TM-44891

Technical Meeting on the Environment to which Packages May be Subject During Transport and Related Issues Concerning the Regulations for the Safe Transport of Radioactive Material

IAEA Headquarters, Vienna
15 to 19 July 2013.

Meeting Report of TM-44891
MEETING REPORT

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Meeting Report

Summary:

As the transport conditions were defined 50 years ago, it seems legitimate to raise again the issue of their pertinence for the current public perception. A review of routine, normal and accident conditions of transport is then necessary to take into account the new transport environment and the impact of climate changes. Additionally, the very less likely accident that is to say beyond the regulatory requirements has to be considered especially taking into account the Fukushima lessons.

From the review of the regulatory requirements/guidance dealing with routine/normal transport environment TM recommends to TRANSSC the formation of an expert working group to review Appendix IV of TS-G-1.1 (rev1) and air/maritime transport practises, the formation of an expert working group on segregation of radioactive material from other dangerous goods for all modes of transport, to consider in the current review/revision cycle proposals made by this TM on the shipment of packages that includes mechanical cooling systems, accumulation of packages on the same vehicle and impact of the conveyances on the temperatures. TM takes action to collect data about extreme ambient temperatures and insolation from Member States for next TRANSSC. For accident conditions of transport, TM recommends also to consider in the current review/revision cycle the increase of duration for the immersion test for the package containing fissile material with the modification and the modification of the crush test.

TM recommends proposal 24 (from WP 04 in attachment 6) on emergency preparedness to be considered as an urgent issue in the current review process including the comments from the WG1 (see attachment 7). In addition TM recommends the revision of TS-G-1.2 to be done in this cycle. Concerning very less likely accident (that is to say beyond regulatory requirements), it is agreed that some guidance is necessary in TS-G-1.2 which is under revision. No change in the regulation is expected.

Concerning the various environment stresses to which a package is likely to be subjected for the routine, normal and accident conditions of transport, the current regulatory test regimes were considered to remain appropriate except for the minor changes TM has identified.
1.0 Opening of the meeting

The meeting convened at 10:00 on 15 July 2013. Mr. H. Mansoux, Acting Head, Regulatory Infrastructure and Transport Section, opened the meeting. The basis for his remarks is provided at Attachment 1. He introduced Mrs MT. Lizot, France, as Chair for the meeting.

As the Chair of the meeting, Mrs MT. Lizot, France, then provided opening comments. The basis for his comments is provided at Attachment 2.

Administrative information

Ms. N. Capadona provided information of an administrative nature. The participants list is found in Attachment 3.

Review of Provisional Agenda (WP01)

The Provisional Agenda for the meeting was introduced by Mrs. Lizot and approved as Revision 1 of Working Paper No. 1 (WP1). The approved Agenda is provided at Attachment 4.

Review of Provisional Terms of Reference (WP02)

The Provisional Terms of Reference were introduced by Mrs. Lizot as working paper No. 2 (WP2). This working paper was discussed and approved as Revision 0 of WP2. These approved Terms of Reference are provided at Attachment 5.

Introduction of Working and Information Papers

The list of working papers is provided at Attachment 6.

2.0 Plenary Session One: plenary

Presentation concerning transport environment in the regulation, IRSN (agenda item 2.1)

As the transport conditions were defined 50 years ago, it seems legitimate to raise again the issue of their pertinence for the current public perception. A review of routine, normal and accident conditions of transport is then necessary to take into account the new transport environment and the impact of climate changes. Concerning the very less likely accident that is to say beyond the regulatory requirements, this issue doesn’t necessarily require additional tests in the regulation but can be treated with a risk analysis whose consequences can lead to propose additional operational or emergency measures.

Climate change impacts and adaptation to international transport networks, UNECE (agenda 2.2)

UNECE took coordinated steps to address climate change adaptation in the field of transport. Adaptation action aims at reducing vulnerabilities and increases the resilience of transport systems to climatic impacts. Resilience refers to the ability of a system to withstand negative impacts without losing its basic functions. A Group of Experts on climate change impacts and adaptation for International transport networks was established in 2011 and completed its work within 2013.
The final report of the group included policy-oriented recommendations that aim to improve the long-term sustainability of transport with an emphasis on international connections and set best examples of national policies, address the issues of transport networks vulnerability amongst member Governments;

More specifically the work of the expert group focused on the following:

(a) Identify potential climatic impacts on transport infrastructure, including ports and their hinterland connections, as well as on transport services and networks across the broader supply-chain;

(b) Prepare, in a coordinated manner, recommendations or proposals to member Governments, with a view to improving the adaptability of transport networks to climate change in areas such as: infrastructure, risk-assessment methodology, evaluation of adaptive measures, risk management, training tools, and cross-border information sharing by national transport authorities;

(c) Identify existing best practices in national policies and risk management as well as formulation of relevant strategies to enhance the resilience of transport networks, through changes in infrastructure design and operation planning and management, taking into account specific risks and vulnerabilities.

(d) Take stock of the available data and analysis of climate change impacts on transport networks in the ECE region and beyond;

(e) Collect information on all relevant planning, management, organizational and other initiatives for adaptation of transport networks to climate change;

One of the recommendations of the group is that UNECE could take a leading role in the development of a mechanism and a process that encourages sharing of best practices for addressing potential impacts of climate change in the transportation sector.

UK Environmental Conditions and Implications for the Transport of Radioactive Material, ONR (agenda item 2.3)

Type B(M) packages are permitted, subject to Competent Authority approval, to use alternative values for ambient temperature ranges and insolation other than those prescribed in the IAEA's Regulations for the Safe Transport of Radioactive Material. In the UK, the agreed values were based on BS3895:1976, and recommended an ambient temperature range of -10 deg C to +26 deg C, and half of the insolation values in Table 13 of TS-R-1 for Type B(M) packages for use solely within the UK. This standard was withdrawn in 2006, and along with a growing appreciation of the impact of climate change, prompted a review of UK climatic conditions. A technical research proposal was developed with industry and regulators, and conducted by the UK's Met Office. A wide range of statistics were produced, including peak maximum, minimum and average figures for insolation and temperature, and averages of these figures over periods of 8 and 24 hours. Criteria were applied to ensure relevance of the input data. Computational modelling was used to predict trends over the next two decades to 2030. The results of the research suggest that the previously accepted range of -10 to +26 degrees and half of the insolation values are increasingly limiting and temperatures and insolation levels will exceed these figures with increasing frequency and severity, although will still be bound, in the main, by the B(U) requirements. Implications for package design
were discussed, as previously approved packages may have increasingly limited operational availability as a result, as prevailing conditions may exceed their approved safety envelope, and package design authorities may wish to consider the operational requirements of the package against the cost of meeting more challenging thermal parameters.

