



Westinghouse Electric Sweden AB

721 63 Västerås

S/50/IF-96 Rev. 11

Our date: 28 March
2019

Your reference: BI

18-255 Ref. no.:

SSM2019-1548

Document no.: SSM2019-

1548-4 Administrative

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Approval of package design for transportation of radioactive substances

Decision of the Swedish Radiation Safety Authority

The Swedish Radiation Safety Authority (SSM) approved a package design for transportation by road, rail and sea under Swedish jurisdiction.

This approval has come about through evaluation of a report as shown in reference [5].

Package design identity designation: S/50/IF-96 (Rev. 11)

Package type: IP-3 for fissile material

Critical Safety Index: 0.5

Designation: EMBRACE

A description of the package and conditions for its use are provided in Appendix 1.

This certificate does not exempt the sender from compliance with all regulations that may be in place in the countries through or in which the package will be transported.

Previous revisions (S/50/IF-96 Rev. 9 and S/50/IF-96 Rev. 10) will cease to be valid when this certificate enters into force. However, transport already under way will be permitted, where copies of any such certificate are included for completion by the consignee, provided that transportation began before this certificate entered into force.

This certificate is valid until 31 December 2022.

Case

An application for extension of a certificate for approval of a package design for transportation by road, rail and sea on Swedish territory was received by SSM from Westinghouse Electric Sweden AB (WSE) on 22 October 2018. This application also included a request for extension of permitted contents to also include the nuclear fuel type "TRITON11".

On 26 February 2019, SSM received information concerning misstatements in certificate S/50/IF-96 Rev. 9 for the safety report [5], which led to the creation of a new revision (S/50/IF-96 Rev. 10). On 18 March 2019, notification was received that a condition in a clarification (footnote 5 and footnote 9) did not reflect the actual situation. SSM therefore decided to create another revision of the certificate for the package design EMBRACE (Rev. 11).



Reasons for the decision

The transport provisions in ADR-S, RID-S and the IMDG Code state that for transportation of class 7 substances, a competent authority must issue certificates for approval of package designs, which require regulatory approval. Pursuant to sections 7 and 8 of the Regulation (2006:311) on transport of dangerous goods, SSM examines such cases.

SSM is of the opinion – see the SSM review report, reference [6, 8 and 10] – that the conditions for approving the package design to which the application relates are met, with the restrictions and conditions as stated in Appendix 1.

Charges

The activity to which this licence relates is subject to a charge of SEK 75,000 in accordance with section 5 (17) of the Regulation (2008:463) on certain charges to the Swedish Radiation Safety Authority. Because this revision is initiated by SSM and the charge was paid in the previous application [5], no charges are payable.

Other information

Further provisions relating to transportation are provided in references [1-4] below.

How to appeal against this decision

Appendix 2 includes a description of how to appeal against this decision.

Unit manager Eva Gimholt made the decision on this case. Inspector Thomas Nilsson provided the report. Investigator Helmuth Zika also participated in the final handling of the case.

SWEDISH RADIATION SAFETY AUTHORITY

Eva Gimholt

Thomas Nilsson

Appendices

1. Scope, restrictions and conditions for use of the package
2. How to appeal against a decision



References

Transport provisions

1. IAEA Safety Standard Series No. SSR-6. Regulations for the Safe Transport of Radioactive Material, 2012 Edition.
2. Swedish Civil Contingencies Agency regulations on the transportation of dangerous goods by road and off-road, ADR-S 2017 (MSBFS 2016:8).
3. Swedish Civil Contingencies Agency regulations on the transportation of dangerous goods by rail, RID-S 2017 (MSBFS 2016:9).
4. Swedish Transport Agency regulations and general guidelines on transportation by sea of packaged dangerous goods, IMDG Code (TSFS 2015:66).

Technical documentation

5. *Application for renewed approval for package design*, SSM2018-5201-1.
6. *Review report (SSM)*, SSM2018-5201-2.
7. *Application for renewed approval for package design*, SSM2019-1548-1.
8. *Review report for EMBRACE package design (SSM)*, SSM2019-1548-2.
9. *Reason for creating a new revision for approval for EMBRACE package design*, SSM2019-1844-1, 2019-03-18.
10. *EMBRACE review report*, SSM2019-1844-3, 2019-03-27.



Appendix 1

I. Description of the packaging

The packaging is a modified variant of RA-2/3, designed for BWR-type fuel cartridges and fuel rods. It comprises an outer packaging section made of wood and an inner packaging section made of stainless steel, separated by shock absorbing material. The packaging must be designed in compliance with drawing Westinghouse Atom AA 281255 revision 5 and detailed drawings specified in this drawing.

