

# **Safety Analysis Report for Packaging Safkeg-LS Design No. 3979A Package Docket No. 71-9337**



# **Safety Analysis Report for Packaging Safkeg-LS Design No. 3979A Package Docket 71-9337**



**Application for Approval by the NRC**

**Applicant: Croft Associates Limited**



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### 0 SARP STATUS AND CONTENTS

This Safety Analysis Report for Packaging (SARP) has been prepared by Croft Associates Ltd for the new approval of the SAFKEG-LS Design No. 3979A transport package as a Type B(U) design.

This section (Section 0) defines the document status and lists the contents of the SARP (SARP sections and appended documents included in the SARP).

This SARP is a controlled document under the Croft Associates Ltd Quality Assurance Program approved by the NRC under Approval Number 71-0939.

Revisions are controlled on a document basis, with revisions indicated by a vertical change bar in the right hand margin.

Reference documents, which are listed in the Appendices to each section, are those available in the general literature and are not provided in the SARP.

Supporting documents are those developed specifically for the SARP and are provided in the section that is most closely associated with the document. These supporting documents are listed in this section, together with their revision status.

Document control for the supporting documents, which have been produced by different organizations at different times with different styles, is established by reference designations and issue status and/or date: there is no significance in the various policies of adding the names of author, checker or approver or whether they are manually or electronically signed.

## 0.1 SARP REVISION STATUS

<b>Title</b> SAFKEG-LS 3979A Docket No. 71-9337	<b>Number</b> CTR 2008/10
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## 0.2 SUPPORTING DOCUMENT REVISION STATUS

Document Reference	Issue Status	Title
<b>Section 1 - GENERAL INFORMATION</b>		
<b>Documents in Section 1.3 Appendix</b>		
<b>Documents in Section 1.3.2 Calculation Model Drawings</b>		
0C-6049	Issue A	Safkeg-LS Construction
1C-6097	Issue A	Containment Vessel LS Lid Construction
1C-6099	Issue A	Containment Vessel LS Body Construction
<b>Documents in Section 1.3.3 Licensing Drawings</b>		
1C-6040	Issue B	Cover sheet for Safkeg-LS design no. 3979A (licensing drawing)
0C-6041	Issue A	Safkeg-LS design no. 3979A (licensing drawing)
0C-6042	Issue B	Keg design no. 3979 (licensing drawing)
0C-6043	Issue A	Cork set for Safkeg-LS (licensing drawing)
1C-6044	Issue B	Containment vessel design no. 3980 (licensing drawing)
1C-6045	Issue B	Containment vessel lid (licensing drawing)
1C-6046	Issue B	Containment vessel body (licensing drawing)

Document Reference	Issue Status	Title
2C-6171	Issue A	LS-12x65-Tu insert design no. 3984 (licensing drawing)
2C-6172	Issue A	LS-31x73-Tu insert design no. 3983 (licensing drawing)
2C-6175	Issue A	LS-50x103-SS insert design no. 3986 (licensing drawing)
<b>Documents in Section 1.3.4 Supporting Documents</b>		
PCS 036	Issue B	Package Contents Specification for Safkeg-LS - Package Design No 3979A
<b>Section 2 - STRUCTURAL EVALUATION</b>		
<b>Documents in Section 2.12.2, Appendix</b>		
CTR 2009/21	Issue B	Prototype Safkeg-LS 3979A/0002 NCT and HAC Regulatory Test Report
SERCO/TAS/002762/01	Issue 1	Compression Testing of Cork
Vectra, 925-3272/R1	Rev 4	Stress Analysis of Safkeg LS 3979A Containment Vessel
CS 2010/11	Issue A	Calculation of the Density of the 3977A Package
Vectra, 925-3274/R1	Rev 1	Safkeg LS 3979A – Additional HAC Case
<b>Section 3 - THERMAL EVALUATION</b>		
<b>Documents in Section 3.5.2, Appendix</b>		
SERCO/TAS/5388/001	Issue 2	Thermal Analysis of the Safkeg LS Design



Document Reference	Issue Status	Title
<b>Section 4 - CONTAINMENT</b>		
<b>Documents in Section 4.5.2, Appendix</b>		
CS 2009/06	Issue A	SAFKEG-LS # 3979A - CV seal leak size for leaktight condition
CS 2009/07	Issue A	SAFKEG-LS 3979A - Gas contents limit for leaktight condition
<b>Section 5 - SHIELDING EVALUATION</b>		
<b>Documents in Section 5.5.2, Appendix</b>		
CTR2009/22	Issue A	SAFKEG LS 3979A: Package Activity Limits Based on Shielding
SERCO/TAS/003191/001	Issue 1	Monte Carlo Modelling of Safkeg LS Container
<b>Section 6 - CRITICALITY EVALUATION</b>		
<b>Documents in Section 6.9, Appendix</b>		
None	-	
<b>Section 7 - OPERATING PROCEDURES</b>		
<b>Documents in Section 7.5, Appendix</b>		
None	-	
<b>Section 8- ACCEPTANCE TESTS AND MAINTENANCE PROGRAM</b>		

Document Reference	Issue Status	Title
Documents in Section 8.3, Appendix		
None	-	



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## 1 GENERAL INFORMATION

### 1.1 Introduction

This Safety Analysis Report for Packaging (SARP) has been prepared by Croft Associates Ltd for the new approval of the Safkeg-LS 3979A package as a Type B(U) design.

The Safkeg-LS 3979A package is a general purpose container for the transport of non-fissile nuclides and limited quantities of fissile nuclides as specified under NRC general licenses, under non exclusive use. The contents may be in solid, liquid and gaseous form. The modes of transport specified are road, rail, sea and air. A detailed list of the nuclides can be found in Section 1.2.2. The contents of the package include some nuclides in excess of 3000 A<sub>2</sub> and therefore the package is classified as Category I as defined in NUREG 1609 [1.1].

The Safkeg-LS 3979A package was designed in 2008 and a prototype package fabricated and tested in 2009. Analysis of the safety of the design has also been carried out: the results of the tests and the analysis are provided in this SARP.

All design, manufacturing and testing has been carried out in accordance with the Croft Quality Assurance program which complies with 10 CFR 71 subpart H [1.2] and is approved by the NRC under Approval Number 0939. This SARP has been prepared in accordance with Regulatory Guide 7.9 [1.3] and demonstrates that the package meets all the applicable requirements in 10 CFR 71 [1.2].

## **1.2 Package Description [ 71.33]**

### **1.2.1 Packaging**

#### **1.2.1.1 General**

The general arrangement of the Safkeg-LS 3979A package is provided in drawing OC-6041 in Section 1.3.3. The drawing shows the package and details all the nominal dimensions and the major design features.

The Safkeg-LS 3979A package (generally called the package in this SARP) consists of a single resealable containment vessel (generally called the CV in this SARP) Design No. 3980 (stainless steel with encased lead shielding), carried within insulating cork packing in an outer stainless steel keg Design No.3979 (generally called the Keg in this SARP).

Section views of the package and the CV are shown in Figures 1-1 and 1-2 respectively. These figures also give the nomenclature used throughout this report.

The maximum weight of the package is 62.1 kg (137 lbs) excluding the contents. The maximum contents weight is 5.9 kg (13 lbs), therefore the gross weight of the package is 68 kg (150 lbs).

#### **1.2.1.2 3979 Keg**

The keg Design No.3979 has a stainless steel outer shell and a stainless steel liner between which insulating cork is fitted. The keg is sealed as it has an O-ring weather seal in its closure, however, there is a fuse plug fitted at the bottom of the keg. This fuse plug contains a low melting point alloy which will vent during the HAC fire test providing pressure relief.

The keg is closed by a flat stainless steel lid which is bolted down with 8 stainless steel studs and nuts against a single O-ring which provides a weather seal to keep rain from entering the keg. The studs are fitted with seal holes for the fitting of a tamper indicating device in accordance with 10 CFR 71.43(b). The lid may also be further secured, to prevent unauthorized removal, by a padlock attached to a lock pin welded to the keg closure flange.

Due to the relatively low weight and size of the package, there are no specific design features to allow for the tie down and handling of the package.



An inner cork liner is fitted between the keg liner and the CV. The inner cork liner consists of a body and a top cork. There is no cork directly underneath the CV as it sits on the keg liner. The top cork varies in thickness between 67.5 mm and 85.5 mm; the variation in thickness is to accommodate the design of the CV lid. The side wall thickness of the inner cork varies from 30.5 mm at the top of the CV to 57 mm at the bottom of the CV. The surface of the cork is sealed with a water-based sealant to enhance its appearance and reduce the potential to produce dust.

#### **1.2.1.3 3980 CV**

The CV is composed of a body and a lid (see Figure 1-2).

The CV body is fabricated from three pieces of stainless steel: the CV flange/cavity wall, the CV outer wall and the CV base. Each piece is machined from solid. The CV flange/cavity wall is welded to the CV outer wall to form the cavity into which the body lead shielding is cast. The base is then welded to the outer wall. Drawing 1C-6044 in Section 1.3.3 shows the general arrangement of the CV body.

The CV lid is fabricated from two pieces of stainless steel, the CV lid top and the CV lid shielding casing. Both pieces are machined from solid. The CV lid shielding casing has the shielding lead cast inside to a depth of 22 mm; the CV lid shielding casing is then welded to the CV lid top. Drawing 1C-6045 in Section 1.3.3 shows the general arrangement of the CV lid.

The CV lid is held in position by eight recessed alloy steel screws. The seal between the CV body and the CV lid is effected by two EPDM O-ring seals of 3 mm cord diameter. Access to the interspace between the two O-rings is provided for operational and maintenance leak testing. Leak testing is required for the CV to ensure that it meets the regulatory release limits specified in 10 CFR 71.51.

The CV has a cavity of overall length of 109 mm and a diameter of 64.5 mm. The vessel operates at atmospheric pressure, although the internal pressure may vary due to heating of the gases within the CV by decay heat of the contents and atmospheric temperature and pressure changes.

#### **1.2.1.4 Containment Boundary**

Figure 1-3 shows the containment boundary of the Safkeg-LS 3979A package. As shown, the containment boundary consists of the CV flange/cavity wall, the CV lid top and the inner O-ring containment seal of CV. The containment seal is tested on manufacture, during periodic maintenance and in operation, to ensure it remains

within regulatory limits regarding leak rate under both NCT and HAC. Section 4 discusses the containment boundary in further detail.

#### **1.2.1.5 Gamma Shielding**

Figure 1-4 shows the gamma shielding present in the Safkeg-LS 3979A package. Beta and Gamma shielding is provided principally by the lead present in the CV body and lid; the steel of the CV provides some additional shielding. The lead is cast in position inside the stainless steel cladding of the CV body and the CV lid. Therefore there are no gaps in the lead shielding or at the interface of the lead and steel parts. The CV is designed so that the shielding in the lid and body are stepped to reduce radiation streaming. The upstanding ring on the lid also provides some additional steel shielding to reduce the radiation streaming from the gap between the CV Lid and CV Body.

The contents of the package are defined as everything that is carried within the CV cavity. For all contents, one of the inserts specified in Section 1.2.2 and shown in Figures 1-5a, 1-5b or 1-5c, is required. These inserts provide different amounts of shielding and also provide confinement for all contents under NCT and confinement for solid contents under HAC.

#### **1.2.1.6 Energy Absorbing Features**

The outer cork, top cork and inner cork provide insulation and energy absorption thus providing protection to the CV during NCT and HAC (see Figure 1-1).

The outer cork is located between the keg liner and the keg outer shell. The outer cork is protected by the keg liner and not intended to be replaced. The inner cork and top cork are readily removable and intended to be replaced if required at pre-shipment or annual maintenance.

#### **1.2.1.7 Heat Transfer Features**

The contents of the Safkeg-LS 3979A package are limited to have a maximum heat output of 10 W for solid or gaseous contents and 5W for liquid contents. With such a small heat source no specific heat transfer design features are required.

Thermal protection of the contents from external heat sources such as insulation or fire is provided by the outer cork, top cork and inner cork. During HAC, the keg is designed to vent by melting of the low melting point alloy in the fuse plug, thus



preventing any pressure build up within the keg cavity due to gasses arising from pyrolysis of the cork.

#### **1.2.1.8 Labelling**

The keg is fitted with a name plate to comply with the requirement in 10 CFR 71.85 [1.2] and 49 CFR 172.310 [1.4].

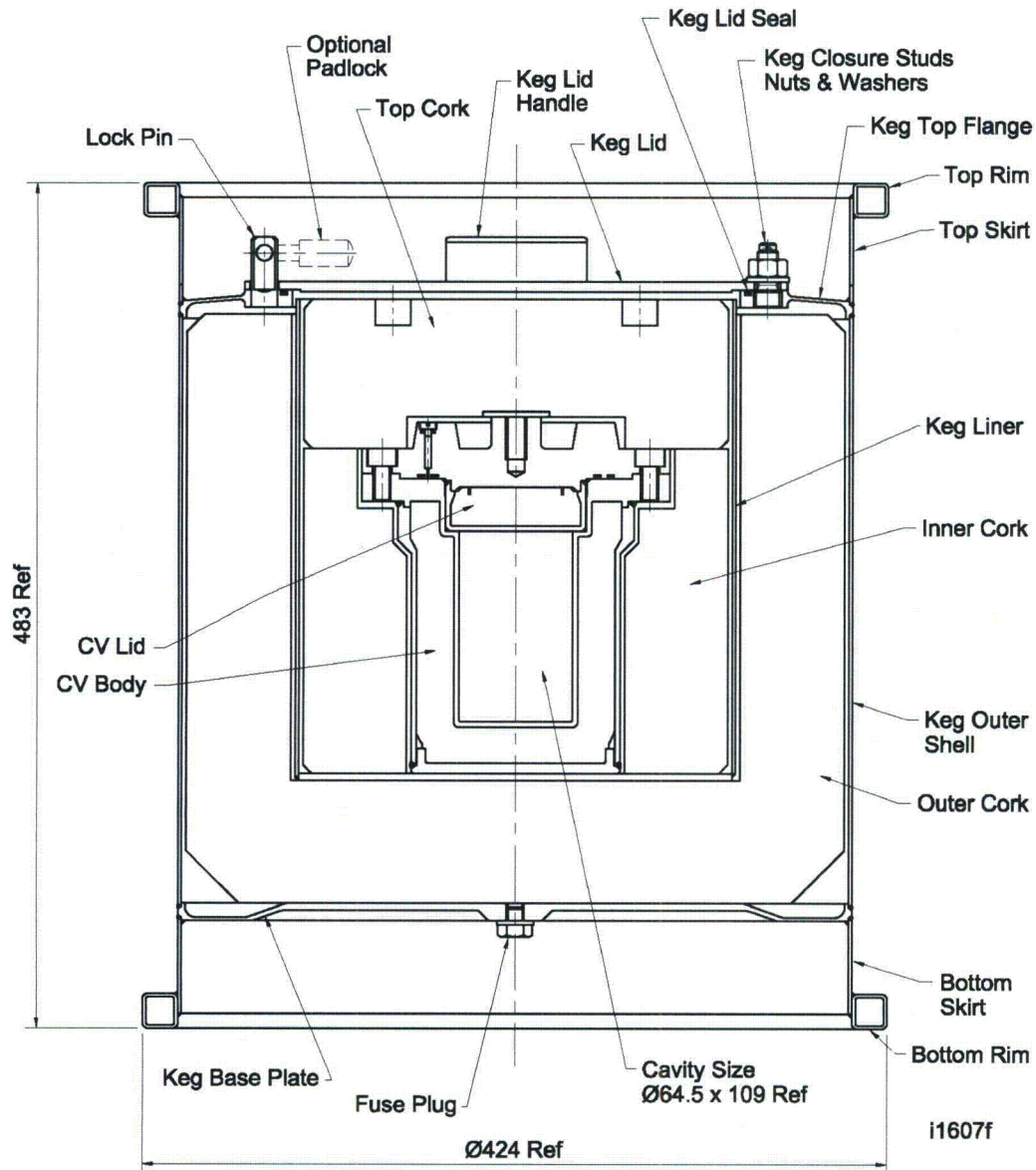
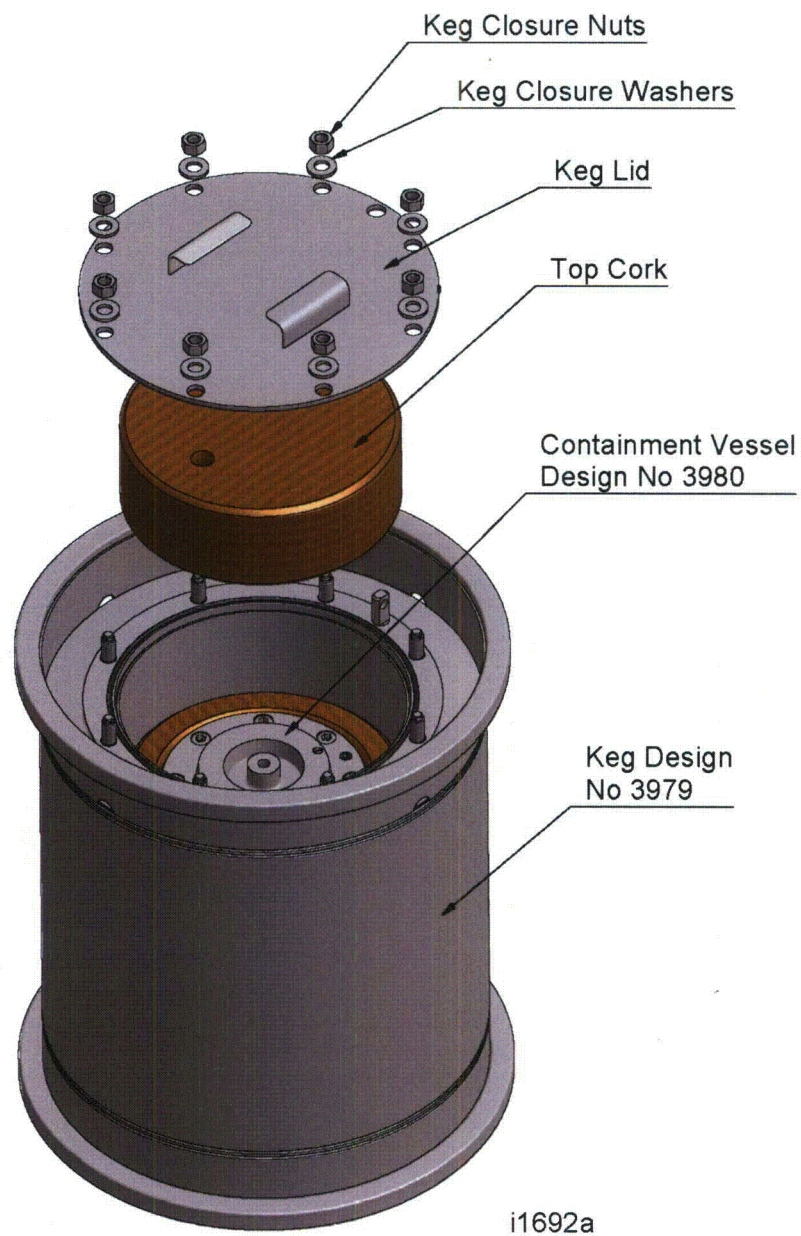


