Main positions and suggestions formulated by group members and conclusions and resolutions adopted by the working group 4 are indicated in the right hand column of the following table.

Description of issue proposals and previous review of the issues are indicated in the other columns.

For issues whose proposals are not withdrawn, when new members are interested to cooperate in the further work, they should liaise with the issue leaders to agree on their respective contributions.
## SSR-6 pending issues about tests and design requirements

17-18 June 2014

<table>
<thead>
<tr>
<th>Comment No.</th>
<th>Para No.</th>
<th>Proposed Change/new regulatory text</th>
<th>Discussion/Reason</th>
<th>Recommendation/Reason for modification/rejection</th>
<th>WG resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>2a J/1.00/2</td>
<td>n/a</td>
<td>Proposal:</td>
<td>Background:</td>
<td>This is a major change.</td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td></td>
<td>A study group by the Member States who interested in the DPC should be established and investigate follows:</td>
<td>A joint TRANSSC/WASSC Working Group was established in April 2011, and has developed a technical document “Guidance for preparation of a safety case for a dual purpose cask containing spent fuel”. As a part of the Terms of Reference the Working Group is also developing following recommendations to TRANSSC.</td>
<td>TRANSSC to consider the revision of the Regulations to incorporate DPC in this revision cycle. A concrete proposal needs to be developed through Working Group.</td>
<td>Further work has to be done to work out the prepared changes: Consultancy meeting, Japan will take the lead. Result is a revised proposal to the next review cycle which is ready to be proposed to TRANSSC.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To establish transport safety requirements on the DPC, including transitional arrangements with consideration to post-storage transport of the DPC. In addition, to provide guidance to identify items to effect post-storage transport of the DPC and propose counter measures when the transitional arrangements will be considered.</td>
<td>To establish a regulatory framework to ensure transport after long-term storage</td>
<td>See also comment 7 (CH/1.00/1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>To realize requirements to consider ageing in design, analysis/evaluation and licensing of the DPC. Draft of revised regulatory text and guidance text should be provided. To review other items related to incorporation of the DPC to the Regulations.</td>
<td>To incorporate a concept of dual purpose (transport and storage) cask into the regulatory framework</td>
<td>WG 1 Discussion: Significant discussion on the issue occurred with a number of views provided by different members</td>
<td></td>
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<td></td>
<td>Refer to Deatailed Report of status</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>CH/1.00/1 Switzerland</td>
<td>Proposed solution introduces the DPC package in the regulations based on the results of the TRANSSC/WASSC joint working group. In particular, requirements for ageing demonstrations and for tracing of regulatory changes are ensured for DPC packages.</td>
<td>A joint TRANSSC/WASSC Working Group was established in 2011. According to the Terms of Reference the Working Group developed a technical document “Guidance for preparation of a safety case for a dual purpose cask containing spent fuel”. The Working Group also developed recommendations to TRANSSC and WASSC for changes to be emphasized the importance of providing a path forward on the issue for the international community. There was strong support for continued specific work on the transport issues related to DPC systems and other wastes, including disused sources.</td>
<td>Text revisions: DPC package 220bis. Dual Purpose Cask package (DPC package) shall mean a Type B package foreseen to be used for transport as well as for of outcome of discussions about DPC issue attached in Annex A of the present report.</td>
<td></td>
</tr>
</tbody>
</table>

framework on the DPC, including consideration of transitional arrangement to make it possible to permit transport of loaded DPC after long-term storage when the Regulations will be revised, and the latter does incorporation of considerations to ageing of packages to the Regulations and guidance material. The recommendations will be developed in the 3rd Working Group meeting in April 2013. TRANSSC should initiate actions to respond the recommendations in this review cycle. |
<table>
<thead>
<tr>
<th>short and long term dry storage of spent fuel. The usual transport situation is one transport to the storage area and a second transport to the unloading or disposal area after the storage period.</th>
</tr>
</thead>
<tbody>
<tr>
<td>668bis. DPC packages shall meet the requirements for Type B(U) packages and have to be subject to ageing considerations to ensure transportability after a specified storage time. A periodic safety review taking into account technical improvements and changes of safety regulations may be required.</td>
</tr>
<tr>
<td>808.(c) A DPC package design shall require multilateral approval.</td>
</tr>
<tr>
<td><strong>DPC packages approved under prior editions of these regulations</strong></td>
</tr>
<tr>
<td>823bis. DPC packages may continue in transport if the requirements of para. 668bis and para. 808(c) are met.</td>
</tr>
<tr>
<td>832.(e) For certificates of approval of DPC package design the symbol “-DPC” shall be added to the type code.</td>
</tr>
<tr>
<td>833.(a) Each certificate and each package shall bear the appropriate identification mark, comprising the symbols prescribed in para. 832(a)-(e), except that, for packages, only the applicable design type codes including, if applicable, the symbol “-96” and “-DPC” shall appear following the second stroke, that is, the</td>
</tr>
</tbody>
</table>

WG 1 Discussion: It was agreed to pass this proposed text forward to the WG on DPC transport issues.

Expected benefit is the safe transport of spent fuel packages after short and long term storage. Although transport will be national, an international safety level would be established. The effort for regulatory control would be reduced due to international standards.
### TRANSSC 28 WG 4 REPORT

**SSR-6 pending issues about tests and design requirements**

**17-18 June 2014**

| 8 CDN/1.0 0/1 Canada | Add to Section II Definitions
|----------------------|---------------------------------|
|                      | Large object
|                      | Large object shall mean a solid object which is contaminated with radioactive material and because of its size must be transported unpackaged.
| Modifications to Section IV Activity Limits and Classification |
|                      | Table 1, change UN 2913 PROPER SHIPPING NAME and description to;
|                      | "RADIOACTIVE MATERIAL, SURFACE CONTAMINATED OBJECTS (SCO-I or SCO-II or SCO-III), non fissile or fissile-excepted"
|                      | 413. SCO shall be in one of two three groups:
|                      | (a) SCO-I... (as is)
|                      | (b) SCO-II...(as is)
|                      | (c) SCO-III: A large object for which: (i) All openings are sealed to prevent release of radioactive material during

|                      | 1. There is an increasing demand in many countries for transporting large radioactive objects, such as equipment from decommissioning or refurbishment activities at nuclear facilities (steam generators, pressurizers, reactor pressure vessels and heads, coolant pumps, etc.). However, many nuclear reactor components are difficult to package because of their large size and weight, making it challenging or impractical to meet standard packaging requirements. This often requires them to be shipped under special arrangement.

Over a hundred shipments of these types of components from replacement or dismantlement of nuclear facilities have been conducted under special arrangement around the world. The advisory material from the

|                      | This is a major change and should be resolved by the revision cycle through Working Group. UN proper shipping name should be confirmed. Guidance should be reorganized in SSG-26.

|                      | Need for clarification of definition of large object concerning minimum dimensions or weight above which it is hard to use the currently applicable requirements

|                      | Large objects with activated materials are not included in the proposal (see note); they could be considered in a second step on the basis of the feedback from using the new proposal.

The “Special
| Routine conditions of transport; | IAEA Regulations includes specific guidance for the transport of large components under special arrangement. However, as experience with this type of transport has grown and is becoming more routine, specific regulatory requirements are needed to allow the movement of large radioactive objects without the need for special arrangement. A set of standard provisions for transport of large objects as surface contaminated objects (new SCO-III category), based on the IAEA “performance package” concept, have been developed for possible incorporation into the SSR-6 Regulations and Advisory Material. | Large experience has been accumulated in several countries for transport of large objects. This experience is felt sufficient to draft new regulation. Review on the deletion of the Appendix A not to lose recommendation, for instance about transport of large activated objects. The member from |
| (ii) The inside of the object is as dry as reasonably achievable; | | arrangement” procedure is not a preferred option for these large objects transports (because they have become regular). |
| (iii) The non-fixed contamination on the external surface does not exceed the limits specified in para. 508; | | |
| (iv) The non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm\(^2\) does not exceed \(8 \times 10^5\) Bq/cm\(^2\) for beta and gamma emitters and low toxicity alpha emitters, or \(8 \times 10^4\) Bq/cm\(^2\) for all other alpha emitters, unless it can be demonstrated that, in accident conditions of transport, the activity intake by a person in the vicinity of the accident does not exceed 10-6A2 or a corresponding inhalation dose of 50 mSv. | | |

