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Transport Permissioning (SVC4334482)

Assessment of the GB/1648CB Package Design for the Transport of HELIOS Components

Project Assessment Report ONR-SDFW-PAR-17-019
Revision 0
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EXECUTIVE SUMMARY

Assessment of the GB/1648CB Package Design for the Transport of HELIOS Components

This Report presents the basis of the regulatory decision by the Office for Nuclear Regulation (ONR) as Great Britain (GB) Competent Authority (CA) for the transport of Class 7 (Radioactive Material) Dangerous Goods, to approve the package design GB/1648CB for transporting HELIOS components by road, rail and sea within the United Kingdom (UK).

Permission Requested

The Applicant, International Nuclear Services Ltd. (INS), has written to ONR to request CA approval of the package design GB/1648CB for transporting HELIOS components by road, rail and sea from Dounreay Site Restoration Limited (DSRL) to Sellafield Ltd. Transport by air has not been requested. This package design approval request was made under the United Nations Economic Commission for Europe (UNECE) modal requirements ADR 2017 and RID 2017 (published by the Intergovernmental Organisation for International Carriage by Rail (OTIF)) for transport of dangerous goods by road and rail and the International Maritime Dangerous Goods (IMDG) Code 2016 for transport by sea. ADR 2017 and RID 2017 are implemented in GB law via 'The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009' (CDG) while IMDG is implemented in the UK by The Merchant Shipping (Dangerous Goods and Marine Pollutants) Regulations 1997. The modal requirements (ADR / RID / IMDG) are based on the International Atomic Energy Agency (IAEA) Regulations for the Safe Transport of Radioactive Material, currently SSR-6 (2012 Edition) supported by advisory material in SSG-26 (2012 Edition).

Background

The HELIOS components to be transported contain rings of uranium that were used in "Neutron time of flight" experiments undertaken at Harwell between 1958 until 1976, in order to ascertain nuclear data in the early days of the British nuclear power programme. The target was dismantled in 1990 and sent to Dounreay in 1991, with the intention to de-clad the components and recover the uranium. However, this did not take place due to the end of reprocessing at Dounreay and the components were placed into storage.

INS has developed a transport solution for the movement of the HELIOS components from the Dounreay site to Sellafield, as part of the Dounreay Exotics Consolidation Programme (DECP). The "Thick [walled] Blue Flask (Design No. 1648C)" package (competent authority design number GB/1648CB) is based on the 1648C design which has been approved by ONR in recent years. This was identified as an existing asset that could be used to transport the HELIOS components. It was originally designed to transport irradiated material from Chapelcross to Sellafield. The packaging is the same as the recently approved design for sealed source transportation. The difference in the current application is with respect to the contents.

There are three individual HELIOS components, each with distinct characteristics that will be accommodated in bespoke HELIOS over-packs that are designed to reduce the ullage space within the flask cavity. The HELIOS components will be transported in separate GB/1648CB transport flasks in a single security container.

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

Taking a proportionate and targeted sampling approach, our assessment of the safety submission has focused on the differences noted above (principally the change of the contents within the GB/1648CB packaging). During early engagement between ONR and INS, several areas of potential concern were identified and resolved before the formal application, resulting in the production of a good quality safety case. ONR were not involved in the design process but did make the Applicant aware of our expectations with regards to the safety of the package. Particular attention was given to:

- the quality of the underpinning specification of the HELIOS components and the requirement to substantiate this by physical investigation (including the uncertainty on the mass of enriched uranium and its maximum enrichment);
- the performance of the seals which are required to prevent water ingress in support of the criticality safety case;
- the calculations undertaken to ascertain the activity of the components to support a Type A approval.

Criticality, engineering, shielding and safety case requirements assessments were undertaken to support the approval.

Criticality Assessment

The ONR assessment of the criticality safety case focused on the uncertainties in the underpinning evidence, specifically the mass of enriched uranium per component, the maximum enrichment and the dimensional tolerances of the HELIOS over-packs (used to accommodate the HELIOS components) and internal package cavity. Sensitivity calculations were provided by the Applicant demonstrating that the package will remain sub-critical for various permutations of fuel break-up, fuel leakage into the package cavity and enrichment following a severe accident. The scope of the criticality assessment took cognisance of an independent peer review undertaken by an independent third-party organisation. The ONR assessment agreed with the Applicant's claim that the package will remain sub-critical under routine, normal and accident conditions of transport and all regulatory relevant requirements relating to fissile material transport are met.