3.0 Plenary Session Two: Presentation concerning accident free transport and regulatory requirements

Transport practices in air transport, ICAO (agenda item 3.1)

A presentation on the environment experienced by a package in an aircraft cargo hold was made by ICAO. Two major aircraft manufacturers had provided data on typical environmental conditions for both in-flight and on ground that may be encountered in their compartment holds; these conditions are prescribed by airworthiness requirements in Annex 8 to the Convention on International Civil Aviation. The concept of ICAO Standard Atmosphere was explained in relation to pressure measurements as were the minimum operational performance standards for humidity, vibration and shock as contained in EUROCAE ED/14 and RTCA DO160. Data for recommended acceleration values were based on military aircraft for normal flight whereas that for emergency landing conditions was based on that in the US CFR Title 14, 25.561. Information was provided about an air packaging environmental conditions research study presently underway using instrumented packages in the air cargo handling and transport system, including that for express carriers. It is hoped that preliminary analyses of the data collected may be available for the next TRANSSC.

The problem presented by explosive or rapid decompression in an aircraft and its impact on the structural integrity of that aircraft together with its contents was illustrated by a number of aircraft accident examples which had resulted from a variety of causes e.g. improper maintenance, metal fatigue, corrosion. It was explained that the ‘useful time of consciousness’ for a pilot to don an oxygen mask in the event of an explosive decompression was only between 5 to 10 seconds and that 63 accidents had been recorded in the period 1983-2012.

The large increase in cargo containing dangerous goods was discussed and it was suggested that radioactive material should be segregated from such cargo, particularly if a leakage or fire emanating from the other dangerous goods cargo could potentially damage the radioactive material packaging.

Load case data under routine conditions of transport, options, proposal to improve the guidance, BAM (agenda item 3.2)

TS-G-1.1 should be the most important source for load case data under routine conditions of transport. A closer look, however, reveals deficiencies or at least an intolerable range of interpretation how to apply those values. Therefore the improvement of the guidance material is recommended by BAM.

Several options exist to improve the values and guidance. At first the goal has to be discussed and agreed, how the guidance should be improved. Is there a need of more reasonable values for different package masses? How to combine acceleration values? And other questions should be discussed and agreed between member states.

Load case values are always connected to the entire design concept. Therefore design criteria should be considered as well, if acceleration values are defined.

To get information about world-wide application and acceptance of values, BAM proposes to start a survey as a first step. The survey shall collect applicable acceleration data and criteria among the member states. A standard transport case shall make standards and codes comparable. Beyond this, an important outcome could be an up-to-date reference list on applicable design standards regarding acceleration values and criteria.
Acceleration under routine conditions of transport, WNTI (agenda item 3.3)

The presentation focused on rules, standards and recommendations in use in the different transport modes for the carriage of general cargo. It gives the legal or regulatory links making those rules, standards and recommendation applicable. It gives the acceleration values to be considered and acceptance criteria and margins coming with.

• For road carriage, the review of rules in use in European countries, USA, CANADA and Australia shows a consensus about g-values to consider. It is noticed that stowage secured in compliance with the EN 12195-1 standard are recognized by ADR as satisfactory. The g-values are 0.8 g forwards, 0.5 g backwards and sideways, each combined with 1.0 g downwards.

• For rail carriage, the review of rules in use in European countries (COTIF + EU), shows that the standard which is recognized by the railways undertakings through the General Contract for wagons of Use of wagons, is the UIC Loading Guidelines. The presentation indicates also which are the applicable rules and standards for the railcar certification from which general information regarding design criteria for wagons may be extracted. The g-values retained are 1g (for railcars subjected to normal shunting operations except when the railcar is fitted with long stroke buffers) or 4 g (other cases) forwards and backwards, 0.5 g sideways, each combined with 1.0 0.3 g downwards;

• For sea carriage, the presentation pointed out that the international law through SOLAS and MARPOL conventions is that stowage of payloads onboard ships shall conform to the “Cargo Securing Manual” of the ship. This CSM shall be issued in accordance with the Code of Safe Practice for Cargo Stowage and Securing (CSS Code), and with the INF Code in case where the INF certification is required. The IMO/ILO/UN-ECE Guidelines for packing of transport cargo units is mandatory through IMDG Code. From those guidelines and the CSS Code, g-values retained are 0.4 g forwards and backwards combined with 1.0 0.8 g downwards, and 0.8 g sideways combined with 1.0 g downwards.

• For air carriage, the review of rules applicable for certification of large aircrafts (EASA CS25 equivalent to FAR part 25 in the USA), shows that the main objective of stowage provisions is to protect the occupants in an emergency landing conditions on land or water. To achieve this objective, each aircraft which has been certified shall conform to its “Weight and Balance Manual” validated by the administration in charge of certification of the aircraft. In particular the WBM specifies, for each compartment, the “ultimate load factors” to be considered in forwards, backwards, sideways and upwards direction to determine the correct lashing or netting of the cargo. Lashing equipments shall be those certified for the aircraft. From the review of the applicable ISO standards and of the Unit Load Device Technical manual of IATA, for lashing equipments the derived g-values proposed for routine conditions of transport are 1.0 g forwards, backwards, and sideways, combined with 1.0 g downwards, 1.0 g (ISO freight containers) or 2.0 g (other cargo) upwards, 2.0 g (ISO freight containers) or 4.0 g (other cargo) downwards.
Regarding attachment points of the package, the presentation recalls requirements in use for portable tanks allowed in IMDG Code, RID and ADR. The g-values prescribed are 2.0 g forwards and backwards, 1.0 g sideways, 2.0 g downwards and 1.0 g upwards. Each force acting separately, the resulting stress in attachment devices shall be less than 2/3 of the yield strength of the material.