### Modifications to Section V Requirements and Controls for Transport

- **517.** The quantity of LSA material or SCO in a single Type IP-1, Type IP-2, Type IP-3 package, or large object, object or collection of objects, whichever is appropriate, shall be so restricted that the external radiation level at 3 m from the unshielded material or object or collection of objects does not exceed 10 mSv/h.
- **520.** LSA material and SCO in groups LSA-I, and SCO-I and SCO-III may be transported, unpackaged, under the
### SSR-6 pending issues about tests and design requirements

**17-18 June 2014**

<table>
<thead>
<tr>
<th>Conditions</th>
<th></th>
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<tbody>
<tr>
<td>(a) through (d) as is; …</td>
<td></td>
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<tr>
<td>(e) For SCO-III;</td>
<td></td>
</tr>
<tr>
<td>(i) Transport shall be under exclusive use by road, rail or vessel;</td>
<td></td>
</tr>
<tr>
<td>(ii) Stacking shall not be permitted;</td>
<td></td>
</tr>
<tr>
<td>(iii) The requirements of para. 624 for a Type IP-2 package shall be satisfied, except that the &quot;maximum damage&quot; requirement of para. 722 may be met using orientation restrictions specified in the transport plan (para. 8X2(d)), and the requirements of para. 723 are not applicable.</td>
<td></td>
</tr>
</tbody>
</table>

- **522.** The total activity in a single hold or compartment of an inland waterway craft, or in another conveyance, for carriage of LSA material or SCO in a Type IP-1, Type IP-2, Type IP-3 package or unpackaged, shall not exceed the limits shown in Table 6. For SCO-III, the limits in Table 6 may be exceeded provided it can be demonstrated that, in accident conditions of transport, the activity intake by a person in the vicinity of the accident does not exceed 10-6A2 or a corresponding inhalation dose of 50 mSv.

- **523.** The TI for a package, overpack or freight container, or for unpackaged LSA-I, or SCO-I or SCO-III, shall be the number derived in accordance with the following procedure:
  - (a) Determine the maximum radiation level

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Canada will consider the above comments to refine the proposal.
in units of millisieverts per hour (mSv/h) at a distance of 1 m from the external surfaces of the package, overpack, freight container or unpackaged LSA-I, and SCO-I and SCO-III. The value determined shall be multiplied by 100 and the resulting number is the TI. For uranium and thorium ores and their concentrates...

(b) For tanks, freight containers and unpackaged LSA-I, and SCO-I and SCO-III, the value determined in step (a) shall be multiplied by the appropriate factor from Table 7.

- Table 7, modify the title to: Multiplication Factors for Tanks, Freight Containers and Unpackaged LSA-I, and SCO-I and SCO-III
- 540. Each label conforming to the applicable models in Figs 2–4 shall be completed with the following information:

(a) Contents:

(i) Except for LSA-I material, the name(s) of the radionuclide(s) as taken from Table 2, using the symbols prescribed therein. For mixtures of radionuclides, the most restrictive nuclides must be listed to the extent the space on the line permits. The group of LSA or SCO shall be shown following the name(s) of the
radionuclide(s). The terms “LSA-II”, “LSA-III”, “SCO-I”, and “SCO-II” and “SCO-III” shall be used for this purpose.

546. The consignor shall include in the transport documents with each consignment the identification of the consignor and consignee, including their names and addresses, and the following information, as applicable, in the order given:…

(n) For LSA-II, LSA-III, SCO-I, and SCO-II and SCO-III, the total activity of the consignment as a multiple of A2. For radioactive material for which the A2 value is unlimited, the multiple of A2 shall be zero.

Add to Section VIII Approval and Administrative Requirements

APPROVAL FOR LARGE OBJECT SHIPMENTS

8X1. Each consignment transported as a large object shall require multilateral approval.

8X2. An application for approval of large object shipments shall include:

(a) A detailed description of the proposed radioactive contents with reference to
8X3. Upon approval of large object shipments the competent authority shall issue a certificate of approval.

Add to Annex I Summary of Approval and Prior Notification Requirements

- Table, modify “LSA material c,d,e and SCO c,e” in Part 1 to “LSA material c,d,e, and SCO-I c,e and SCO-II c,e”
- Table, add a row to Part 4 for SCO-III:

<table>
<thead>
<tr>
<th>Key</th>
<th>Class of package or</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Competent authority
Consignor required

paragraphs material
approval required
to
notify country of

in the

origin and countries

Regulations
Country of Countries en
en routea of each

routea
shipment

_____________________________

_____________________________

413, 520, 522 SCO-III shipments
Yes Yes Yes

8X1, 8X2, 8X3

Add to Annex III Summary of Consignments
Requiring Exclusive Use

• Modify bullet (a) to “Unpackaged LSA-I material, and SCO-I and SCO-III (see para. 520);”
Modifications to the Advisory Material (DS425)

- Remove paragraph 310.15 and distribute the applicable guidance to the appropriate paragraphs of the Regulations above and remove any references to special arrangement.

- Remove Appendix VII and distribute the applicable guidance to appropriate paragraphs of the Regulations above and remove any references to special arrangement. Note that in many cases the guidance currently in Appendix VII has been moved to the proposed Regulations above and may be removed altogether. Also note that guidance should be added for paragraph 413 above indicating that contamination on the inaccessible surface may be determined by conservative estimates and/or analysis by methods other than direct contamination measurements.

Note that the above provisions do not include components such as reactor vessels at this time, due to the limited experience and greater radioactivity levels. LSA large object provisions may be proposed in the future to cover such components.
Deletion of Leaching Test for LSA-III Material

Text revisions (SSR-6):
- a) Delete para. 409 (c) (ii) and para. 409 (c) (iii) becomes para. 409 (c) (ii)
- b) Delete para. 601 and the heading above para. 601
- c) In para. 701 (a) delete in the first line: “LSA-III material, or”
- d) In the heading above para. 703 delete: “LSA-III MATERIAL AND”

Text revisions (TS-G-1.1):
- Include additional explanatory text regarding the deletion of the LSA-III leaching test in conjunction with para. 226.9 as follows:

The LSA-III material requirements were introduced into the regulations in the early 70s of last century. In the meantime much progress has been achieved internationally regarding knowledge of the kind and characteristics of LSA-II and LSA-III materials and their release behaviour in accident conditions. It has been demonstrated that the factor of 20 in specific

The justification of the assumptions of the leaching test for LSA-III material and its relevance with respect to transport safety have often been questioned. In practice various interpretations and implementations of this test with regard to the classification of material as LSA-III material have been found over the years in particular for radioactive waste. This situation raised difficulties in a harmonized and consistent application of the related regulatory requirements which may also cause non-compliances especially for the classification of radioactive waste forms with LSA-III requirements.

To overcome these problems research work was initiated in Germany to analyse the consistency and adequacy of TS-R-1 requirements for LSA-II und LSA-III material and in particular the LSA-III leaching

This is a major change. Considering that this is a proposal for changing the technical requirement it should be determined based on scientific evidence. Therefore, a TM or a technical consultancy should be considered to resolve this matter.

The objective is to make a joint proposal for the next review cycle.

Proposal raises no discussion when activity concentration of material is homogeneous.

France and Germany are currently working on the definition of allowed maximum heterogeneity.

WNTI is taking part in the work.

See comment 25 (F/1.00/2)
activity limit of LSA-III material compared to solid LSA-II has sufficient safety margins. These safety margins result from other currently required material properties than those involved in the previously required leaching test, e.g. activity distribution within the material and restriction to solids excluding powders.

The rationale given for this test requirement in the previous regulations was to restrict leaching of activity by water postulated to have penetrated into the packaging during transport operations. The limited solubility had to be demonstrated by a leaching test of a material sample representing the entire contents of the package in water for one week and a following analysis of the dissolved activity.

Compared to this accident scenario given as a justification for the LSA-III requirements more detailed analyses of different types of accident scenarios have been carried out applying current knowledge on airborne release behaviour of powders, brittle materials and other applied LSA-II and LSA-III materials [3], [4], [5], [6]. The low relevance of the limited solubility of solid LSA material for transport safety compared to the potential of airborne release from mechanical impact has been verified by scenario analyses of potential radiological consequences from transport and handling test requirement with respect to transport safety.

The main findings and conclusions are based on comprehensive research work which was performed in recent years in Germany and which includes results of collaborations with other European research institutions in this field. Based on this work a modification of the IAEA Transport Regulations regarding the solubility requirement and associated leaching test for LSA-III is proposed. For packages with LSA-III material it can be concluded that the achieved high level of transport safety is not connected with the currently required limited solubility of the material but is resulting from the other required material properties. Therefore the leaching test for LSA-III material does not contribute to the requested safety level and can be omitted without decreasing
accidents. In these analyses no scenario has been identified which could lead to an activity intake of $10^6 A_2$ (equivalent to 50 mSv effective dose) due to a lacking leaching test [1], [2].