Figure 1 shows a general drawing of the packaging. The following data is applicable

to the packaging:

Length, outer container	5290 mm
Width, outer container	885 mm
Height, outer container	886 mm
Tare weight, inner container	370 kg
Tare weight, outer container	555 kg
Tare weight, complete packaging	925 kg
Gross weight, complete packaging	max. 1570 kg

The limiting system is made up of the complete package (reference 1, section 209). The containment system is made up of the enclosure for the fuel rods¹ (reference 1, section 213).

II. Description of permitted contents

Permitted contents 1

The contents may be made up of no more than two unirradiated and complete BWR fuel cartridges² of type SVEA 96, containing fuel elements (fuel rods) with sintered pellets of uranium oxide, with or without gadolinium oxide.

The enclosure of the fuel rods must be made of a zirconium alloy. Tubular pellets are not allowed.

Fissile material must meet the requirements for LSA-II or LSA-III, according to references 2-4.

Any plastic sleeves for protecting the fuel cartridges must be open at both ends and must not extend beyond the ends of the fuel cartridges. The plastic must not be folded or taped in a manner that could prevent the free flow of water into or out of the fuel cartridge.

Each individual package may contain no more than 10 kg of plastic or rubber material.

The maximum permissible enrichment of uranium-235 is stated in table 1 below.

The contents of the package must be compliant with the specifications in tables 1, 2 and 3 below.



¹ In formal terms, the containment system is also made up of the complete package, the properties of the load (primarily the sealed fuel enclosure) preventing the spread of the radioactive contents.

² Fuel elements arranged in a matrix with spreaders to the fuel bundles, placed in a fuel box, as they are intended to be used in the reactor core.



Table 1

	Fuel bundles without with BA rods ³	Fuel bundles BA rods
Enrichment uranium-235 in Enrichment uranium-235 in node ⁴ , max.	5.0 % by 3.50 % by weight	5.0 % by 5.0 % by weight
Gd ₂ O ₃ content in pellets,	-	1.95 % by

Table 2

Maximum average enrichment in node per	Minimum number of BA rods per fuel bundle/cartridge ⁵
5.00 % by weight	9
4.85 % by weight	8
4.65 % by weight	7
4.45 % by weight	6
3.50 % by weight	0

Table 3

Quantity of uranium per fuel bundle, max.	209.5 kg
Number of fuel rods per bundle, max.	96
Width of rod lattice, max.	134.2 x 134.2 mm
Centre distance between rods, max.	13.3 mm
Active length, max.	4000 mm
Density of UO ₂ pellets, max.	10.96 g/cm ³
Density of pellets with Gd ₂ O ₃ , min.	9.0 g/cm ³
Rod radius, min.	4.87 mm
Pellet radius, max.	4.25 mm
Pellet radius for pellets with Gd ₂ O ₃ , min.	4.23 mm
Material thickness of enclosure, min.	0.56 mm

³"BA rods" means fuel elements with combustible absorber

⁴"Node" means an approx. 16 cm axial length (a cross-section) of the fuel elements, with a certain enrichment distribution and a certain number of BA rods.

⁵If there are two BA rods directly next to one another, only one of them is to be counted as a BA rod. Any BA rods placed in the outermost rod positions must not be counted. The BA rods must be positioned symmetrically in relation to a diagonal. A part-length BA rod should not be counted as a BA rod (part-length means that the BA rod is shorter than the standard length).



Permitted contents 2

The contents may be made up of no more than two unirradiated and complete BWR fuel cartridges⁶ of type TRITON11, containing fuel elements (fuel rods) with sintered pellets of uranium oxide, with or without gadolinium oxide.

The enclosure of the fuel rods must be made of a zirconium alloy. Tubular pellets are not allowed.

Fissile material must meet the requirements for LSA-II or LSA-III, according to references 2-4.

Any plastic sleeves for protecting the fuel cartridges must be open at both ends and must not extend beyond the ends of the fuel cartridges. The plastic must not be folded or taped in a manner that could prevent the free flow of water into or out of the fuel cartridge.

Each individual package may contain no more than 10 kg of plastic or rubber material. The maximum permissible

enrichment of uranium-235 is stated in table 4 below. The contents of the package must be compliant with the specifications in tables 4, 5 and 6 below.

Table 4

	Fuel bundles without BA rods ⁷	Fuel bundles with BA rods ⁷
Enrichment uranium-235 in pellet, max.	5.0 % by weight	5.0 % by weight
Enrichment uranium-235 in node ⁸ , max.	3.50 % by weight	5.0 % by weight
Gd ₂ O ₃ content in pellets, min.	-	1.95 % by weight



⁶ Fuel elements arranged in a matrix with spreaders to the fuel bundles, placed in a fuel box, as they are intended to be used in the reactor core.