Analysis of Accelerations and Strains Measured on a Tie-Down System of a Heavy Nuclear Transport package during a Routine Rail Journey, WNTI (agenda item 3.4)

This presentation was focused on the results of measurements made by INS on a railcar carrying a heavy package (>100 t) over a typical UK rail journey between Barrow and Sellafield. Frequency analysis has been used to determine the nature of the loading and the extent of vibration transmission into the package. Results show that the accelerations transmitted to the package are very low in the horizontal directions compared to those recommended in table IV-2 of the TS – G-1.1 (identical to those of UIC Guidelines) and, in the vertical direction, close, but still lower, to those recommended in the same table. A paper relative to this study will be presented in next PATRAM.

Acceleration – new spectral density approach, IRSN (agenda item 3.5)

Gilles Sert presented the literature survey performed by IRSN about tie-down forces applied to packages during transport in routine conditions. The aim of this survey was more specifically to check the consistency of recommended g-loads to experimental data. Too rare data were found. Accounting for large variations in tie-down forces according to transport modes, package mass range, conveyance equipment kind or capacity (suspension, railcar buffers, ship size), stowage location aboard ship, normal routing speed, carriage specific instructions (rail shunting method as signalized by RID label 15…) and sea state (Beaufort scale levels 0 to 13), it was found that new experimental measurement campaigns would be desirable. A large cooperation would be recommended to provide the missing information in view of improving the appendix IV of TS-G-1.1.

Another approach based on dynamic response of the package and conveyance system was presented as an alternative to the more common static assessment approach. To use the power spectrum density approach it would be needed new experimental data applicable to main types of packages and conveyances. This approach could also be used through an intercomparison assessment to check the safety margins that may eventually be embedded in the static approach.

4.0 Plenary Session Three: CNT and CAT

Interaction between package and conveyance during routine/normal transport, ONR (agenda item 4.1)

This presentation outlines how the IAEA regulations for the safe transport of radioactive material (TS-R-1 2009 Edition, and SS-R-6) control radiation dose in single and multiple packages through the Transport Index (TI), and then how criticality is similarly controlled in single and multiple packages through the Criticality Safety Index (CSI). A comparison is made with how thermal safety is controlled for single packages only, and not multiple heat generating packages or other heat sources. Regulations and guidance provide for surface
temperatures at various ambient ranges to protect people and environment, but these regulations do not directly consider the reverse effect of the environment on the package itself. Generally, conveyances do not present any additional dose or criticality hazards, although many will provide additional thermal considerations through heat sources such as pipe-work or engine rooms, and confined enclosures, restricted air flows etc. The existing structure of the regulations are therefore questioned by asking if they are sufficient to control thermal aspects introduced by the conveyance, even though they were not designed for this purpose, or whether further provisions should be made.

Thermal assessment of flask in INF vessel _ loss of cooling system, WNTI (agenda item 4.2)

A study of an extreme accident situation, inspired by the Japanese tsunami of 2011 indicate that without intervention, loss of containment of the flask would be very unlikely but some loss of neutron shielding performance is probable. Temperatures would not be sufficient to ignite the ship fuel oil.

Reviewing immersion test conditions, IRSN (agenda item 4.3)

Gilles Sert presented some issues about the conditions of the three immersion tests defined in the regulation, the water immersion test (para. 729), the enhanced water immersion test (para. 730) and the water leakage test (para. 733). These issues are derived from lessons drawn from past events that showed that there could be safety implications of the depth and period of immersion. They have been proposed by France as issue identification sheets to be considered within the current review cycle.

Though at low depth (15 m), recovery of cylinders trapped in the hold of the MontLouis cargo took 40 days during which water ingress took place, which, if concerning fissile material, would correspond to higher hazard than what is covered by the current regulatory test condition (limited to 8 hours). This contributed to think to change the time period of the water immersion test and water leakage test to 1 week or so instead of 8 hours.

The MSC Carla shipwreck also contributed to thoughts about validity of the 200 m testing depth for the enhanced test considering the existence of fishing activities in the area where the shipwreck may occur. In addition, better knowledge of time necessary to retrieve packages lost at sea contributed to consider that corrosion phenomena may develop in the meantime with possible impact on the mechanical resistance of the containment system. This raised the issue of increasing the period of the enhanced water immersion test to 6 months or more with due account for corrosion phenomena.

Effect of immersion on packages, WNTI (agenda item 4.4)

The intent of the 200 m immersion test is to facilitate recovery of the package on the continental shelf. Therefore, the acceptance requirement is that the package would withstand the immersion “without rupture”. Studied have demonstrated that the doses due to the release of the radioactive material following a deeper immersion are tiny.

Tests, and calculations in some instances, allowed to assess the behaviour of packages after an immersion deeper than 200 m. The packages which were considered include packages for plutonium oxide (PuO2) powder, spent fuel assemblies, high activity waste and fresh mixed
oxide (MOX) fuel assemblies. The result is that these packages can withstand immersion with a depth ranging from a few times the regulatory depth up to several thousands of meters.

One important lesson from these experiences is that compliance with all the regulatory requirements leads to high performances regarding each of them. For instance, packages designed to transport spent fuel assemblies or high activity waste include a body which is very thick in order to provide adequate gamma shielding. This shielding provides strong mechanical resistance and a capacity to withstand an immersion test significantly more severe than was is strictly required. Another lesson is that there is no cliff effect: when the Regulations require that a package withstand a 200 m immersion test and a package passes this test, that does not mean that it will fail when sunk to 201 m.

As a conclusion, the 200 m immersion test has sound technical basis: the Regulations are adequate. In addition, it must be recognized that the packages are able to withstand more severe immersion tests and that this contributes to the defence in depth (!).