Engineering Assessment

ONR has recently approved a different variant of the GB/1648C packaging for different contents. ONR's engineering assessment in support that approval provided confidence in the package integrity. The engineering assessment focused on the changes due to the contents and the performance of the closure system (which prevent the release of material of ingress of water following a severe accident). Several issues were identified during the early engagement phase. Most of these were resolved relatively simply. The exception was that it had not been adequately demonstrated that the O-ring seal would remain leak-tight following regulatory accident conditions of transport (ACT) tests involving a 9m package drop followed by 800ºC 30-minute fire. In response the Applicant undertook further finite element analyses which adequately demonstrated that the package would contain its contents, prevent ingress of water and meet the regulatory thermal requirements in all conditions of transport.

Shielding Assessment

Dose rate measurements taken during inspection of one of the HELIOS components provided confidence during early engagement that the regulatory dose rate requirements would be achieved. The 1648 package was designed to transport irradiated material, and since the HELIOS components have only been 'lightly' irradiated, it was to be expected that package dose rates would be well below the regulatory requirements. Detailed calculations undertaken by the Applicant demonstrated that dose rates would be orders of magnitude lower than the relevant criteria. Attention was given to the calculations undertaken to ascertain the activity of the HELIOS components as these served a dual purpose; to demonstrate compliance with dose rate criteria and to demonstrate compliance with the Type A package activity limits. It was determined by ONR that the calculations were adequate and demonstrated compliance with the relevant dose rate regulations and that the activity was 35% of the Type A activity limit.

Safety Case Requirements Assessment

A safety case requirements (SCR) assessment addresses the non-engineering means of achieving compliance with the relevant regulations, such as through instructions for the use, operation and maintenance of the approved package design. An SCR assessment was undertaken in 2015 as part of the GB/1648C approval. The GB/1648CB design has the same packaging, and involves the same design authority (INS) as the current GB/1648CB package design. With this in mind, an additional SCR assessment has been undertaken in support of the

current application, with consideration made to the consignor, consignee and carriers of the packages. Inspections of DSRL and INS have been undertaken in 2017 and 2014, with focus on management systems, control of changes to management systems and implementation of management systems. An inspection was also undertaken in support of this permission, with attention given to operation and maintenance of the packages. No issues were identified with respect to the implementation of the safety case by the consignor, carriers or consignee.

Matters arising from ONR's work

There is a requirement for Type A packages to meet IAEA SSR-6 paragraph 639 requirements, demonstrating that the design of the package shall take into account temperatures ranging from –40℃ to +70℃ for the components of the packaging. The Applicant has only demonstrated safety for a limited temperature range of -10℃ to 31℃.

In order that the full temperature range specified in IAEA SSR-6 paragraph 639 is accounted for, the package can only be transported for a restricted temperature range of -10℃ to 31℃ which is stipulated by ONR on the certificate of approval.

The ONR assessment noted that the Applicant's criticality assessment did not fully account for tolerances on package dimensions as shown on the design drawings. In response, the Applicant provided additional evidence that the criticality assessment remained valid as the 'as built' packages had been measured and they were bounded by the dimensions assumed in the criticality assessment. Accordingly, only those packages that were measured and shown to be bounded by the criticality assessment (numbers: 1648CB/1B, 1648CB/3B, 1648CB/4B, 1648CB/5B and1648CB/6B) are permitted by the certificate of approval.

Conclusions

The safety submission from the Applicant, together with supporting documentation provided to ONR following the submission, is considered to be adequate to meet applicable regulatory requirements and the package design is judged to be safe.

Recommendation

Issue of GB approval certificate GB/1648CB/AF-96 (Rev. 0).

