

INL BEA EFCOG Best Practice Summary

Facility: Idaho National Laboratory – Battelle Energy Alliance

Best Practice Title: CsCl Source Exemption from Nuclear Facility Categorization

Point of Contact: Bradley Schrader, INL/BEA

Brief Description of Best Practice:

The Health Physics Laboratory (HPL), located in Central Facilities Area (CFA) 1618, services the Idaho National Laboratory (INL) by procuring, calibrating, repairing, and testing health physics monitoring instruments and direct reading dosimeters and provides basic research and development support services. CFA-1618 is sometimes identified as the Health Physics Instrumentation Laboratory.

The HPL maintains National Institute of Standards and Technology (NIST) quality calibration services and provides support in specification and acceptance evaluation of new health physics monitoring instrumentation. These instruments are calibrated and maintained in compliance with American National Standards Institute (ANSI) standards.

A request was made to the EFCOG Committee for assistance in information related to re-certifying the Cesium Chloride calibration sources. Argonne National Laboratory and Los Alamos National Laboratory responded and provided background and basis information that led to INLs ability to maintain the exemption from nuclear facility accountability.

The EFCOG radiological safety group provides a complex wide resource for discussion and information on how similar problems are handled at the various national labs. This collaboration allowed us to bring to the discussion what Argonne and Los Alamos generated to solve a similar problem. The Argonne situation was not similar to the INLs but the Los Alamos documentation demonstrated that it was almost exactly what we needed

This allowed the INLs Health Physics Laboratory to maintain less than Category III Radiological Facility Categorization. If the HPL would not have been able to maintain the source exemption it would have been required to generate a facility safety analysis report with a cost in excess of a million dollars.

Why the best practice was used:

DOE-STD-1027-92 allows certain exclusions from a facility's radioactive material inventory when determining the hazard categorization of a facility or activity.

- Sealed radioactive sources that are engineered to pass the Special Form testing specified by the Department of Transportation (DOT) in 49 CFR 173.469, "Tests for Special Form Class 7 (Radioactive) Materials,"¹¹ or testing specified by ANSI N43.6, "Sealed Radioactive Sources - Classification,"¹² may be excluded from summation of a facility's radioactive inventory.

INL BEA EFCOG Best Practice Summary

What are the benefits of the best practice: Sealed sources are specifically excluded in DOE STD 1027 92 from the facility radionuclide inventory if they are engineered to pass the special form testing specified by the DOT in 49 CFR 173.46911 or testing specified by ANSI N43.6.12

Therefore, following this guidance, the INL sealed sources have not previously been considered part of the facility's radioactive material inventory. Six of the Cs-137 sources with original activities of approximately 1,250 Ci (one), 100 Ci (three), and 50 Ci (two) are excluded from inventory for hazard categorization purposes based on special form certifications that expire on October 31, 2019.

Justification for continued exclusion

- A justification for continued inventory exclusion of the six Cs-137 sources after October 31, 2019 is required or the facility will require re-evaluation as a Category 3 nuclear facility at a cost of more than a million dollars.
- The sources were manufactured by REVISS Services (UK), a commercial provider that began business liquidation in 2015 and then was acquired by Nordion (Canada) in 2016. The business focus of Nordion (Canada) is Co-60 gamma sources. With the expiration of the applicable current special form certificates looming, and the uncertain outlook for Nordion (Canada) support to re-certify Cs-137 sources, INL prepared an evaluation and documentation of the history, testing, pedigree, and compliance of the sources to meet the DOT regulations and definition of special form consistent with 49 CFR 173.469.
- To document demonstration of compliance with special form requirements for use with the hazard categorization exclusion for special form materials contained in DOE STD 1027-92, INL has previously relied on the competent authority certifications issued by Great Britain.
- The environmental and physical conditions of source use/location in HPL is non-corrosive environment and scientific use only. It is extremely unlikely that the sources will be subject to extreme conditions, such as fire, physical damage, corrosion, or accident in excess of the source's ANSI performance category classification.
- The sources are inventoried and leak tested at intervals not to exceed six months per 10 CFR 835 Subpart M and INL's Radiation Protection Program. These sources are not intended to be used for any purpose other than as designed for the Hopewell Irradiators.