**Severity of fires in railway and highway transportation in the united states, US NRC (agenda item 4.6)**

The U.S. NRC performed the research and presented the results of severe fire accidents of railway and roadway transportation in the United States. The results show the severe fire scenario case study in railway and roadway accidents occurring in open field and within a tunnel, and the actions taken to mitigate the risk of fire accidents. The results conclude that for the severe fire accidents for transporting spent nuclear fuel on railway and highway, the frequency is very low and the consequence is not significant. The U.S. NRC concludes that the current regulatory framework is adequate and there is no need to change the regulations at this time. Through the group discussion, the Member States agree with NRC’s conclusion that the current regulations are adequate and there is no need to change at this time.

**5.0 Plenary Session Four: very less likely accident**

**A review of the impacts on the transport safety standards in the light of the Fukushima lessons, JNES (agenda item 5.1)**

Why Fukushima lessons learned are incorporated into technical meeting agenda has been explained. Further, the selected items to be discussed in the TM and associated matters that had been agreed according to the revision of the SSR-6 in light of the Fukushima events through discussions with TRANNSC or CS was introduced.

**Identification and classification of transport incidents potentially caused by natural events, NMRI (agenda item 5.2)**

The technique of identifying and classifying transport incidents potentially caused by natural events is proposed to respond issues from gap reviews of the Fukushima accident. Expert judgment is employed to identify potential incidents comprehensively using the hazard matrix. The concept of probabilistic risk assessment has been introduced to evaluate the identified incidents using risk indices. Then they are placed on the risk matrix to focus on the group of incidents requiring special attention, or the bounding cases. It is useful to simply evaluate using risk index of small numbers of ranks, representing an order of frequency magnitude or the grade of package test condition. Also, an application example of domestic
spent fuel transport case is shown for demonstrating the use of the technique. It would be helpful to finish gap reviews in Japan and also support the present approach in the Regulation.

**A proposed risk management regulatory framework, US NRC (agenda item 5.3)**

The U.S. NRC has developed a Proposed Risk Management Regulatory Framework (NUREG 2150), which builds upon well-established practices and incorporates risk-informed and performance-based approaches in the agency’s regulations. A Risk Management Task Force has been developed to focus on specific areas, including reactors, materials uses, waste, uranium recovery, fuel cycle, interim spent fuel storage, and transportation. This presentation includes background information on the mission and goals of the U.S. NRC, and a summary of the steps used by the agency to regulate the civilian use of nuclear materials. The presentation emphasized the agency’s use of regulatory guides and the benefits gained from operational experience. The charter for the Task Force and their recommendations related to transportation are included. Moving forward, the U.S. NRC recognizes the value added by the consensus-based international transportation standards, and the benefit of the stability of those standards over the past 50 years. Additionally, the agency recommends that a risk-informed, performance-based approach be considered for future proposed changes to the international/IAEA packaging and transportation standards. Lastly, the U.S. NRC concludes that the current regulatory framework for packaging and transportation is adequate, and that future proposed changes to the packaging and transportation standards should be focused on development/revision of guidance documents rather than actual changes to the current transportation standards.

**Behaviour of packages involved in an earthquake, WNTI (agenda item 5.5)**

The transport Regulations does not include requirements regarding the behaviour of packages during an earthquake. However, assessments have been performed on dual purpose casks, for the transport and storage of spent fuel assemblies and high active waste, as part of the storage licensing process.

Casks are considered to be in a storage configuration and position, which are more damaging than the transport configuration and position.

The conclusions are that (i) the vibrations due to the earthquake do not jeopardize the leaktightness of the package, (ii) the packages are stable in most instances, and – should the package tip over – the damages will be less severe than those induced by a regulatory drop test, and (iii) horizontal displacement are limited, and consequences of an interaction between two packages or between a package and other equipment will be less severe than those induced by a regulatory drop test.

More generally, an earthquake cannot – per se – significantly damage a package which design has been approved according to the “Regulations for the Safe Transport of Radioactive Material”.

**Burial effect on package, WNTI (agenda item 5.6)**

Except for Type C packages, there is no requirement regarding the behaviour of packages after burial. However, assessments have been performed considering (i) casks, for the transport of spent fuel, buried in a soft ground (swamp), and (ii) casks, for the transport and storage of spent fuel, buried under a collapsed building (after an aircraft crash or an earthquake).
The results are similar for the two types of casks. Sinking of half of the package in a swamp or 50% burial under debris has no consequence. Sinking of the complete package in a swamp or 100% burial under debris could lead to the package losing part of their containment ability after a period of time, typically more than two days, which is longer than what is needed for the emergency team to respond.

This shows that the Type B(U) and Type B(M) packages are able to withstand non-conventional accidents such as burial. Actually, packages potentially sensitive to burial are those with a significant heat load and subsequent high radiation source term. Then, shielding against gamma radiation will induce heavy packagings, and subsequent high thermal capacity and ability to withstand burial. There is no need for a specific burial test.

For the most stringent and less probable situations (100% allowable heat load, 100% burial), time is available for the emergency responders to intervene before any radioactive consequences could occur.

**Heat dissipation hazards, package burial in a marsh or covering with debris, impact on the design rules or emergency response needs, IRSN (agenda item 5.7)**

The design of packages, developed to transport radioactive contents with high thermal power, takes into account the heat exchanges between air and external surfaces of the packaging. But, in case of burial, the heat dissipation capacity of the packages may significantly decrease with a risk of overheating package components which are important to safety.

This scenario seems to be realistic considering the transport by rail of French spent fuel packages from the Nuclear Power Plants to the French reprocessing plant located in La Hague because the spent fuel packages transport crosses a soft ground area with significant depth which is called the Carentan marsh.

In order to evaluate the consequences of burial on package thermal behaviour, IRSN performed first a mechanical study to evaluate the burial depth and secondly a thermal study in order to assess the temperature increase of some package components which are important for safety.

The drop of a typical French spent fuel package in horizontal position in the Carentan marsh, without initial speed, could lead to the burial of half of the package circumference immediately after the impact and to the complete burial of the package around 15 days after the drop. Concerning the other drop configurations, the burial of the package is instantaneous.

The results of the calculations performed by IRSN put in light that in case of complete burial of a package with an internal thermal power equal to 50 kW, the temperature limit of the containment gaskets may be reached in around 2.5 days only. In this regard, emergency plans should include, for all packages transported across areas with an important risk of burial in case of accident, specific provisions to recover heat dissipation capacity before time.