⁷ "BA rods" means fuel elements with combustible absorber

⁸ "Node" means an approx. 16 cm axial length (a cross-section) of the fuel elements, with a certain enrichment distribution and a certain number of BA rods.



Table 5

Maximum average enrichment in node per	Minimum number of BA rods per fuel bundle/cartridge ⁹
5.00 % by weight	9
4.85 % by weight	8
4.65 % by weight	7
4.45 % by weight	6
3.50 % by weight	0

Table 6

Quantity of uranium per fuel bundle, max.	206 kg
Number of fuel rods per bundle, max.	109
Width of rod lattice, max.	134.2 x 134.2 mm
Centre distance between rods, max.	12.47 mm
Active length, max.	4000 mm
Density of UO ₂ pellets, max.	10.96 g/cm ³
Density of pellets with Gd ₂ O ₃ , min.	9.0 g/cm ³
Rod radius, min.	4.72 mm
Pellet radius, max.	4.115 mm
Pellet radius for pellets with Gd ₂ O ₃ , min.	4.095 mm
Material thickness of enclosure, min.	0.52 mm

⁹ If there are two BA rods directly next to one another, only one of them is to be counted as a BA rod. Any BA rods placed in the outermost rod positions must not be counted. The BA rods must be positioned symmetrically in relation to a diagonal. A part-length BA rod should not be counted as a BA rod (part-length means that the BA rod is shorter than the standard length).



Permitted contents 3

The contents of a package may be made up of loose fuel elements (fuel rods), intended for BWR fuel bundles either of type SVEA 96 or of type TRITON11, containing sintered pellets of uranium oxide, with or without gadolinium oxide. The enclosure of the fuel rods must be made of a zirconium alloy. Tubular pellets are not allowed.

The fuel rods must be positioned in no more than two inner transport boxes designed for the purpose and made of stainless steel. These boxes must be compliant with drawing Westinghouse Atom AAP 10901 revision 4. If any such box is not filled entirely with fuel rods, the remaining space must be filled with zirconium alloy tubes so that a closely packed lattice is achieved.

Fissile material must meet the requirements for LSA-II or LSA-III, according to references 2-4. Each individual package may contain no more than 10 kg of plastic or rubber material.

The contents must be compliant with the specifications in table 7 below.

Table
7

Enrichment uranium-235 in pellet, max.	5.0 % by weight
Quantity of uranium per box, fuel rods SVEA 96, max.	209.5 kg
Quantity of uranium per box, fuel rods TRITON11, max.	206 kg
Number of rods per box, max. (package)	96 (max. 192 rods per package)
Rod radius	4.45 – 6.25 mm
Pellet diameter	3.77 – 5.57 mm
Material thickness of enclosure SVEA 96, min	0.56 mm
Material thickness of enclosure TRITON11, min	0.52 mm

III. Transport conditions

All applicable parts of references 2-4 must be observed.

Applicable instructions for handling and regular inspection must be followed.

IV. Quality assurance

Steering documents for quality assurance of the packaging with regard to design, manufacture, testing, documentation, use, maintenance and inspection must be kept up to date.

V. Emergency response in the event of an accident



In the event of an accident on Swedish territory, the officer on call (TiB) at SSM must be contacted immediately via SOS-alarm on telephone +46 8 454 24 66, or 112 (national). A written report on the accident must be submitted to SSM as soon as possible afterwards, but at the latest within two weeks of the accident.

In the event of other incidents that are of significance from a nuclear safety or radiation safety standpoint, a written report on the incident must be submitted to SSM within no more than two weeks of the incident.

VI. Use of this certificate

This certificate may also be used by any party that has received a copy of the certificate, with the permission of the original applicant.