Los Alamos National Laboratory (LANL) evaluated continued use and inventory exclusion for hazard categorization purposes of radioactive sealed sources at LANL, including cesium chloride sources with up to 1,300 Ci activity.

- The cesium chloride sources evaluated by LANL were manufactured by CIS Bio International in 1992, whereas the HPL cesium chloride sources were manufactured by REVISS in 2002 (five sources) or 2004 (one source). However, the LANL and HPL cesium chloride sources are quite similar in design.

INL BEA EFCOG Best Practice Summary

The following information supporting continued inventory exclusion of the HPL Cs-137 sources was drawn from the LANL analysis:

- The recommended working life (RWL) is not the maximum safe period of use. RWL is a concept first developed in 1980 and adopted by some regulatory bodies without clearly defining the intent and requirements of the RWL.
- The only time RWL would be useful is when there is significant uncertainty in the environment for intended use or where design considerations show the source will deteriorate after a certain time period.
- The LANL calculation demonstrates the suitability of continued use of the Cs-137 sources provided the required periodic leak tests (at least every six months) continue to show no detectable activity.
- The LANL calculation states: "Furthermore, this calculation bounds any other Cs-137 sources of equal or lesser Curie content provided the materials of construction are the same and the capsule geometry and wall thicknesses are equal to or greater than the source design analyzed herein."
- REVISS drawings demonstrate that the INL Cs-137 source materials of construction, capsule geometry, and wall thicknesses are bounded by the LANL analysis

What problems/issues were associated with the best practice: The DOE Idaho Operations Office (DOE-ID) issued Supplemental Guidance on DOE-STD-1027-92, Change 1, to the INL contractor in 2007

- The Supplemental Guidance allows "engineering, test, and safety analysis" to be used instead of current special form certification to justify exclusion of sealed sources for hazard categorization purposes. Without this supplemental guidance the sources could not have been excluded.
- The bounding LANL engineering analysis combined with the Supplemental Guidance provided a complete exclusion argument for the INL Cs-137 sources
- Similar Supplemental Guidance may have been issued by other DOE field offices
- Due to
 - (1) protection provided by doubly encapsulated sources within a robust containment ,
 - (2) the lack of available dispersive energy sources or adverse or extreme environmental conditions (e.g., corrosive environs, excessive thermal, and mechanical stress) in the facility, and
 - (3) the hazard controls provided by the INL Radiation Protection Program, the radiological inventory in the subject Cs-137 sealed sources may continue to be excluded from HPL inventory for hazard categorization purposes after expiration of the applicable special form certificates on October 31, 2019. Source integrity will be monitored at least every six months under the requirements of the INL Radiation Protection Program

INL BEA EFCOG Best Practice Summary

How the success of the Best Practice was measured: HAD revision for the facility including the LANL analysis was submitted to DOE-ID for review and concurrence. That concurrence was received and the sources are excluded from the facility inventory.

- DOE nuclear safety was part of the development of the HAD revision. They commented on earlier versions and this allowed them to expedite concurrence (not approval).
- The HAD revision doesn't meet any of the criteria that would normally drive us to seek DOE-ID approval of a facility hazard categorization (use of alternate release fractions, Type B container exclusion, segmentation, or nature of process).
- And, if we ask for approval, it drives DOE-ID to perform an extensive review so they can issue a Safety Evaluation Report (a formal report approving safety basis documents). If we ask for concurrence, they do not need to issue an SER, so they can perform a less extensive review. So, we requested and received concurrence.

Description of process experience using the Best Practice: The LANL evaluation, supportive DOE-ID Supplemental Guidance, and integration of DOE-ID in our review process were critical to our success in maintaining the CsCl sources exempt from inventory inclusion.

The EFCOG radiological safety group provides a complex wide resource for discussion and information on how similar problems are handled at the various national labs. This collaboration allowed us to bring to the discussion what Argonne and Los Alamos generated to solve a similar problem.