In conclusion, with a deletion of the leaching test requirement for LSA-III material the IAEA Transport Regulations still guarantee a high level of safety for IP-2 and IP-3 packages which is fully consistent with that of other package types of the Transport Regulations.

<table>
<thead>
<tr>
<th>25 F/1.00/2 France</th>
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<tbody>
<tr>
<td>The purpose of the present sheet is to identify an issue. It does not provide complete solution. Work should be done to reach a consensus. Possible solutions may be:</td>
</tr>
<tr>
<td>- Limit the use of LSA categories to materials intrinsically homogeneous down to the mg level i.e. where the specific activity is known not to exceed ca. 10^{-4} A_2/g in any mg or 10 mg. Examples of such materials: reprocessed uranium oxide, activated metal after decontamination…;</td>
</tr>
<tr>
<td>- Assure that the possible maximum size airborne particle with maximum possible specific activity would not lead to a dose above 0.1 mSv when inhaled;</td>
</tr>
<tr>
<td>- Exclude the use of LSA categories for limits of heterogeneity of LSA material are not clearly stated in the Regulations. But consequences of heterogeneity might be far beyond the radiation protection goals relative to human life and health in case of transport accident.</td>
</tr>
<tr>
<td>DUPLICATE</td>
</tr>
<tr>
<td>Considering that this is an issue it should be resolved through a TM or a technical consultancy.</td>
</tr>
<tr>
<td>See comment 14 (D/1.00/4)</td>
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<tr>
<td>WG 1 Discussion: Already discussed</td>
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</tbody>
</table>
contaminated equipment or wastes coming from facilities where contaminants may have high specific activity.

- Text revisions (SSR-6):
  - Paras 226 and 409 should be reviewed to define heterogeneity limits consistent with the radiation protection goals of this Regulations.
  - Para. 601 should be reviewed to take into account influence of temperatures and vibrations in routine conditions of transport on the activity leaching rate.
  - Text revisions (TS-G-1.1):
    - Paragraphs 226-1 to 226-21, 409.4 to 409-14 should be completely rewritten.
    - Paragraphs 601.1 and 601.2 should be reviewed.

| 31 F/1.00/8 France | 612, 661, 809, 812, 827 | When a mechanical cooling system is needed to justify compliance with maximum allowable temperatures for sensitive package components, its efficiency should be documented so as to demonstrate:
  - capacity to maintain safe ambient temperatures, taking into account the
For a Type B(M) package design, the maximum ambient temperature to be considered to simulate normal conditions of transport may, subject to multilateral agreement, be taken as a value different from 38°C as required for Type B(U)
DUPLICATE This proposal is a major change and should be considered by the revision cycle taking into account the
Agreement that occasional use of forced mechanical cooling to match specific shipment conditions does not prevent a
| number of packages allowed in the cargo with, for each package, the maximal thermal power and the thermal environment (ambient temperature and solar flux) defined in the Regulations or in the approval certificate;

- reliability of the cooling system and its energy source, considering the redundancies of the system, the repair possibilities and the time available, in case of failure, for sensitive components of the package before reaching their temperature limit.

These elements should be included either in the documentation supporting the application for shipment approval or in the application for package design approval:

- for a Type B(M) package, in the Safety Analysis Report when the ambient temperature taken into account is less than 38°C;
- for Type B(U) packages in numbers or in confined space leading to exceed the ambient maximal temperature of 38°C, in the application for shipping approval conditions submitted to competent authority.

In addition, the fact that tarpaulins and packages. In addition, when transporting a Type B(U) package, the maximum temperature of the cargo space may also exceed 38°C if the space is confined. In a number of cases, compliance with the maximum allowable temperature for the components of the package requires the use of a mechanical cooling energized system (forced ventilation or refrigeration) while the current regulations do not require any demonstration of efficiency or robustness of such a system since it is generally excluded from the package design (see para. 661).

In addition, packages carried under tarpaulins or canopies can lead, when the radioactive contents is characterized by high heat power, for some components of the package, to recommendations of the TM-44891 on Transport Environment held in July 2013 at a Working Group.

WG 1 Discussion: Already discussed.

SSR-6 para. 809(g) relative to contents of approval application already includes provisions necessary to ensure safe heat dissipation so that CAs may request whichever thermal assessment they need, but it should be clear...
<table>
<thead>
<tr>
<th></th>
<th>canopies constitute features added to the package for which it is necessary to demonstrate that they don’t reduce the package safety should be stated in the guide.</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Text revisions (SSR-6):</td>
</tr>
<tr>
<td>612.</td>
<td>Any features added to the package at the time of transport that are not part of the package shall not reduce its safety.</td>
</tr>
<tr>
<td>661.</td>
<td>Compliance with the permitted activity release limits shall depend neither upon filters nor upon a mechanical cooling system, whether this system is integrated to the package or to the conveyance.</td>
</tr>
<tr>
<td>668bis.</td>
<td>When a mechanical cooling system is needed to ensure that package temperatures do not exceed the maximum allowable temperatures for the package components under the ambient conditions stated in paras 656 and 657, evidence shall be provided that this system remains efficient and reliable in routine conditions of transport or that the period between the failure of this system and the achievement of maximum temperatures is sufficient to avoid this risk taking into account special higher temperatures than in the safety demonstration case where the package is subjected to solar insolation. In this case it must be checked that these tarpaulins or canopies which may be viewed as features added to the package but are not mentioned as features in the TS-G-1.2 guide do not compromise its safety according to para 612. This should be clearly stated in the guide.</td>
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<td>that it is applicable to the intended number of packages in shipments.</td>
</tr>
<tr>
<td></td>
<td>Not necessary to add new requirement in SSR-6.</td>
</tr>
<tr>
<td></td>
<td>Advisory text to be recommended to address intended shipments conditions.</td>
</tr>
<tr>
<td></td>
<td>The case may be included in PDSR as far as intended shipment conditions are known.</td>
</tr>
<tr>
<td></td>
<td>Complementary application may be needed when shipment conditions become more stringent for new</td>
</tr>
</tbody>
</table>
provisions...

809. An application for approval shall include:

(g) Any special stowage provisions necessary to ensure the safe dissipation of heat from the package or packages intended for transport aboard the conveyance considering the various modes of transport to be used and the type of conveyance or freight container and documented evidence that the maximum allowable temperature for the package components important to safety will not be exceeded when ambient conditions satisfy provisions of paras 656 and 657;

812. An application for approval of a Type B(M) package design shall include, in addition to the information required in para. 809 for Type B(U) packages:

(a) A list of the requirements specified in paras 639, 655–657 and 660–666 with which the package does not conform;

(b) Any proposed supplementary operational controls to be applied during transport not regularly provided for in these Regulations, but which are necessary to ensure the safety of the package or to
compensate for the deficiencies listed in (a);

(c) A statement relative to any restrictions on the mode of transport and to any special loading, carriage, unloading or handling procedures;

(d) A statement of the range of ambient conditions (temperature, solar insolation) that are expected to be encountered during transport and which have been taken into account in the design.

827. An application for approval of shipment shall include:

(a) The period of time, related to the shipment, for which the approval is sought;

(b) The actual radioactive contents, the expected modes of transport, the type of conveyance and the probable or proposed route;

(c) The details of how the precautions and administrative or operational controls, referred to in the certificates of approval for the package design, if applicable, issued under paras 810, 813 and 816, are to be put into effect.
(d) When using a mechanical cooling system, documented evidence as required in 668bis.

Text revisions (TS-G-1.1):

612.1. This requirement is intended to prevent such action as placing handling tools, auxiliary equipment, transport frames or spare parts on or near the package in any manner such that the intended functions of packaging components could be impaired either during normal transport or in the event of an accident.

612.1bis When a package loaded with contents dissipating heat is carried under tarpaulins or canopies or in a confined space, some components of the package might reach higher temperatures than allowed in the safety case. In this case it should be checked that the heat dissipation capacity of these tarpaulins or canopies or confined space still guarantees acceptable temperatures.

668bis.1 A mechanical cooling system may be needed on a conveyance in order to limit the ambient temperature inside the cargo space one or several Type B(M) packages approved with restricted
ambient temperature. This may also be the case when carrying several Type B(U) packages within the same conveyance in particular where the cargo space is confined by some enclosure (tarpaulins, canopies, ship hold...)