LIST OF ABBREVIATIONS

ACT	Accident Conditions of Transport
ADR	European Agreement Concerning the International Carriage of Dangerous Goods by Road
CA	Competent Authority
CDG	Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009
DCI	Deputy Chief Inspector
DECP	Dounreay Exotics Consolidation Programme
DSRL	Dounreay Site Restoration Limited
GB	Great Britain
IAEA	International Atomic Energy Agency
IMDG	International Maritime Dangerous Goods
INS	International Nuclear Services
ONR	Office for Nuclear Regulation
OTIF	Intergovernmental Organisation for International Carriage by Rail
Q1AR	Assessment Record with regulatory question set
RID	Intergovernmental Organisation for International Carriage by Rail, Regulations Concerning the International Carriage of Dangerous Goods by Rail
SCR	Safety Case Requirements (Assessment)
SDFW	Sellafield Decommissioning Fuel & Waste
SI	Superintending Inspector
TRIM	ONR Document Record System
UK	United Kingdom
UNECE	United Nations Economic Commission for Europe

TABLE OF CONTENTS

1 PERMISSION REQUESTED

1. The Office for Nuclear Regulation (ONR) is the Great Britain (GB) Competent Authority (CA) for the civil inland surface transport of Class 7 (radioactive material) dangerous goods. This statutory duty is given to ONR through 'The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations' (CDG) [1]. ONR also acts on behalf of other civilian United Kingdom (UK) CAs with respect to the issuing of transport approvals; namely:

   - The Competent Authority of the United Kingdom of Great Britain and Northern Ireland in respect of sea transport, being the Secretary of State for Transport including the Maritime and Coastguard Agency;
   - The Competent Authority of the United Kingdom of Great Britain and Northern Ireland in respect of air transport, being the Civil Aviation Authority; and
   - The Competent Authority of Northern Ireland in respect of road transport, being the Department of Agriculture, Environment and Rural Affairs - Northern Ireland.

2. International Nuclear Services (INS) is the design authority for the GB/1648CB Type A transport package containing fissile material. As it is intended to use the GB/1648CB/AF-96 package to transport fissile material in the UK by road, rail and sea INS requested CA approval as required under provision 6.4.22.4 of the following modal regulations:

   - European Agreement Concerning the International Carriage of Dangerous Goods by Road, ADR [2];
   - Regulations concerning the International Carriage of Dangerous Goods by Rail, RID [3];
   - International Maritime Dangerous Goods Code, IMDG [4].

3. An application was submitted by INS, 'the Applicant', for approval of the GB/1648CB as a Type AF package [5, 6].

4. This report presents the findings of ONR's assessment of the GB/1648CB transport package application from INS against the requirements of ADR, RID and IMDG which are based on International Atomic Energy Agency (IAEA) Regulations for the Safe Transport of Radioactive Material, Specific Safety Requirements No. 6 (SSR-6), 2012 Edition [7].

2 BACKGROUND

5. The HELIOS components to be transported contain rings of uranium that were used in "Neutron time of flight" experiments undertaken at Harwell between 1958 until 1976, in order to ascertain nuclear data in the early days of the British nuclear power programme. The target was dismantled in 1990 and sent to Dounreay in 1991, with the intention to de-clad the components and recover the uranium. This did not take place due to the end of reprocessing at Dounreay and the components were placed into storage.

6. INS was tasked with developing a transport solution for the movement of the HELIOS components from the Dounreay site to Sellafield, as part of the Dounreay Exotics Consolidation Programme (DECP).

7. The "Thick [walled] Blue Flask (Design No. 1648C)" packaging was identified as an existing asset that could be used to transport the HELIOS components. The resulting package, comprising the packaging and the HELIOS components, is given the Competent Authority design number GB/1648CB.

8. The GB/1648CB package is based on the 1648C design which has been approved by ONR in recent years. It was originally designed to transport irradiated material from Chapelcross to Sellafield.

9. The 1648CB is a thick-wall forged carbon steel flask with a forged stainless steel lid secured by 12 M36 stainless steel bolts. The packaging lid is sealed against the body by two concentric O-ring seals with a testable interspace seal. An aluminium shock absorber is bolted to the top of the packaging by 6 M20 stainless steel bolts prior to transporting.

10. The packaging is the same as the recently approved design for sealed source transportation. The difference in the current application is with respect to the contents.

11. There are three individual HELIOS components, each with distinct characteristics that have been identified in the package design safety report.