INL BEA EFCOG Best Practice Summary



Office for
Nuclear Regulation

GB/197/S-96
Issue 4
Page 1 of 3

CERTIFICATE OF APPROVAL FOR DESIGN OF SPECIAL FORM RADIOACTIVE MATERIAL

Identification:R6010	Description: Special Form Radioactive Material
Drawing and Specification References Assembly Drawing: GA60100 Issue C Special Form Drawing List: QS6010 Issue 4 dated 5 May 2000 Special Form Design Specification Document: R6010SFA Issue 11 dated 18 July 2013	
Quality Assurance Programme: REVISS Services Quality Manual Issue 8 dated 31 July 2013; Letter Nixon / Barlow dated 16 October 2014 (TRIM 2014/382187)	
Radioactive Material Caesium – 137 (compressed anhydrous)	Maximum Activity 2.0TBq
Actions required before shipment: None specified	

This is to certify that, for the purposes of the Regulations of the International Atomic Energy Agency:

- The Competent Authority of Great Britain in respect of inland surface transport, being the Office for Nuclear Regulation;
- 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;
- 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 the Environment Northern Ireland

approve the above mentioned Special Form Radioactive Material design, as applied for by REVISS Services (UK) Limited.

Special Form Radioactive Material manufactured to this design meets the requirements of the regulations and codes on page 2, relevant to the mode of transport, subject to the following general conditions:

This certificate is valid for Special Form Radioactive Material manufactured before the end of August 2014; and

In the event of any alteration in the design of the Special Form Radioactive Material; the Quality Assurance Programme(s) [unless the alteration falls within the agreed change control procedures set out in the programme(s)]; or in any of the facts stated in the application for approval, this certificate will cease to have effect unless the Office for Nuclear Regulation is notified of the alteration and the Office for Nuclear Regulation confirms, on behalf of the relevant Competent Authority, the certificate notwithstanding the alteration.

Expiry Date: This certificate cancels all previous issues and is valid until the end of October 2019.

COMPETENT AUTHORITY IDENTIFICATION MARK: GB/197/S-96

Signature:

Date of Issue: 23 October 2014

David Ian Barlow, Superintending Inspector
Office for Nuclear Regulation
4SG Redgrave Court
Merton Road, Bootle
Merseyside L20 7HS

on behalf of the Office for Nuclear Regulation; the Department for Transport; the Civil Aviation Authority; and the Department of the Environment Northern Ireland

This certificate does not relieve the consignor from compliance with any requirement of the government of any country through or into which the package will be transported.

TRIM Reference: 2014/346302

CsCl Source Inclusion in the HPL Facility Categorization –Status Update

**Chere' D. Morgan
INL Radiological Control Director**

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Health Physics Laboratory

- The Health Physics Laboratory (HPL), located in Central Facilities Area (CFA) 1618, services the Idaho National Laboratory (INL) by procuring, calibrating, repairing, and testing health physics monitoring instruments and direct reading dosimeters and provides basic research and development support services. CFA-1618 is sometimes identified as the Health Physics Instrumentation Laboratory.
- The HPL maintains National Institute of Standards and Technology (NIST) quality calibration services and provides support in specification and acceptance evaluation of new health physics monitoring instrumentation. These instruments are calibrated and maintained in compliance with American National Standards Institute (ANSI) standards.

Gamma Beam Lab (GBL)

- The GBL allows irradiations to be performed using one of eight sources (seven specified and a dummy blank) stored below the floor in a carousel.
- The gamma source activities are nominally 1,250 Ci, 100 Ci, 10 Ci, 0.5 Ci, and 0.015 Ci of Cs 137, and 250 Ci and 2.5 Ci of Co 60.
- The HPL is categorized as a radiological facility in accordance with 10CFR830 subpart B.

Gamma Beam Lab



Facility Categorization

- DOE-STD-1027-92 allows certain exclusions from a facility's radioactive material inventory when determining the hazard categorization of a facility or activity.
 - 1. Sealed radioactive sources that are engineered to pass the Special Form testing specified by the Department of Transportation (DOT) in 49 CFR 173.469, "Tests for Special Form Class 7 (Radioactive) Materials,"¹¹ or testing specified by ANSI N43.6, "Sealed Radioactive Sources - Classification,"¹² may be excluded from summation of a facility's radioactive inventory.