668bis.2 The efficiency, the reliability and the robustness of the mechanical cooling system should be documented taking into account the maximum allowable number of packages and considering for each package the maximal thermal power allowed in the safety case or the certificate of approval.

668bis.3 The mechanical cooling system may also be considered efficient, reliable and robust enough when it is shown that a failure will not lead to exceed the temperature limits thanks to actions planned to restore the cooling capacity (for instance repair, connecting an extra power supply, etc.) when it is shown that these actions can be performed in due time before overheating.
use and assigned to category III-YELLOW;
- it is demonstrated, to the satisfaction of concerned competent authorities, that in normal conditions of transport the radiation levels remain lower than the regulatory limits for routine conditions of transport;
- the consignor provides specific instructions to be used by the workers to ensure compliance with their objectives of individual annual dose including instructions for applying protection in the event of a minor mishap;
- the shipping conditions are subject to multilateral approval, and
- access to the package by members of public is excluded.

Text revisions (SSR-6):

648. A package shall be so designed that if it were subjected to the tests specified in paras 719–724, it would prevent:

(a) Loss or dispersal of the radioactive contents;
(b) More than a 20% increase in the maximum radiation level at any external

C (§ 669) that, at the end of tests designed to demonstrate the ability of the package design to withstand normal conditions of transport the maximal radiation level at any external surface of the package shall not increase by more than 20%.

Demonstration of compliance with this criterion is in most cases carried out by calculation taking into account the damage caused to the shielding under the tests simulating normal conditions of transport (§ 719-727). However, these tests may also result in respective movements of the radioactive material and of the inactive parts of the contents when the contents are not blocked. For instance, this is the case for waste composed of activated steel loaded in bulk inside a packaging.

The main objective of the 20% shielding pieces.

The current solution of special arrangement procedure is not the preferred long term solution for repetitive transports of for instance transport of decommissioning wastes, with a growing need.

Participants indicate there are difficulties in mixing design and operational requirements.

The proposal should be reworked for instance using a requirement to keep the same
surface of the package.

...652. Type B(U) packages shall be designed to meet the requirements specified in paras 607–618, the requirements specified in paras 619–621 if carried by air, and in paras 636–649, except as specified in para. 648(a), and, in addition, the requirements specified in paras 653–666.

...529. Packages, overpacks and freight containers shall be assigned to either category I-WHITE, II-YELLOW or III-YELLOW in accordance with the conditions specified in Table 8 and with the following requirements:

(a) For a package, overpack or freight container, the TI and the surface radiation level conditions shall be taken into account in determining which category is appropriate. Where the TI satisfies the condition for one category but the surface radiation level satisfies the condition for a different category, the package, overpack or freight container shall be assigned to the higher category. For this purpose, category I-WHITE shall be regarded as the lowest category.

(b) The TI shall be determined following the criterion is to ensure that during transport there is no risk of exceeding the regulatory limits of annual individual dose of 20 mSv for the workers and 1 mSv for members of the public.

While this criterion may be considered convenient to meet the radiation protection goal, there are situations characterized by much higher dose rate increase factors but where individual dose limits are not jeopardized by transport exposures thanks to low initial dose rates. For such situations, if the dose rate increase factor limitation implies additional handling of the radioactive material in the consignor facility to restrict degrees of freedom of the material, facility operators may receive unjustified radiation doses.

Moreover, special arrangement
(c) If the surface radiation level is greater than 2 mSv/h, the package or overpack shall be transported under exclusive use and under the provisions of paras 573(a), 575 or 579, as appropriate.

(d) A package transported under a special arrangement shall be assigned to category III-YELLOW except under the provisions of para. 530.

(dbis) A Type B(U), Type B(M) or Type C package which does not satisfy the requirement 648 (b) shall be assigned to category III-YELLOW.

(e) An overpack or freight container that contains packages transported under special arrangement shall be assigned to category III-YELLOW except under the provisions of para. 530.

Alternative requirements when the radiation level increase in normal conditions of transport exceeds 20%

567bis. For a Type B(U), Type B(M) or Type C package which does not satisfy the requirement in para. 648 (b) the transport shall be performed under is not desirable when a large number of transports is foreseen.

It would be useful in order to reduce these doses for nuclear facility workers to relax the 20% criterion when the effect on doses to transport workers and members of the public is acceptable. It is proposed that this criterion could be relaxed when:

- the transport is performed under exclusive use and assigned to category III-YELLOW;

- it is demonstrated that in normal conditions of transport the radiation levels remain lower than the regulatory limits for routine conditions of transport;

- the consignor provides specific instructions to be used by the workers to minimize occurrences of minor mishaps as well as instructions to ensure compliance with their objectives.
| exclusive use and the consignor shall provide specific instructions to all the workers involved in the transport to ensure compliance with their objectives of individual annual dose even in the event of minor incidents and to prevent access of unauthorized persons to the contact of package. |

825. Multilateral approval shall be required for:

(a) The shipment of Type B(M) packages not conforming with the requirements of para. 639 or designed to allow controlled intermittent venting.

(b) The shipment of Type B(M) packages containing radioactive material with an activity greater than 3000A1 or 3000A2, as appropriate, or 1000 TBq, whichever is the lower.

(c) The shipment of packages containing fissile material if the sum of the CSIs of the packages in a single freight container or in a single conveyance exceeds 50. Excluded from this requirement shall be shipments by seagoing vessels, if the sum of the CSIs does not exceed 50 for any hold, compartment or defined deck area and the distance of 6 m between

and individual annual dose, including instructions for applying protection in the event of a minor incident;

- the shipping conditions are subject to multilateral approval.
groups of packages or overpacks, as required in Table 11, is met.

(d) Radiation protection programmes for shipments by special use vessels in accordance with para. 576(a).

(e) The shipment of Type B(U), Type B(M) or Type C packages which do not satisfy the requirement of para. 648 (b).

827. An application for approval of shipment shall include:

(a) The period of time, related to the shipment, for which the approval is sought;

(b) The actual radioactive contents, the expected modes of transport, the type of conveyance and the probable or proposed route;

(c) The details of how the precautions and administrative or operational controls, referred to in the certificates of approval for the package design, if applicable, issued under paras 810, 813 and 816, are to be put into effect;

(d) For packages which do not satisfy the requirement of para. 648 (b), the assessment of the maximum radiation
levels expected in normal conditions of transport and the details of how the specific shipment conditions and instructions are to be put into effect.

837. Each certificate of approval for a shipment issued by a competent authority shall include the following information:

(a) Type of certificate.

(b) The competent authority identification mark(s).

(c) The issue date and an expiry date.

(d) List of applicable national and international regulations, including the edition of the IAEA Regulations for the Safe Transport of Radioactive Material under which the shipment is approved.

(e) Any restrictions on the modes of transport, type of conveyance, freight container and any necessary routeing instructions.

(f) The following statement: "This certificate does not relieve the consignor from compliance with any requirement of the government of any country through or into which the package will be
(g) A detailed listing of any supplementary operational controls required for preparation, loading, carriage, unloading and handling of the consignment, including any special stowage provisions for the safe dissipation of heat or maintenance of criticality safety.

(h) Reference to information provided by the applicant relating to specific actions to be taken prior to shipment.

(i) Reference to the applicable certificate(s) of approval of design.

(j) A specification of the actual radioactive contents, including any restrictions on the radioactive contents that might not be obvious from the nature of the packaging. This shall include the physical and chemical forms, the total activities involved (including those of the various isotopes, if appropriate), mass in grams (for fissile material or for each fissile nuclide, when appropriate) and whether special form radioactive material, low dispersible radioactive material or fissile material excepted under para. 417(f), if applicable.

(k) Any emergency arrangements deemed
necessary by the competent authority.

(l) A specification of the applicable management system, as required in para. 306. (m) If deemed appropriate by the competent authority, reference to the identity of the applicant.

(lbis) For packages which do not satisfy the requirement of para. 648 (b), specific instructions to workers involved in the transport, to ensure compliance with their objectives of individual annual dose even in the event of minor mishaps and to prevent access of unauthorized persons to the contact of package.

(n) Signature and identification of the certifying official.

Ensure consistency of:

- Annex I: SUMMARY OF APPROVAL AND PRIOR NOTIFICATION REQUIREMENTS;
- Annex III: SUMMARY OF CONSIGNMENTS REQUIRING EXCLUSIVE USE.

| 36 F/1.00/13 France | 659, 667, 685 | For less than 500 kg packages, extend the crush test to Type B and fissile packages whose apparent density exceeds 1. Text revisions (SSR-6): | Paragraphs 659 b) i), 667 and 685 b) i) of the SSR-6 require, for Type B(U) and B(M) packages loaded with a radioactive contents greater than the applicable limit, to be taken into account in the revision cycle when applying the dynamic crush test more stringent than package drop test. | Dynamic crush test more stringent than package drop test when |
659. A package shall be so designed that if it were subjected to:

(a) The tests specified in paras 719–724, it would restrict the loss of radioactive contents to not more than $10^{-6}$ A2 per hour.