Figure 1-1a Safkeg-LS 3979A package – Section View and Nomenclature





Safkeg LS Design No 3979A

**Figure 1-1b Safkeg-LS 3979A package – Isometric view**

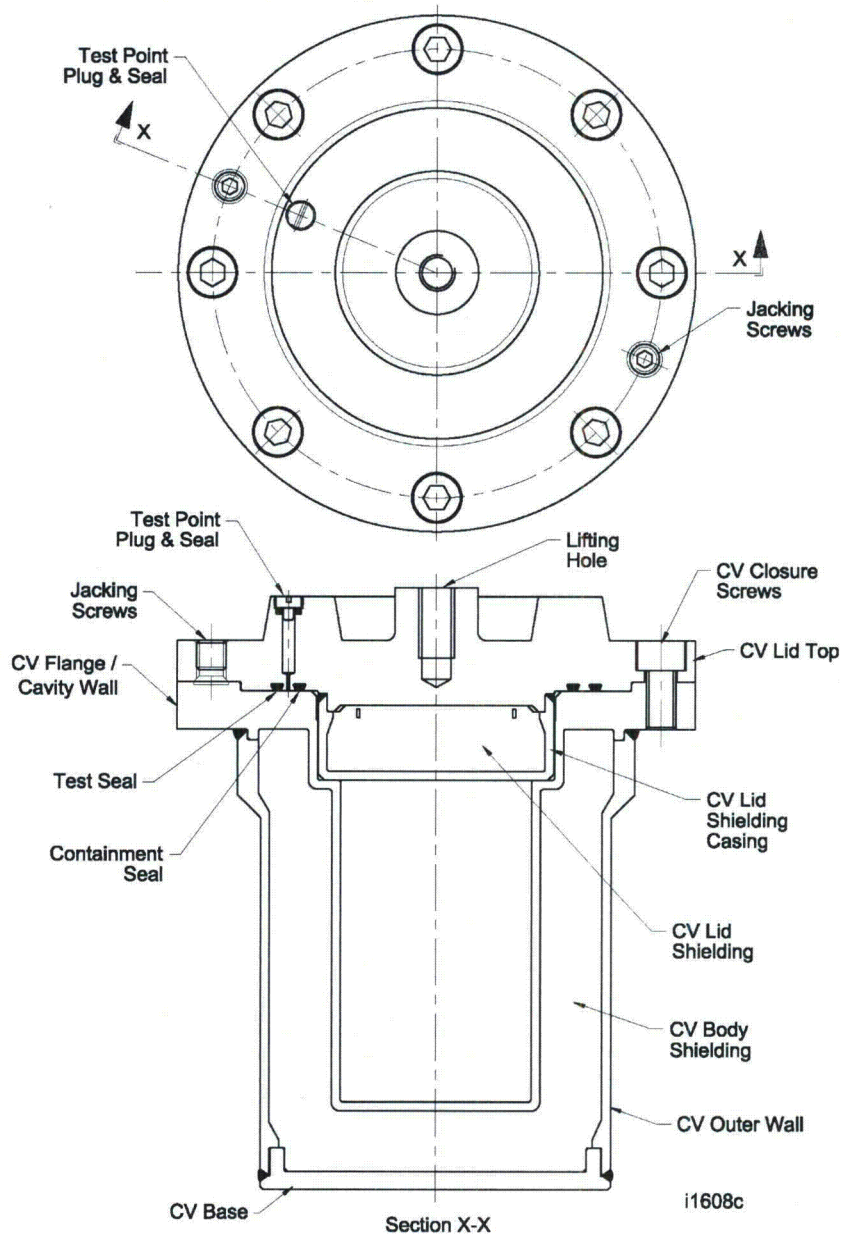
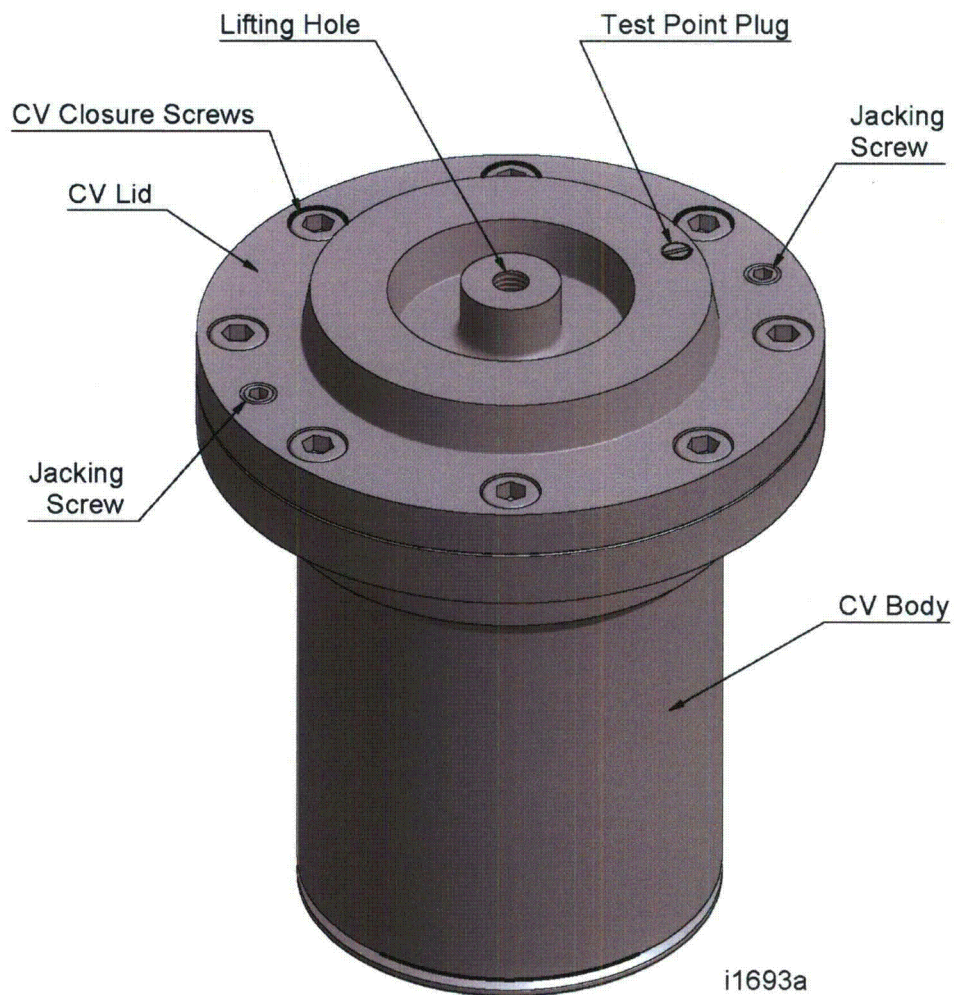


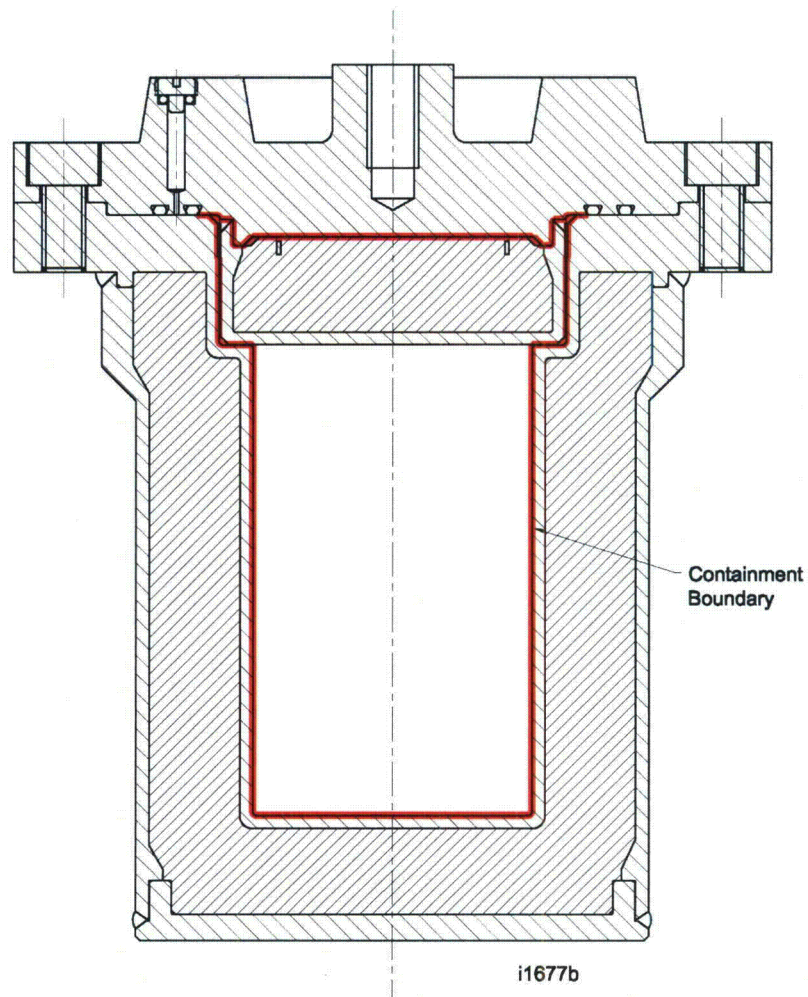
Figure 1-2a 3980 CV – Top and Section View and Nomenclature



Containment Vessel Design No 3980

**Figure 1-2b 3980 CV – Isometric View**





**Figure 1-3 Containment boundary of the Safkeg-LS 3979A package**

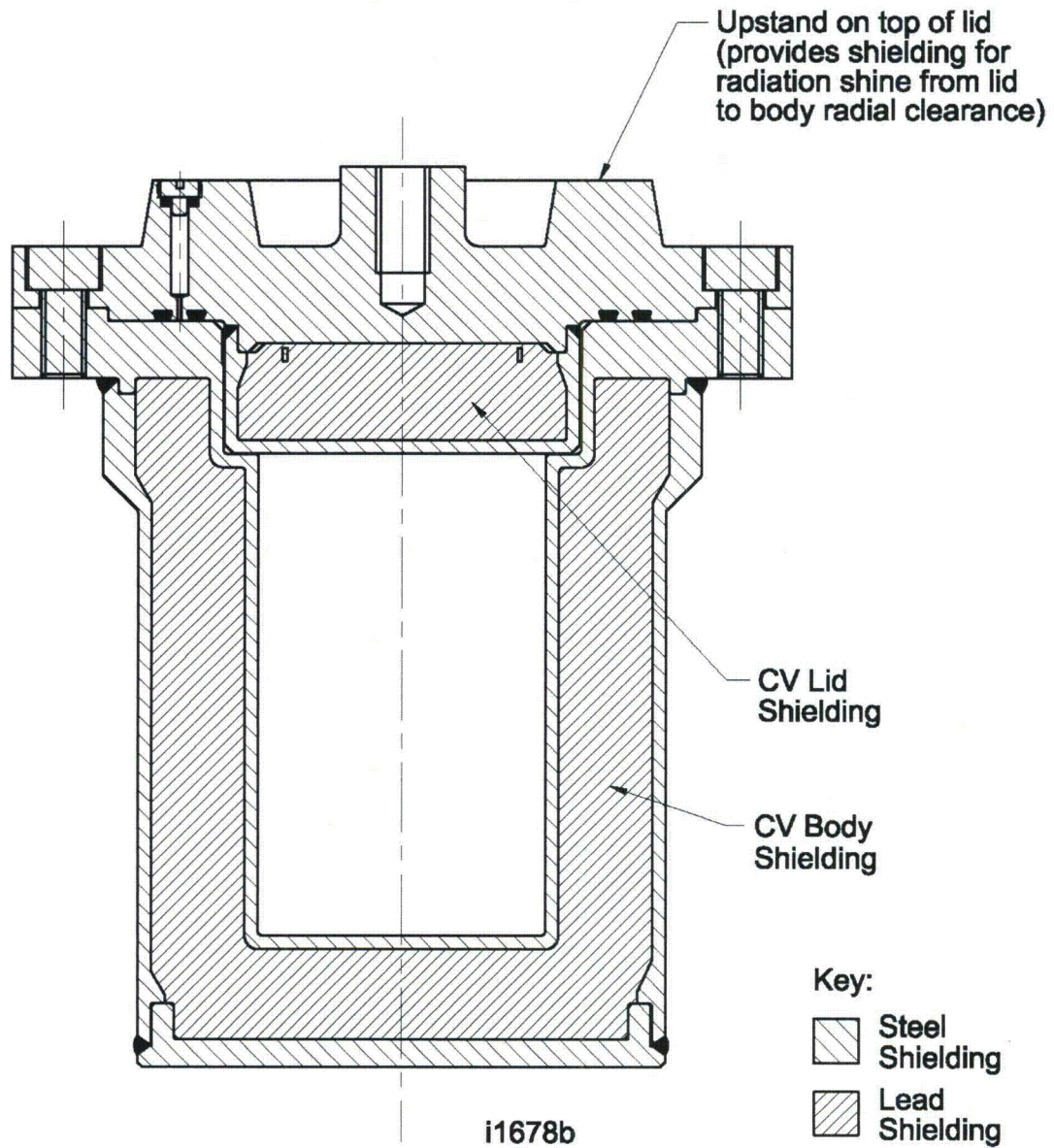


Figure 1-4 Gamma shielding present in the Safkeg-LS 3979A package

## 1.2.2 Contents

### 1.2.2.1 Contents - General

The Safkeg-LS 3979A package is designed as a general purpose package for radioactive material that requires no shielding or limited shielding. The inserts provide additional shielding for radioactive material that requires a significant amount of shielding.

The package is designed for radioactive material that emits alpha, beta or gamma radiation. The specified contents do not include materials that emit a significant amount of neutrons.

The contents may be in solid, liquid or gaseous form.

The contents may also include inorganic non-radioactive materials associated with the radioactive materials, such as contents holders or fixtures and packing materials. No organic/hydrogenous materials are allowed in the cavity of the CV.

Fissile materials and irradiated fissile materials containing fission products are permitted within the limits specified in Table 1-3-7.

Pyrophoric materials are permitted under the conditions specified.

As the maximum contents are  $> 3,000 A_2$ , the package is designated as Category I as defined in NUREG 1609 [1.1].

The maximum activity of the radioactive contents is limited principally by the radiation shielding.

The contents heat limit is 10 W for solid or gaseous contents and 5W for liquid contents.

The contents will be carried in a product container appropriate for the contents and chosen by the shipper.

The product containers will, in all cases, be carried in shielding inserts as specified in the licensing drawings in section 1.3.3.

The maximum mass of all material (radioactive contents, product capsules or containers, shielding inserts, and all associated items such as product container holders and packing) inside the CV is 5.9 kg (13 lbs).



Various restrictions and limits of quantity of radionuclides apply according to the insert used and the form of the radioactive material (solid, liquid or gas). These restrictions and contents limits are detailed in Section 1.2.2 in the tables for the different Contents Types (eg CT-1).

The maximum pressure assumed for the CV under NCT and HAC is 7 barg (100 psig): this is the design envelope.

#### 1.2.2.2 Inserts

The inserts, which are required for all contents (in suitable product containers), provide different degrees of shielding and confinement under NCT.

The inserts are as shown in Figures 1-5a, 1-5b or 1-5c. The weights of the inserts and the contents of the inserts are given in Table 1-1.

Table 1-1 Maximum mass of the radionuclides				
Shielding Insert	Mass of Insert	Mass of steel cavity filler	Mass of insert + steel cavity filler	Maximum mass of radionuclides (nominally 50% of max steel cavity filler)
	g	g	kg (rounded)	g
LS-12x65-Tu Design No 3984	5,750	57	5.8	30
LS-31x73-Tu Design No 3983	4,860	429	5.3	200
LS-50x103-SS Design No 3986	570	1570	2.1	800

The insert designation is coded as below.

- 1<sup>st</sup> 2 letters eg LS      Designate the insert fits the Safkeg-LS
- Numbers eg 12x65      indicate the cavity size of the insert (dia mm x ht mm)
- Last 2 letters      Tu indicates tungsten and SS indicates stainless steel

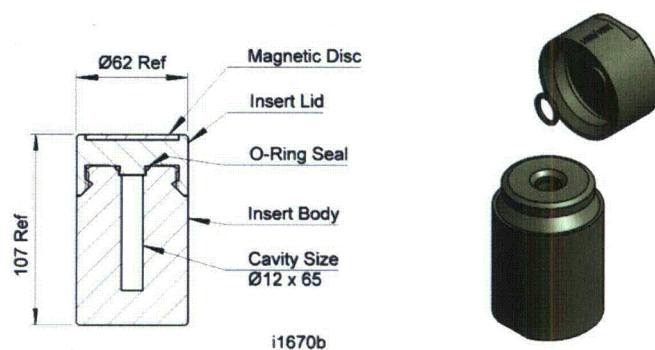


Figure 1-5a Shielding insert LS-12x65-Tu – Design # 3984

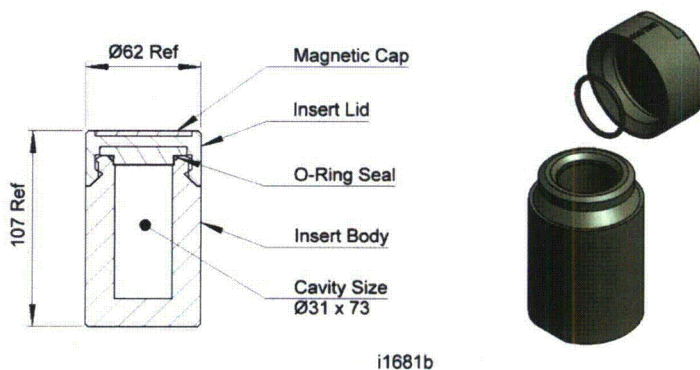


Figure 1-5b Shielding insert LS-31x73-Tu – Design # 3983

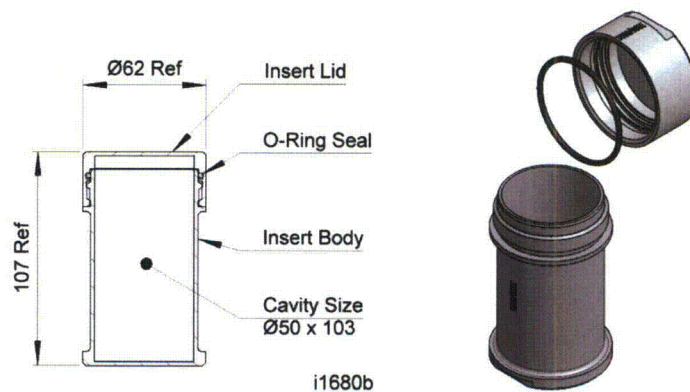


Figure 1-5c Shielding insert LS-50x103-SS – Design # 3986

### 1.2.2.3 Contents Types

The contents to be carried shall be as specified in the Contents Types listed in Table 1-2.

The package activity limit for each Contents Type is given in Tables 1-3-1 to 1-3-8. **These tables specify the shipping limits for the package.**

The limit for each nuclide **given in Tables 1-4-1 to 1-4-8** is determined as the least of the limits determined on the basis of heat output, mass limit, shielding limit and, for gas contents, the limit based on allowable leakage under NCT or HAC. The details of the determinations are given in report PCS 036 (Section 1.3.4).