12. The HELIOS components will be accommodated in bespoke HELIOS over-packs. Each of the HELIOS over-pack variants is identical in principle, the only variations being in the internal dimensions for accommodating the geometry of each HELIOS component. The over-pack sits inside the 1648CB cavity and provides confinement of the fissile contents by minimising the void space in the 1648CB cavity.

13. The three HELIOS components will be transported in separate transport flasks in a single security container.

14. The underpinning data used in the current application was taken from a report (the 'Deconstruction Manual') that was produced in the 1990's to assist with the deconstruction of the HELIOS components at Dounreay (as was then the intention). Specification gaps were identified in the report, and Dounreay Site Restoration Limited (DSRL) undertook a physical investigation to ensure that the correct parameters were being used in the safety justification and substantiate the data in the 'Deconstruction Manual'.

15. The containment system is formed by the flask body, flask lid, inner fluoroelastomer O-rings and stainless steel lid bolts.

16. External dose rates are controlled through the permitted contents and package shielding.

17. Criticality is prevented through control of permitted contents and the demonstration of leak-tightness following accident conditions of transport.

18. Thermal protection is provided through control of permitted contents and a thermal shield.

3 ASSESSMENT AND INSPECTION WORK CARRIED OUT BY ONR IN CONSIDERATION OF THIS REQUEST

19. Under ONR's Transport Permissioning Process [8], this application is a new package design and the required output for each supporting assessment work as a Major Assessment Report.

20. Taking a proportionate and targeted sampling approach, our assessment of the safety submission has focused on the differences noted above (principally the change of the contents within the GB/1648CB packaging). During early engagement between ONR and INS, many of the underlying issues were resolved, resulting in the production of a good quality safety case. Particular attention was given to the quality of the underpinning specification and the requirement to substantiate this by physical investigation (including the uncertainty on the mass of enriched uranium and its

maximum enrichment), performance of the seals which are required to prevent water ingress in support of the criticality safety case and the calculations undertaken to ascertain the activity of the components to support a Type A approval.

21. ONR's internal process for issuing transport approvals [8] was followed and assessment was undertaken in accordance with the relevant ONR guidance. In accordance with ONR's transport process, a pre-job brief and assessment scope decision record have been compiled, identifying potential areas of concern and agreeing the assessment strategy, scope, timescales and assessment output [9, 10].

22. ONR carried out a detailed programme of work that involved the assessment of the Applicant's transport safety case [11 to 13], supporting documentation and evidence, and the mechanisms for implementation via the relevant management systems. Assessments were undertaken for: criticality, engineering (accounting for the thermal and containment requirements), shielding and safety case requirements (the implementation of the safety case). Assessment reports were produced for each assessment undertaken [14 to 17]. An assessment record was kept to track ONR assessment questions and Applicant responses (Q1AR) [18]. Once the ONR assessment comments were closed out, the certificate was drafted and sent to the Applicant for comments. Following approval of the assessment reports, this project assessment report was compiled.

3.1 CRITICALITY ASSESSMENT [14]

23. The ONR assessment of the criticality safety case focused on the uncertainties in the underpinning evidence, specifically the mass of enriched uranium per component, the maximum enrichment and the dimensional tolerances of the HELIOS over-packs (used to accommodate the HELIOS components) and internal package cavity. Sensitivity calculations were provided by the Applicant demonstrating that the package will remain sub-critical for various permutations of fuel break-up, fuel leakage into the package cavity and enrichment following a severe accident. The scope of the criticality assessment took cognisance of an independent peer review undertaken by an external organisation. It was determined that the package will remain sub-critical under routine, normal and accident conditions of transport and all regulatory relevant requirements relating to fissile material transport are met.

3.2 ENGINEERING ASSESSMENT [15]

24. The engineering assessment took account of a recent ONR engineering assessment of a package integrity justification for a variant of the GB/1648CB. The engineering assessment focused on the changes due to the contents and the performance of the closure system which is designed to prevent the release of material or ingress of water following regulatory accident conditions of transport (ACT) involving a 9m package drop test and 800ºC thermal test.

25. Several issues were identified during the early engagement phase. These were resolved relatively simply, except for one outstanding issue whereby the Applicant's safety case did not adequately demonstrate that the O-ring seal would provide the required level of leak-tightness during ACT regulatory tests. In response the Applicant provided further finite element analysis evidence which demonstrated adequately that the package would contain its contents, prevent ingress of water and meet the regulatory thermal requirements in all conditions of transport.