(b) The tests specified in paras 726, 727(b), 728 and 729 and either the test in:

—Para. 727 (c), when the package has a mass not greater than 500 kg, an overall density not greater than 1000 kg/m³ based on the external dimensions, and radioactive contents greater than 1000A2 not as special form radioactive material; or

—Para. 727(a), for all other packages,

(i) It would retain sufficient shielding to ensure that the radiation level 1 m from the surface of the package would not exceed 10 mSv/h with the maximum radioactive contents that the package is designed to contain.

(ii) It would restrict the accumulated loss of radioactive contents in a period of one week to not more than 10A2 for krypton-85 and not more than A2 for all other than 1000 A2 (excluding special form radioactive material) and for packages loaded with fissile material, and characterized by:

- a mass not greater than 500 kg;

- an overall density not greater than 1000 kg/m³;

a dynamic crush test in which the specimen is placed on the package target so as to suffer maximum damage by the drop of a plate of 500 kg from a height of 9 m. The plate consists of a solid mild steel plate of 1 m x 1 m which shall fall in a horizontal attitude (§ 727 (c) drop III). This dynamic crush test replaces the 9 m drop of the package (§ 659 b) ii), 667, 685 b) i) and 727) drop I).

In paragraph 727.4 of TS-G-1.1, it is explained that the dynamic crush test plate is justified for packages weighing less than 500 kg for which the energy to be absorbed by the package...
radionuclides.
Where mixtures of different radionuclides are present, the provisions of paras 405–407 shall apply, except that for krypton-85 an effective $A_2(i)$ value equal to $10A_2$ may be used. For case (a), the assessment shall take into account the external contamination limits of para. 508.

685. A number $N$ shall be derived, such that two times $N$ packages shall be subcritical for the arrangement and package conditions that provide the maximum neutron multiplication consistent with the following:

(a) Hydrogenous moderation between the packages and the package arrangement reflected on all sides by at least 20 cm of water.

(b) The tests specified in paras 719–724 followed by whichever of the following is the more limiting:

(i) The tests specified in para. 727(b) and either para. 727(c) for packages having a mass not greater than 500 kg and an overall density not greater than 1000 kg/m$^3$ based on the external dimensions or para. 727(a) for all other packages, followed by the test specified in para. 728 and completed by the tests specified in after the 9 m drop test is low. This is the case for packages containing a large amount of alpha emitters which are generally light and are characterized by a low density due to their limited shielding. This includes, for example, plutonium oxide powders and plutonium nitrate solutions, which are radioactive material with high potential hazards. However, this type of packages must withstand impact at 13.3 m/s by projectiles weighing up to 500 kg that could occur during phases of handling or carriage.

The mass of 500 kg would correspond to the average mass of the packages or other objects usually handled and transported with radioactive material packages. Although the value of 500 kg could be discussed, the principle of mass limit seems appropriate to the risk that it is intended to cover namely the aggression of a RAM package kg/m$^3$
Proposal to select most damaging test condition looks reasonable if restricted to new designs.

It is intended to propose transitional condition for existing package designs $< 500$ kg and density $> 1000$ kg/m$^3$

Justification of safety benefit: showing practical case not possible, due to proprietary information.

The group suggests preparing a chart of package design mass vs
| paras 731–733; or (ii) The test specified in para. 729. |
| (c) Where any part of the fissile material escapes from the containment system following the tests specified in para. 685(b), it shall be assumed that fissile material escapes from each package in the array and that all of the fissile material shall be arranged in the configuration and moderation that results in the maximum neutron multiplication with close reflection by at least 20 cm of water. |

Text revisions (TS-G-1.1):

682.1. With the 1996 Edition of the Transport Regulations, tests for the accident conditions of transport must consider the crush test of para. 727(c) for lightweight (<500 kg) and low density (<1000 kg/m3) packages. The criteria for invoking the crush test as opposed to the drop test of para. 727(a) is the same as that used for packages with contents greater than 1000A2 not as special form (see para. 657(b)).

727.4. The degree of safety provided by the 9 m drop test is smaller for light, low density packages than for heavy, high density packages, owing to the reduced by the drop of another package.

The upper overall density limit underlies that high density packages are more resistant to crush test than low density packages. But if a package density can be an indicator of the package resistance it could not be an objective criterion. The mechanical strength of a package is not directly linked to its overall density. This criterion was adopted for plutonium packages that did not require significant shielding.

Thus, it seems wrong to think that a package of density greater than 1000 kg/m3 would not be sensible to the drop of a plate of 500 kg. Also, we consider that the dynamic crush test should be applicable independently of the package density.

apparent density to see how many designs are concerned. Each country to provide data on existing designs with mass < 500 kg and with contents either fissile or >1000 A2.

Germany will collect data and prepare chart.

Issue to be further discussed.

France will work on amended proposal considering above comments.
impact energy and to the increased probability of impacting a relatively unyielding ‘target’ [17–23]. Such packages may also be sensitive to crush loads. Accident analyses show that the probability of dynamic crush loads in land transport accidents is higher than that of impact loads because lightweight packages are transported in larger numbers or together with other packages [14–16]. Also, handling and stowage mishaps can lead to undue static or dynamic crush loads. The end result of this was the inclusion of the crush test (drop III) in the 1985 Edition of the Transport Regulations. Packages containing a large amount of alpha emitters are generally light, low density packages due to their limited shielding, and may fit into this category. This includes, for example, plutonium oxide powders and plutonium nitrate solutions, which are radioactive material with high potential hazards. Because of their physical characteristics, most packages will be subject to the 9 m drop (impact) test rather than the crush test. With the 201X Edition of the Transport Regulations the apparent density limit was removed considering that some package designs with an apparent

<table>
<thead>
<tr>
<th>Following the discussions held after the Fukushima accident that has shown that some parameters of the design basis accidents could be questioned, this change is perceived as the more urgently needed as the concerned package designs are very sensitive (plutonium, MOX, etc…).</th>
</tr>
</thead>
<tbody>
<tr>
<td>A high benefit for safety is expected by limiting occurrences of foreseeable events with large potential radiological consequences in accident conditions.</td>
</tr>
<tr>
<td>A few fissile package designs will have to be reinforced. The upgrading cost will depend on which transitional conditions are decided.</td>
</tr>
</tbody>
</table>
## SSR-6 pending issues about tests and design requirements

**17-18 June 2014**

| 56 | WNTI/1.0 0/9 WNTI | 621 | - It is proposed to have a gradual system:

- for excepted packages, industrial packages and type A packages containing solid radioactive material except when in powder form and also for LSA-I in powder form (LSA-I is a material, which can be carried unpackaged for the other modes, is the less dangerous material regarding the potential consequences of its dispersal) the requirement should be that in case of depressurisation of the cargo compartment, the package shall retain its contents (packagings may be designed to offer radiation shielding, it is then important that the content remains in the package);

- for excepted packages, industrial packages and type A packages containing solid radioactive material in powder form other than LSA-I, the requirement should be that the packages shall be able to withstand a pressure differential of 95 kPa without loss or dispersal of radioactive content (same as for density greater than 1000 kg/m³) may still be much less rigid than the dropped steel plate (whose density is 7800 kg/m³) and could receive damages from the crush test more important than those produced by the 9 m drop test.

|  |  |  | - There is a need to harmonise the internal pressure to which a package transported by air shall be submitted without loss or dispersal of its contents between IAEA SSR-6 (para. 621), UN Model Regulations (para. 4.1.1.4.1) and Modal Regulations (ICAO TI - Part 4, Chapter 1 para 1.1.6).

|  |  |  | - This is a major change should be considered by revision cycle through a TM taking into account the recommendations of TM-44891.

|  |  |  | - ICAO representatives are not present so it is difficult to discuss this in great detail. Prepare the proposal in a more detailed, elaborated form. Benefit: Packaging groups I and II could be used for class 7.

|  |  |  | - Correspondence group is needed led by WNTI joined by France, Switzerland and ICAO.