**Note that the shipping limits must not exceed any of the limits in Tables 1-3-1 to 1-3-8.**

Table 1-2 Contents Types				
Contents Type Designation	Material Form	Shielding Insert	General Requirements for each Contents Type	Activity Limits for each Contents Type
CT-1	Solid	LS-12x65-Tu Design No 3984	See Table 1-3-1	See Table 1-4-1
CT-2	Solid	LS-31x73-Tu Design No 3983	See Table 1-3-2	See Table 1-4-2
CT-3	Solid	LS-50x103-SS Design No 3986	See Table 1-3-3	See Table 1-4-3
CT-4	Liquid	LS-31x73-Tu Design No 3983	See Table 1-3-4	See Table 1-4-4
CT-5	Liquid	LS-50x103-SS Design No 3986	See Table 1-3-5	See Table 1-4-5
CT-6	Gas	LS-31x73-Tu Design No 3983	See Table 1-3-6	See Table 1-4-6
CT-7	Solid/ Fissile Normal Form	LS-50x103-SS Design No 3986	See Table 1-3-7	See Table 1-4-7
CT-8	Solid/ Fissile Special Form	LS-50x103-SS Design No 3986	See Table 1-3-8	See Table 1-4-8



**Table 1-3-1 CT-1 – Solid in heavy tungsten insert (LS-12x65-Tu Design No 3984)**

Parameter	Restrictions
Contents Type name	CT-1 – Solid in heavy tungsten insert
Comments on contents	General use including bulk medical and industrial source material.
Insert in CV cavity	LS-12x65-Tu Design No 3984 (mass 5,750g)
Maximum quantity of radioactive material	See Table 1-4-1
Maximum mass of radioactive material	30g
Mixtures of radionuclides	Mixtures of the nuclides are allowed providing that the sum of the proportionate amounts of each nuclide with respect to the quantity shown does not exceed unity.
Maximum decay heat of radioactive material	10W
Maximum quantity of fissile material	None
Physical form of radioactive material	Solid
Chemical form of radioactive material	Element or compound <b>Compound only for Cs, Hg, I, Na and P.</b>
Pyrophoric contents	The contents may be pyrophoric.
Product containers	The radioactive material may be carried in any convenient product container such as a quartz vial or aluminum capsule. Irradiated items may be carried in a plastic or metal can or wrapping to minimize the contamination of the insert.
Location of radioactive material	Within the shielding insert
Maximum weight of contents of the CV	5.9 kg This includes the insert, radioactive material, product containers and any other packing.
Maximum weight of contents of the insert	57g
Loading restrictions	None

<b>Table 1-3-2 CT-2 – Solid in light tungsten insert (LS-31x73-Tu Design No 3983)</b>	
<b>Parameter</b>	<b>Restrictions</b>
Contents Type name	CT-2 – Solid in light tungsten insert
Comments on contents	General use including bulk medical and industrial source material.
Insert in CV cavity	LS-31x73-Tu Design No 3983 (mass 4,860g)
Maximum quantity of radioactive material	See Table 1-4-2
Maximum mass of radioactive material	200g
Mixtures of radionuclides	Mixtures of the nuclides are allowed providing that the sum of the proportionate amounts of each nuclide with respect to the quantity shown does not exceed unity.
Maximum decay heat of radioactive material	10W
Maximum quantity of fissile material	None
Physical form of radioactive material	Solid
Chemical form of radioactive material	Element or compound <b>Compound only for Cs, Hg, I, Na and P.</b>
Pyrophoric contents	The contents may be pyrophoric.
Product containers	The radioactive material may be carried in any convenient product container such as a quartz vial or aluminum capsule. Irradiated items may be carried in plastic or metal can or wrapping to minimize the contamination of the insert.
Location of radioactive material	Within the shielding insert
Maximum weight of contents of the CV	5.3 kg This includes the insert, radioactive material, product containers and any other packing.
Maximum weight of contents of the insert	429g
Loading restrictions	None



<b>Table 1-3-3 CT-3 – Solid in steel insert (LS-50x103-SS Design No 3986)</b>	
<b>Parameter</b>	<b>Restrictions</b>
Contents Type name	CT-3 – Solid in steel insert
Comments on contents	General use including bulk medical and industrial source material.
Insert in CV cavity	LS-50x103-SS Design No 3986 (mass 570g)
Maximum quantity of radioactive material	See Table 1-4-3
Maximum mass of radioactive material	800g
Mixtures of radionuclides	Mixtures of the nuclides are allowed providing that the sum of the proportionate amounts of each nuclide with respect to the quantity shown does not exceed unity.
Maximum decay heat of radioactive material	10W
Maximum quantity of fissile material	None
Physical form of radioactive material	Solid
Chemical form of radioactive material	Element or compound <b>Compound only for Cs, Hg, I, Na and P.</b>
Pyrophoric contents	The contents may be pyrophoric.
Product containers	The radioactive material may be carried in any convenient product container such as a quartz vial or aluminum capsule. Irradiated items may be carried in plastic or metal can or wrapping to minimize the contamination of the insert.
Location of radioactive material	Within the shielding insert
Maximum weight of contents of the CV	2.1 kg This includes the insert, radioactive material, product containers and any other packing.
Maximum weight of contents of the insert	1,570g
Loading restrictions	None



Table 1-3-4 CT-4 - Liquid in light tungsten insert (LS-31x73-Tu Design No 3983)	
Parameter	Restrictions
Contents Type name	CT-4 – Liquid in light tungsten insert
Comments on contents	General use including bulk medical material.
Insert in CV cavity	LS-31x73-Tu Design No 3983 (mass 4,860g)
Maximum quantity of radioactive material	See Table 1-4-4
Maximum mass of radioactive material	200g
Mixtures of radionuclides	Mixtures of the nuclides are allowed providing that the sum of the proportionate amounts of each nuclide with respect to the quantity shown does not exceed unity.
Maximum decay heat of radioactive material	5W
Maximum quantity of fissile material	None
Physical form of radioactive material	Liquid
Chemical form of radioactive material	Salts in solution which may be alkaline or acidic. Acids restricted to HCL, H <sub>2</sub> SO <sub>4</sub> , HNO <sub>3</sub> , of maximum concentration 0.1N.
Pyrophoric contents	Not applicable
Product containers	The radioactive material may be carried in any convenient product container such as a quartz vial or aluminum capsule. Irradiated items may be carried in plastic or metal can or wrapping to minimize the contamination of the insert.
Location of radioactive material	Within the shielding insert
Maximum weight of contents of the CV	5.3 kg This includes the insert, radioactive material, product containers and any other packing.
Maximum weight of contents of the insert	429g
Loading restrictions	None

<b>Table 1-3-5 CT-5 – Liquid in steel insert (LS-50x103-SS Design No 3986)</b>	
<b>Parameter</b>	<b>Restrictions</b>
Contents Type name	CT-5 – Liquid in steel insert
Comments on contents	General use including bulk medical material.
Insert in CV cavity	LS-50x103-SS Design No 3986 (mass 570g)
Maximum quantity of radioactive material	See Table 1-4-5
Maximum mass of radioactive material	800g
Mixtures of radionuclides	Mixtures of the nuclides are allowed providing that the sum of the proportionate amounts of each nuclide with respect to the quantity shown does not exceed unity.
Maximum decay heat of radioactive material	5W
Maximum quantity of fissile material	None
Physical form of radioactive material	Liquid
Chemical form of radioactive material	Salts in solution which may be alkaline or acidic. <b>Acids restricted to HCL, H2SO4, HNO3, of maximum concentration 0.1N.</b>
Pyrophoric contents	Not applicable
Product containers	The radioactive material may be carried in any convenient product container such as a quartz vial or aluminum capsule. Irradiated items may be carried in plastic or metal can or wrapping to minimize the contamination of the insert.
Location of radioactive material	Within the shielding insert
Maximum weight of contents of the CV	2.1 kg This includes the insert, radioactive material, product containers and any other packing.
Maximum weight of contents of the insert	1,570g
Loading restrictions	<b>None</b>



Table 1-3-6 CT-6 – Gas in light tungsten insert (LS-31x73-Tu Design No 3983)	
Parameter	Restrictions
Contents Type name	CT-6 – Gas in light tungsten insert
Comments on contents	General use including bulk medical material.
Insert in CV cavity	LS-31x73-Tu Design No 3983 (mass 4,860g)
Maximum quantity of radioactive material	See Table 1-4-6
Maximum mass of radioactive material	200g Maximum amount of gas = 25 bar-cc
Mixtures of radionuclides	Mixtures of the nuclides are allowed providing that the sum of the proportionate amounts of each nuclide with respect to the quantity shown does not exceed unity.
Maximum decay heat of radioactive material	5W
Maximum quantity of fissile material	None
Physical form of radioactive material	Gas
Chemical form of radioactive material	Elemental gas
Pyrophoric contents	Not applicable
Product containers	The product container shall be a quartz vial sealed by fusing or an aluminum capsule. Irradiated items may be carried in plastic or metal can or wrapping to minimize the contamination of the insert.
Location of radioactive material	Within the shielding insert
Maximum weight of contents of the CV	5.3 kg This includes the insert, radioactive material, product containers and any other packing.
Maximum weight of contents of the insert	429g
Loading restrictions	None



<b>Table 1-3-7 - CT-7 – Fissile solid in Normal Form in steel insert (LS-50x103-SS Design No 3986)</b>	
<b>Parameter</b>	<b>Restrictions</b>
Contents Type name	CT-7 – Fissile solid in steel insert
Comments on contents	Fissile samples and standards
Insert in CV cavity	LS-50x103-SS Design No 3986 (mass 570g)
Maximum quantity of radioactive material	See Table 1-4-7 (subject to the limits below which provide a maximum for each case) Limit for air transport is A2 in accordance with 10CFR 71.88
Maximum mass of radioactive material	800g (subject to the limits below which provide a maximum for each case)
Mixtures of radionuclides	Mixtures of the nuclides are allowed providing that the sum of the proportionate amounts of each nuclide with respect to the quantity shown does not exceed unity.
Maximum decay heat of radioactive material	10W
Maximum quantity of fissile material	Contents limited to the quantities specified in the following references. 10CFR 71.15 Exemption from classification as fissile material 10CFR 71.22 General license: Fissile material 10CFR 71.23 General license: Plutonium-beryllium special form material.
Physical form of radioactive material	Solid in Normal Form
Chemical form of radioactive material	Element or compound
Pyrophoric contents	The contents may be pyrophoric.
Product containers	The radioactive material may be carried in any convenient product container such as a quartz vial or aluminum capsule. Irradiated items may be carried in plastic or metal can or wrapping to minimize the contamination of the insert.
Location of radioactive material	Within the shielding insert
Maximum weight of contents of the CV	2.1 kg This includes the insert, radioactive material, product containers and any other packing.
Maximum weight of contents of the insert	1,570g
Loading restrictions	None

<b>Table 1-3-8 - CT-8 – Fissile solid in Special Form in steel insert (LS-50x103-SS Design No 3986)</b>	
<b>Parameter</b>	<b>Restrictions</b>
Contents Type name	CT-8 – Fissile solid in steel insert
Comments on contents	Fissile samples and standards in Special Form
Insert in CV cavity	LS-50x103-SS Design No 3986 (mass 570g)
Maximum quantity of radioactive material	See Table 1-4-8 (subject to the limits below which provide a maximum for each case) Limit for air transport is A2 in accordance with 10CFR 71.88
Maximum mass of radioactive material	800g (subject to the limits below which provide a maximum for each case)
Mixtures of radionuclides	Mixtures of the nuclides are allowed providing that the sum of the proportionate amounts of each nuclide with respect to the quantity shown does not exceed unity.
Maximum decay heat of radioactive material	10W
Maximum quantity of fissile material	Contents limited to the quantities specified in the following references.  10CFR 71.15 Exemption from classification as fissile material 10CFR 71.22 General license: Fissile material 10CFR 71.23 General license: Plutonium-beryllium special form material.
Physical form of radioactive material	Solid in Special Form
Chemical form of radioactive material	Element or compound
Pyrophoric contents	The contents may be pyrophoric.
Product containers	The radioactive material may be carried in any convenient product container such as a quartz vial or aluminum capsule. Irradiated items may be carried in plastic or metal can or wrapping to minimize the contamination of the insert.
Location of radioactive material	Within the shielding insert
Maximum weight of contents of the CV	2.1 kg This includes the insert, radioactive material, product containers and any other packing.
Maximum weight of contents of the insert	1,570g
Loading restrictions	None



**Table 1-4-1 CT-1 – Solid in heavy tungsten insert (LS-12x65-Tu) – Activity Limits**

Contents Type 1 - CT-1 - Solid in heavy tungsten insert

1	2	3	4	5	6	7	8	9	10
Nuclide	Max TBq	Activity Ci	A2 TBq	# A2s	Spec Ac TBq/g	Mass g	Heat gen W/Ci	Heat output W	PackageType A or B
Ac-225	1.22E-01	3.29E+00	6.00E-03	20.29	2.10E+03	5.80E-05	3.46E-02	1.14E-01	B
Ac-227	8.38E-01	2.27E+01	9.00E-05	9311.69	2.70E+00	3.10E-01	4.72E-04	1.07E-02	B
Ac-228	1.07E-02	2.89E-01	5.00E-01	0.02	8.40E+04	1.27E-07	8.04E-03	2.32E-03	A
Am-241	3.90E+00	1.05E+02	1.00E-03	3900.00	1.30E-01	3.00E+01	3.28E-02	3.46E+00	B
As-77	1.95E+02	5.28E+03	7.00E-01	278.86	3.90E+04	5.01E-03	1.41E-03	7.41E+00	B
Au-198	2.33E+00	6.29E+01	6.00E-01	3.88	9.00E+03	2.59E-04	4.34E-03	2.73E-01	B
Ba-131	4.52E-01	1.22E+01	2.00E+00	0.23	3.10E+03	1.46E-04	3.06E-03	3.73E-02	A
C-14	4.80E+00	1.30E+02	3.00E+00	1.60	1.60E-01	3.00E+01	2.93E-04	3.80E-02	B
Co-60	2.28E-03	6.17E-02	4.00E-01	0.01	4.20E+01	5.44E-05	1.54E-02	9.52E-04	A
Cs-131	2.24E+03	6.05E+04	3.00E+01	74.58	3.80E+03	5.89E-01	1.65E-04	1.00E+01	B
Cs-134	2.24E-02	6.06E-01	7.00E-01	0.03	4.80E+01	4.67E-04	1.02E-02	6.17E-03	A
Cs-137	1.42E-01	3.83E+00	6.00E-01	0.24	3.20E+00	4.43E-02	1.01E-03	3.88E-03	A
Cu-67	2.30E+02	6.22E+03	7.00E-01	328.92	2.80E+04	8.22E-03	1.61E-03	1.00E+01	B
Hg-203	1.86E+02	5.03E+03	1.00E+00	185.96	5.10E+02	3.65E-01	1.99E-03	1.00E+01	B
Ho-166	2.42E-01	6.53E+00	4.00E-01	0.60	2.60E+04	9.30E-06	4.29E-03	2.80E-02	A
I-125	1.06E+03	2.87E+04	3.00E+00	354.17	6.40E+02	1.66E+00	3.48E-04	1.00E+01	B
I-129	1.95E-04	5.27E-03	unlimited	unlimited	6.50E-06	3.00E+01	4.68E-04	2.47E-06	B
I-131	1.34E+00	3.62E+01	7.00E-01	1.91	4.60E+03	2.91E-04	3.39E-03	1.23E-01	B
In-111	1.42E+02	3.85E+03	3.00E+00	47.45	1.50E+04	9.49E-03	2.60E-03	1.00E+01	B
Ir-192	9.60E-01	2.59E+01	6.00E-01	1.60	3.40E+02	2.82E-03	6.13E-03	1.59E-01	B
Ir-194	2.58E-01	6.96E+00	3.00E-01	0.86	3.10E+04	8.31E-06	5.35E-03	3.72E-02	A
Lu-177	3.43E+02	9.27E+03	7.00E-01	490.10	4.10E+03	8.37E-02	1.08E-03	1.00E+01	B
Mo-99	2.80E-01	7.58E+00	6.00E-01	0.47	1.80E+04	1.56E-05	3.27E-03	2.48E-02	A
Na-24	7.80E-04	2.11E-02	2.00E-01	0.00	3.20E+05	2.44E-09	2.77E-02	5.85E-04	A
Np-237	7.80E-04	2.11E-02	2.00E-03	0.39	2.60E-05	3.00E+01	2.88E-02	6.07E-04	A
P-32	1.90E-02	5.12E-01	5.00E-01	0.04	1.10E+04	1.72E-06	4.12E-03	2.11E-03	A
P-33	8.15E+02	2.20E+04	1.00E+00	814.82	5.80E+03	1.40E-01	4.54E-04	1.00E+01	B
Pb-203	1.45E+01	3.91E+02	3.00E+00	4.83	1.10E+04	1.32E-03	2.14E-03	8.35E-01	B
Pb-210	8.40E+01	2.27E+03	5.00E-02	1680.00	2.80E+00	3.00E+01	2.31E-04	5.24E-01	B
Pd-109	1.73E+02	4.67E+03	5.00E-01	345.39	7.90E+04	2.19E-03	2.14E-03	1.00E+01	B
Ra-223	8.46E-01	2.29E+01	7.00E-03	120.84	1.90E+03	4.45E-04	3.50E-02	8.00E-01	B
Ra-224	3.33E-03	8.99E-02	2.00E-02	0.17	5.90E+03	5.64E-07	3.37E-02	3.03E-03	A
Ra-226	3.62E-03	9.79E-02	3.00E-03	1.21	3.70E-02	9.79E-02	2.84E-02	2.78E-03	B
Re-186	1.38E+02	3.74E+03	6.00E-01	230.66	6.90E+03	2.01E-02	2.14E-03	8.00E+00	B
Re-188	5.74E-01	1.55E+01	4.00E-01	1.43	3.60E+04	1.59E-05	4.97E-03	7.70E-02	B
Rh-105	2.71E+02	7.31E+03	8.00E-01	338.13	3.10E+04	8.73E-03	1.37E-03	1.00E+01	B
Se-75	1.54E+02	4.16E+03	3.00E+00	51.27	5.40E+02	2.85E-01	2.41E-03	1.00E+01	B
Sm-153	1.90E+02	5.15E+03	6.00E-01	317.41	1.60E+04	1.19E-02	1.94E-03	1.00E+01	B
Sr-89	1.07E+02	2.89E+03	6.00E-01	178.41	1.10E+03	9.73E-02	3.46E-03	1.00E+01	B
Sr-90	1.62E+01	4.37E+02	3.00E-01	53.92	5.10E+00	3.17E+00	3.46E-03	1.51E+00	B
Tb-161	3.19E+02	8.62E+03	2.00E-02	15948.28	4.35E+03	7.33E-02	1.16E-03	1.00E+01	B
Th-227	1.79E+00	4.85E+01	5.00E-03	358.70	1.10E+03	1.63E-03	3.59E-02	1.74E+00	B
Th-228	2.53E-03	6.84E-02	1.00E-03	2.53	3.00E+01	8.44E-05	3.21E-02	2.20E-03	B
Ti-201	4.84E+02	1.31E+04	4.00E+00	120.90	7.90E+03	6.12E-02	7.65E-04	1.00E+01	B
W-187	1.96E-01	5.31E+00	3.00E-01	0.65	2.60E+04	7.55E-06	4.54E-03	2.41E-02	A
W-188	6.02E-01	1.63E+01	6.00E-01	1.00	3.70E+02	1.63E-03	5.98E-04	9.73E-03	B
Y-90	8.76E-03	2.37E-01	3.00E-01	0.03	2.00E+04	4.38E-07	5.54E-03	1.31E-03	A
Yb-169	1.47E+02	3.98E+03	1.00E+00	147.37	8.90E+02	1.66E-01	2.51E-03	1.00E+01	B
Yb-175	3.69E+02	9.96E+03	9.00E-01	409.64	6.60E+03	5.59E-02	1.00E-03	1.00E+01	B
Max	2.24E+03	6.05E+04		1.59E+04		3.00E+01		1.00E+01	

**Notes**

Column  
1 Identifies nuclide



- |    |   |
|----|---|
| 2  | Package activity limit for this Contents Type           |
| 3  | Calculated from Bq amount in Col 2                      |
| 4  | A2 from 10CFR71   |
| 5  | # of A2's of nuclide at package activity limit          |
| 6  | Specific activity from 10CFR71                          |
| 7  | Mass of nuclide at package activity limit               |
| 8  | Heat generation rate of nuclide - from Microshield.     |
| 9  | Heat output of nuclide at package activity limit        |
| 10 | Package Type [A or B] based on individual nuclide limit |

