

Influence on Transport of Fissile Material

by Proposed Changes to TS-R-1

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Abstract:

As part of the developments of the next Edition of the IAEA Transport Requirements, major changes have been proposed to the requirements on the fissile material. This paper compares the provisions between 2009 Edition and new edition (20xx) and lists the requirements for typical fissile material (U-235) under these two editions.

1. INTRODUCTION

The IAEA Regulations for the Safe Transport of Radioactive Material are reviewed once in two years keeping pace with the two-year review cycle of the UN Modal Regulations.

Because of the complex technical issues regarding the transport of radioactive materials, safety concern of transport of fissile material and needs from member states for additional exception from fissile material, IAEA 52nd and 53rd General Conference encouraged the Secretariat to develop new fissile-exception material requirements for the transport of radioactive materials.

Started in March 2009, the new revision cycle yielded a large number of comments from the Member States. Over 100 proposals are related to the transport of fissile-exception material. In TRANSSEC 19, the conclusion was that the issue of the fissile exception requirements met the decision criteria and were important enough to safety to warrant a revision of the Regulations.

2. INTENTION OF THE CHANGES

The proposed changes to fissile material are intended to simplify regulations and to support flexibility and easier introduction of new exceptions while improving safety.

The safety concerns of the existing exceptions of para 417 will be removed by reducing additional transport controls (CSI control) to avoid mistakes.

Flexibility for Member States will be introduced to provide some competent authority judgement in specifying exceptions for fissile material judged to provide no criticality risk in transport.

For small quantity of fissile material or low risk fissile material, simple and conservative methods will be provided to calculate values of CSI and to simplify the control of transport while ensuring criticality safety to the same standards as the packages complying with CA approved fissile package designs.

The new framework of fissile-exception clearly classifies materials into four categories and graded approach is implemented for this four categories:

- 1) Non-fissile material which is excluded from the definition of fissile material (Para. 222):
-- The material may be transported without any criticality control of transport and package;
- 2) The fissile-exception material which is excepted from all requirements (Para. 417):

- The material may be transported without any criticality control of transport and package except the requirement for smallest external dimension of package (10 cm);
- 3) Fissile material (CSI-controlled material) that is excepted from certification requirements for fissile material(672, 672bis):
 - The material may be transported with simple self-assessed package control and transport control (labelling , marking, CSI control).
- 4) Fissile material in packages that comply with certified package designs for fissile material:
 - The material needs package and often transport control.

Table 1 provides a table showing the typical fissile material, U-235, on how this material be classified according to its enrichment, nuclides mass and package size under 2009 and 20xx editions of TS-R-1.

3. IMPORTANT CHANGES AND IMPACT

The changes to para. 417 and the new para. 672 and 672bis will affect the classification of some material and further influence the requirements for package and transport.

Table 2 lists all requirements for fissile material in TS-R-1 and their applicability to these four types of fissile materials.

3.1 The changes to **para. 417** will reduce the possible content of one package which will affect all non-fissile or fissile-excepted packages.

3.1.1 Currently up to **15 g** of fissile material can be transported in an excepted package (subject to radiological considerations). Under the new proposals, the 15 g limit has been removed from para. 417. 15 g of fissile material is no longer fissile excepted and therefore cannot be transported in an excepted package. The new proposals will be more restrictive.

3.1.2 Under the existing Regulations para. 417a(ii)-(iii), the material with ratio of fissile nuclides to hydrogen < 5% and 5g fissile per 10 L material can be shipped in excepted package without requiring survival of the normal condition tests (NCT). Under the new proposals, they are no longer the excepted package under new provisions. They are the CSI-controlled fissile material.

3.2 New provisions of **para. 672** allow some fissile material to be transported by packages which do not designed for fissile material, for example Industry Package and Type A package. New requirements are introduced for their size and integrity under NCT for these packages to contain fissile material.

If these packages cannot be demonstrated to retain its contents under NCT, the subpara 672 (a) could be used to calculate CSI.