|  |  |  | - Representation of ICAO at

|  |  |  | The UN Modal Regulations and ICAO Regulations require that packagings, transported by air, for which retention of liquid is a basic function must be capable of withstanding without leakage an internal pressure which produces a pressure differential of not less than 95 kPa (not less than 75 kPa for liquids in Packing Group III of Class 3 or Division 6.1), or a pressure

WG 1 Discussion: General agreement that the issue warrants further discussion through a TM/Working group.
### SSR-6 pending issues about tests and design requirements  
17-18 June 2014

<table>
<thead>
<tr>
<th>Cases</th>
<th>Requirements</th>
</tr>
</thead>
</table>
| Solid infectious substances in ICAO-TI | - for other cases the requirement should be that the packages shall be able to withstand a pressure differential of the total gauge pressure developed in the package at 55°C multiplied by a safety factor of 1.5 with a minimum of 95 kPa (same as for liquid dangerous goods in ICAO-TI), or as an alternative, the packages shall be able to withstand a pressure differential of the total gauge pressure developed in the package at 55°C plus 75 kPa with a minimum of 95 kPa (covers any foreseen situations)  
| - Avoid misunderstanding and improve the efficiency of the regulations especially for packages which do not require package design approval, by having requirements easier to comply with. | Except in the specific case of infectious substances (UN 3373, UN2814 and UN2900, Division 6.2) for which the packaging must be capable of withstanding without leakage an internal pressure which produces a pressure differential of not less than 95 kPa (see Packing Instructions 620, 650 in ICAO-TI, ADR and IMDG/IMO), this requirement does not apply to packagings for solid dangerous goods other than radioactive ones  
| - for excepted packages, industrial packages and type A packages containing solid radioactive material except when in powder form + LSA-I in powder form: | Most of the UN packagings designed for liquid dangerous goods are qualified for an internal pressure of 95 kPa and are easy to supply. It is much more difficult to find UN packagings already qualified for internal pressure greater than |
| o 25 kPa is the minimum pressure in a cargo compartment depressurized (100 kPa – 75 kPa = 25 kPa) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| o the package shall retain its contents: offers several possibilities to complied related to the vapour pressure of the liquid to be conveyed, whichever is the greater. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
### SSR-6 pending issues about tests and design requirements
17-18 June 2014

<table>
<thead>
<tr>
<th>with</th>
<th>95 kPa. It is then difficult to find UN packagings designed for Packing Group I or II dangerous goods which can be used as IP-2 as allowed in para 626 of SSR-6.</th>
</tr>
</thead>
<tbody>
<tr>
<td>• package which is able to withstand the pressure differential of 75 kPa (what is required for packagings for liquid packing group III material in ICAO-TI), or</td>
<td>Harmonization may also help in the case of liquid radioactive material having other dangerous properties, where requirements for radioactive contents and those for other dangerous goods classes are simultaneously applicable.</td>
</tr>
<tr>
<td>• use of valves + filters to allow pressure equilibrium without dispersal of radioactive solid material content (when the content can be subject to dispersal), or</td>
<td>It could also be possible to except from this requirement certain kinds of radioactive material (special form, SCO…) or to express differently the rule for them, without reducing the safety.</td>
</tr>
<tr>
<td>• use of valves without any supplementary equipment (if the content is not subject to dispersal);</td>
<td>There is no identified reason to specify a pressure test differently for packages</td>
</tr>
<tr>
<td>• for excepted packages, industrial packages and type A packages containing solid radioactive material in powder form other than LSA-I</td>
<td></td>
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<tr>
<td>o the packages shall be able to withstand a pressure differential of 95 kPa without loss or dispersal of radioactive content (these packagings are generally leaktight and dispersal of the radioactive material content may be of a greater concern than for LSA-I : the rule retained is that in force for</td>
<td></td>
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</table>
infectious substances): except the increase of pressure due to heating of the gas content (air or other) between 15 and 55°C (this increase of pressure ≤ 15 kPa), no other source of increase of the pressure is expected (activities are low, so heating by the radioactive content will be very low, production of gases by radiolysis phenomenon will also be low) => 75 kPa + 15 kPa = 90 kPa which is less than 95 kPa.

- for other cases
  - the packages shall be able to withstand a pressure differential of the total gauge pressure developed in the package at 55°C multiplied by a safety factor of 1.5 with a minimum of 95 kPa (alternative: Packages shall be able to withstand a pressure differential of the total gauge pressure developed in the package at 55°C + 75 kPa with a minimum of 95 kPa): the pressure which have to be taken into account is that which can develop above atmospheric pressure at sea level in the containment system when the package considered to be filled at 15°C, is submitted to an ambient temperature of 55°C, taking account of containing radioactive material from what is done for packages containing other dangerous goods.

For information, the note 3 about pressure variations in airplanes in introductory notes of Part 4 of ICAO-TI, indicates that the pressure differential between atmospheric pressure at sea level and the pressure inside cargo compartment of an airplane may vary from 25 kPa (pressurized compartments) to 75 kPa (partially pressurized or non-pressurized compartment).

Example to illustrate the differences:
Example 1 for solid material
- For a package loaded with solid radioactive LSA-I at 100 kPa ambient pressure and 15°C ambient
all phenomena which can participate to increase the pressure in routine condition of transport (heating produced by the content, thermal decomposition, radiolysis, increase of vapour pressure for liquids, etc - the MNOP is generally envelop of this situation). The minimum pressure of 95 kPa is the condition required by ICAO for packaging containing liquid dangerous goods. This rule is that required for liquid dangerous goods in ICAO-TI (see Part 4, Chapter 1 para. 1.1.6 a)).

- Text revisions (SSR-6):
  - 621. Packages containing radioactive material to be transported by air shall conform to the most appropriate condition among the following ones:
    - (a) the following packages shall retain their radioactive contents under a reduction of ambient pressure to 25 kPa:
      - (i) packages containing only special form radioactive material or SCO-I or SCO-II,
      - (ii) excepted packages, industrial packages and type A packages, containing solid radioactive

<table>
<thead>
<tr>
<th>temperature:</th>
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<tr>
<td>o the internal pressure at 55°C due to the increase of pressure of the air content is:</td>
</tr>
<tr>
<td>(100 x (273 + 55)/(273+15))-100 = MNOP = 13.9 kPa</td>
</tr>
<tr>
<td>o the rules in para. 621 of SSR-6 indicates that the pressure test shall be at least of:</td>
</tr>
<tr>
<td>95 + 13.9 = 108.9 kPa</td>
</tr>
</tbody>
</table>

- A package loaded with other dangerous goods, even in powder form, is not required in ICAO-TI to be subjected to such a test.

Example 2 for liquid material:
- For a package loaded with water as radioactive
material, excluding powders,

(iii) packages containing LSA-I material in powder form;

(b) excepted packages, industrial packages and type A packages containing solid radioactive material in powder form other than LSA-I, shall be capable of withstanding, without loss or dispersal of radioactive contents from the containment system, a pressure differential of 95 kPa;

(c) other packages containing radioactive material shall be capable of withstanding, without loss or dispersal of radioactive contents from the containment system, an internal pressure that produces a pressure differential of not less than the maximal gauge pressure that may be developed in the package at 55°C when it has been filled at 15°C (or the maximum normal operating pressure) multiplied by a safety factor of 1.5, with a minimum of 95 kPa.

Alternative to (c):

(c) other packages containing radioactive material shall be capable of withstanding, without loss or dispersal of LSA-I at 100 kPa ambient pressure and 15°C ambient temperature, at 55°C:

- increase of pressure of the air content is:
  \[
  (100 \times \frac{273 + 55}{273+15}) - 100 = 13.9 \text{ kPa}
  \]

- increase of the vapour pressure due to water is:
  \[
  (1.706 \text{ kPa at } 15°C \text{ to } 15.76 \text{ kPa at } 55°C) = 14 \text{ kPa}
  \]

the rules in para. 621 of SSR-6 indicates that the pressure test shall be at least of:

95 + 13.9 + 14 = 122.9 kPa

For a package loaded with water from another Class, the rules in Part 4, Chapter 1, para 1.1.6 are the followings:
<table>
<thead>
<tr>
<th></th>
<th>radioactive contents from the containment system, an internal pressure that produces a pressure differential of not less than the maximal gauge pressure that may be developed in the package at 55°C when it has been filled at 15°C (or the maximum normal operating pressure) plus 75 kPa, with a minimum of 95 kPa.</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>- Text revisions (TS-G-1.1):</td>
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<tr>
<td></td>
<td>- 621.1. This is a similar provision to that required by the ICAO [10] for packages containing certain liquid dangerous goods or infectious substances intended for transport by air. Taking account of the form of the radioactive material and of the risk level a release of this radioactive material out of the containment system of the package may induce for the aircraft security, its crew's and passenger's safety, a set of three situations and corresponding conditions were defined:</td>
</tr>
<tr>
<td></td>
<td>- (a) For the cases where dispersal of the radioactive material is improbable due to its form (special form, SCO, solid LSA in non powder form, solid radioactive material in a Type A), and for LSA-I in powder form, it is required that the o The vapour pressure of the filling substance and the partial pressure of air at 55°C less 100 kPa multiplied by a safety factor of 1.5:</td>
</tr>
<tr>
<td></td>
<td>• The Civil Aviation Competent Authorities and Airline operators, who are much more familiar with the generic rules (pressure test = 95 kPa, only in case of liquids) than with</td>
</tr>
</tbody>
</table>

\[(15.76 + 113.9) – 100 \times 1.5 = 44.5 \text{ kPa},\]

this value being less than 95 kPa, the pressure test shall be 95 kPa.