**Table 1-4-2 CT-2 – Solid in light tungsten insert (LS-31x73-Tu) – Activity Limits**

Contents Type 2 - CT-2 - Solid in light tungsten insert

1	2	3	4	5	6	7	8	9	10
Nuclide	Max TBq	Activity Ci	A2 TBq	# A2s	Spec Ac TBq/g	Mass g	Heat gen W/Ci	Heat output W	PackageType A or B
Ac-225	8.35E-02	2.26E+00	6.00E-03	13.92	2.10E+03	3.98E-05	3.46E-02	7.80E-02	B
Ac-227	4.70E-01	1.27E+01	9.00E-05	5217.15	2.70E+00	1.74E-01	4.72E-04	5.99E-03	B
Ac-228	6.90E-03	1.86E-01	5.00E-01	0.01	8.40E+04	8.21E-08	8.04E-03	1.50E-03	A
Am-241	1.13E+01	3.05E+02	1.00E-03	11276.02	1.30E-01	8.67E+01	3.28E-02	1.00E+01	B
As-77	7.84E+01	2.12E+03	7.00E-01	111.95	3.90E+04	2.01E-03	1.41E-03	2.98E+00	B
Au-198	1.32E+00	3.56E+01	6.00E-01	2.19	9.00E+03	1.46E-04	4.34E-03	1.54E-01	B
Ba-131	2.56E-01	6.93E+00	2.00E+00	0.13	3.10E+03	8.27E-05	3.06E-03	2.12E-02	A
C-14	3.20E+01	8.65E+02	3.00E+00	10.67	1.60E-01	2.00E+02	2.93E-04	2.54E-01	B
Co-60	1.53E-03	4.12E-02	4.00E-01	0.00	4.20E+01	3.63E-05	1.54E-02	6.36E-04	A
Cs-131	2.24E+03	6.05E+04	3.00E+01	74.58	3.80E+03	5.89E-01	1.65E-04	1.00E+01	B
Cs-134	1.29E-02	3.49E-01	7.00E-01	0.02	4.80E+01	2.69E-04	1.02E-02	3.55E-03	A
Cs-137	7.09E-02	1.92E+00	6.00E-01	0.12	3.20E+00	2.22E-02	1.01E-03	1.94E-03	A
Cu-67	2.30E+02	6.22E+03	7.00E-01	328.92	2.80E+04	8.22E-03	1.61E-03	1.00E+01	B
Hg-203	1.86E+02	5.03E+03	1.00E+00	185.96	5.10E+02	3.65E-01	1.99E-03	1.00E+01	B
Ho-166	1.66E-01	4.49E+00	4.00E-01	0.42	2.60E+04	6.40E-06	4.29E-03	1.93E-02	A
I-125	1.06E+03	2.87E+04	3.00E+00	354.17	6.40E+02	1.66E+00	3.48E-04	1.00E+01	B
I-129	1.30E-03	3.51E-02	unlimited	unlimited	6.50E-06	2.00E+02	4.68E-04	1.64E-05	B
I-131	6.71E-01	1.81E+01	7.00E-01	0.96	4.60E+03	1.46E-04	3.39E-03	6.14E-02	A
In-111	1.42E+02	3.85E+03	3.00E+00	47.45	1.50E+04	9.49E-03	2.60E-03	1.00E+01	B
Ir-192	4.30E-01	1.16E+01	6.00E-01	0.72	3.40E+02	1.27E-03	6.13E-03	7.12E-02	A
Ir-194	1.66E-01	4.48E+00	3.00E-01	0.55	3.10E+04	5.35E-06	5.35E-03	2.40E-02	A
Lu-177	3.43E+02	9.27E+03	7.00E-01	490.10	4.10E+03	8.37E-02	1.08E-03	1.00E+01	B
Mo-99	1.52E-01	4.12E+00	6.00E-01	0.25	1.80E+04	8.47E-06	3.27E-03	1.35E-02	A
Na-24	5.66E-04	1.53E-02	2.00E-01	0.00	3.20E+05	1.77E-09	2.77E-02	4.24E-04	A
Np-237	5.20E-03	1.41E-01	2.00E-03	2.60	2.60E-05	2.00E+02	2.88E-02	4.04E-03	B
P-32	1.35E-02	3.64E-01	5.00E-01	0.03	1.10E+04	1.22E-06	4.12E-03	1.50E-03	A
P-33	8.15E+02	2.20E+04	1.00E+00	814.82	5.80E+03	1.40E-01	4.54E-04	1.00E+01	B
Pb-203	7.34E+00	1.98E+02	3.00E+00	2.45	1.10E+04	6.67E-04	2.14E-03	4.24E-01	B
Pb-210	5.60E+02	1.51E+04	5.00E-02	11200.00	2.80E+00	2.00E+02	2.31E-04	3.49E+00	B
Pd-109	1.73E+02	4.67E+03	5.00E-01	345.39	7.90E+04	2.19E-03	2.14E-03	1.00E+01	B
Ra-223	4.74E-01	1.28E+01	7.00E-03	67.72	1.90E+03	2.50E-04	3.50E-02	4.48E-01	B
Ra-224	2.44E-03	6.60E-02	2.00E-02	0.12	5.90E+03	4.14E-07	3.37E-02	2.23E-03	A
Ra-226	2.54E-03	6.85E-02	3.00E-03	0.85	3.70E-02	6.85E-02	2.84E-02	1.95E-03	A
Re-186	7.21E+01	1.95E+03	6.00E-01	120.21	6.90E+03	1.05E-02	2.14E-03	4.17E+00	B
Re-188	3.55E-01	9.59E+00	4.00E-01	0.89	3.60E+04	9.86E-06	4.97E-03	4.76E-02	A
Rh-105	2.71E+02	7.31E+03	8.00E-01	338.13	3.10E+04	8.73E-03	1.37E-03	1.00E+01	B
Se-75	1.54E+02	4.16E+03	3.00E+00	51.27	5.40E+02	2.85E-01	2.41E-03	1.00E+01	B
Sm-153	1.90E+02	5.15E+03	6.00E-01	317.41	1.60E+04	1.19E-02	1.94E-03	1.00E+01	B
Sr-89	6.64E+01	1.79E+03	6.00E-01	110.61	1.10E+03	6.03E-02	3.46E-03	6.20E+00	B
Sr-90	6.89E+00	1.86E+02	3.00E-01	22.97	5.10E+00	1.35E+00	3.46E-03	6.44E-01	B
Tb-161	2.99E+02	8.08E+03	2.00E-02	14955.54	4.35E+03	6.88E-02	1.16E-03	9.38E+00	B
Th-227	1.01E+00	2.72E+01	5.00E-03	201.06	1.10E+03	9.14E-04	3.59E-02	9.75E-01	B
Th-228	1.86E-03	5.02E-02	1.00E-03	1.86	3.00E+01	6.20E-05	3.21E-02	1.61E-03	B
Ti-201	4.84E+02	1.31E+04	4.00E+00	120.90	7.90E+03	6.12E-02	7.65E-04	1.00E+01	B
W-187	1.01E-01	2.74E+00	3.00E-01	0.34	2.60E+04	3.90E-06	4.54E-03	1.24E-02	A
W-188	3.72E-01	1.01E+01	6.00E-01	0.62	3.70E+02	1.01E-03	5.98E-04	6.02E-03	A
Y-90	6.41E-03	1.73E-01	3.00E-01	0.02	2.00E+04	3.20E-07	5.54E-03	9.59E-04	A
Yb-169	1.47E+02	3.98E+03	1.00E+00	147.37	8.90E+02	1.66E-01	2.51E-03	1.00E+01	B
Yb-175	3.65E+02	9.87E+03	9.00E-01	405.84	6.60E+03	5.53E-02	1.00E-03	9.91E+00	B
Max	2.24E+03	6.05E+04		1.50E+04		2.00E+02		1.00E+01	

**Notes**

Column  
1 Identifies nuclide

- |    |   |
|----|---|
| 2  | Package activity limit for this Contents Type           |
| 3  | Calculated from Bq amount in Col 2                      |
| 4  | A2 from 10CFR71   |
| 5  | # of A2's of nuclide at package activity limit          |
| 6  | Specific activity from 10CFR71                          |
| 7  | Mass of nuclide at package activity limit               |
| 8  | Heat generation rate of nuclide - from Microshield.     |
| 9  | Heat output of nuclide at package activity limit        |
| 10 | Package Type [A or B] based on individual nuclide limit |



**Table 1-4-3 CT-3 – Solid in steel insert (LS-50x103-SS) – Activity Limits**

Contents Type 3 - CT-3 - Solid in steel insert

1	2	3	4	5	6	7	8	9	10
Nuclide	Max TBq	Activity Ci	A2 TBq	# A2s	Spec Ac TBq/g	Mass g	Heat gen W/Ci	Heat output W	PackageType A or B
Ac-225	2.08E-02	5.61E-01	6.00E-03	3.46	2.10E+03	9.89E-06	3.46E-02	1.94E-02	B
Ac-227	5.40E-02	1.46E+00	9.00E-05	599.72	2.70E+00	2.00E-02	4.72E-04	6.89E-04	B
Ac-228	1.41E-03	3.81E-02	5.00E-01	0.00	8.40E+04	1.68E-08	8.04E-03	3.06E-04	A
Am-241	1.13E+01	3.05E+02	1.00E-03	11276.02	1.30E-01	8.67E+01	3.28E-02	1.00E+01	B
As-77	2.85E+00	7.71E+01	7.00E-01	4.08	3.90E+04	7.32E-05	1.41E-03	1.08E-01	B
Au-198	7.61E-02	2.06E+00	6.00E-01	0.13	9.00E+03	8.46E-06	4.34E-03	8.92E-03	A
Ba-131	2.31E-02	6.24E-01	2.00E+00	0.01	3.10E+03	7.45E-06	3.06E-03	1.91E-03	A
C-14	1.28E+02	3.46E+03	3.00E+00	42.67	1.60E-01	8.00E+02	2.93E-04	1.01E+00	B
Co-60	3.68E-04	9.95E-03	4.00E-01	0.00	4.20E+01	8.77E-06	1.54E-02	1.53E-04	A
Cs-131	2.24E+03	6.05E+04	3.00E+01	74.58	3.80E+03	5.89E-01	1.65E-04	1.00E+01	B
Cs-134	1.62E-03	4.37E-02	7.00E-01	0.00	4.80E+01	3.37E-05	1.02E-02	4.44E-04	A
Cs-137	5.85E-03	1.58E-01	6.00E-01	0.01	3.20E+00	1.83E-03	1.01E-03	1.60E-04	A
Cu-67	7.67E+01	2.07E+03	7.00E-01	109.51	2.80E+04	2.74E-03	1.61E-03	3.33E+00	B
Hg-203	6.03E+01	1.63E+03	1.00E+00	60.26	5.10E+02	1.18E-01	1.99E-03	3.24E+00	B
Ho-166	4.46E-02	1.21E+00	4.00E-01	0.11	2.60E+04	1.72E-06	4.29E-03	5.18E-03	A
I-125	1.06E+03	2.87E+04	3.00E+00	354.17	6.40E+02	1.66E+00	3.48E-04	1.00E+01	B
I-129	5.20E-03	1.41E-01	unlimited	unlimited	6.50E-06	8.00E+02	4.68E-04	6.58E-05	B
I-131	5.03E-02	1.36E+00	7.00E-01	0.07	4.60E+03	1.09E-05	3.39E-03	4.61E-03	A
In-111	1.42E+02	3.85E+03	3.00E+00	47.45	1.50E+04	9.49E-03	2.60E-03	1.00E+01	B
Ir-192	2.10E-02	5.68E-01	6.00E-01	0.04	3.40E+02	6.18E-05	6.13E-03	3.48E-03	A
Ir-194	3.35E-02	9.05E-01	3.00E-01	0.11	3.10E+04	1.08E-06	5.35E-03	4.84E-03	A
Lu-177	3.43E+02	9.27E+03	7.00E-01	490.10	4.10E+03	8.37E-02	1.08E-03	1.00E+01	B
Mo-99	1.70E-02	4.60E-01	6.00E-01	0.03	1.80E+04	9.46E-07	3.27E-03	1.50E-03	A
Na-24	1.79E-04	4.84E-03	2.00E-01	0.00	3.20E+05	5.59E-10	2.77E-02	1.34E-04	A
Np-237	2.08E-02	5.62E-01	2.00E-03	10.40	2.60E-05	8.00E+02	2.88E-02	1.62E-02	B
P-32	2.20E-02	5.95E-01	5.00E-01	0.04	1.10E+04	2.00E-06	4.12E-03	2.45E-03	A
P-33	8.15E+02	2.20E+04	1.00E+00	814.82	5.80E+03	1.40E-01	4.54E-04	1.00E+01	B
Pb-203	5.70E-01	1.54E-01	3.00E+00	0.19	1.10E+04	5.18E-05	2.14E-03	3.29E-02	A
Pb-210	2.39E+02	6.46E+03	5.00E-02	4781.91	2.80E+00	8.54E+01	2.31E-04	1.49E+00	B
Pd-109	1.50E+01	4.06E+02	5.00E-01	30.03	7.90E+04	1.90E-04	2.14E-03	8.69E-01	B
Ra-223	5.46E-02	1.47E+00	7.00E-03	7.80	1.90E+03	2.87E-05	3.50E-02	5.16E-02	B
Ra-224	7.83E-04	2.12E-02	2.00E-02	0.04	5.90E+03	1.33E-07	3.37E-02	7.13E-04	A
Ra-226	6.81E-04	1.84E-02	3.00E-03	0.23	3.70E-02	1.84E-02	2.84E-02	5.23E-04	A
Re-186	6.93E+00	1.87E+02	6.00E-01	11.55	6.90E+03	1.00E-03	2.14E-03	4.00E-01	B
Re-188	6.02E-02	1.63E+00	4.00E-01	0.15	3.60E+04	1.67E-06	4.97E-03	8.08E-03	A
Rh-105	1.48E+01	4.00E+02	8.00E-01	18.52	3.10E+04	4.78E-04	1.37E-03	5.48E-01	B
Se-75	1.28E+00	3.47E+01	3.00E+00	0.43	5.40E+02	2.38E-03	2.41E-03	8.34E-02	A
Sm-153	3.15E+01	8.52E+02	6.00E-01	52.55	1.60E+04	1.97E-03	1.94E-03	1.66E+00	B
Sr-89	1.06E+01	2.86E+02	6.00E-01	17.64	1.10E+03	9.62E-03	3.46E-03	9.89E-01	B
Sr-90	8.94E-01	2.42E+01	3.00E-01	2.98	5.10E+00	1.75E-01	3.46E-03	8.35E-02	B
Tb-161	1.69E+01	4.58E+02	2.00E-02	846.49	4.35E+03	3.89E-03	1.16E-03	5.31E-01	B
Th-227	1.16E-01	3.12E+00	5.00E-03	23.10	1.10E+03	1.05E-04	3.59E-02	1.12E-01	B
Th-228	5.96E-04	1.61E-02	1.00E-03	0.60	3.00E+01	1.99E-05	3.21E-02	5.18E-04	A
Tl-201	4.84E+02	1.31E+04	4.00E+00	120.90	7.90E+03	6.12E-02	7.65E-04	1.00E+01	B
W-187	8.88E-03	2.40E-01	3.00E-01	0.03	2.60E+04	3.41E-07	4.54E-03	1.09E-03	A
W-188	6.31E-02	1.71E+00	6.00E-01	0.11	3.70E+02	1.71E-04	5.98E-04	1.02E-03	A
Y-90	6.02E-03	1.63E-01	3.00E-01	0.02	2.00E+04	3.01E-07	5.54E-03	9.02E-04	A
Yb-169	5.06E+01	1.37E+03	1.00E+00	50.62	8.90E+02	5.69E-02	2.51E-03	3.43E+00	B
Yb-175	2.56E+00	6.92E-01	9.00E-01	2.84	6.60E+03	3.88E-04	1.00E-03	6.94E-02	B
Max	2.24E+03	6.05E+04		1.13E+04		8.00E+02		1.00E+01	

**Notes**

Column

1

Identifies nuclide

2	Package activity limit for this Contents Type
3	Calculated from Bq amount in Col 2
4	A2 from 10CFR71
5	# of A2's of nuclide at package activity limit
6	Specific activity from 10CFR71
7	Mass of nuclide at package activity limit
8	Heat generation rate of nuclide - from Microshield.
9	Heat output of nuclide at package activity limit
10	Package Type [A or B] based on individual nuclide limit



**Table 1-4-4 CT-4 - Liquid in light tungsten insert (LS-31x73-Tu) – Activity Limits**

Contents Type 4 - CT-4 - Liquid in light tungsten insert

1	2	3	4	5	6	7	8	9	10
Nuclide	Max	Activity	A2	# A2s	Spec Ac	Mass	Heat gen	Heat output	PackageType
	TBq	Ci	TBq		TBq/g	g	W/Ci	W	A or B
Ho-166-Liquid	2.22E+01	6.00E+02	4.00E-01	55.50	2.60E+04	8.54E-04	4.29E-03	2.58E+00	B
Lu-177-Liquid	1.72E+02	4.64E+03	7.00E-01	245.05	4.10E+03	4.18E-02	1.08E-03	5.00E+00	B
Mo-99-Liquid	7.13E+00	1.93E+02	6.00E-01	11.88	1.80E+04	3.96E-04	3.27E-03	6.30E-01	B
Se-75-Liquid	6.94E+01	1.88E+03	3.00E+00	23.13	5.40E+02	1.29E-01	2.41E-03	4.51E+00	B
Tl-201-Liquid	2.42E+02	6.54E+03	4.00E+00	60.45	7.90E+03	3.06E-02	7.65E-04	5.00E+00	B
Max	2.42E+02	6.54E+03		2.45E+02		1.29E-01		5.00E+00	

**Notes**

Column	
1	Identifies nuclide
2	Package activity limit for this Contents Type
3	Calculated from Bq amount in Col 2
4	A2 from 10CFR71
5	# of A2's of nuclide at package activity limit
6	Specific activity from 10CFR71
7	Mass of nuclide at package activity limit
8	Heat generation rate of nuclide - from Microshield.
9	Heat output of nuclide at package activity limit
10	Package Type [A or B] based on individual nuclide limit



**Table 1-4-5 CT-5 – Liquid in steel insert (LS-50x103-SS) – Activity Limits**

Contents Type 5 - CT-5 - Liquid in steel insert

1	2	3	4	5	6	7	8	9	10
Nuclide	Max	Activity	A2	# A2s	Spec Ac	Mass	Heat gen	Heat output	PackageType
	TBq	Ci	TBq		TBq/g	g	W/Ci	W	A or B
Ho-166-Liquid	2.22E+01	6.00E+02	4.00E-01	55.50	2.60E+04	8.54E-04	4.29E-03	2.58E+00	B
Lu-177-Liquid	1.72E+02	4.64E+03	7.00E-01	245.05	4.10E+03	4.18E-02	1.08E-03	5.00E+00	B
Mo-99-Liquid	7.13E+00	1.93E+02	6.00E-01	11.88	1.80E+04	3.96E-04	3.27E-03	6.30E-01	B
Se-75-Liquid	6.94E+01	1.88E+03	3.00E+00	23.13	5.40E+02	1.29E-01	2.41E-03	4.51E+00	B
Tl-201-Liquid	2.42E+02	6.54E+03	4.00E+00	60.45	7.90E+03	3.06E-02	7.65E-04	5.00E+00	B
Max	2.42E+02	6.54E+03		2.45E+02		1.29E-01		5.00E+00	

**Notes**

Column	
1	Identifies nuclide
2	Package activity limit for this Contents Type
3	Calculated from Bq amount in Col 2
4	A2 from 10CFR71
5	# of A2's of nuclide at package activity limit
6	Specific activity from 10CFR71
7	Mass of nuclide at package activity limit
8	Heat generation rate of nuclide - from Microshield.
9	Heat output of nuclide at package activity limit
10	Package Type [A or B] based on individual nuclide limit

**Table 1-4-6 CT-6 – Gas in light tungsten insert (LS-31x73-Tu) – Activity Limits**

Contents Type 6 - CT-6 - Gas in light tungsten insert

1	2	3	4	5	6	7	8	9	10
Nuclide	Max	Activity	A2	# A2s	Spec Ac	Mass	Heat gen	Heat output	PackageType
	TBq	Ci	TBq		TBq/g	g	W/Ci	W	A or B
Kr-79	2.00E-01	5.41E+00	2.00E+00	0.10	9.24E+04	2.17E-06	1.67E-03	9.02E-03	A
Xe-133	3.45E+02	9.33E+03	1.00E+01	34.51	6.90E+03	5.00E-02	1.07E-03	1.00E+01	B
Max	3.45E+02	9.33E+03		3.45E+01		5.00E-02		1.00E+01	

**Notes**

Column	
1	Identifies nuclide
2	Package activity limit for this Contents Type
3	Calculated from Bq amount in Col 2
4	A2 from 10CFR71
5	# of A2's of nuclide at package activity limit
6	Specific activity from 10CFR71
7	Mass of nuclide at package activity limit
8	Heat generation rate of nuclide - from Microshield.
9	Heat output of nuclide at package activity limit
10	Package Type [A or B] based on individual nuclide limit

**Table 1-4-7 CT-7 – Fissile solid in Normal Form in steel insert (LS-50x103-SS) – Activity Limits**

Contents Type 7 - CT-7 - Fissile solid in steel insert

1	2	3	4	5	6	7	8	9	10
Nuclide	Max	Activity	A2	# A2s	Spec Ac	Mass	Heat gen	Heat output	PackageType
	TBq	Ci	TBq		TBq/g	g	W/Ci	W	A or B
Pu-238	1.14E+01	3.07E+02	1.00E-03	11354.22	6.30E-01	1.80E+01	3.26E-02	1.00E+01	B
Pu-239	1.84E+00	4.97E+01	1.00E-03	1840.00	2.30E-03	8.00E+02	3.06E-02	1.52E+00	B
Pu-240	6.72E+00	1.82E+02	1.00E-03	6720.00	8.40E-03	8.00E+02	3.06E-02	5.56E+00	B
Pu-241	3.04E+03	8.22E+04	6.00E-02	50666.67	3.80E+00	8.00E+02	3.10E-05	2.55E+00	B
U-235	6.40E-05	1.73E-03	unlimited	unlimited	8.00E-08	8.00E+02	2.71E-02	4.69E-05	B
Max	3.04E+03	8.22E+04		5.07E+04		8.00E+02		1.00E+01	

**Notes**

Column	
1	Identifies nuclide
2	Package activity limit for this Contents Type
3	Calculated from Bq amount in Col 2
4	A2 from 10CFR71
5	# of A2's of nuclide at package activity limit
6	Specific activity from 10CFR71
7	Mass of nuclide at package activity limit
8	Heat generation rate of nuclide - from Microshield.
9	Heat output of nuclide at package activity limit
10	Package Type [A or B] based on individual nuclide limit

**Table 1-4-8 CT-8 – Fissile solid in Special Form in steel insert (LS-50x103-SS) – Activity Limits**

Contents Type 7 - CT-7 - Fissile solid in steel insert

1	2	3	4	5	6	7	8	9	10
Nuclide	Max	Activity	A2	# A2s	Spec Ac	Mass	Heat gen	Heat output	PackageType
	TBq	Ci	TBq		TBq/g	g	W/Ci	W	A or B
Pu-238	1.14E+01	3.07E+02	1.00E-03	11354.22	6.30E-01	1.80E+01	3.26E-02	1.00E+01	B
Pu-239	1.84E+00	4.97E+01	1.00E-03	1840.00	2.30E-03	8.00E+02	3.06E-02	1.52E+00	B
Pu-240	6.72E+00	1.82E+02	1.00E-03	6720.00	8.40E-03	8.00E+02	3.06E-02	5.56E+00	B
Pu-241	3.04E+03	8.22E+04	6.00E-02	50666.67	3.80E+00	8.00E+02	3.10E-05	2.55E+00	B
U-235	6.40E-05	1.73E-03	unlimited	unlimited	8.00E-08	8.00E+02	2.71E-02	4.69E-05	B
Max	3.04E+03	8.22E+04		5.07E+04		8.00E+02		1.00E+01	

**Notes**

Column	
1	Identifies nuclide
2	Package activity limit for this Contents Type
3	Calculated from Bq amount in Col 2
4	A2 from 10CFR71
5	# of A2's of nuclide at package activity limit
6	Specific activity from 10CFR71
7	Mass of nuclide at package activity limit
8	Heat generation rate of nuclide - from Microshield.
9	Heat output of nuclide at package activity limit
10	Package Type [A or B] based on individual nuclide limit



### **1.2.3 Special Requirements for Plutonium**

The 10 CFR 71 [1.2] regulatory limit for plutonium in liquid form of 0.74 TBq (20Ci) of plutonium is met, as the liquid contents as specified in Section 1.2.2 (in contents types CT-4 and CT-5) do not include plutonium.