**CERTIFICATE OF APPROVAL FOR DESIGN OF
SPECIAL FORM RADIOACTIVE MATERIAL**

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Drawing and Specification References Assembly Drawing: GA60100 Issue C Special Form Drawing List: QS6010 Issue 4 dated 5 May 2000 Special Form Design Specification Document: R6010SFA Issue 11 dated 18 July 2013	
Quality Assurance Programme: REVISS Services Quality Manual Issue 8 dated 31 July 2013; Letter Nixon / Barlow dated 16 October 2014 (TRIM 2014/382187)	
Radioactive Material Caesium – 137 (compressed anhydrous)	Maximum Activity 2.0TBq
Actions required before shipment: None specified	

This is to certify that, for the purposes of the Regulations of the International Atomic Energy Agency:

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- 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 the Environment Northern Ireland

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David Ian Barlow, Superintending Inspector
Office for Nuclear Regulation
45G Redgrave Court
Merton Road, Bootle
Merseyside L20 7HS

on behalf of the Office for Nuclear Regulation; the Department for Transport; the Civil Aviation Authority; and the Department of the Environment Northern Ireland

This certificate does not relieve the consignor from compliance with any requirement of the government of any country through or into which the package will be transported.

CsCl powder

- Sealed sources are specifically excluded in DOE STD 1027 92 from the facility radionuclide inventory if they are engineered to pass the special form testing specified by the DOT in 49 CFR 173.46911 or testing specified by ANSI N43.6.12
 - Therefore, following this guidance, these sealed sources have not considered part of the facility's radioactive material inventory. Six of the Cs-137 sources with original activities of approximately 1,250 Ci (one), 100 Ci (three), and 50 Ci (two) are excluded from inventory for hazard categorization purposes based on special form certifications that expire on October 31, 2019.
 - The sources are cesium chloride powder form within inner and outer Type 316L stainless steel capsules sealed by a tungsten inert gas (TIG) weld .

Justification for continued exclusion

- A justification for continued inventory exclusion of the six Cs-137 sources after October 31, 2019 is required or the facility will require re-evaluation as a Category 3 nuclear facility.
- The sources were manufactured by REVISS Services (UK), a commercial provider that began business liquidation in 2015 and then was acquired by Nordion (Canada) in 2016. The business focus of Nordion (Canada) is Co-60 gamma sources. With the expiration of the applicable current special form certificates looming, and the uncertain outlook for Nordion (Canada) support to re-certify Cs-137 sources, INL prepared an evaluation and documentation of the history, testing, pedigree, and compliance of the sources to meet the DOT regulations and definition of special form consistent with 49 CFR 173.469.

Basis for Exclusion after Certification Expiration

- To document demonstration of compliance with special form requirements for use with the hazard categorization exclusion for special form materials contained in DOE STD 1027-92, INL has previously relied on the competent authority certifications issued by Great Britain.

Environmental

- The environmental and physical conditions of source use/location in HPL is non-corrosive environment and scientific use only. It is extremely unlikely that the sources will be subject to extreme conditions, such as fire, physical damage, corrosion, or accident in excess of the source's ANSI performance category classification. Cs-137 decays to Ba-137m by gamma and beta emission. Ba-137m decays by gamma

Inventory and Leak Testing

- The sources are inventoried and leak tested at intervals not to exceed six months per 10 CFR 835 Subpart M and INL's Radiation Protection Program. These sources are not intended to be used for any purpose other than as designed for the Hopewell Irradiators.

Comparison of Requirements

Test	IAEA SSR-6 (2018)	DOT 49 CFR 173.469* Note: Cited in DOE-STD-1027-92	ANSI N542/N43.6** (1977/1989) Testing Criteria (Subject Sources meet AN Class E63646) Note: Cited DOE-STD-1027-92
Heat Test	The specimen shall be heated in air to a temperature of 800 °C and held at that temperature for a period of 10 minutes and shall then be allowed to cool. (DOT EQUIVALENT)	The specimen must be heated in air to a temperature of not less than 800 °C (1,475 °F), held at that temperature for a period of 10 minutes, and then allowed to cool. (IAEA EQUIVALENT)	See ANSI temp test.
ANSI Temperature (Class 6)	IAEA N/A	DOT N/A	-40°C (20 min) +800°C (1 hr thermal shock 800°C to 20°C (NOTE: More stringent test than DOT special form heat test.)
ANSI External Pressure (Class 3)	IAEA N/A	DOT N/A	25 kN/m ² abs. to 2 MN/m ² (290 lbf/in ²) absolute. (NOTE: Additional and more stringent test than DOT special form testing since there is no DOT test for vibration.)
Impact Test (Drop)	The specimen shall drop onto the target from a height of 9 m. The target for the free drop test shall be a flat, horizontal surface of such character that any increase in its resistance to displacement or deformation upon impact by the specimen would not significantly increase the damage to the specimen. (DOT EQUIVALENT)	The specimen must fall onto the target from a height of 9 m (30 ft) or greater. The target for the free drop test must be a flat, horizontal surface of such mass and rigidity that any increase in its resistance to displacement or deformation upon impact by the specimen would not significantly increase the damage to the specimen. (IAEA EQUIVALENT)	ANSI N/A
ANSI Impact Test (Class 6)	IAEA N/A	DOT N/A	20 kg (44 lb) from 1 m