Burial in a marsh is a specific accident configuration that may not be relevant for other transport activities than spent fuel transportation. However, there are other accident scenarios such as tarpaulins openings obstructions or covering of packages by debris after an accident that may lead to similar situations and that should be evaluated.
Presentation about the following work in workings groups

It was proposed for Wednesday and Thursday to create two working groups, the first one dealing with mechanical and criticality safety topics and the second one dealing with thermal and design philosophy. Terms of references for these working groups are given in attachment 5.

6.0 Plenary Session Five:

Report from working group 1 on mechanical and criticality safety topics

The first draft of WG meeting report was discussed with the participants.

Concerning routine/normal conditions of transport, it was proposed to create a working group to review Appendix IV of TS-G-1.1 (rev.1) on stowage and tie down systems. France will lead the working group. The identified participants are:

- Canada, MA Charrette
- China, Y. Du
- Germany, F. Wille
- India, M. Saimi to be informed of the progress
- USA, D. Pstrak
- WNTI, B. Desnoyers
- ICAO, K. Rooney
- Belgium, Japan, Egypt, Italy, Jordan, Poland, Spain, Sweden, UK: contact person to provide in each country if interested by email to MT. Lizot.

WG1 will give specifications on the work to be produced by this working group. The airport handling conditions report will be included in the task of this WG. If data are available the maritime conditions of transport will also be included in this WG. The WG will have to conclude on the need to review the normal conditions tests, especially the stacking test.

Concerning the accident conditions of transport, the current tests seem adequate except for crush test and immersion test:

Proposal 35 (from WP04 in attachment 6) for package containing fissile material has to be rewritten to take into account the comment from WG. The issue has to be considered by current review/revision cycle.

Proposal 36 (from WP04 in attachment 6) concerning the crush test, the issue has to be considered by current review/revision cycle.

Proposal 24 (from WP04 in attachment 6) has to be reviewed by WG1.

Report from working group 2 on thermal and design basis philosophy

The first draft of the WG meeting report was discussed with the participants.

Concerning the routine, normal and accident conditions of transport, the current regulatory test regimes were considered to remain appropriate.

The following issues were identified by the TM:
• Segregation in the context of air transport was discussed and a need for further detailed discussion was identified which is applicable to all modes of transport. An expert WG will be created.

• Concerning the climate change, taking into account the same hypothesis as in the UK study, countries will provide the highest and the lowest temperature in their country relating transport routes and if available insolation values over the past ten years in order to confirm the values given in the regulation. The values have be provided to MT. Lizot by email before next TRANSSC. M. Jon Hursthouse will provide the UK research specification by next week to the participants of the TM and M. Chris Bajwa will contact WMO to have datas.

• Concerning the accumulation of packages on the same vehicles, the impact of the conveyances on the temperatures of the packages and the consequences of the loss of mechanical cooling system, TM proposed some modifications of the regulation and guidance and especially concerning proposals 31 and 37 from the member states. TM could not agree where this assessment should take place (package design safety report, shipment approval, emergency response plan).

• Concerning very less likely accident, it is agreed that some guidance advising for instance an assessment of package performance in these situations is necessary in TS-G-1.2 which is under revision. No change in the regulation is expected.

7.0 Plenary Session Six: Conclusion

Report from working group 1
The meeting report provided in attachment 7 was discussed with the participants.

Report from working group 2
The meeting report provided in attachment 8 was discussed with the participants.

Mrs Capadona warms the participants about the schedule for next TRANSSC, papers for consideration have to be provided before 11th of September and papers for information two weeks before TRANSSC.

8.0 Conclusions for TRANSSC:
As the transport conditions were defined 50 years ago, it seems legitimate to raise again the issue of their pertinence for the current public perception. A review of routine, normal and accident conditions of transport is then necessary to take into account the new transport environment and the impact of climate changes. Additionally, the very less likely accident that is to say beyond the regulatory requirements has to be considered especially taking into account the Fukushima lessons.

8.1 Recommendations to TRANSSC
From the review of the regulatory requirements/guidance dealing with transport environment TM recommends to TRANSSC:
• Routine/normal conditions of transport:
  - The formation of an expert working group leaded by France to review Appendix IV of TS-G-1.1 (rev1) and air/maritime transport practises. This WG has to review the normal conditions of transport tests taking into account the result of the air transport practices study. Draft terms of references for this WG are provided in attachment 7.
  - WNTI to present to ICAO panel in October 2013 proposal 56 (from WP04 in attachment 6) and to provide feedback to next TRANSSC.
  - The formation of an expert working group on segregation of radioactive material from other dangerous goods for all modes of transport.
  - To consider in the current review/revision cycle proposals made by this TM on the shipment of packages that includes mechanical cooling systems (proposal 31 from WP04 in attachment 6). This kind of shipment would require a competent authority shipment approval including the time duration in which the package remains within its safe operating envelope (this information will be a part of the application). Concerning proposal 31 (from WP04 in attachment 6), TM proposes some modifications of the regulation and guidance. Additionally, TM proposes to consider in the current review/revision cycle proposal 37 dealing with the accumulation of packages on the same vehicle and impact of the conveyances on the temperatures of the package and UK will propose a redrafting of paragraph 565 of SSR6.
  - To collect datas about extreme ambient temperatures and insolation from Members States in order to review data stated in SSR6.

• Accident conditions of transports:
  - To consider in the current review/revision cycle the increase of duration for the immersion test (proposal 35 from WP04 in attachment 6) for the package containing fissile material with the modification proposed by WG1 (see attachment 7).
  - To consider in the current review/revision review cycle the modification of the crush test (proposal 36 from WP04 in attachment 6).

TM recommends proposal 24 (from WP04 in attachment 6) on emergency preparedness to be considered as an urgent issue in the current review process including the comments from the WG1 (see attachment 7). In addition TM recommends the revision of TS-G-1.2 to be done in this cycle. Concerning very less likely accident (that is to say beyond regulatory requirements), it is agreed that some guidance is necessary in TS-G-1.2 which is under revision. No change in the regulation is expected.