### **1.2.4 Operational Features**

The package has no complex operational features. All the operational features of the package are given in the General Arrangement drawing 0C-6041 (Section 1.3.3) and the operational instructions are presented in Section 7.

## 1.3 Appendix

### 1.3.1 References

- [1.1] NUREG-1609, Standard Review Plan for Transportation Packages for Radioactive Material, 1999
- [1.2] Title 10, Code of Federal Regulations, Part 71, Office of the Federal Register, Washington, DC, 2009
- [1.3] Regulatory Guide 7.9, Standard Format And Content Of Part 71 Applications For Approval Of Packages For Radioactive Material
- [1.4] Title 49, Code of Federal Regulations, Part 171, Office of the Federal Register, Washington, DC, 2009

### 1.3.2 Calculation Model Drawings

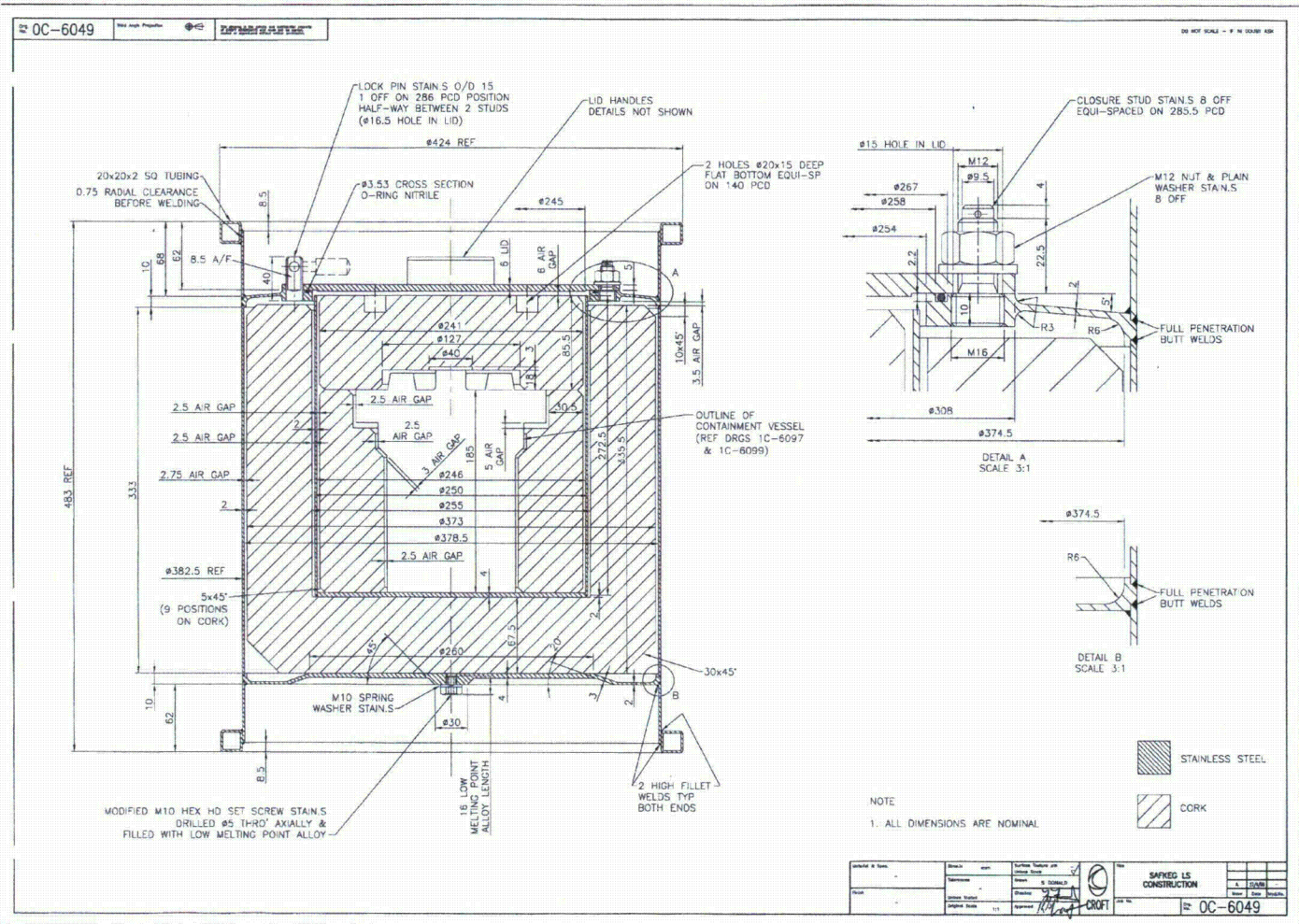
The drawings listed below and provided in this section show the details used for setting up the calculation models for stress FEA, thermal FEA and shielding calculations (Monte Carlo and Microshield).

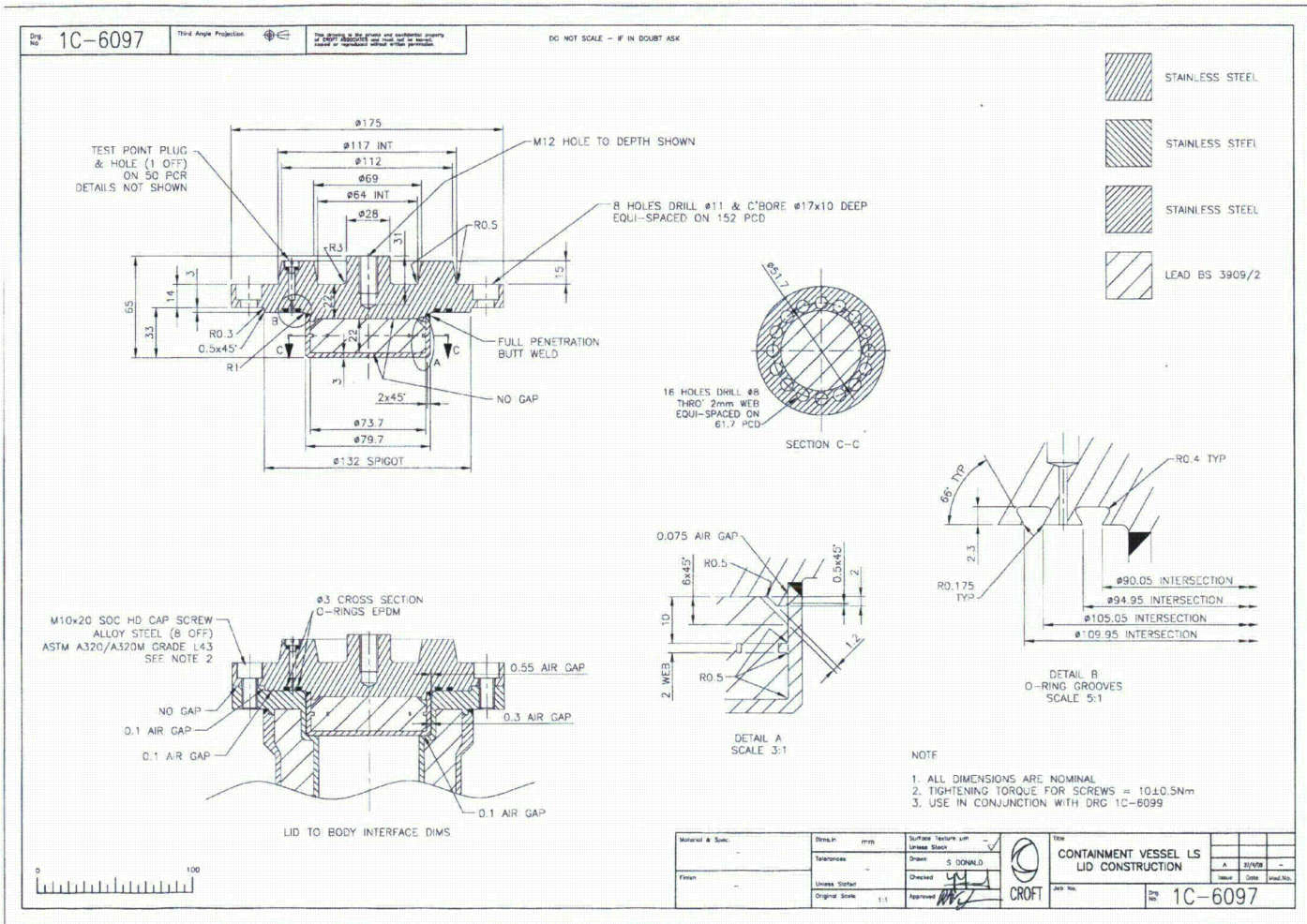
These drawings specify nominal dimensions with particular reference to key features (such as gaps for shielding calculations).

These drawings also specify the materials: details of the materials are given in Section 2.

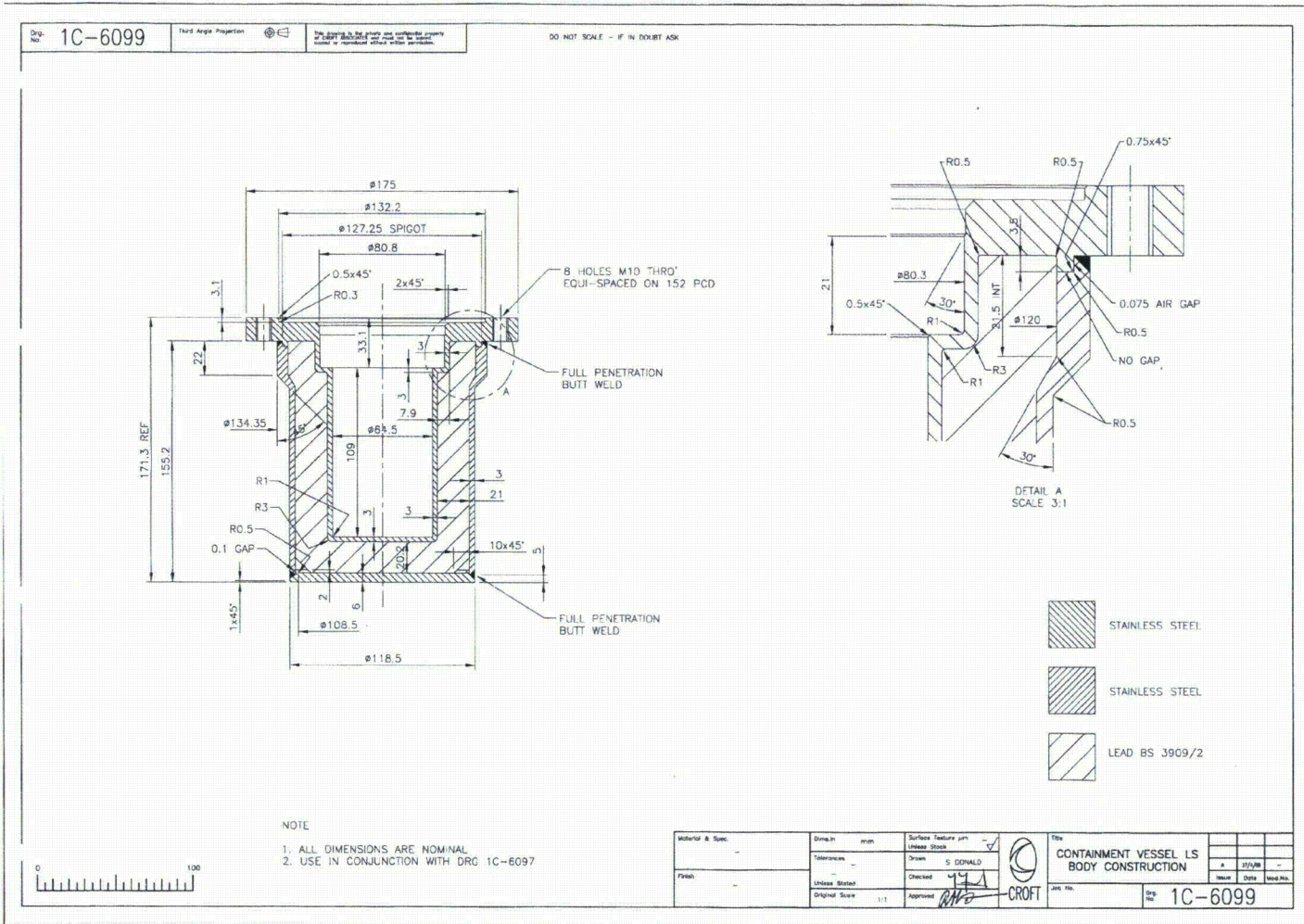
Drawing No.	Title
0C-6049	Safkeg-LS Construction
1C-6097	CV LS Lid Construction
1C-6099	CV LS Body Construction













### 1.3.3 Licensing Drawings

The package is defined by the drawings listed below for which the revision status is given in Section 0. The drawings are appended to this section.

The drawings specify dimensions, fasteners, welding requirements, non-destructive examination requirements, O-ring specifications, method of O-ring retention, and closure surface requirements.

The drawings also specify the materials: details of the materials are given in Section 2.



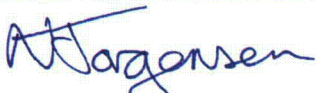
Drawing No.	Title
1C-6040	Cover sheet for Safkeg-LS design no. 3979A (licensing drawing)
0C-6041	Safkeg-LS design no. 3979A (licensing drawing)
0C-6042	Keg design no. 3979 (licensing drawing)
0C-6043	Cork set for Safkeg-LS (licensing drawing)
1C-6044	CV design no. 3980 (licensing drawing)
1C-6045	CV lid (licensing drawing)
1C-6046	CV body (licensing drawing)
2C-6171	LS-12x65-Tu insert design no. 3984 (licensing drawing)
2C-6172	LS-31x73-Tu insert design no. 3983 (licensing drawing)
2C-6175	LS-50x103-SS insert design no. 3986 (licensing drawing)

### 1.3.4 Supporting Documents

Document Reference	Title
PCS 036	Package Contents Specification for Safkeg-LS - Package Design No 3979A

**Proprietary Information Withheld Pursuant to  
10 CFR 2.390**

**Package Contents Specification  
for Safkeg-LS  
Package Design No 3979A**

Title	Package Contents Specification for Safkeg-LS - Package Design No 3979A	Number Issue File Ref	PCS 036 B PCS036-B-v1-Safkeg-LS-Contents
Compiled	 R A Vaughan	Checked	 A L Ferguson
Approved	 N Jorgensen	Date	23 March 2010
Croft Associates Ltd, F4 Culham Science Centre, Abingdon, Oxfordshire, OX14 3DB. 01865 407740			



## 1 Specification of contents

### 1.1 General nature of contents

The Safkeg-LS 3979A package is designed as a general purpose package for radioactive material that requires limited shielding and, with optional shielding inserts, for radioactive material that requires a significant amount of shielding.

The package is designed for radioactive material that emits alpha, beta or gamma radiation. The specified contents do not include materials that emit a significant amount of neutrons.

The contents may be in solid, liquid or gaseous form and carried in various inserts as specified in the Table 1 below.

**Table 1 Contents Types**

Contents Type Designation	Material Form	Shielding Insert	General Requirements for each Contents Type (1)	Activity Limits for each Contents Type
CT-1	Solid	LS-12x65-Tu Design No 3984	See Table 1-3-1	See Table 3
CT-2	Solid	LS-31x73-Tu Design No 3983	See Table 1-3-2	See Table 4
CT-3	Solid	LS-50x103-SS Design No 3986	See Table 1-3-3	See Table 5
CT-4	Liquid	LS-31x73-Tu Design No 3983	See Table 1-3-4	See Table 6
CT-5	Liquid	LS-50x103-SS Design No 3986	See Table 1-3-5	See Table 7
CT-6	Gas	LS-31x73-Tu Design No 3983	See Table 1-3-6	See Table 8
CT-7	Solid/ Fissile Normal Form	LS-50x103-SS Design No 3986	See Table 1-3-7	See Table 9
CT-8	Solid/ Fissile Special Form	LS-50x103-SS Design No 3986	See Table 1-3-8	See Table 10

1 These are the tables in the SARP [1].

## **1.2 Shielding inserts**

The shielding inserts specified in Section 1 of the SARP for Safkeg-LS 3979A [1] and listed in Table 1 above are required for all contents.

Under NCT, the shielding inserts, together with the user defined product containers, provide confinement of the radioactive material within the shielding.

Under HAC, the shielding inserts, together with the user defined product containers, provide confinement of solid radioactive material within the shielding. However, liquids and gasses are assumed to leak from the user defined product containers and the shielding inserts under HAC.

## **1.3 Radionuclides included**

See Tables 3 to 9.

## **1.4 Quantity**

The maximum mass of each radionuclide is detailed in Table 2 and Tables 3 to 9 for specific contents types CT-1 to CT-8.

## **1.5 Activity limit**

The package activity limits for individual nuclides, according to the insert used, are given in Tables 3 to 9. The activity limit is determined in accordance with the methodology in Section 2 below.

## **1.6 Other limiting factors**

Various restrictions and limits of quantity of radionuclides apply according to the insert used and for the form of the radioactive material (solid, liquid or gas). These restrictions and contents limits are detailed in Section 1 of the SARP for Safkeg-LS 3979A in Section 1.2.2 in the tables for contents types CT-1 to CT-8.

# **2 Calculation of allowable contents**

The package activity limit in Tables 3 to 9 is the least of the limits determined on the basis of heat output, mass limit, shielding limit and, for gas contents, the limit based on allowable leakage under NCT or HAC.

## **2.1 Heat limits**

The heat limit for solid and gaseous contents is 10 W and for liquid contents the heat limit is 5 W.

## 2.2 Mass limit

The upper limit on the mass is different for each insert - as specified in section 1.4 above.

The maximum mass of the radionuclides is set at nominally 50% the mass of a steel cylinder that would fill the cavity of the insert (see Table 1-2).