3.3 SHIELDING ASSESSMENT [16]

26. During early engagement, dose rate measurements taken by DSRL during their inspection of one of the HELIOS components provided initial evidence of compliance with the regulatory dose rate requirements.

27. The 1648 package was designed to transport irradiated material, and since the HELIOS components have only been lightly irradiated, ONR shielding assessor judged that package dose rates would be below the regulatory requirements.

28. Detailed calculations undertaken by the Applicant confirmed this initial judgement, in that dose rates were shown to be orders of magnitude lower than the relevant regulatory requirements. ONR assessment paid particular attention to the Applicant's calculations to ascertain the activity of the HELIOS components as these served a dual purpose; to demonstrate compliance with dose rate criteria and to demonstrate compliance with the Type A package activity limits.

29. ONR assessment concluded that the Applicant's calculations were adequate and demonstrated compliance with the relevant dose rate requirements and that the activity was within the Type A activity limit.

3.4 SAFETY CASE REQUIREMENTS ASSESSMENT [17]

30. A safety case requirements (SCR) assessment addresses the non-engineering means of achieving compliance with the requirements of SSR-6, such as through instructions for the use, operation and maintenance of the approved package design.

31. ONR assessed the arrangements for implementation of the transport safety case requirements and the requirements of the certificate of approval. This was supported by a site inspection targeted at this permissioning activity [19], followed up with a further meeting where maintenance records and more detailed local operating instructions used by consignors were inspected [20].

32. The management systems for the design authority, consignor and consignee and their control of changes / implementation of these systems were also considered in previous ONR inspections undertaken between 2014 and 2017.

33. The Applicant's safety case states that the package will be marked with a trefoil symbol. However, this is only a regulatory requirement for Type B(U), Type B(M) or Type C packages, not for Type A (including Type AF) packages. Therefore, the Applicant has informed ONR that they will not mark the package with a trefoil symbol. ONR have confirmed that this is acceptable.

34. There were no significant findings from the SCR assessment and the design authority, consignor and consignee arrangements to implement the safety case were deemed adequate.

4 MATTERS ARISING FROM ONR'S WORK

35. The design safety report suggests that compliance with paragraph 639 of SSR-6 2012 has not been fully demonstrated. There is a requirement for Type A packages to meet paragraph 639 requirements, demonstrating that the design of the package shall take into account temperatures ranging from –40°C to +70°C for the components of the packaging.

36. The Applicant has accounted for the temperature requirements and demonstrated safety for a limited ambient temperature range of -10°C to 31°C (given the heat generation from the package contents is low, < 0.5 W, the temperatures reached by the components of the packaging will essentially be that same as ambient temperature[1]). Ordinarily, for a Type B(M) package, if safety for the full temperature

[1] It is further noted that the area of interest is the seal performance at low ambient temperatures, thus any heat generation by the contents will actually be of benefit in that the temperature of the components of the packaging could be at a slightly higher temperature than ambient.

range has not been demonstrated then the mechanism for implementing a restricted temperature range in the certificate would be via paragraph 667 of SSR-6 2012.

37. There is no mechanism in Type A approvals to insert the temperature restriction on the certificate of approval. However, the package is fissile and additional requirements for fissile material allow the restriction to be stipulated on the certificate via paragraph 679 of SSR-6 2012.

38. Therefore, via the fissile requirements, the package can only be transported for a restricted temperature range of -10°C to 31°C (the seals have not been demonstrated to ensure criticality safety below -10°C). The temperature range in SSR-6 2012 paragraph 639 has been accounted for, and safety demonstrated for a limited range that has been stipulated on the certificate via SSR-6 2012 paragraph 679.

39. The Applicant's criticality assessment did not fully account for tolerances on package dimensions as shown on the design drawings. The Applicant justified that the criticality assessment remained valid as the 'as built' packages had been measured and they were bounded by the dimensions assumed in the criticality assessment. Accordingly, only those packages that were measured and shown to be bounded by the criticality assessment (numbers: 1648CB/1B, 1648CB/3B, 1648CB/4B, 1648CB/5B and1648CB/6B) are permitted by the certificate of approval.