Concerning the various environment stresses to which a package is likely to be subjected for the routine, normal and accident conditions of transport, the current regulatory test requirements were considered to remain appropriate except for the minor changes TM has identified.
8.2 TM actions

- UK will provide its research specification to the participants of the TM. Participants to provide their climate data (monthly data on the past ten years, and any data on the past hundred years) for the end of August to be presented during next TRANSSC (by email to MT. Lizot).

- UK will propose a redrafting of paragraph 565 of SSR6 concerning mechanical cooling system.

- Participants will provide a contact person in their country to participate to the international working group on the review of Appendix IV of TS-G-1.1 (rev1) and air/maritime transport practices (if interested) by email to MT. Lizot.

9.0 Meeting Report

The meeting report was discussed with the participants.

10.0 Close of Meeting

Both Mrs. Lizot and M. Mansoux thanked the participants for their contribution. It is considered that the meeting accomplished its Terms of Reference.
Attachment 1: Opening Remarks of Mr. Mansoux, the Acting Head of Regulatory Infrastructure and Transport Safety Section

Good Morning everyone

Let me make a few remarks, on behalf of Mr Al Khatibeh, the head of the regulatory infrastructure and transport safety section, who I have the honour to replace today.

I would like to welcome all of you to Vienna, and thank each of you for your continued dedication to the safe transport of radioactive material and of your support of the work that the IAEA is doing in this area.

This week you will face a couple of challenges. The first of them is related to the title of this meeting which is: “Technical Meeting on the Environment to which Packages May be Subject during Transport and Related Issues Concerning the Regulations for the Safe Transport of Radioactive Material”. It would be impossible for the Agency to find a longer one; If at the end of the meeting, anyone can still remember the complete title, that will be an achievement! So far we friendly call it “Technical meeting on Environment”, or maybe Technical meeting on Transport environment, as we do not intend to address all issues related to the environment !

The second challenge, and of course the most important one, is related to the topic of the meeting, addressing some aspects of the safety of transport of radioactive material.

Some years ago, the IAEA General Conference called upon the Agency to continue to take into account scientific evidence of changing global weather patterns, changes to infrastructure and changes to industry operations in the ongoing review of the relevant Agency safety standards.

As you might know, in light of this request, we have recently started a new cycle of review of transport safety standards, and this is the time for discussion. Not only the climate change and extreme severe events provide new scenarios to transport, but the industry itself is looking for new technologies and the way forward to comply with its duty effectively and efficiently. This changes continuously the environment to which packages are exposed during transport.

Are the established basis for current requirements still valid? or should we investigate if safety requirements linked to external parameters should be revised?

Is the data available at the time of fixing requirements sufficient? or would it be convenient to perform specific measurements campaigns or other new data collection that can provide more clarity on current assumptions or identify the need of formulating new ones?

To address these questions during this week, environmental parameters and initiating events will be reviewed with specialists from weather, accelerations per mode of transport, air and sea transport, external events (such as earthquakes, flooding including tsunami, etc.) and packaging experts; the background of the provisions in the regulation and guidance, where package transport environment is quoted will be presented.

That being said, and remaining open for new considerations, we should not forget the excellence that compliance with transport regulations has shown to the world: more than fifty years of radioactive material transport to improve life conditions all over the world, with
many transit accidents of course, but without any single important radiological consequence to human life, properties or environment.

Transport regulations are very well established through the world, and stability of transport regulations is one the key milestones, credibility in regulations itself and in the people involved in its review and revision has a strong component in its stability. Nevertheless, transport regulations need to be changed each time that it is demonstrated to be necessary, but only when it is absolutely necessary.

The second part of this meeting will focus on this essential issue. Your work in groups will analyse, investigate, evaluate and propose, if necessary, subsequent changes to transport regulations, or if evidence of the need of change cannot be demonstrated. You are expected to propose further methodologies on the way forward to find the final documented decision on the need, or not, of modifying current requirements to transport radioactive material in a safe and sustainable way.

As you can see from your material, you have a very populated agenda for this week; the presentations will be of such a variety that I am sure they will enrich everybody’s knowledge, and your further discussions will be of the most importance for the future of transport regulations. I hope you will share nice, friendly and fruitful discussions during this week and in the future in case of identifying areas that require additional study.

I am very pleased to welcome Ms Marie-Therese Lizot, the Chair of this meeting. I want to thank her for taking this role, and I want to ask you to do whatever you can to make her job as smooth as possible. I am very confident that she will perform her duties with professionalism and success.

I wish you well over the next days, and have no doubt that as a result of this meeting, you will provide the secretariat with useful recommendations for revision of the current transport regulations to make them even more practical, useful and accessible. I now turn to Ms. Lizot for some opening remarks.
Attachment 2: Opening Remarks of Mrs. Marie-Thérèse Lizot, Meeting Chair

Thank you, Mr. Mansoux, for your opening remarks.

Good Morning Ladies and Gentlemen.

It is also a pleasure to be able to welcome each of you here in Vienna and thank you in taking time from your busy schedules (or from your holiday) to participate to this TM and a special thank for all the presenters which will contribute to the quality of this meeting.

In the year 1960, tests were developed that can be reproduced in order to predict the capability of the package to withstand the various environment stresses to which it is likely to be subjected for the routine, normal and accident conditions of transport. We are here today to review the current package environment to check the adequacy of the tests proposed fifty years ago or to propose modifications of the regulations if needed.

Another objective of the meeting is to take into account the feedback from the Fukushima accident and to propose a way to deal with the very less likely accidents that is to say beyond the regulatory requirements.

The conclusion of this meeting will be very important for the current review/revision cycle of SSR6 and its associated guidance.

We have a very heavy workload this week but I am confident we can reach the objectives or at least we will be able to propose a way forward for the issues we will identify.