**Table 2 Maximum mass of the radionuclides**

Shielding Insert	Mass of a steel cylinder that would fill the cavity of the insert	Maximum mass of the radionuclides
	g	g
LS-12x65-Tu Design No 3984	57	30
LS-31x73-Tu Design No 3983	429	200
LS-50x103-SS Design No 3986	1570	800

## 2.3 Shielding limit

The package design is such that the surface dose rate, as opposed to the TI, is the limiting factor, except for liquids, under HAC. The shielding limits in Tables 3 to 9 for each radionuclide and each insert, are based on an assessment in Report CTR 2008/22[2] of the maximum activity to give the maximum allowable package surface dose rate (for  $\beta$ ,  $\gamma$  and n emitters) of 2mSv/h (200 mrem/h). These calculations are based on the worst case assumption of the radioactive material being a point source at the centre of the base of the insert (neglecting spacing due to use of product containers). This location has been shown to produce the highest package surface dose rate in report SERCO/TAS/003191/001 [3].

For each liquid radionuclide, the HAC shielding limits in Tables 6 and 7 for each applicable insert are based on an assessment in report SERCO/TAS/003191/001 [3] of the maximum activity to give the maximum allowable package dose rate at 1m from the external surface of the package, assuming that the liquid contents leaked into the space between the CV lid and CV body. Liquid contents are limited to the lesser of: a) the activity to give the maximum allowable regulatory dose rate at the package surface under NCT (with the material assumed to be a point source at the centre of the base of the insert) or b) the activity to give the maximum allowable regulatory dose rate at 1m from the external surface of the package, assuming that the liquid contents leaked into the space between the CV lid and CV body.



## 2.4 Leakage limit

For solid and liquid contents, the contents are completely contained as the O-ring seal of the CV meets the requirement of Leaktight as defined in ANSI N 14.5 [4].

For gaseous radionuclides, it is assumed that they will escape from their product containers under HAC and leak past the seal in the insert within the CV and leak from the CV and the package past the O-ring seal of the CV.

The allowable gas leakage rates in 10CFR Part 71 [5][4] are  $1 \times 10^{-6}$  A<sub>2</sub>/h under NCT and A<sub>2</sub>/week under HAC.

The maximum gas contents are determined as the contents that would leak at the HAC rate of A<sub>2</sub>/week from a "Leaktight" seal (as defined in ANSI N14.5 [4] as a leakage rate less than or equal to  $1 \times 10^{-7}$  ref cm<sup>3</sup>/s, of air at an upstream pressure of 1 atmosphere (atm) absolute (abs) and a downstream pressure of 0.01 atm abs or less). The calculation of the maximum gas contents is given in report CS 2009/07 [6].

## 2.5 Criticality Limits

The quantities of fissile material are restricted to the limits in this document and according to the criteria specified in Section 1 of the SARP for Safkeg-LS 3979A [1] in Section 1.2.2 in the tables for Contents Types CT-7 and CT-8 Fissile solid.

## 3 References

- [1] CTR 2008/10, Revision 1, SARP for Safkeg-LS 3979A, Docket No. 71-9337
- [2] Croft, CTR 2009/22, Issue A, SAFKEG LS 3979A, Package Activity Limits Based on Shielding
- [3] SERCO/TAS/003191/001, Monte Carlo Modelling of Safkeg LS Container
- [4] ANSI N14.5, American National Standard for Radioactive Materials - Leakage Test on Packages for Shipment, American National Standards Institute, Inc., 1997
- [5] 10CFR PART 71, Packaging And Transportation Of Radioactive Material, U.S. Nuclear Regulatory Commission
- [6] CS 2009/07, Issue A, SAFKEG-LS 3979A - Gas contents limit for leaktight condition

Table 3 Activity Limits for Contents Type 1 - CT-1 - Solid in heavy tungsten insert – Design No 3984

Contents Type 1 - CT-1 - Solid in heavy tungsten insert										Package limits calculations for each nuclide											
										Contents heat limit				Contents mass limit		Package shielding limit		Package limit			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
Nuclide	Max	Activity	A2	# A2s	Spec Ac	Mass	Heat gen	Heat output	Package type	Mass	W	Ci	Mass	Act	Act	Act	Code				
	TBq	Ci	TBq		TBq/g	g	W/Ci	W	A or B	W			g	Bq	Bq	Bq	H	M	S		
Ac-225	1.22E-01	3.29E+00	6.00E-03	20.29	2.10E+03	5.80E-05	3.46E-02	1.14E-01	B	10.00	2.89E+02	1.0702E+13	30	6.30E+16	1.22E+11	1.22E+11					
Ac-227	8.38E-01	2.27E+01	9.00E-05	9311.69	2.70E+00	3.10E-01	4.72E-04	1.07E-02	B	10.00	2.12E+04	7.8377E+14	30	8.10E+13	8.38E+11	8.38E+11					
Ac-228	1.07E-02	2.89E-01	5.00E-01	0.02	8.40E+04	1.27E-07	8.04E-03	2.32E-03	A	10.00	1.24E+03	4.6023E+13	30	2.52E+18	1.07E+10	1.07E+10					
Am-241	3.90E+00	1.05E+02	1.00E-03	3900.00	1.30E-01	3.00E+01	3.28E-02	3.46E+00	B	10.00	3.05E+02	1.1276E+13	30	3.90E+12	7.07E+19	3.90E+12			M		
As-77	1.95E+02	5.28E+03	7.00E-01	278.86	3.90E+04	5.01E-03	1.41E-03	7.41E+00	B	10.00	7.12E+03	2.6329E+14	30	1.17E+18	1.95E+14	1.95E+14					
Au-198	2.33E+00	6.29E+01	6.00E-01	3.88	9.00E+03	2.59E-04	4.34E-03	2.73E-01	B	10.00	2.31E+03	8.5301E+13	30	2.70E+17	2.33E+12	2.33E+12					
Ba-131	4.52E-01	1.22E+01	2.00E+00	0.23	3.10E+03	1.48E-04	3.06E-03	3.73E-02	A	10.00	3.27E+03	1.2111E+14	30	9.30E+16	4.52E+11	4.52E+11					
C-14	4.80E+00	1.30E+02	3.00E+00	1.60	1.60E-01	3.00E+01	2.93E-04	3.80E-02	B	10.00	3.41E+04	1.2617E+15	30	4.80E+12	4.55E+36	4.80E+12			M		
Co-60	2.28E-03	6.17E-02	4.00E-01	0.01	4.20E+01	5.44E-05	1.54E-02	9.52E-04	A	10.00	6.48E+02	2.3990E+13	30	1.26E+15	2.28E+09	2.28E+09					
Co-131	2.24E+03	6.05E+04	3.00E+01	74.58	3.80E+03	5.89E-01	1.65E-04	1.00E+01	B	10.00	6.05E+04	2.2373E+15	30	1.14E+17	4.85E+35	2.24E+15			H		
Co-134	2.24E-02	6.06E-01	7.00E-01	0.03	4.80E+01	4.87E-04	1.02E-02	6.17E-03	A	10.00	9.82E+02	3.6349E+13	30	1.44E+15	2.24E+10	2.24E+10					
Co-137	1.42E-01	3.83E+00	6.00E-01	0.24	3.20E+00	4.43E-02	1.01E-03	3.88E-03	A	10.00	9.88E+03	3.6554E+14	30	9.60E+13	1.42E+11	1.42E+11					
Cu-67	2.30E+02	6.22E+03	7.00E-01	328.92	2.80E+04	8.22E-03	1.61E-03	1.00E+01	B	10.00	6.22E+03	2.3024E+14	30	8.40E+17	4.53E+16	2.30E+14			H		
Hg-203	1.86E+02	5.03E+03	1.00E+00	185.96	5.10E+02	3.65E-01	1.99E-03	1.00E+01	B	10.00	5.03E+03	1.8596E+14	30	1.53E+16	1.06E+19	1.86E+14			H		
Ho-166	2.42E-01	6.53E+00	4.00E-01	0.60	2.60E+04	9.30E-06	4.29E-03	2.80E-02	A	10.00	2.33E+03	8.6175E+13	30	7.80E+17	2.42E+11	2.42E+11					
I-125	1.06E+03	2.87E+04	3.00E+00	354.17	6.40E+02	1.66E+00	3.48E-04	1.00E+01	B	10.00	2.87E+04	1.0625E+15	30	1.92E+16	2.61E+35	1.06E+15			H		
I-129	1.95E-04	5.27E-03	unlimited	unlimited	6.50E-06	3.00E+01	4.68E-04	2.47E-06	B	10.00	2.14E+04	7.9067E+14	30	1.95E+08	4.57E+35	1.95E+08			M		
I-131	1.34E+00	3.62E+01	7.00E-01	1.91	4.60E+03	2.91E-04	3.39E-03	1.23E-01	B	10.00	2.95E+03	1.0920E+14	30	1.38E+17	1.34E+12	1.34E+12					
In-111	1.42E+02	3.85E+03	3.00E+00	47.45	1.50E+04	9.49E-03	2.60E-03	1.00E+01	B	10.00	3.85E+03	1.4234E+14	30	4.50E+17	1.38E+22	1.42E+14			H		
Ir-192	9.60E-01	2.59E+01	6.00E-01	1.60	3.40E+02	2.82E-03	6.13E-03	1.59E-01	B	10.00	1.63E+03	6.0404E+13	30	1.02E+16	9.60E+11	9.60E+11					
Ir-194	2.58E-01	6.96E+00	3.00E-01	0.86	3.10E+04	8.31E-06	5.35E-03	3.72E-02	A	10.00	1.87E+03	6.9220E+13	30	9.30E+17	2.58E+11	2.58E+11					
Lu-177	3.43E+02	9.27E+03	7.00E-01	490.10	4.10E+03	8.37E-02	1.08E-03	1.00E+01	B	10.00	9.27E+03	3.4307E+14	30	1.23E+17	1.21E+19	3.43E+14			H		
Mo-99	2.80E-01	7.58E+00	6.00E-01	0.47	1.80E+04	1.56E-05	3.27E-03	2.48E-02	A	10.00	3.06E+03	1.1324E+14	30	5.40E+17	2.80E+11	2.80E+11					
Na-24	7.80E-04	2.11E-02	2.00E-01	0.00	3.20E+05	2.44E-09	2.77E-02	5.85E-04	A	10.00	3.61E+02	1.3351E+13	30	9.60E+18	7.80E+08	7.80E+08					
Np-237	7.80E-04	2.11E-02	2.00E-03	0.39	2.60E-05	3.00E+01	2.88E-02	6.07E-04	A	10.00	3.47E+02	1.2857E+13	30	7.80E+08	6.93E+18	7.80E+08			M		
P-32	1.90E-02	5.12E-01	5.00E-01	0.04	1.10E+04	1.72E-06	4.12E-03	2.11E-03	A	10.00	2.43E+03	8.9819E+13	30	3.30E+17	1.90E+10	1.90E+10					
P-33	8.15E+02	2.20E+04	1.00E+00	814.82	5.80E+03	1.40E-01	4.54E-04	1.00E+01	B	10.00	2.20E+04	8.1482E+14	30	1.74E+17	2.37E+23	8.15E+14			H		
Pb-203	1.45E+01	3.91E+02	3.00E+00	4.83	1.10E+04	1.32E-03	2.14E-03	8.35E-01	B	10.00	4.68E+03	1.7328E+14	30	3.30E+17	1.45E+13	1.45E+13					
Pb-210	8.40E+01	2.27E+03	5.00E-02	1680.00	2.80E+00	3.00E+01	2.31E-04	5.24E-01	B	10.00	4.34E+04	1.6045E+15	30	8.40E+13	3.31E+15	8.40E+13			M		
Pd-109	1.73E+02	4.67E+03	5.00E-01	345.39	7.90E+04	2.19E-03	2.14E-03	1.00E+01	B	10.00	4.67E+03	1.7270E+14	30	2.37E+18	1.17E+15	1.73E+14			H		
Ra-223	8.46E-01	2.29E+01	7.00E-03	120.84	1.90E+03	4.45E-04	3.50E-02	8.00E-01	B	10.00	2.86E+02	1.0580E+13	30	5.70E+16	8.46E+11	8.46E+11					
Ra-224	3.33E-03	8.99E-02	2.00E-02	0.17	5.90E+03	5.64E-07	3.37E-02	3.03E-03	A	10.00	2.97E+02	1.0975E+13	30	1.77E+17	3.33E+09	3.33E+09					
Ra-226	3.62E-03	9.79E-02	3.00E-03	1.21	3.70E-02	9.79E-02	2.84E-02	2.78E-03	B	10.00	3.52E+02	1.3031E+13	30	1.11E+12	3.62E+09	3.62E+09					
Re-186	1.38E+02	3.74E+03	6.00E-01	230.66	6.90E+03	2.01E-02	2.14E-03	8.00E+00	B	10.00	4.68E+03	1.7303E+14	30	2.07E+17	1.38E+14	1.38E+14					
Re-188	5.74E-01	1.55E+01	4.00E-01	1.43	3.60E+04	1.59E-05	4.97E-03	7.70E-02	B	10.00	2.01E+03	7.4517E+13	30	1.08E+18	5.74E+11	5.74E+11					
Rh-105	2.71E+02	7.31E+03	8.00E-01	338.13	3.10E+04	8.73E-03	1.37E-03	1.00E+01	B	10.00	7.31E+03	2.7051E+14	30	9.30E+17	1.69E+17	2.71E+14			H		
Se-75	1.54E+02	4.16E+03	3.00E+00	51.27	5.40E+02	2.85E-01	2.41E-03	1.00E+01	B	10.00	4.16E+03	1.5381E+14	30	1.62E+16	6.39E+14	1.54E+14			H		
Sm-153	1.90E+02	5.15E+03	6.00E-01	317.41	1.60E+04	1.19E-02	1.94E-03	1.00E+01	B	10.00	5.15E+03	1.9045E+14	30	4.80E+17	9.33E+15	1.90E+14			H		
Sr-89	1.07E+02	2.89E+03	6.00E-01	178.41	1.10E+03	9.73E-02	3.46E-03	1.00E+01	B	10.00	2.89E+03	1.0704E+14	30	3.30E+16	1.11E+14	1.07E+14			H		
Sr-90	1.62E+01	4.37E+02	3.00E-01	53.92	5.10E+00	3.17E+00	3.46E-03	1.51E+00	B	10.00	2.89E+03	1.0704E+14	30	1.53E+14	1.62E+13	1.62E+13					
Tb-161	3.19E+02	8.62E+03	2.00E-02	15948.28	4.35E+03	7.33E-02	1.16E-03	1.00E+01	B	10.00	8.62E+03	3.1897E+14	30	1.31E+17	6.57E+17	3.19E+14			H		
Th-227	1.79E+00	4.85E+01	5.00E-03	358.70	1.10E+03	1.63E-03	3.59E-02	1.74E+00	B	10.00	2.79E+02	1.0316E+13	30	3.30E+16	1.79E+12	1.79E+12					
Th-228	2.53E-03	6.84E-02	1.00E-03	2.53	3.00E+01	8.44E-05	3.21E-02	2.20E-03	B	10.00	3.11E+02	1.1512E+13	30	9.00E+14	2.53E+09	2.53E+09					
Tl-201	4.84E+02	1.31E+04	4.00E+00	120.90	7.90E+03	6.12E-02	7.65E-04	1.00E+01	B	10.00	1.31E+04	4.8362E+14	30	2.37E+17	1.11E+30	4.84E+14			H		
W-187	1.96E-01	5.31E+00	3.00E-01	0.65	2.60E+04	7.55E-06	4.54E-03	2.41E-02	A	10.00	2.20E+03	8.1534E+13	30	7.80E+17	1.96E+11	1.96E+11					
W-188	6.02E-01	1.63E+01	6.00E-01	1.00	3.70E+02	1.63E-03	5.98E-04	9.73E-03	B	10.00	1.67E+04	6.1860E+14	30	1.11E+16	6.02E+11	6.02E+11					
Y-90	8.76E-03	2.37E-01	3.00E-01	0.03	2.00E+04	4.38E-07	5.54E-03	1.31E-03	A	10.00	1.80E+03	6.6774E+13	30	6.00E+17	8.76E+09	8.76E+09					
Yb-169	1.47E+02	3.98E+03	1.00E+00	147.37	8.90E+02	1.66E-01	2.51E-03	1.00E+01	B	10.00	3.98E+03	1.4737E+14	30	2.67E+16	6.48E+17	1.47E+14			H		
Yb-175	3.69E+02	9.96E+03	9.00E-01	409.64	6.60E+03	5.59E-02	1.00E-03	1.00E+01	B	10.00	9.96E+03	3.6867E+14	30	1.98E+17	1.41E+15	3.69E+14			H		
Max	2.24E+03	6.05E+04		1.59E+04		3.00E+01		1.00E+01													

Notes

- Column
- Identifies nuclide
  - Package activity limit for this Contents Type - from Col 17
  - Calculated from Bq amount in Col 2
  - A2 from 10CFR71
  - # of A2's of nuclide at package activity limit
  - Specific activity from 10CFR71
  - Mass of nuclide at package activity limit
  - Heat generation rate of nuclide - from Microshield.
  - Heat output of nuclide at package activity limit
  - Package Type [A or B] based on individual nuclide limit
  - Mass limit of nuclide based on package heat limit
  - Calculated from limit in Col 11
  - Calculated from Bq amount in Col 12
  - Mass limit of nuclide based on capacity of insert
  - Calculated from Bq amount in Col 14

Colour codes

- Radionuclides  
Package limit  
Physics data  
Contents limit based on heat, mass or shielding

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- |    |  |
|----|--|
| 16 | Package shielding limit  |
| 17 | Package limit = least of heat, mass and shielding limits in Cols 13, 15 & 16 |
| 18 | H shown where package limit is Heat limit                                    |
| 19 | M shown where package limit is Mass limit                                    |
| 20 | S shown where package limit is Shielding limit                               |



Table 4 Activity Limits for Contents Type 2 - CT-2 - Solid in light tungsten insert - Design No 3983

