaging is based on a full height International Organization for Standardization (ISO) container design with capacity for up to 64 Thermal Oxide Reprocessing Plant (THORP) uranium trioxideproduct drums.

ONR has undertaken a programme of work to assess the claims, arguments and evidence presented within the Package Design Safety Report (PDSR) submitted by the applicant. This is phase 2 of the ONR assessment. Phase 1 considered the strategy adopted to ensure criticality safety and was accepted by ONR in April 2024. Phase 2 of the approval focused on the technical criticality safety case. Over both phases of the approval, proportionate and targeted criticality, engineering and radiation shielding assessments have been undertaken. The project inspector review in this phase of the approval focused on the impact of human intervention and mitigation of risks during consignment operations, targeting the operational and managerial requirements necessary to ensure safe implementation of the design. Technical queries were raised through the assessment process – the applicant responded with further documentary evidence supporting safety claims and queries were adequately addressed.

Each of the assessments concluded that the package meets the relevant regulatory requirements and recommended approval of the package design. The project inspector review also recommended that the manufacturer of the GB/3573A/IF should be inspected prior to the package being used - inspection IR-53533 has been added to the transport CA 2024-25 inspection plan.

Table 1: List of abbreviations.

|  |  |
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| Term/Acronym | Description |
| CA | Competent Authority |
| IAEA | International Atomic Energy Agency |
| INS | International Nuclear Services |
| ISO | International Organization for Standardization |
| IAEA | International Atomic Energy Authority |
| NTS | Nuclear Transport Solutions |
| ONR | Office for Nuclear Regulation |
| PDSR | Package design safety report |
| TAG | Technical assessment guide (ONR) |
| THORP | Thermal Oxide Reprocessing Plant |

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# Permission requested

1. International Nuclear Services (INS) Ltd, trading as Nuclear Transport Solutions (NTS) (the applicant), has applied (ref. [1]) to the Office for Nuclear Regulation (ONR) for the approval of transport package design (ref. [2]) GB/3573A/IF ‘Uranium Trioxide Industrial Fissile Package’.
2. The package will be used to transport uranium trioxide (UO3) by road, rail and sea.
3. This report presents the basis of the regulatory decision by ONR as Great Britain competent authority (CA) for the transport of Class 7 (radioactive material) dangerous goods to approve the application for design approval.

# Background

## The Package

1. The applicant and designer is INS, trading as NTS.
2. The GB/3573A/IF package is based on an International Organization for Standardization (ISO) container design and was conceived for the export of Thermal Oxide Reprocessing Plant (THORP) UO3 product drums (Type 3508) from Sellafield Ltd. This material arose from the commercial reprocessing of Light Water Reactor uranium oxide fuels in the THORP facility and has been held in interim storage at the THORP UO3 Drum Store.
3. The GB/3573A/IF package design comprises a standard 20’ full height ISO container with capacity for up to 64 THORP UO3 product drums (4 steel pallets, each holding up to 2 wooden pallets with up to 8 drums per wooden pallet). The Type 3508 drum has previously been self-certified by International Nuclear Services as a Type IP-2 industrial package for the transport of non-fissile UO3 powder. The Certificate of Compliance has lapsed, but the drum was tested in isolation to meet IP-2 requirements following normal conditions of transport - this test has been used, alongside physical testing of the ISO container and finite element analyses to support the GB/3573A/IF containment claim.
4. The package manufacturer is JGC Engineering & Technical Services Ltd. Package manufacturing has commenced.

## Regulatory History

1. The GB CA first approved this package in 2010 and the certificate of approval (CoA) (ref. [3]) expired in 2015. No packages were manufactured during that approval period.
2. This package design is for the transport of UO3 powder used in fuel processing and fabrication.
3. In 2021, INS applied (ref. [4]) for a design approval (ref. [5]) utilising new International Atomic Energy Authority (IAEA) guidance SSG-26 (ref. [6]) paragraph 676.2 This provides additional guidance to the applicant in relation to removing pessimisms from the criticality safety case where the number of possible parameters is very large and the probability of them all achieving their most reactive value is extremely small.
4. ONR concluded that the application of SSG-26 paragraph 676.2 required further justification and the application was not approved.
5. Following engagement with the applicant, they constructed a robust argument supporting the justification to apply SSG-26 paragraph 676.2 and we produced a decision record (ref. [7]) that accepted the criticality safety strategy – this became phase 1 of the approval.
6. During the phase 1 approval, we completed engineering (ref. [8]) and radiation shielding (ref. [9]) assessments – both concluded that the package design was safe and compliant and recommended that the CA approve the design.

# Assessment and inspection work carried out by ONR in consideration of this request

1. INS applied (ref. [10]) for a revised (Issue 2) Package Design Safety Report (PDSR) (ref. [11]) approval.
2. This project is ‘phase 2’ of the approval and focused on:

* The technical aspects of the criticality safety case;
* Any delta that could impact previous engineering and radiation shielding judgements; and,
* The project inspector review (focusing on and the risks associated with human intervention in the consignment process).