Attachment 3: List of Participants

<table>
<thead>
<tr>
<th>Country</th>
<th>Name</th>
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</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>HESIUS, Marlon</td>
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<tr>
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<td>CHARETTE, Marc André</td>
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<td>RAMSAY, Jeff</td>
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<td>DU, Ying</td>
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<td>WANG, Erqi</td>
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<td>Cote d'Ivoire</td>
<td>KANON, Simon Evariste</td>
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<tr>
<td>Cuba</td>
<td>SORIA GUEVARA, Miguel Antonio</td>
</tr>
<tr>
<td>Egypt</td>
<td>EZZ EL-DIN, Mohamed Reda Mahmoud</td>
</tr>
<tr>
<td>France</td>
<td>GETREY, Christophe</td>
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<tr>
<td>France</td>
<td>LIZOT, Marie-Thérèse</td>
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<td>KROCHMALUK, Julie</td>
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<td>HAMONIAUX, Didier</td>
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<td>SERT, Gilles</td>
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<td>BORST, Frank-Michael</td>
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<td>APEL, Andreas</td>
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<td>WILLE, Frank</td>
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<td>TRIVELLONI, Sandro</td>
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<td>YAGIHASHI, Hideki</td>
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<td>SAHGEER, Muhammad</td>
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<td>CHANG, Fon Chieh</td>
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<td>PATCO, Anthony L.</td>
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<td>CORY, Anthony</td>
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<td>HIROSE, Makoto</td>
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<td>IAEA</td>
<td>CAPADONDA, Nancy</td>
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Attachment 4: Agenda for TM Meeting

<table>
<thead>
<tr>
<th>15 JULY 2013</th>
<th>10:00 (10AM)</th>
</tr>
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<tbody>
<tr>
<td><strong>IAEA, VIC Board Room (A)</strong></td>
<td></td>
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<tr>
<td><strong>1.0 OPENING SESSION (Monday 1000-1030)</strong></td>
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**Purpose**
- To Welcome Participants
- To inform about the aim of the meeting
- To adopt the agenda
- To adopt the terms of reference
- To inform about administrative items

| 1.1. Opening Remarks | 1. IAEA, Hilaire Mansoux  
2. Chair, Marie-Thérèse Lizot |
|----------------------|--------------------------|
# 2.0 PLENARY SESSION 1 (Monday 1030-1245)

## Purpose
- Presentation concerning transport environment in the regulation

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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</thead>
<tbody>
<tr>
<td>10:30 - 11:00</td>
<td>Influence of package environment on the IAEA transport regulations</td>
</tr>
<tr>
<td>11:00-11:15</td>
<td>Coffee break</td>
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</tbody>
</table>

## Purpose
- Presentations concerning changes in natural environments

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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</thead>
<tbody>
<tr>
<td>11:15 – 11:45</td>
<td>Climate change impacts and adaptation to international transport networks</td>
</tr>
<tr>
<td>11:45 - 12:15</td>
<td>Effect of climate change on radioactive material transport requirements*</td>
</tr>
<tr>
<td>12:15 - 12:30</td>
<td>Discussion concerning climate changes</td>
</tr>
</tbody>
</table>

*The background of the regulation and guidance if any will be presented.*

---

## 3.0 PLENARY SESSION 2 (Monday 1400 - 1700)

## Purpose
- Presentations concerning accident free transport and regulatory requirements

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>14:00 - 14:30</td>
<td>Transport practices in air transport* (presentation and discussion)</td>
</tr>
<tr>
<td>14:30 - 15:00</td>
<td>Acceleration* making the load case data under routine conditions of transport more consistent for a harmonized interstate application</td>
</tr>
<tr>
<td>15:00 - 15:15</td>
<td>Coffee break</td>
</tr>
<tr>
<td>15:15 - 15:45</td>
<td>Acceleration under routine conditions of transport*</td>
</tr>
<tr>
<td>15:45 – 15:50</td>
<td>Analysis of Accelerations and Strains Measured on a Tie-Down System of a Heavy Nuclear Transport package during a Routine Rail Journey</td>
</tr>
<tr>
<td>15:50 - 16:15</td>
<td>Acceleration – new spectral density approach*</td>
</tr>
<tr>
<td>16:15 - 17:00</td>
<td>Discussion about 3.2.to 3.5.</td>
</tr>
</tbody>
</table>

*The background of the regulation and guidance if any will be presented.*
### 4.0 PLENARY SESSION 3 (Tuesday 0900-1200)

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Presentations concerning interaction between package and conveyance: thermal environment during routine/normal transport*</th>
<th>J. Hursthouse, UK, ONR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1.</td>
<td>Interaction between package and conveyance: thermal environment during routine/normal transport*</td>
<td>J. Hursthouse, UK, ONR</td>
</tr>
<tr>
<td>09:00 - 09:30</td>
<td>Thermo-assessment of flask in an INF vessel – loss of cooling system</td>
<td>T. Cory, WNTI</td>
</tr>
<tr>
<td>4.2.</td>
<td>Thermo-assessment of flask in an INF vessel – loss of cooling system</td>
<td>T. Cory, WNTI</td>
</tr>
<tr>
<td>09:00 - 09:30</td>
<td>Discussion about 4.1., 4.2.</td>
<td></td>
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<tr>
<td>09:30 - 10:00</td>
<td>Reviewing immersion test conditions</td>
<td>G. Sert, IRSN</td>
</tr>
<tr>
<td>10:00 - 11:00</td>
<td>Effect of immersion on packages*</td>
<td>P. Malesys, WNTI</td>
</tr>
<tr>
<td>11:00 - 11:15</td>
<td>Reviewing immersion test conditions</td>
<td>G. Sert, IRSN</td>
</tr>
<tr>
<td>11:15 - 12:00</td>
<td>Discussion about 4.3., 4.4.</td>
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<tr>
<td>11:30 - 12:30</td>
<td>Severity of Fires in Railway and Highway Transportation in the United States*</td>
<td>J. Chang and J. Borowski, US NRC</td>
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*The background of the regulation and guidance if any will be presented.