Contents Type 2 - CT-2 - Solid in light tungsten insert

										Package limits calculations for each nuclide									
										Contents heat limit		Contents mass limit		Package shielding limit		Package limit			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Nuclide	Max	Activity	A2	# A2s	Spec Ac	Mass	Heat gen	Heat output	PackageType	Mass	Cl	Act	Mass	Act	Act	Act	Code		
	TBq	Cl	TBq		TBq/g	g	W/Cl	W	A or B	W	Bq	Bq	Bq	Bq	Bq	Bq	H	M	S
Ac-225	8.35E-02	2.28E+00	6.00E-03	13.92	2.10E+03	3.98E-05	3.46E-02	7.80E-02	B	10.00	2.89E+02	1.0702E+13	200	4.20E+17	8.35E+10	8.35E+10			
Ac-227	4.70E-01	1.27E+01	9.00E-05	5217.15	2.70E+00	1.74E-01	4.72E-04	5.99E-03	B	10.00	2.12E+04	7.8377E+14	200	5.40E+14	4.70E+11	4.70E+11			
Ac-228	6.90E-03	1.86E-01	5.00E-01	0.01	8.40E-04	8.21E-08	8.04E-03	1.50E-03	A	10.00	1.24E+03	4.8023E+13	200	1.68E+19	6.90E+09	6.90E+09			
Am-241	1.13E+01	3.05E+02	1.00E-03	11278.02	1.30E-01	8.67E+01	3.28E-02	1.00E+01	B	10.00	3.05E+02	1.1278E+13	200	2.60E+13	1.88E+19	1.13E+13			
As-77	7.84E+01	2.12E+03	7.00E-01	111.95	3.90E+04	2.01E-03	1.41E-03	2.98E+00	B	10.00	7.12E+03	2.6329E+14	200	7.80E+18	7.84E+13	7.84E+13			
Au-198	1.32E+00	3.58E+01	6.00E-01	2.19	9.00E+03	1.46E-04	4.34E-03	1.54E-01	B	10.00	2.31E+03	8.5301E+13	200	1.80E+18	1.32E+12	1.32E+12			
Ba-131	2.56E-01	6.93E+00	2.00E+00	0.13	3.10E-03	8.27E-05	3.06E-03	2.12E-02	A	10.00	3.27E+03	1.2111E+14	200	6.20E+17	2.56E+11	2.56E+11			
C-14	3.20E+01	8.65E+02	3.00E+00	10.67	1.60E-01	2.00E+02	2.93E-04	2.54E-01	B	10.00	3.41E+04	1.2617E+15	200	3.20E+13	4.26E+36	3.20E+13			
Co-60	1.53E-03	4.12E-02	4.00E-01	0.00	4.20E+01	3.63E-05	1.54E-02	6.38E-04	A	10.00	6.48E+02	2.3990E+13	200	8.40E+15	1.53E+09	1.53E+09			
Ca-131	2.24E+03	6.05E+04	3.00E+01	74.58	3.80E+03	5.89E-01	1.65E-04	1.00E+01	B	10.00	6.05E+04	2.2373E+15	200	7.60E+17	4.54E+35	2.24E+15			
Ca-134	1.29E-02	3.49E-01	7.00E-01	0.02	4.80E+01	2.69E-04	1.02E-02	3.55E-03	A	10.00	9.82E+02	3.6349E+13	200	9.60E+15	1.29E+10	1.29E+10			
Ca-137	7.09E-02	1.92E+00	6.00E-01	0.12	3.20E+00	2.22E-02	1.01E-03	1.94E-03	A	10.00	9.88E+03	3.6554E+14	200	6.40E+14	7.09E+10	7.09E+10			
Cu-67	2.30E+02	6.22E+03	7.00E-01	328.92	2.80E+04	8.22E-03	1.61E-03	1.00E+01	B	10.00	6.22E+03	2.3024E+14	200	5.60E+18	1.21E+16	2.30E+14			
Hg-203	1.86E+02	5.03E+03	1.00E+00	185.96	5.10E+02	3.65E-01	1.99E-03	1.00E+01	B	10.00	5.03E+03	1.8596E+14	200	1.02E+17	8.26E+17	1.86E+14			
Ho-166	1.66E-01	4.49E+00	4.00E-01	0.42	2.60E+04	6.40E-06	4.29E-03	1.93E-02	A	10.00	2.33E+03	8.6175E+13	200	5.20E+18	1.66E+11	1.66E+11			
I-125	1.06E+03	2.87E+04	3.00E+00	354.17	6.40E+02	1.68E+04	3.48E-04	1.00E+01	B	10.00	2.87E+04	1.0625E+15	200	1.28E+17	2.44E+35	1.06E+15			
I-129	1.30E-03	3.51E-02	unlimited	unlimited	6.50E-06	2.00E+02	4.68E-04	1.64E-05	B	10.00	2.14E+04	7.9067E+14	200	1.30E+09	4.28E+35	1.30E+09			
I-131	6.71E-01	1.81E+01	7.00E-01	0.96	4.60E+03	1.46E-04	3.39E-03	6.14E-02	A	10.00	2.96E+03	1.0920E+14	200	9.20E+17	6.71E+11	6.71E+11			
In-111	1.42E+02	3.85E+03	3.00E+00	47.45	1.50E+04	9.49E-03	2.60E-03	1.00E+01	B	10.00	3.85E+03	1.4234E+14	200	3.00E+18	4.81E+20	1.42E+14			
Ir-192	4.30E-01	1.16E+01	6.00E-01	0.72	3.40E+02	1.27E-03	6.13E-03	7.12E-02	A	10.00	1.63E+03	6.0404E+13	200	6.80E+16	4.30E+11	4.30E+11			
Ir-194	1.66E-01	4.48E+00	3.00E-01	0.55	3.10E+04	5.35E-06	5.35E-03	2.40E-02	A	10.00	1.87E+03	6.9220E+13	200	6.20E+18	1.66E+11	1.66E+11			
Lu-177	3.43E+02	9.27E+03	7.00E-01	490.10	4.10E+03	8.37E-02	1.08E-03	1.00E+01	B	10.00	9.27E+03	3.4307E+14	200	8.20E+17	1.73E+18	3.43E+14			
Mo-99	1.52E-01	4.12E+00	6.00E-01	0.25	1.80E+04	8.47E-06	3.27E-03	1.35E-02	A	10.00	3.06E+03	1.1324E+14	200	3.60E+18	1.52E+11	1.52E+11			
Na-24	5.66E-04	1.53E-02	2.00E-01	0.00	3.20E+05	1.77E-09	2.77E-02	4.24E-04	A	10.00	3.61E+02	1.3351E+13	200	6.40E+19	5.66E+08	5.66E+08			
Np-237	5.20E-03	1.41E-01	2.00E-03	2.60	2.60E-05	2.00E+02	2.88E-02	4.04E-03	B	10.00	3.47E+02	1.2857E+13	200	5.20E+09	6.49E+18	5.20E+09			
P-32	1.35E-02	3.64E-01	5.00E-01	0.03	1.10E+04	1.22E-06	4.12E-03	1.50E-03	A	10.00	2.43E+03	8.9819E+13	200	2.20E+18	1.35E+10	1.35E+10			
P-33	8.15E+02	2.20E+04	1.00E+00	814.82	5.80E+03	1.40E-01	4.54E-04	1.00E+01	B	10.00	2.20E+04	8.1482E+14	200	1.16E+18	9.18E+21	8.15E+14			
Pb-203	7.34E+00	1.98E+02	3.00E+00	2.45	1.10E+04	6.67E-04	2.14E-03	4.24E-01	B	10.00	4.68E+03	1.7328E+14	200	2.20E+18	7.34E+12	7.34E+12			
Pb-210	5.60E+02	1.51E+04	5.00E-02	11200.00	2.80E+00	2.00E+02	2.31E-04	3.49E+00	B	10.00	4.34E+04	1.6045E+15	200	5.60E+14	1.87E+15	5.60E+14			
Pd-109	1.73E+02	4.67E+03	5.00E-01	345.39	7.90E+04	2.19E-03	3.37E-02	2.23E-03	A	10.00	4.67E+03	1.7270E+14	200	1.58E+19	4.58E+14	1.73E+14			
Ra-223	4.74E-01	1.28E+01	7.00E-03	67.72	1.90E+03	2.50E-04	3.50E-02	4.48E-01	B	10.00	2.86E+02	1.0580E+13	200	3.80E+17	4.74E+11	4.74E+11			
Ra-224	2.44E-03	6.60E-02	2.00E-02	0.12	5.90E+03	4.14E-07	3.37E-02	2.23E-03	A	10.00	2.97E+02	1.0975E+13	200	1.18E+18	2.44E+09	2.44E+09			
Ra-226	2.54E-03	6.85E-02	3.00E-03	0.85	3.70E-02	6.85E-02	2.84E-02	1.95E-03	A	10.00	3.52E+02	1.3031E+13	200	7.40E+12	2.54E+09	2.54E+09			
Re-186	7.21E+01	1.95E+03	6.00E-01	120.21	6.90E+03	1.05E-02	2.14E-03	4.17E+00	B	10.00	4.68E+03	1.7303E+14	200	1.38E+18	7.21E+13	7.21E+13			
Re-188	3.55E-01	9.59E+00	4.00E-01	0.89	3.60E+04	9.86E-06	4.97E-03	4.76E-02	A	10.00	2.01E+03	7.4517E+13	200	7.20E+18	3.55E+11	3.55E+11			
Rh-105	2.71E+02	7.31E+03	8.00E-01	338.13	3.10E+04	8.73E-03	1.37E-03	1.00E+01	B	10.00	7.31E+03	2.7051E+14	200	6.20E+18	2.33E+16	2.71E+14			
Se-75	1.54E+02	4.16E+03	3.00E+00	51.27	5.40E+02	2.85E-01	2.41E-03	1.00E+01	B	10.00	4.16E+03	1.5381E+14	200	1.08E+17	1.70E+14	1.54E+14			
Sm-153	1.90E+02	5.15E+03	6.00E-01	317.41	1.60E+04	1.19E-02	1.94E-03	1.00E+01	B	10.00	5.15E+03	1.9045E+14	200	3.20E+18	2.76E+15	1.90E+14			
Sr-89	6.64E+01	1.79E+03	6.00E-01	110.61	1.10E+03	6.03E-02	3.46E-03	6.20E+00	B	10.00	2.89E+03	1.0704E+14	200	2.20E+17	6.64E+13	6.64E+13			
Sr-90	6.89E+00	1.86E+02	3.00E-01	22.97	5.10E+00	1.35E+00	3.46E-03	6.44E-01	B	10.00	2.89E+03	1.0704E+14	200	1.02E+15	6.89E+12	6.89E+12			
Tb-161	2.99E+02	8.08E+03	2.00E-02	14955.54	4.35E+03	6.88E-02	1.16E-03	9.38E+00	B	10.00	8.62E+03	3.1897E+14	200	8.70E+17	2.99E+14	2.99E+14			
Th-227	1.01E+00	2.72E+01	5.00E-03	201.06	1.10E+03	9.14E-04	3.59E-02	9.75E-01	B	10.00	2.79E+02	1.0316E+13	200	2.20E+17	1.01E+12	1.01E+12			
Th-228	1.86E-03	5.02E-02	1.00E-03	1.86	3.00E+01	6.20E-05	3.21E-02	1.61E-03	B	10.00	3.11E+02	1.1512E+13	200	6.00E+15	1.86E+09	1.86E+09			
Ti-201	4.84E+02	1.31E+04	4.00E+00	120.90	7.90E+03	6.12E-02	7.65E-04	1.00E+01	B	10.00	1.31E+04	4.8362E+14	200	1.58E+18	1.04E+30	4.84E+14			
W-187	1.01E-01	2.74E+00	3.00E-01	0.34	2.60E+04	3.90E-06	4.54E-03	1.24E-02	A	10.00	2.20E+03	8.1534E+13	200	5.20E+18	1.01E+11	1.01E+11			
W-188	3.72E-01	1.01E+01	6.00E-01	0.82	3.70E+02	1.01E-03	5.98E-04	6.02E-03	A	10.00	1.67E+04	6.1860E+14	200	7.40E+16	3.72E+11	3.72E+11			
Y-90	6.41E-03	1.73E-01	3.00E-01	0.02	2.00E+04	3.20E-07	5.54E-03	9.59E-04	A	10.00	1.80E+03	6.6774E+13	200	4.00E+18	6.41E+09	6.41E+09			
Yb-169	1.47E+02	3.98E+03	1.00E+00	147.37	8.90E+02	1.66E-01	2.51E-03	1.00E+01	B	10.00	3.98E+03	1.4737E+14	200	1.78E+17	9.51E+16	1.47E+14			
Yb-175	3.65E+02	9.87E+03	9.00E-01	405.84	6.60E+03	5.53E-02	1.00E-03	9.91E+00	B	10.00	9.96E+03	3.6867E+14	200	1.32E+18	3.65E+14	3.65E+14			
Max	2.24E+03	6.05E+04		1.50E+04		2.00E+02		1.00E+01											

Notes

- Column
- Identifies nuclide
  - Package activity limit for this Contents Type - from Col 17
  - Calculated from Bq amount in Col 2
  - A2 from 10CFR71
  - # of A2's of nuclide at package activity limit
  - Specific activity from 10CFR71
  - Mass of nuclide at package activity limit
  - Heat generation rate of nuclide - from Microshield
  - Heat output of nuclide at package activity limit
  - Package Type [A or B] based on individual nuclide limit
  - Mass limit of nuclide based on package heat limit
  - Calculated from limit in Col 11
  - Calculated from Bq amount in Col 12
  - Mass limit of nuclide based on capacity of insert
  - Calculated from Bq amount in Col 14

Colour codes

- Radionuclides
- Package limit
- Physics data
- Contents limit based on heat, mass or shielding

- 16 Package shielding limit
- 17 Package limit = least of heat, mass and shielding limits in Cols 13, 15 & 16
- 18 H shown where package limit is Heat limit
- 19 M shown where package limit is Mass limit
- 20 S shown where package limit is Shielding limit



Table 5 Activity Limits for Contents Type 3 - CT-3 - Solid in steel insert - Design No 3986

Contents Type 3 - CT-3 - Solid in steel insert

Contents Type 3 - CT-3 - Solid in steel insert										Package limits calculations for each nuclide										Package shielding limit		Package limit	
										Contents heat limit			Contents mass limit										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20				
Nuclide	Max TBq	Activity Ci	A2 TBq	# A2s	Spec Ac TBq/g	Mass g	Heat gen W/Ci	Heat output W	PackageType A or B	Mass W	Ci	Act Bq	Mass g	Act Bq	Act Bq	Act Bq	Code	H	M S				
Ac-225	2.08E-02	5.61E-01	6.00E-03	3.46	2.10E+03	9.89E-06	3.46E-02	1.94E-02	B	10.00	2.89E+02	1.0702E+13	800	1.68E+18	2.08E+10	2.08E+10			S				
Ac-227	5.40E-02	1.46E+00	9.00E-05	599.72	2.70E+00	2.00E-02	4.72E-04	6.89E-04	B	10.00	2.12E+04	7.8377E+14	800	2.16E+15	5.40E+10	5.40E+10			S				
Ac-228	1.41E-03	3.81E-02	5.00E-01	0.00	8.40E+04	1.68E-08	8.04E-03	3.06E-04	A	10.00	1.24E+03	4.6023E+13	800	6.72E+19	1.41E+09	1.41E+09			S				
Am-241	1.13E+01	3.05E+02	1.00E-03	11278.02	1.30E-01	8.67E+01	3.28E-02	1.00E+01	B	10.00	3.05E+02	1.1276E+13	800	1.04E+14	1.18E+17	1.13E+13	H		S				
As-77	2.85E+00	7.71E+01	7.00E-01	4.08	3.90E+04	7.32E-05	1.41E-03	1.08E-01	B	10.00	7.12E+03	2.6329E+14	800	3.12E+19	2.85E+12	2.85E+12			S				
Au-198	7.61E-02	2.06E+00	6.00E-01	0.13	9.00E+03	8.46E-06	4.34E-03	8.92E-03	A	10.00	2.31E+03	8.5301E+13	800	7.20E+18	7.61E+10	7.61E+10			S				
Ba-131	2.31E-02	6.24E-01	2.00E+00	0.01	3.10E+03	7.45E-06	3.06E-03	1.91E-03	A	10.00	3.27E+03	1.2111E+14	800	2.48E+18	2.31E+10	2.31E+10			S				
C-14	1.28E+02	3.46E+03	3.00E+00	42.67	1.60E-01	8.00E+02	2.93E-04	1.01E+00	B	10.00	3.41E+04	1.2617E+15	800	1.28E+14	1.47E+29	1.28E+14		M	S				
Co-60	3.68E-04	9.95E-03	4.00E-01	0.00	4.20E+01	8.77E-06	1.54E-02	1.53E-04	A	10.00	6.48E+02	2.3990E+13	800	3.36E+16	3.68E+08	3.68E+08			S				
Cs-131	2.24E+03	6.05E+04	3.00E+01	74.58	3.80E+03	5.89E-01	1.65E-04	1.00E+01	B	10.00	6.05E+04	2.2373E+15	800	3.04E+18	3.59E+35	2.24E+15	H		S				
Cs-134	1.62E-03	4.15E-02	7.00E-01	0.00	4.80E+01	3.37E-05	1.02E-02	4.44E-04	A	10.00	9.82E+02	3.6349E+13	800	3.84E+16	1.62E+09	1.62E+09			S				
Cs-137	5.85E-03	1.58E-01	6.00E-01	0.01	3.20E+00	1.83E-03	1.01E-03	1.80E-04	A	10.00	9.88E+03	3.8554E+14	800	2.56E+15	5.85E+09	5.85E+09			S				
Cu-67	7.67E+01	2.07E+03	7.00E-01	109.51	2.80E+04	2.74E-03	1.61E-03	3.33E+00	B	10.00	6.22E+03	2.3024E+14	800	2.24E+19	7.67E+13	7.67E+13			S				
Hg-203	6.03E+01	1.63E+03	1.00E+00	60.26	5.10E+02	1.18E-01	1.99E-03	3.24E+00	B	10.00	5.03E+03	1.8596E+14	800	4.08E+17	6.03E+13	6.03E+13			S				
Ho-166	4.46E-02	1.21E+00	4.00E-01	0.11	2.60E+04	1.72E-06	4.29E-03	5.18E-03	A	10.00	2.33E+03	8.6175E+13	800	2.08E+19	4.46E+10	4.46E+10			S				
I-125	1.06E+03	2.87E+04	3.00E+00	354.17	6.40E-02	1.66E+00	3.48E-04	1.00E+01	B	10.00	2.87E+04	1.0625E+15	800	5.12E+17	1.93E+35	1.06E+15	H		S				
I-129	5.20E-03	1.41E-01	unlimited	unlimited	6.50E-06	8.00E+02	4.68E-04	6.88E-05	B	10.00	2.14E+04	7.9067E+14	800	5.20E+09	3.38E+35	5.20E+09		M	S				
I-131	5.03E-02	1.36E+00	7.00E-01	0.07	4.80E+03	1.09E-05	3.39E-03	4.61E-03	A	10.00	2.95E+03	1.0920E+14	800	3.68E+18	5.03E+10	5.03E+10			S				
In-111	1.42E+02	3.85E+03	3.00E+00	47.45	1.50E+04	9.49E-03	2.60E-03	1.00E+01	B	10.00	3.85E+03	1.4234E+14	800	1.20E+19	1.70E+15	1.42E+14	H		S				
Ir-192	2.10E-02	5.68E-01	6.00E-01	0.04	3.40E+02	6.18E-05	6.13E-03	3.48E-03	A	10.00	1.63E+03	6.0404E+13	800	2.72E+17	2.10E+10	2.10E+10			S				
Ir-194	3.35E-02	9.05E-01	3.00E-01	0.11	3.10E+04	1.08E-06	5.35E-03	4.84E-03	A	10.00	1.87E+03	6.9220E+13	800	2.48E+19	3.35E+10	3.35E+10			S				
Lu-177	3.43E+02	9.27E+03	7.00E-01	490.10	4.10E+03	8.37E-02	1.08E-03	1.00E+01	B	10.00	9.27E+03	3.4307E+14	800	3.28E+18	1.29E+15	3.43E+14	H		S				
Mo-99	1.70E-02	4.60E-01	6.00E-01	0.03	1.80E+04	9.46E-07	3.27E-03	1.50E-03	A	10.00	3.06E+03	1.1324E+14	800	1.44E+19	1.70E+10	1.70E+10			S				
Na-24	1.79E-04	4.84E-03	2.00E-01	0.00	3.20E+05	5.59E-10	2.77E-02	1.34E-04	A	10.00	3.61E+02	1.3351E+13	800	2.56E+20	1.79E+08	1.79E+08			S				
Np-237	2.08E-02	5.62E-01	2.00E-03	10.40	2.60E-05	8.00E+02	2.88E-02	1.62E-02	B	10.00	3.47E+02	1.2857E+13	800	2.08E+10	5.02E+18	2.08E+10		M	S				
P-32	2.20E-02	5.95E-01	5.00E-01	0.04	1.10E+04	2.00E-06	4.12E-03	2.45E-03	A	10.00	2.43E+03	8.9819E+13	800	8.80E+18	2.20E+10	2.20E+10			S				
P-33	8.15E+02	2.20E+04	1.00E+00	814.82	5.80E+03	1.40E-01	4.54E-04	1.00E+01	B	10.00	2.20E+04	8.1482E+14	800	4.64E+18	1.37E+17	8.15E+14	H		S				
Pb-203	5.70E-01	1.54E+01	3.00E+00	0.19	1.10E+04	5.18E-05	2.14E-03	3.29E-02	A	10.00	4.68E+03	1.7328E+14	800	8.80E+18	5.70E+11	5.70E+11			S				
Pb-210	2.39E+02	6.46E+03	5.00E-02	4781.91	2.80E+00	8.54E-01	2.31E-04	1.49E+00	B	10.00	4.34E+04	1.6045E+15	800	2.24E+15	2.39E+14	2.39E+14			S				
Pd-109	1.50E+01	4.06E+02	5.00E-01	30.03	7.90E+04	1.90E-04	2.14E-03	6.89E-01	B	10.00	4.67E+03	1.7270E+14	800	6.32E+19	1.50E+13	1.50E+13			S				
Ra-223	5.46E-02	1.47E+00	7.00E-03	7.80	1.90E+03	2.87E-05	3.50E-02	5.16E-02	B	10.00	2.86E+02	1.0580E+13	800	1.52E+18	5.46E+10	5.46E+10			S				
Ra-224	7.83E-04	2.12E-02	2.00E-02	0.04	5.90E+03	1.33E-07	3.37E-02	7.13E-04	A	10.00	2.97E+02	1.0975E+13	800	4.72E+18	7.83E+08	7.83E+08			S				
Ra-226	6.81E-04	1.84E-02	3.00E-03	0.23	3.70E-02	1.84E-02	2.84E-02	5.23E-04	A	10.00	3.52E+02	1.3031E+13	800	2.96E+13	6.81E+08	6.81E+08			S				
Re-186	6.93E+00	1.87E+02	6.00E-01	11.55	6.90E+03	1.00E-03	2.14E-03	4.00E-01	B	10.00	4.68E+03	1.7303E+14	800	5.52E+18	6.93E+12	6.93E+12			S				
Re-188	6.02E-02	1.63E+00	4.00E-01	0.15	3.60E+04	1.67E-06	4.97E-03	8.08E-03	A	10.00	2.01E+03	7.4517E+13	800	2.88E+19	6.02E+10	6.02E+10			S				
Rh-105	1.48E+01	4.00E+02	8.00E-01	18.52	3.10E+04	4.78E-04	1.37E-03	5.48E-01	B	10.00	7.31E+03	2.7051E+14	800	2.48E+19	1.48E+13	1.48E+13			S				
Se-75	1.28E+00	3.47E+01	3.00E+00	0.43	5.40E+02	2.38E-03	2.41E-03	8.34E-02	A	10.00	4.16E+03	1.5381E+14	800	4.32E+17	1.28E+12	1.28E+12			S				
Sm-153	3.15E+01	8.52E+02	6.00E-01	52.55	1.60E+04	1.97E-03	1.94E-03	1.68E+00	B	10.00	5.15E+03	1.9045E+14	800	1.28E+19	3.15E+13	3.15E+13			S				
Sr-89	1.06E+01	2.86E+02	6.00E-01	17.64	1.10E+03	9.62E-03	3.46E-03	9.89E-01	B	10.00	2.89E+03	1.0704E+14	800	8.80E+17	1.06E+13	1.06E+13			S				
Sr-90	8.94E-01	2.42E+01	3.00E-01	2.98	5.10E+00	1.75E-01	3.46E-03	8.35E-02	B	10.00	2.89E+03	1.0704E+14	800	4.08E+15	8.94E+11	8.94E+11			S				
Tb-161	1.69E+01	4.58E+02	2.00E-02	846.49	4.35E+03	3.89E-03	1.16E-03	5.31E-01	B	10.00	8.62E+03	3.1897E+14	800	3.48E+18	1.69E+13	1.69E+13			S				
Th-227	1.16E-01	3.12E+00	5.00E-03	23.10	1.10E+03	1.05E-04	3.59E-02	1.12E-01	B	10.00	2.79E+02	1.0316E+13	800	8.80E+17	1.16E+11	1.16E+11			S				
Th-228	5.96E-04	1.61E-02	1.00E-03	0.60	3.00E+01	1.99E-05	3.21E-02	5.18E-04	A	10.00	3.11E+02	1.1512E+13	800	2.40E+16	5.96E+08	5.96E+08			S				
Tl-201	4.94E+02	1.31E+04	4.00E+00	120.90	7.90E+03	6.12E-02	7.65E-04	1.00E+01	B	10.00	1.31E+04	4.8362E+14	800	6.32E+18	1.16E+25	4.84E+14	H		S				
W-187	5.88E-03	2.40E-01	3.00E-01	0.03	2.60E+04	3.41E-07	4.54E-03	1.09E-03	A	10.00	2.20E+03	8.1534E+13	800	2.08E+19	8.88E+09	8.88E+09			S				
W-188	6.31E-02	1.71E+00	6.00E-01	0.11	3.70E+02	1.71E-04	5.98E-04	1.02E-03	A	10.00	1.67E+04	6.1860E+14	800	2.96E+17	6.31E+10	6.31E+10			S				
Y-90	6.02E-03	1.63E-01	3.00E-01	0.02	2.00E+04	3.01E-07	5.54E-03	9.02E-04	A	10.00	1.80E+03	6.6774E+13	800	1.60E+19	6.02E+09	6.02E+09			S				
Yb-169	5.06E+01	1.37E+03	1.00E+00	50.62	8.90E+02	5.89E-02	2.51E-03	3.43E+00	B	10.00	3.98E+03	1.4737E+14	800	7.12E+17	5.06E+13	5.06E+13			S				
Yb-175	2.56E+00	6.92E+01	9.00E-01	2.84	6.60E+03	3.88E-04	1.00E-03	6.94E-02	B	10.00	9.96E+03	3.6867E+14	800	5.28E+18	2.56E+12	2.56E+12			S				
Max	2.24E+03	6.05E+04		1.13E+04		8.00E+02		1.00E+01															