Because of the differences in requirements between Class 7 and other Classes, these requirements are not very well known or followed:
<table>
<thead>
<tr>
<th>Package shall retain its radioactive contents under a reduction of ambient pressure to 25 kPa. This pressure corresponds to the pressure at sea level (100 kPa) less the highest pressure differential between sea level and the pressure within a non-pressurized or partially pressurized cargo compartment of an airplane (75 kPa) (see note 3 in introductory notes of Part 4 of ICAO-TI 2013-2014 Edition);</th>
</tr>
</thead>
<tbody>
<tr>
<td>(b) For the cases of solid radioactive material in powder form other than LSA-I in non approved packages, taking account of the relative high radioactive concentration those materials may reach, and taking account that package may include a hermetically closed containment system, the requirement is the same as for infectious substances (UN2814 and UN2900): the package shall be able of withstanding, without loss or dispersal of radioactive contents from the containment system, a pressure differential of 95 kPa;</td>
</tr>
<tr>
<td>(c) For the other cases (liquids, gases, and high radioactive material non-special form, and radioactive material in approved package type), for which specifics ones for Class 7 (pressure test = MNOP + 95 kPa, whatever the form of the radioactive material), from time to time, may not use the rules applicable for packages of radioactive material;</td>
</tr>
</tbody>
</table>

- From time to time, consignors and packers do not identify the slight differences in the requirements between pressure test for Class 7 packages (pressure test = MNOP + 95 kPa) and pressure test for the other Classes (pressure test = 95 kPa), leading to the use of packagings which do not strictly comply with the requirement;

- In most of the cases, the rule generally followed for solids, like SCO, is not really that prescribed (withstand a
significant pressure may develop within the containment system due to heating, radiolytic and or thermolytic decomposition of materials, the requirement adopted is the same as for liquid dangerous goods (see Part 4, Chapter 1, para 1.1.6 a) of ICAO-TI 2013-2014 Edition): the package shall be capable of withstanding, without loss or dispersal of radioactive contents from the containment system, an internal pressure that produces a pressure differential of not less than the maximal gauge pressure that may be developed in the package at 55°C when it has been filled at 15°C (or the maximum normal operating pressure - MNOP) multiplied by a safety factor of 1.5, with a minimum of 95 kPa.

- Alternative to (c)

- (c) For the other cases (liquids, gases, and high radioactive material non-special form, and radioactive material in approved package type), for which significant pressure may develop within the containment system due to heating, radiolytic and or thermolytic decomposition of materials, the requirement adopted is the same as for pressure differential of 95 kPa + MNOP), although it satisfies fully the objective (no loss or dispersal of radioactive contents from the containment system in case of depressurisation of the airplane compartment): it is generally considered that variations of pressure cannot have effects on a SCO, so the package is equipped with valves (which permits to keep the pressure equilibrium between internal and external) and filters (qualified to retain radioactive particles).
liquid dangerous goods (see Part 4, Chapter 1, para 1.1.6 a) of ICAO-TI 2013-2014 Edition): the package shall be capable of withstanding, without loss or dispersal of radioactive contents from the containment system, an internal pressure that produces a pressure differential of not less than the maximal gauge pressure that may be developed in the package at 55°C when it has been filled at 15°C (or the maximum normal operating pressure - MNOP) plus 75 kPa, with a minimum of 95 kPa.

- 621.2 Several possibilities to comply with the requirements in 621 (a) may be used:

- use of a packaging which is able to withstand the pressure differential of 75 kPa, or

- use of a packaging equipped with valves and filters to allow pressure equilibrium without dispersal of radioactive solid material content (when the content can be subject to dispersal like LSA-I, or small dispersal like SCO-I and SCO-II), or

- use of valves without any supplementary equipment (if the content is not subject to
dispersal, like special form);

- 621.3. If, within the definition of MNOP, the phrase “conditions of temperature and solar radiation corresponding to environmental conditions” is interpreted to include consideration of conditions specific to air transport (para. 620), then the MNOP does provide a suitable basis for specifying this requirement. If the temperature range contained in para. 620 (−40°C to 55°C) is used, self-heating of the package contents is taken into account, and the solar radiation input is considered to be zero, as the package is inside an aircraft, and hence the MNOP is consistent with the ICAO approach.

<table>
<thead>
<tr>
<th></th>
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<th>Inclusion of large component provisions into SSR-6 would be beneficial for the industry, particularly in respect of increased decommissioning activities.</th>
<th>DUPLICATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TM-44897 (WG4)</td>
<td>n/a</td>
<td>None</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>DUPLICATE This is a major change and should be resolved by the revision cycle through Working Group. UN proper shipping name should be confirmed.</td>
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</table>
## SSR-6 pending issues about tests and design requirements

### 17-18 June 2014

<table>
<thead>
<tr>
<th>FROM</th>
<th>729, 659, 667, 685, 730, 660, 667, 670, 733</th>
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</thead>
<tbody>
<tr>
<td>WG1</td>
<td>Increase the duration of the 15m and 0.9m water leakage tests for packages.</td>
</tr>
<tr>
<td>35</td>
<td>It is proposed that the issues be discussed in detail by the Technical Committee that should meet from 15 to 19 July 2013 in Vienna.</td>
</tr>
<tr>
<td>F/1.00/12</td>
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<td>France</td>
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### Guidance should be reorganized in SSG-26.

**WG 1 Discussion:**
Already discussed.

### 3.1 TEST DURATION OF THE 15 M WATER IMMERSION TEST

The regulations requires to take into account the consequences of a water immersion test under 15 m for at least 8 hours (§ 729) on the release of radioactive contents for Type B(U) (§ 659 b)) and B(M) (§ 667) packages and for evaluation of the maximum neutron multiplication for packages containing fissile material (§ 685). This test simulates an accident resulting in submersion of a package in a canal or river under a depth of water bounding the vicinity of most bridges, roadways or harbours.

This proposal is a major change and should be considered by the revision cycle taking into account the recommendations of the TM-44891 on Transport Environment held in July 2013.

**WG 1 Discussion:**
General agreement that the issue should be carried forward to a TM or Working group for discussion.

Discussion about level of watertightness which is actually required by 680a (absolute or relative as checked by leaktightness test before shipment).

Duration of 1 week would raise questions (2 weeks, 1 month...?). Note that the 1 week is consistent with another accident requirement (A2 in one week).

The proposal for the 15 m
ensuring the absence of mechanical failure for type B packages (para.663).

Duration of water immersion test appears too optimistic compared to the duration probably needed to retrieve submerged packages that include delays for arrival of rescue teams and preparation of equipment needed for package retrieval.

A French study whose results were presented at the PATRAM 98 conference: “Assessment of the consequences of accidental burial into soft ground of a spent fuel transport container” showed that for spent fuel packages that could sink below the surface of a marsh it would take at least several days to lift them back to surface.

Furthermore, the recovery of UF6 cylinders housed in the immersion test needs be further worked.

There is no intention to make any change proposal concerning 200 m immersion test.

Another accident involving a spent fuel cask tipped over in the soft ditch resulted in 1987 at Lailly-en-Val (France) in partial burying of the package at a depth of 1m and 2 days were needed to lift the package back to dry location.

It could therefore be envisaged to increase the duration of the 15 m water immersion test.

In practice, prolonged water immersion may affect the amount of water entering the package, which can lead to an increase in reactivity when a
### Package Containing Fissile Material

- Package containing fissile material is immersed at 15 m.

### Test Duration of the 200 m Enhanced Water Immersion Test

The regulations require a test under 200 m of water for at least 1 hour (§ 730) for Type B(U) (§ 660) or B(M) (§ 667) whose content is characterized by an activity greater than 105 A2 and Type C packages (§ 670), to evaluate the mechanical strength of the containment system.