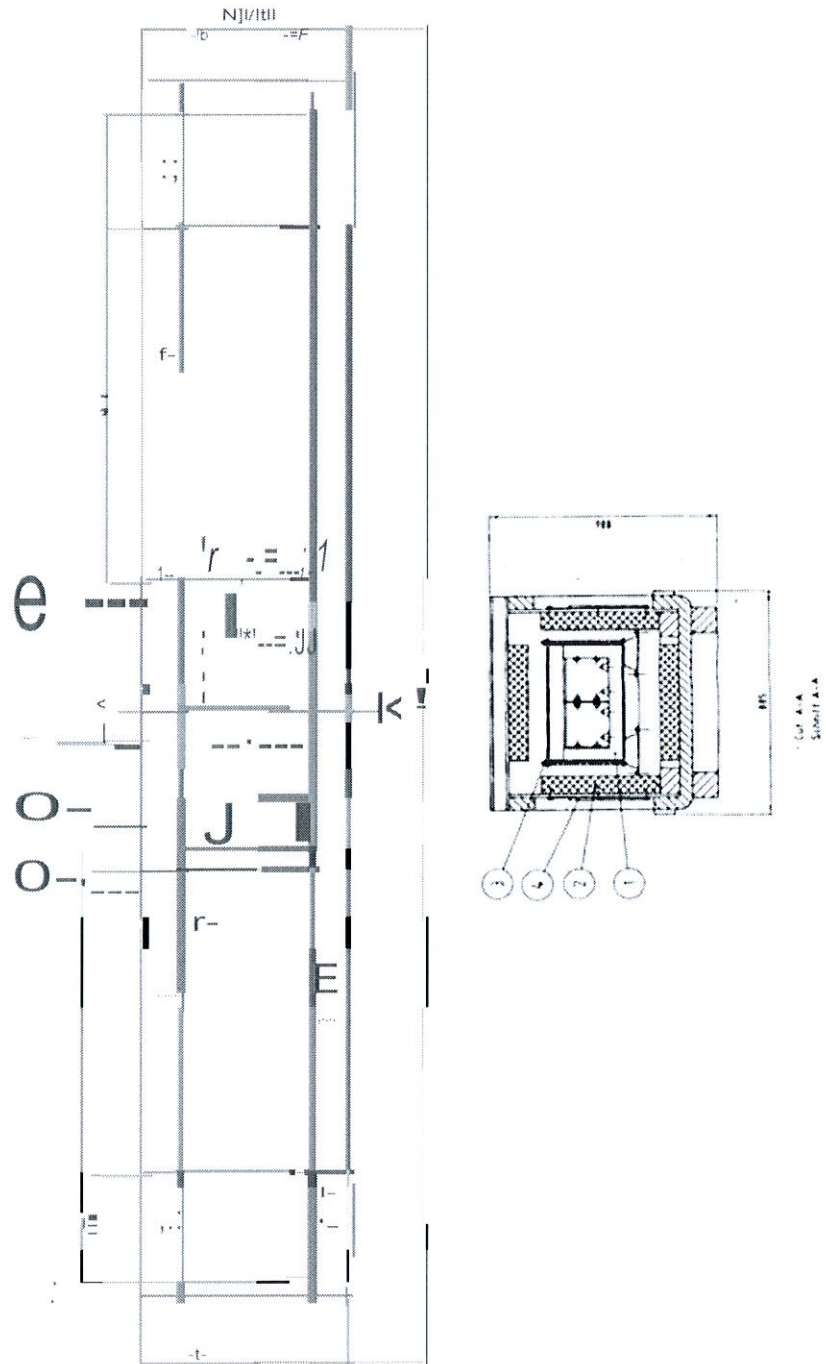


Figure I Overview of EMBRACE transport packaging.



List of revisions

Revision no.	Date of issue	Comments
0	2000-12-15	First edition
1	2001-01-25	Amendment of Permitted content I, with regard to approved fuel types
2	2003-10-14	Upgrade to IF-96 Amendment of Permitted content I Amendment of
3	2006-08-30	Extension of validity period with no substantial changes
4	2007-05-02	Extension of validity period with no substantial changes
5	2007-06-18	Extension of validity period with no substantial changes
6	2010-06-04	Extension of validity period with no substantial changes
7	2013-06-14	Extension of validity period with no substantial changes. Technical nomenclature in
8	2016-07-01	Extension of validity period with no substantial changes
9	2019-01-08	Extension of validity period, plus expansion of permitted content (nuclear fuel of type TRITON 11)
10	2019-03-12	Extension of validity period, editorial update and correction of erroneous data for permitted contents
11	2019-03-28	Correction of condition in footnote 5 and footnote 9



Appendix 2

How to appeal against a decision

An appeal against the Swedish Radiation Safety Authority's decision may be submitted to the government.

The appeal must be made in writing and must be sent or handed in to the Swedish Radiation Safety Authority.

- Postal address: Swedish Radiation Safety Authority, 171 16 Stockholm.
- Email: registrator@ssm.se
- Street address: Köpmangatan 18, Katrineholm, Solna strandväg 96, Solna.

The appeal must state the reference number of the decision, how the decision is to be changed, and why. The appeal must be received by the Swedish Radiation Safety Authority within three weeks of notification of the decision, otherwise it will not be possible to examine the appeal.

The Swedish Radiation Safety Authority will submit the appeal to the government for examination.