Notes

- Column
- Identifies nuclide
  - Package activity limit for this Contents Type - from Col 17
  - Calculated from Bq amount in Col 2
  - A2 from 10CFR71
  - # of A2's of nuclide at package activity limit
  - Specific activity from 10CFR71
  - Mass of nuclide at package activity limit
  - Heat generation rate of nuclide - from Microshield
  - Heat output of nuclide at package activity limit
  - Package Type [A or B] based on individual nuclide limit
  - Mass limit of nuclide based on package heat limit
  - Calculated from limit in Col 11
  - Calculated from Bq amount in Col 12
  - Mass limit of nuclide based on capacity of insert

Colour codes

- Radionuclides
- Package limit
- Physics data
- Contents limit based on heat, mass or shielding



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15	Calculated from Bq amount in Col 14
16	Package shielding limit
17	Package limit = least of heat, mass and shielding limits in Cols 13, 15 & 16
18	H shown where package limit is Heat limit
19	M shown where package limit is Mass limit
20	S shown where package limit is Shielding limit

Table 6 Activity Limits for Contents Type 4 - CT-4 - Liquid in light tungsten insert – Design No 3983

Contents Type 4 - CT-4 - Liquid in light tungsten insert										Package limits calculations for each nuclide													
										Contents heat limit				Contents mass limit				Package shielding limit		Package limit			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20				
Nuclide	Max TBq	Activity Ci	A2 TBq	# A2s	Spec Ac TBq/g	Mass g	Heat gen W/Ci	Heat output W	PackageType A or B	Mass W	Ci	Act Bq	Mass g	Act Bq	Act Bq	Code	H	M	S				
Ho-166-Liquid	2.22E+01	6.00E+02	4.00E-01	55.50	2.60E+04	8.54E-04	4.29E-03	2.58E+00	B	5.00	1.16E+03	4.3087E+13	200	5.20E+18	2.22E+13	2.22E+13			S				
Lu-177-Liquid	1.72E+02	4.64E+03	7.00E-01	245.05	4.10E+03	4.18E-02	1.08E-03	5.00E+00	B	5.00	4.64E+03	1.7153E+14	200	8.20E+17	1.99E+15	1.72E+14	H		S				
Mo-99-Liquid	7.13E+00	1.93E+02	6.00E-01	11.88	1.80E+04	3.96E-04	3.27E-03	6.30E-01	B	5.00	1.53E+03	5.6620E+13	200	3.60E+18	7.13E+12	7.13E+12			S				
Se-75-Liquid	6.94E+01	1.88E+03	3.00E+00	23.13	5.40E+02	1.29E-01	2.41E-03	4.51E+00	B	5.00	2.08E+03	7.6907E+13	200	1.08E+17	6.94E+13	6.94E+13			S				
Tl-201-Liquid	2.42E+02	6.54E+03	4.00E+00	60.45	7.90E+03	3.06E-02	7.65E-04	5.00E+00	B	5.00	6.54E+03	2.4181E+14	200	1.58E+18	8.39E+15	2.42E+14	H		S				
Max	2.42E+02	6.54E+03		2.45E+02		1.29E-01		5.00E+00															

Contents Type 4 - CT-4 - Liquid in light tungsten insert										Package limits calculations for each nuclide									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Notes

Column	
1	Identifies nuclide
2	Package activity limit for this Contents Type - from Col 17
3	Calculated from Bq amount in Col 2
4	A2 from 10CFR71
5	# of A2s of nuclide at package activity limit
6	Specific activity from 10CFR71
7	Mass of nuclide at package activity limit
8	Heat generation rate of nuclide - from Microshield.
9	Heat output of nuclide at package activity limit
10	Package Type [A or B] based on individual nuclide limit
11	Mass limit of nuclide based on package heat limit
12	Calculated from limit in Col 11
13	Calculated from Bq amount in Col 12
14	Mass limit of nuclide based on capacity of insert
15	Calculated from Bq amount in Col 14
16	Package shielding limit
17	Package limit = least of heat, mass and shielding limits in Cols 13, 15 & 16
18	H shown where package limit is Heat limit
19	M shown where package limit is Mass limit
20	S shown where package limit is Shielding limit

Colour codes	
	Radionuclides
	Package limit
	Physics data
	Contents limit based on heat, mass or shielding

Table 7 Activity Limits for Contents Type 5 - CT-5 - Liquid in steel insert – Design No 3986

Contents Type 5 - CT-5 - Liquid in steel insert										Package limits calculations for each nuclide									
										Contents heat limit			Contents mass limit		Package shielding limit	Package limit			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Nuclide	Max TBq	Activity Ci	A2 TBq	# A2s	Spec Ac TBq/g	Mass g	Heat gen W/Ci	Heat output W	Package Type A or B	Mass W	Ci	Act Bq	Mass g	Act Bq	Act Bq	Act Bq	Code		
Ho-166-Liquid	2.22E+01	6.00E+02	4.00E-01	55.50	2.60E+04	8.54E-04	4.29E-03	2.58E+00	B	5.00	1.16E+03	4.3087E+13	800	2.08E+19	2.22E+13	2.22E+13			S
Lu-177-Liquid	1.72E+02	4.64E+03	7.00E-01	245.05	4.10E+03	4.18E-02	1.08E-03	5.00E+00	B	5.00	4.64E+03	1.7153E+14	800	3.28E+18	1.99E+15	1.72E+14	H		
Mo-99-Liquid	7.13E+00	1.93E+02	6.00E-01	11.88	1.80E+04	3.96E-04	3.27E-03	6.30E-01	B	5.00	1.53E+03	5.6620E+13	800	1.44E+19	7.13E+12	7.13E+12			S
Se-75-Liquid	6.94E+01	1.88E+03	3.00E+00	23.13	5.40E+02	1.29E-01	2.41E-03	4.51E+00	B	5.00	2.08E+03	7.6907E+13	800	4.32E+17	6.94E+13	6.94E+13			S
Ti-201-Liquid	2.42E+02	6.54E+03	4.00E+00	60.45	7.90E+03	3.06E-02	7.65E-04	5.00E+00	B	5.00	6.54E+03	2.4181E+14	800	6.32E+18	8.39E+15	2.42E+14	H		
Max	2.42E+02	6.54E+03		2.45E+02		1.29E-01		5.00E+00											
Notes																			
Column																			
1	Identifies nuclide																		
2	Package activity limit for this Contents Type - from Col 17																		
3	Calculated from Bq amount in Col 2																		
4	A2 from 10CFR71																		
5	# of A2's of nuclide at package activity limit																		
6	Specific activity from 10CFR71																		
7	Mass of nuclide at package activity limit																		
8	Heat generation rate of nuclide - from Microshield.																		
9	Heat output of nuclide at package activity limit																		
10	Package Type [A or B] based on individual nuclide limit																		
11	Mass limit of nuclide based on package heat limit																		
12	Calculated from limit in Col 11																		
13	Calculated from Bq amount in Col 12																		
14	Mass limit of nuclide based on capacity of insert																		
15	Calculated from Bq amount in Col 14																		
16	Package shielding limit																		
17	Package limit = least of heat, mass and shielding limits in Cols 13, 15 & 16																		
18	H shown where package limit is Heat limit																		
19	M shown where package limit is Mass limit																		
20	S shown where package limit is Shielding limit																		

Colour codes

Radionuclides

Package limit

Physics data

Contents limit based on heat, mass or shielding

Colour codes	
	Radionuclides
	Package limit
	Physics data
	Contents limit based on heat, mass or shielding



**Table 8 Activity Limits for Contents Type 6 - CT-6 - Gas in light tungsten insert – Design No 3983**

Contents Type 6 - CT-6 - Gas in light tungsten insert										Package limits calculations for each nuclide									
1	2	3	4	5	6	7	8	9	10	Contents heat limit		Contents mass limit		Gas limit		Package shielding limit		Package limit	
Nuclide	Max	Activity	A2	# A2s	Spec Ac	Mass	Heat gen	Heat output	Package Type	Mass	Act	Mass	Act	15a	Act	16	17	18	19
	TBq	Cl	TBq		TBq/g	g	W/Cl	W	A or B	W	Cl	g	Bq	Bq	Bq	Bq	Bq	Code	
Kr-79	2.00E-01	5.41E+00	2.00E+00	0.10	9.24E+04	2.17E-06	1.67E-03	9.02E-03	A	10.00	5.99E+03	2.2176E+14	200	1.85E+19	3.46E+15	2.00E+11	2.00E+11		
Xe-133	3.45E+02	9.33E+03	1.00E+01	34.51	6.90E+03	5.00E-02	1.07E-03	1.00E+01	B	10.00	9.33E+03	3.4515E+14	200	1.38E+18	8.92E+15	2.87E+35	3.45E+14	H	
Max	3.45E+02	9.33E+03		3.45E+01		5.00E-02		1.00E+01											

Notes	
Column	
1	Identifies nuclide
2	Package activity limit for this Contents Type - from Col 17
3	Calculated from Bq amount in Col 2
4	A2 from 10CFR71
5	# of A2's of nuclide at package activity limit
6	Specific activity from 10CFR71
7	Mass of nuclide at package activity limit
8	Heat generation rate of nuclide - from Microshield.
9	Heat output of nuclide at package activity limit
10	Package Type [A or B] based on individual nuclide limit
11	Mass limit of nuclide based on package heat limit
12	Calculated from limit in Col 11
13	Calculated from Bq amount in Col 12
14	Mass limit of nuclide based on capacity of insert
15	Calculated from Bq amount in Col 14
15a	Gas limit from CS 2009/07
16	Package shielding limit
17	Package limit = least of heat, mass and shielding limits in Cols 13, 15 & 16
18	H shown where package limit is Heat limit
19	M shown where package limit is Mass limit
19a	L shown where package limit is Gas Limit
20	S shown where package limit is Shielding limit

Colour codes	
	Radionuclides
	Package limit
	Physics data
	Contents limit based on heat, mass or shielding

**Table 9 Activity Limits for Contents Type 7 - CT-7 - Fissile solid in Normal Form in steel insert – Design No 3986**

Contents Type 7 - CT-7 - Fissile solid in Normal Form in steel insert

Contents Type 7 - CT-7 - Fissile solid in Normal Form in steel insert										Package limits calculations for each nuclide										
										Contents heat limit			Contents mass limit		Package shielding limit		Package limit			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Nuclide	Max	Activity	A2	# A2s	Spec Ac	Mass	Heat gen	Heat output	PackageType	Mass	Act	Act	Mass	Act	Act	Act	Code			
	TBq	Cl	TBq		TBq/g	g	W/Cl	W	A or B	W	Cl	Bq	g	Bq	Bq	Bq	H	M	S	
Pu-238	1.14E+01	3.07E+02	1.00E-03	11354.22	6.30E-01	1.80E+01	3.26E-02	1.00E+01	B	10.00	3.07E+02	1.1354E+13	800	5.04E+14	2.99E+14	1.14E+13	H			
Pu-239	1.84E+00	4.97E+01	1.00E-03	1840.00	2.30E-03	8.00E+02	3.06E-02	1.52E+00	B	10.00	3.27E+02	1.2111E+13	800	1.84E+12	8.26E+20	1.84E+12		M		
Pu-240	6.72E+00	1.82E+02	1.00E-03	6720.00	8.40E-03	8.00E+02	3.06E-02	5.56E+00	B	10.00	3.27E+02	1.2086E+13	800	6.72E+12	1.15E+13	6.72E+12		M		
Pu-241	3.04E+03	8.22E+04	6.00E-02	50666.67	3.80E+00	8.00E+02	3.10E-05	2.55E+00	B	10.00	3.23E+05	1.1934E+16	800	3.04E+15	4.32E+18	3.04E+15		M		
U-235	6.40E-05	1.73E-03	unlimited	unlimited	8.00E-08	8.00E+02	2.71E-02	4.69E-05	B	10.00	3.69E+02	1.3646E+13	800	6.40E+07	3.60E+13	6.40E+07		M		
Max	3.04E+03	8.22E+04		5.07E+04		8.00E+02		1.00E+01												

**Notes**

Column	
1	Identifies nuclide
2	Package activity limit for this Contents Type - from Col 17
3	Calculated from Bq amount in Col 2
4	A2 from 10CFR71
5	# of A2's of nuclide at package activity limit
6	Specific activity from 10CFR71
7	Mass of nuclide at package activity limit
8	Heat generation rate of nuclide - from Microshield.
9	Heat output of nuclide at package activity limit
10	Package Type [A or B] based on individual nuclide limit
11	Mass limit of nuclide based on package heat limit
12	Calculated from limit in Col 11
13	Calculated from Bq amount in Col 12
14	Mass limit of nuclide based on capacity of insert
15	Calculated from Bq amount in Col 14
16	Package shielding limit
17	Package limit = least of heat, mass and shielding limits in Cols 13, 15 & 16
18	H shown where package limit is Heat limit
19	M shown where package limit is Mass limit
20	S shown where package limit is Shielding limit

**Colour codes**

	Radionuclides
	Package limit
	Physics data
	Contents limit based on heat, mass or shielding

**Table 10 Activity Limits for Contents Type 8 - CT-8 - Fissile solid in Special Form in steel insert – Design No 3986**

Contents Type 8 - CT-8 - Fissile solid in Special Form in steel insert

Contents Type 8 - CT-8 - Fissile solid in Special Form in steel insert										Package limits calculations for each nuclide										
1	2	3	4	5	6	7	8	9	10	Contents heat limit			Contents mass limit			Package shielding limit		Package limit		
Nuclide	Max	Activity	A2	# A2s	Spec Ac	Mass	Heat gen	Heat output	PackageType	Mass	Act	Act	Mass	Act	Act	Act	Code	18	19	20
	TBq	Cl	TBq		TBq/g	g	W/Cl	W	A or B	W	Cl	Bq	g	Bq	Bq	Bq	H	M	S	
Pu-238	1.14E+01	3.07E+02	1.00E-03	11354.22	6.30E-01	1.80E+01	3.26E-02	1.00E+01	B	10.00	3.07E+02	1.1354E+13	800	5.04E+14	2.99E+14	1.14E+13	H			
Pu-239	1.84E+00	4.97E+01	1.00E-03	1840.00	2.30E-03	8.00E+02	3.06E-02	1.52E+00	B	10.00	3.27E+02	1.2111E+13	800	1.84E+12	8.26E+20	1.84E+12		M		
Pu-240	6.72E+00	1.82E+02	1.00E-03	6720.00	8.40E-03	8.00E+02	3.06E-02	5.56E+00	B	10.00	3.27E+02	1.2086E+13	800	6.72E+12	1.15E+13	6.72E+12		M		
Pu-241	3.04E+03	8.22E+04	6.00E-02	50666.67	3.80E+00	8.00E+02	3.10E-05	2.55E+00	B	10.00	3.23E+05	1.1934E+16	800	3.04E+15	4.32E+18	3.04E+15		M		
U-235	6.40E-05	1.73E-03	unlimited	unlimited	8.00E-08	8.00E+02	2.71E-02	4.69E-05	B	10.00	3.69E+02	1.3646E+13	800	6.40E+07	3.60E+13	6.40E+07		M		
Max	3.04E+03	8.22E+04		5.07E+04		8.00E+02		1.00E+01												

Notes

Column	
1	Identifies nuclide
2	Package activity limit for this Contents Type - from Col 17
3	Calculated from Bq amount in Col 2
4	A2 from 10CFR71
5	# of A2's of nuclide at package activity limit
6	Specific activity from 10CFR71
7	Mass of nuclide at package activity limit
8	Heat generation rate of nuclide - from Microshield.
9	Heat output of nuclide at package activity limit
10	Package Type [A or B] based on individual nuclide limit
11	Mass limit of nuclide based on package heat limit
12	Calculated from limit in Col 11
13	Calculated from Bq amount in Col 12
14	Mass limit of nuclide based on capacity of insert
15	Calculated from Bq amount in Col 14
16	Package shielding limit
17	Package limit = least of heat, mass and shielding limits in Cols 13, 15 & 16
18	H shown where package limit is Heat limit
19	M shown where package limit is Mass limit
20	S shown where package limit is Shielding limit

Colour codes

	Radionuclides
	Package limit
	Physics data
	Contents limit based on heat, mass or shielding