If the package can be demonstrated to retain its contents under NCT then para. 672 (b) or para. 672 (c) can be applied.

SCO-1 requires an IP-1 package which is not required to retain its contents under NCT so para. 672 (a) would apply.

3.3 Effects of the new proposals on non-fissile Type B(U) and Type A package classification and ID mark:



Contents in CA approved Type B(U) package and self approved Type A package currently include up to 15 g of fissile nuclides. New scheme will mean that unless fissile mass limit is reduced to 0.25 g the package must carry a CSI label. It is important to note that multilateral approval is not required under the new proposals.

In above situation the UN classification will change from “non-fissile/fissile excepted” to “fissile”. This is necessary because accumulation control is required for criticality safety purposes but does NOT mean that the package design for fissile material will require CA approval.

Table 1: Provisions of 2009 vs 20xx edition of TS-R-1 on fissile material

1) Fissile nuclide is U-235, Z value: General use, CSI limit for conveyance: 50

2); There are conditions in the provisions which are not listed here for simplification purpose.

3) 417 (a)*: para No. with asterisk refer to 2009 Edition of TR-R-1 and without asterisk refer to 20xx edition;

Enrichment	Fissile nuclide mass limit (g) package/consignment (\leq)	Smallest external dimension (cm)(\geq)	CSI limit (\leq)	Provisions In 2009 edition	Provisions In 20xx edition	Remark
Nature or depleted				Exempt	Exempt	222
Ore or concentrates or NORM				Exempt	Exempt	222
$\leq 1\%$				Fissile excepted	Fissile excepted	417 (b)*, (417 (a))
$\leq 1.5\%$	15/400	10	10	Fissile excepted	CSI-controlled Fissile	417 (a)*, 672 (a)
$\leq 1.5\%$	15/1000	10	0.8	Fissile	CSI-controlled Fissile	(417 (a))* , (672 (c))
$\leq 1.5\%$	80/400	10	10	Fissile	CSI-controlled Fissile	417 (a)*, 672 (a)
$\leq 1.5\%$	200/1000	30	10	Fissile	CSI-controlled Fissile	417 (a)*, 672 (b)
$\leq 2\%$ liquid				Fissile excepted	Fissile excepted	417 (c)*, 417 (b)
$\leq 5\%$	3.5/45	10		Fissile excepted	Fissile excepted	417 (a)(i)*, 417 (c)
$\leq 5\%$	15/154	10	10	Fissile excepted	CSI-controlled Fissile	417 (a)(i)*, 672 (a)
$\leq 5\%$	15/385	10	1.9	Fissile excepted	CSI-controlled Fissile	417 (a)(i)*, 672 (c)

Enrichment	Fissile nuclide mass limit (g) package/consignment (\leq)	Smallest external dimension (cm)(\geq)	CSI limit (\leq)	Provisions In 2009 edition	Provisions In 20xx edition	Remark
$\leq 5\%$	15/385	30	10	Fissile excepted	CSI-controlled Fissile	417 (a)(i)*, 672 (b)
$\leq 5\%$	32/154	10	10	Fissile	Fissile	417 (a)(i)*, 672 (a)
$\leq 5\%$	32/385	30	10	Fissile	CSI-controlled Fissile	417 (a)(i)*, 672 (b)
$\leq 10\%$	22/110	10	10	Fissile	CSI-controlled Fissile	417 (a)(i)*, 672 (a)
$\leq 10\%$	55/275	30	10	Fissile	CSI-controlled Fissile	417 (a)(i)*, 672 (b)
$\leq 20\%$	15/400	10	2.1	Fissile excepted	Fissile	417 (a)(i)*, 672 (c)
$\leq 20\%$	18.8/94	10	10	Fissile	CSI-controlled Fissile	417 (a)(i)*, 672 (a)
$\leq 20\%$	18.8/235	30	10	Fissile	CSI-controlled Fissile	417 (a)(i)*, 672 (b)
$\geq 5\%$	2/45	10		Fissile excepted	Fissile excepted	417 (a)(i)*, 417 (c)
$\leq 100\%$	0.25 / xx			Fissile excepted	Exempt	417 (a)*, 222,
$\leq 100\%$	0.5/15			Fissile excepted	Fissile excepted	417 (a)*, 417 (d),
$\leq 100\%$	xx/45 under Excl. use			? Fissile excepted	Fissile excepted	417 (a)*, 417 (e)
$\leq 100\%$	14/72	10	10	Fissile excepted	CSI-controlled Fissile	417 (a)*, 672 (a)
$\leq 100\%$	15/180	10	xx	Fissile excepted	CSI-controlled Fissile	417 (a)*, 672 (c)