1. Since the design for phase 2 was submitted, there have been several design changes, most notably to the pallet design, radioactive contents and incorporation of human factors learning from a different package that we recently approval. These were all considered in the individual ONR assessments.
2. INS submitted (ref. [1]) a revised PDSR (Issue 3) (ref. [2]) incorporating these changes – this application for approval and our assessment of it is based on that version (Issue 3) of the PDSR.

## Criticality Assessment (ref. [12] [13])

1. The criticality strategy was accepted in the phase 1 criticality assessment (ref. [12]).
2. Our phase 2 criticality assessment (ref. [13]) focused on the technical report supporting criticality safety. We assessed the calculational methods and data used to underpin the criticality calculations, and whether the geometry/moderation conditions assumed for the various conditions of transport are appropriately conservative and bounding.
3. Following a hypothetical transport accident, criticality safety is demonstrated without taking credit for the package on the condition that the package meets the fissile mass restriction – this restriction is dependent on the highest enriched drum in the consignment.
4. We raised seven criticality questions (ref. [14]) during the assessment and received adequate responses from the applicant.
5. We concluded that on the basis of the claims, arguments and evidence contained in the application, the package design meets the criticality safety requirements of the relevant transport regulations under routine, normal and accident conditions of transport.
6. We recommended that the CA should approve the transport package design for a period of up to 5 years.

## Radiation Shielding Assessment (ref. [9] [15])

1. We undertook a comprehensive radiation shielding review (ref. [9]) during the phase 1 assessment. The applicant’s radiation shielding assessment recognised the significance of unextracted trace quantities of gamma emitting radionuclides from chemical separation and calculated dose rates during routine and normal conditions of transport, as required for industrial packages.
2. The dose rate safety margin during routine conditions of transport is high and evidence is provided that any increase to dose rates following normal conditions of transport testing is within the regulatory limit.
3. The applicant’s radiation shielding safety case was revised for the phase 2 submission. We undertook a further shielding assessment (ref. [15]) to account for the principal design change– UO3 material not within the scope of the phase 1 submission. Whilst dose rates increased by approximately 10%, the safety margin against regulatory requirements remains high.
4. We concluded that the GB/3573A/IF transport package meets the applicable regulatory design requirements with respect to radiation shielding.
5. We recommended that the CA should approve the transport package design.

## Engineering Assessment (ref. [8])

1. We undertook an engineering assessment (ref. [8]) during phase 1.
2. Our assessment focused on changes to the design since the previous ONR approval.
3. We reviewed and were satisfied with the structural calculations and finite element analysis for impact loads supporting the containment claim. NTS provided a detailed design review - we concluded that the design changes would not invalidate the impact performance safety justification.
4. We considered regulatory changes, revised operating methods and consignor operational feedback, management arrangement changes and ageing degradation. We are satisfied that NTS have considered and implemented these aspects of management and safety.
5. When planning our engineering assessment for phase 2, we identified that further design changes would not invalidate our phase 1 engineering judgement and that no further engineering assessment was required. This justification was captured in the permissioning plan (ref. [16]).
6. As such, the phase 1 engineering assessment that recommended approval of the package design remains valid for the phase 2 approval.

## Project Inspector Review (ref. [17])

1. The project inspector review (ref. [17]) considers various non-technical aspects of the application including: its implementation; conditions required to be considered before the commencement of assessment work; the history of the package and applicant / consignor; and management arrangements pertinent to the dutyholders transport activities.
2. This package was not manufactured following the previous regulatory approval and as such, there is no operational history. We have sampled the management arrangements associated with design and competent authority application and are satisfied that the arrangements are adequate to support this approval.
3. A review of the operating and maintenance instructions considered the risks due to human interactions in activities associated with consigning the package.
4. The NTS package design management arrangements had triggered a requirement to review human factors aspects. A multidisciplinary team had considered the sequential tasks required to consign the package and identified risks associated with human intervention. Operational support from a potential consignor was sought and evidence of a consignor feedback loop has been established. There are clear links between the assessment of risks and the tasks in the operating instruction that contains warnings, cautions and notes proportionate to the risks identified.
5. We concluded that, based on the criteria sampled:

* The applicant has adequately integrated human factors into the design process and operational instructions; and,
* The package is safe and meets the relevant transport requirements.

1. We recommended that:

* The package design should be approved; and,
* The ONR CA should inspect the arrangements of the manufacturer prior to first use of the package.

# Matters arising from ONR’s work

1. No matters were identified during the assessments.

# Conclusions

1. Based on the assessment work carried we have undertaken, I am satisfied that the package design meets the requirements of the relevant transport regulations.

# Recommendations

1. Each of our assessments concluded that the package meets the relevant regulatory requirements and recommended approval of the package design.
2. I recommend that:

* The ONR CA should approve the transport package design ‘Uranium Trioxide Industrial Fissile Package’ by issuing the competent authority transport package design certificate GB/3573A/IF (Rev.1) (Ref. [18]); and,
* The manufacturer of the GB/3573A/IF is inspected prior to the package being used. Inspection IR-53533 has been added to the transport CA 2024-25 inspection plan.

# References

|  |  |
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