Los Alamos National Laboratory Analysis of Similar Cs-137 Sources

- Los Alamos National Laboratory (LANL) evaluated continued use and inventory exclusion for hazard categorization purposes of radioactive sealed sources at LANL, including cesium chloride sources with up to 1,300 Ci activity.
- The cesium chloride sources evaluated by LANL were manufactured by CIS Bio International in 1992, whereas the HPL cesium chloride sources were manufactured by REVISS in 2002 (five sources) or 2004 (one source). However, the LANL and HPL cesium chloride sources are quite similar in design.

LANL Analysis

- The following information supporting continued inventory exclusion of the HPL Cs-137 sources is drawn from the LANL analysis:
 - The recommended working life (RWL) is not the maximum safe period of use. RWL is a concept first developed in 1980 and adopted by some regulatory bodies without clearly defining the intent and requirements of the RWL.
 - The only time RWL would be useful is when there is significant uncertainty in the environment for intended use or where design considerations show the source will deteriorate after a certain time period.

LANL Analysis Continued

- The LANL calculation demonstrates the suitability of continued use of the Cs-137 sources provided the required periodic leak tests (at least every six months) continue to show no detectable activity.
- The LANL calculation states: “Furthermore, this calculation bounds any other Cs-137 sources of equal or lesser Curie content provided the materials of construction are the same and the capsule geometry and wall thicknesses are equal to or greater than the source design analyzed herein.”
- REVISS drawings demonstrate that the INL Cs-137 source materials of construction, capsule geometry, and wall thicknesses are bounded by the LANL analysis

DOE-ID Supplemental Guidance

- The DOE Idaho Operations Office (DOE-ID) issued Supplemental Guidance on DOE-STD-1027-92, Change 1, to the INL contractor in 2007
- The Supplemental Guidance allows “engineering, test, and safety analysis” to be used instead of current special form certification to justify exclusion of sealed sources for hazard categorization purposes
- The bounding LANL engineering analysis combined with the Supplemental Guidance provides a complete exclusion argument for the INL Cs-137 sources
- Similar Supplemental Guidance may have been issued by other DOE field offices

Conclusion

- Due to
 - (1) protection provided by doubly encapsulated sources within a robust containment ,
 - (2) the lack of available dispersive energy sources or adverse or extreme environmental conditions (e.g., corrosive environs, excessive thermal, and mechanical stress) in the facility, and
 - (3) the hazard controls provided by the INL Radiation Protection Program,
 - the radiological inventory in the subject Cs-137 sealed sources may continue to be excluded from HPL inventory for hazard categorization purposes after expiration of the applicable special form certificates on October 31, 2019. Source integrity will be monitored at least every six months under the requirements of the INL Radiation Protection Program

Today

- HAD revision for the facility including the LANL analysis has been submitted to DOE for concurrence.
 - DOE nuclear safety has been part of the development of the HAD revision. They commented on earlier versions and is expected to expedite concurrence.
 - The HAD revision doesn't meet any of the criteria that would normally drive us to seek DOE-ID approval of a facility hazard categorization (use of alternate release fractions, Type B container exclusion, segmentation, or nature of process).
 - Also, if we ask for approval, it drives DOE-ID to perform an extensive review so they can issue a Safety Evaluation Report (a formal report approving safety basis documents). If we ask for concurrence, they do not need to issue an SER, so they can perform a less extensive review. So, we requested concurrence

Take away

- The LANL evaluation, supportive DOE-ID Supplemental Guidance, and integration of DOE-ID in our review process were critical to our success in maintaining the CsCl sources exempt from inventory inclusion.
- Request concurrence and not approval.