5 CONCLUSIONS

40. This report presents the findings and basis of ONR's regulatory decision following our assessment of the application for Competent Authority approval of package design GB/1648CB/AF-96.

41. Based on our assessment activities and inspections, ONR is satisfied that the claims, arguments and evidence presented by the Applicant adequately demonstrate that the package design is safe and meets relevant legal requirements.

6 RECOMMENDATIONS

42. Competent Authority approval of package design GB/1648CB/AF-96 should be granted.

7 REFERENCES

1. The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations (CDG) 2009, (SI 2009 No. 1348). www.legislation.gov.uk

2. United Nations Economic Commission for Europe (UNECE), European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) 2017 Edition. www.unece.org

3. Intergovernmental Organisation for International Carriage by Rail (OTIF), Regulations concerning the International Carriage of Dangerous Goods by Rail (RID) 2017 Edition. www.otif.org

4. International Maritime Dangerous Goods Code (IMDG) 2014 Edition incorporating Amendment 37-14 (until end of December 2017) or IMDG 2016 Edition incorporating Amendment 38-16.

5. 17081648CB.01: 'Application for UK Certificate of Approval of Package Design for the Carriage of Radioactive Materials – GB/1648CB/AF-96', 23 August 2017. TRIM Record: 2017/338350.

6. 17111648CB.01: 'Application for UK Certificate of Approval of Package Design for the Carriage of Radioactive Materials – GB/1648CB/AF-96', 7 November 2017. TRIM Record: 2017/411689.

7. IAEA Safety Standards:
SSR-6: 'Regulations for the Safe Transport of Radioactive Material (2012 Edition)', IAEA, Vienna, 2012.
www.iaea.org.

8. ONR Process Guides:
TRA PER GD 001 Revision 1: 'Transport Permissioning Assessment'.
ONR Process Guides on How2

9. GB/1648 (SVC4334482) - Pre-job Brief - GB/1648CB PJB - 27 September 2017. TRIM Record: 2017/363895.

10. GB/1648 (SVC4334482) - Decision Record- GB/1648CB DR. TRIM Record: 2017/417152.

11. TRANSPORT REPORT No. 172: 'Design Safety Report in Support of Application for the HELIOS Neutron Booster Target Transport Package Design No. GB/1648CB/AF-96 In accordance with SSR-6: 2012 Edition', Issue 01, 22 August 2017. TRIM Record: 2017/338350.

12. INS ENG R 17 345 Rev 1: 'Drawing List DL/1648CB HELIOS Transport Package', 6 November 2017. TRIM Record: 2017/411689.

13. INS ENG R 17 346 Rev 0: 'Specification List SL/1648CB HELIOS Transport Package', 18 August 2017. TRIM Record: 2017/338350.

14. ONR-SDFW-AR-17-087 Revision 0: 'Criticality Assessment of the Transport Package Application for the GB/1648CB/AF-96 Carrying HELIOS Components', 21 November 2017. TRIM Record: 2017/389740.

15. ONR-SDFW-AR-17-101 Revision 0: 'ONR Engineering Assessment of GB/1648CB Package Design Application for the Transport of HELIOS Components', 30 November 2017. TRIM Record: 2017/432966.

16. ONR-SDFW-AR-17-093 Revision 0: ‘ONR Shielding Assessment of GB/1648CB Transport Package Application from INS’, 13 November 2017. TRIM Record: 2017/395311.

17. ONR-SDFW-AR-17-102 Revision 0: ‘Safety Case Requirements Assessment for the Transport Package Application for the GB/1648CB/AF-96 Carrying HELIOS Components’, 29 November 2017. TRIM Record: 2017/397488.

18. GB/1648 (SVC4334482) - Q1AR - GB/1648CB Q1AR, 11 November 2017. TRIM Record: 2017/374208.

19. ONR-SDFW-IR-17-143 Revision 0: ‘International Nuclear Services Limited (INS), Risley; Planned Class 7 Transport Inspection of INS as design authority for 1648CB package approval application’, October 2017. TRIM Record: 2017/393074.

20. ONR-SDFW-CR-17-790 Revision 0: ‘Dounreay Exotics Consolidation Programme (DECP) Board’, 28 November 2017. TRIM Record: 2017/442696.