This test simulates the sinking of a ship carrying a package on the continental shelf (200 m). In addition to preventing important releases of radioactivity in shallow waters close to human activities, it also aims at ensuring protection of divers responsible for conducting recovery operations.
operations from any mechanical failure of the package that would lead to sudden release of radioactive material close to the diver.

Durations of water immersion test appear too optimistic compared to the time probably needed to retrieve packages submerged at this depth.

The recovery of UF6 cylinders housed in the cargo hold of the Mont-Louis which sank off Ostend in 1984 and based on a sandbank by 15 meter depth at low tide took 40 days (see \[\text{http://www.iaea.org/Publications/Magazines/Bulletin/Bull271/French/27104592832_fr.pdf}\]).

It could therefore be envisaged to increase the duration of the 200 m enhanced water immersion test. Since the new time period may imply corrosion
phenomena, it is also proposed to define a degree of salinity and an oxygen concentration of water for this test.

3.3 TEST DURATION OF THE 0.9 M WATER LEAKAGE TEST

The regulations require taking into account the consequences of the water leakage test under 0.9 m for at least 8 hours (§ 733) following the accident sequence of drop tests and thermal test for packages containing fissile material, for evaluation of the maximum neutron multiplication.

This test simulates shallow water caused by flooding or by water used to extinguish fire.

Duration of water immersion test appears too optimistic compared to the duration probably needed to retrieve partly submerged
packages taking into account delays for arrival of rescue teams and preparation of equipment needed for package lifting.

As already presented above the accident of Lailly-en-Val (France) involving a spent fuel cask tipped over in the soft ditch in resulted in partial burying of the package at a depth of 1m and 2 days were needed to lift the package back to dry location.

In practice, prolonged water immersion may affect the amount of water entering the package, which can lead to an increase in reactivity of packages containing fissile material.

It could therefore be envisaged to increase the duration of the
### SSR-6 pending issues about tests and design requirements

**17-18 June 2014**

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<tr>
<td><strong>34</strong></td>
<td><strong>680</strong></td>
<td><strong>Requiring the absence of interaction between the plug and other components of the package.</strong></td>
</tr>
<tr>
<td><strong>F/1.00/11</strong></td>
<td></td>
<td><strong>It is allowed by paragraph 680 b) i) not to consider water penetration within packages where, following the tests defined in para. 685(b), there is no physical contact between the valve and any other component of the packaging other than at its original point of attachment and where, in addition, following</strong></td>
</tr>
<tr>
<td><strong>France</strong></td>
<td></td>
<td><strong>This is a major change in design requirement and should be considered by the revision cycle through discussion at a TM.</strong></td>
</tr>
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</table>

- **0.9 m water leakage test.**

As a whole it appears that some of the parameters of the IAEA regulatory water immersion tests may be questionable with regard to what can be imagined as reasonably credible accidents in transport. Consistently with the complementary safety approach adopted after the Fukushima accident (stress test approach), the above issues could be examined during an appropriate technical meeting organized by the IAEA Agency.

- **Plugging and valve side of 30B cylinders are not symmetrical.**

A water leak at plug would impair criticality safety.
including those within the containment system. However, if the design incorporates special features to prevent such leakage of water into or out of certain void spaces, even as a result of error, absence of leakage may be assumed in respect of those void spaces. Special features shall include either of the following:

(a) Multiple high standard water barriers, not less than two of which would remain watertight if the package were subject to the tests prescribed in para. 685(b), a high degree of quality control in the manufacture, maintenance and repair of packagings, and tests to demonstrate the closure of each package before each shipment; or

(b) For packages containing uranium hexafluoride only, with a maximum uranium enrichment of 5 mass per cent uranium-235:

(i) Packages where, following the tests prescribed in para. 685(b), there is no physical contact between the valve and the plug and any other component of the packaging other than at its original point of attachment and where, in addition, following the test prescribed in para. 728, the test prescribed in para. 728, the valves remain leaktight.

Assessment of package designs for transport of UF6 in 30B cylinders has shown in some cases that there could be contact between overpack and plug surface when subjected to 1 m or 9 m drop tests. In such cases it is not obvious that the plug would remain perfectly leaktight which implies some uncertainty about criticality-safety. We propose that the plug of 30 cylinders which has the same safety function as the valve, and might be subjected to some mechanical interaction with other components of the package should also be included in the requirements of 680 b) i).

WG 1 Discussion: General agreement that the issue should be examined in light of consequences that may follow from any change in this area.

The plug side should be examined as well as the valve side.

The group recommends technical evaluation of performance of plug side in drop tests.

WNTI will provide evaluation for existing designs.
(ii) A high degree of quality control in the manufacture, maintenance and repair of packagings, coupled with tests to demonstrate closure of each package before each shipment.
Annex A. Proposed changes to SSR6 and recommendations for TS-G-1.1

106. These Regulations apply to the transport of radioactive material by all modes on land, water, or in the air, including transport that is incidental to the use of the radioactive material. Transport comprises all operations and conditions associated with, and involved in, the movement of radioactive material; these include the design, manufacture, maintenance and repair of packaging, and the preparation, consigning, loading, shipment after storage, carriage including in-transit storage, unloading and receipt at the final destination of loads of radioactive material and packages.

In guidance: Explaining the concept of DPC

In guidance for 306: Considerations of ageing in the design as well as in maintenance by an appropriate ageing management program

Define “storage” in guidance material? Not a definition of storage time in SSR-6, only in guidance material with a link to the ageing management plan.

Maybe define “In-transit storage” to cover interim storage instead of new definition of storage? (IAEA Safety Glossary).

503. Before each shipment of any package, it shall be ensured that all the requirements specified in the relevant provisions of these Regulations and in the applicable certificates of approval have been fulfilled. The following requirements shall also be fulfilled, if applicable:

(a) It shall be ensured that lifting attachments that do not meet the requirements of para. 608 have been removed or otherwise rendered incapable of being used for lifting the package, in accordance with para. 609.

(b) Each Type B(U), Type B(M) and Type C package shall be held until equilibrium conditions have been approached closely enough to demonstrate compliance with the requirements for temperature and pressure, unless an exemption from these requirements has received unilateral approval.

(c) For each Type B(U), Type B(M) and Type C package, it shall be ensured by
inspection and/or appropriate tests that all closures, valve and other
openings of the containment system through which the radioactive contents
might escape are properly closed and, where appropriate, sealed in the
manner for which the demonstrations of compliance with the requirements
of paras 659 and 671 were made.
(d) For packages containing fissile material, the measurement specified in
para. 677(b) and the tests to demonstrate closure of each package as
specified in para. 680 shall be performed.
(e) For packages provided for shipment after storage, it shall be ensured that all package components have been maintained during storage in a
manner of which the demonstration of compliance with the regulations were made.

Interface between country of approval of DPC and country of storage?
If there is no longer a transport than no renewal of certificate by country of origin? Taking over the approval by the country of storage. Is not a
problem for the transport regulations.

In guidance for 503 (e): Which regulations? Regulations stated in the current approval certificate.
Link to transitional arrangements for taking care of older approval certificates.
“Advisory material for 503: Include ageing management program, inspection program preparation before shipment.”
Guidance on AMP is needed in future revisions of the TECDOC.
“Clarification of the definition of storage is necessary in SSR6? Look at SSG-15 or glossary for definitions”

Proposal new 614bis:
614bis. The design of the package shall take into account ageing mechanisms that are likely to be encountered in storage operations before
transportation.

Proposition: Change 614 or 607: …and its intended use (e.g. DPC).

614: … irradiation and any other form of ageing.

More explanations on this in advisory material.
809. (f) bis
If the package is to be used for transport after storage, the applicant shall state and justify the consideration of ageing on the safety analysis and within the proposed operating and maintenance instructions.

809. (j) For packages which are also used for transport after storage, a gap analysis program shall be provided, considering changes of regulations, changes in knowledge and changes of the state of the package design, as appropriate. A gap analysis program is a program of systematic analysis of the package design, comparing it to the regulatory requirements, identifying differences, where necessary, proposing actions to deal with those differences.
Proposition: … proposing actions to deal with those differences where safety is enhanced.
More explanation on Gap analysis program: In advisory material

838. (r)”No modification would be necessary.”
Additional guidance could cover for AMP and Gap management program, specific inspections prior to shipment? See paragraph 838: Management program is covered.
Country which validates has to receive information (country of origin is not the same as country for storage).