Enrichment	Fissile nuclide mass limit (g) package/consignment (\leq)	Smallest external dimension (cm)(\geq)	CSI limit (\leq)	Provisions In 2009 edition	Provisions In 20xx edition	Remark
$\leq 100\%$	15/180	30	10	Fissile excepted	CSI-controlled Fissile	417 (a)(i)*, 672 (b)
$\leq 100\%$	15/400	30	10	Fissile excepted	Fissile	417 (a)*, 672 (b)
$\leq 100\%$	36/180	30	10	Fissile	CSI-controlled Fissile	417 (a)*, 672 (b)
$\leq 100\%$	xx/400, Homogeneous, Ratio of fissile nuclide/hydrogen $\leq 5\%$	10		Fissile excepted	? CSI-controlled Fissile	417 (a)(ii)*, 627
$\leq 100\%$	xx/400 $\leq 5\text{g}$ of fissile nuclide in and 10 L material	10		Fissile excepted	? CSI-controlled Fissile	417 (a)(iii)*, 627

Table 2: Fissile material and means of control

Means of control	Non-Fissile	Fissile excepted	CSI controlled fissile	Fissile
Package control:				
Basic requirement for transport of fissile material (671)	No	No	Yes	Yes

Means of control	Non-Fissile	Fissile excepted	CSI controlled fissile	Fissile
Package design for Fissile material (671 (b) (iv), 673-683)	No	No	No	Yes
Integrity under NCT (Retain fissile material content) (672)	No	No	Yes (except 672 (a))	No
Smallest external size (634, 672)	No	Yes	Yes	Yes
Package design certificates (833)	No	Only for 417 (f)	No	Yes
CA approval of fissile package (802, 806 (a), 809, 812, 813, 814)	No	No	No	Yes
Approval of fissile material exception (605bis, 804bis, 804ter, 830bis)	No	Only for 417 (f)	No	No
Identification mark with "F" (828, 829)	No	Only for 417 (f)	No	Yes
Consignment control:				
Mass limit (417)	No	Yes	Yes	Yes
No fissile material different from package design (418)	No	No	Yes	Yes
Labelling of CSI (539, 540, Fig. 5)	No	No	Yes	Yes
Labelling of mass of fissile nuclides (538 (b), Fig. 2-4)	No	No	Yes	Yes
Transport control:				
UN classification (Fissile or non-fissile UN number) (401, Table 1)	Non-fissile	Fissile excepted	Fissile	Fissile

Means of control	Non-Fissile	Fissile excepted	CSI controlled fissile	Fissile
UF6 classification (419)	No	No	Yes	Yes
CSI control (672, 672bis, 565, 566)	No	No	Yes	Yes
Tamper-evident seal (635)	No	No	Yes	Yes
Content of transport document (544 (i))	No	Yes	Yes	Yes
Content of consignment notification (556(e))	No	No	Yes	Yes
Confirmation before shipment (501, 502)	No	No	Yes	Yes
Segregation (565, 566)	No	No	Yes	Yes
Approval of shipment of CSI \geq 50 (820 (c))	No	No	Yes	Yes
unpacked fissile material (518, 566bis)	No	Yes	No	No
Transitional arrangement (816, 817)				Yes
Content of special arrangement certification (831, 832)		Only for 417 (f)		Yes