### 5.0 PLENARY SESSION 4 (Tuesday 1400-1700)

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Presentations concerning severe natural events including Fukushima lessons</th>
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<tbody>
<tr>
<td>5.1.</td>
<td>A Review of the Impacts on the Transport Safety Standards in the Light of Fukushima Lessons Learned</td>
</tr>
<tr>
<td>14:00 - 14:20</td>
<td>Identification and Classification of Transport Incidents Potentially Caused by Natural Events</td>
</tr>
<tr>
<td>14:20 - 14:40</td>
<td>A Proposed risk management regulatory framework</td>
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<tr>
<td>14:40 - 15:00</td>
<td>A Proposed risk management regulatory framework</td>
</tr>
<tr>
<td>15:00 - 15:30</td>
<td>Discussion on 5.1 - 5.3.</td>
</tr>
<tr>
<td>15:30-15:45</td>
<td>Coffee break</td>
</tr>
<tr>
<td>5.5.</td>
<td>Behavior of packages involved in an earthquake* (15min)</td>
</tr>
<tr>
<td>15:45 - 16:10</td>
<td>Behavior of packages involved in an earthquake* (15min)</td>
</tr>
<tr>
<td>5.6.</td>
<td>Burial* effect on the package</td>
</tr>
<tr>
<td>16:10 - 16:30</td>
<td>Burial* effect on the package</td>
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<tr>
<td>5.7.</td>
<td>Heat dissipation hazards - Package burial in a marsh or covering debris fallen on a package – Impact on design rules or emergency response needs</td>
</tr>
<tr>
<td>16:30 - 17:05</td>
<td>Heat dissipation hazards - Package burial in a marsh or covering debris fallen on a package – Impact on design rules or emergency response needs</td>
</tr>
<tr>
<td>5.8.</td>
<td>Discussion on 5.4 and 5.5.</td>
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<tr>
<td>16:50 - 17:05</td>
<td>Discussion on 5.4 and 5.5.</td>
</tr>
<tr>
<td>5.9.</td>
<td>Presentation about the following work in working groups</td>
</tr>
<tr>
<td>17:05 - 17:15</td>
<td>Presentation about the following work in working groups</td>
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</tbody>
</table>

*The background of the regulation and guidance if any will be presented.
<table>
<thead>
<tr>
<th>6.0</th>
<th>Work in working groups (Wednesday 0900 – 1700)</th>
</tr>
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<tbody>
<tr>
<td><strong>Purpose</strong></td>
<td>• To discuss the presentations to identify problems, suggest a way forward to solve them and to organize the future work</td>
</tr>
<tr>
<td>6.1.</td>
<td>Work in working groups</td>
</tr>
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<table>
<thead>
<tr>
<th>7.0</th>
<th>PLENARY SESSION 5(Thursday 0900-1000)</th>
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</thead>
<tbody>
<tr>
<td><strong>Purpose</strong></td>
<td>• Receive preliminary conclusions from the working groups</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8.0</th>
<th>Work in working groups (Thursday 1000 - 1700)</th>
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<tbody>
<tr>
<td><strong>Purpose</strong></td>
<td>• To discuss the presentations to identify problems, suggest a way forward to solve them and to organize the future work</td>
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<tr>
<td>8.1.</td>
<td>Work in working groups</td>
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<table>
<thead>
<tr>
<th>9.0</th>
<th>PLENARY SESSION 6 (Friday 0900-1230)</th>
</tr>
</thead>
</table>
| **Purpose** | • Receive conclusions of the working group  
• Discussion of meeting report  
• Recommendations for TRANSSC  
• Closing remarks |
| 9.1. | See purpose |
| **Output Required** | • Meeting report including working group reports and recommendations for TRANSSC |
A. Background

The IAEA General Conference resolution GC(53)/RES/10, September 2009 stated:

48. Calls upon the Agency to continue to take into account scientific evidence of changing global weather patterns, changes to infrastructure and changes to industry operations in the ongoing review of the relevant Agency safety standards, and encourages the Secretariat to facilitate the development of new fissile-excepted material requirements for the transport of radioactive material;

The Secretariat requested a review of the environment experienced in the transport as inputs for next edition of the regulation and its guidance and has convened a technical meeting to resolve these issues. Such a meeting was convened in July 2013.

B. Work to be done by plenary

Review and discuss the working group proposals and issues about environmental parameters defined in the regulation.

C. Output of plenary

The plenary will produce for TRANSSC a report containing a set of identified issues and/or proposals for changes for the next edition of the regulation/guidance related to the environment to which packages may be subject during transport, recommendations for a way forward to solve the identified issues, identification of countries interested in contributing to address them with a leading country to organize future work (correspondence groups, consultancy..) and an analysis of advantages and disadvantages of changing transport regulations for each change proposed.

Working group 1: Mechanical and criticality experts

B. Work to be done by WG1

- Review the information provided in the available presentations and papers and in the draft technical basis document; review the changes and issues about SSR6 already identified under the current review cycle (changes n°35, 36 and 56 from “120 Day Comments and Recommendations on 2012 SSR6 20Jun13.doc”); review the mechanical and criticality
paragraphs of the regulation for routine/normal and accident conditions of transport. Special care for loadings applied to packages by handling equipment and tie down systems during transport and handling for all modes of transport, vibrations, ambient pressure (air transport, altitude) and interaction between conveyances and packages both in normal and accident conditions of transport and immersion test.

TS-G-1.1: appendix 4

SSR-6 / Chapter 6:
Routine conditions:
612: features added to the packages
608, 613: routine effects of acceleration and vibrations (see appendix IV of TS-G-1.1 (rev.1))
616: ambient pressure for all package types
621: differential pressure during air transport
645: containment system designed for a reduction of ambient pressure to 60kPa
681, 682: reflection of confinement system 20 cm of water (see para 680.2 of TS-G-1.1 (rev.1).

Normal conditions of transport
648, 626 to 630: normal conditions of transport
671: environment of the package for criticality
684: reflection of confinement system with 20 cm of water

Accident conditions of transport
671: environment of the package for criticality
685: reflection of confinement system : 20 cm of water

SSR6 / Chapter 7:
Nearly all the conditions tests are concerned: depth of the immersion test, Paragraphs 717, 719 to 724, 725 to 733

Review Fukushima lessons dealing with mechanics, crush test … (lessons 1 and 8).

C. Output of WG1

WG1 will produce for the plenary a report containing a set of identified issues and/or proposals for changes for the next edition of the regulation/guidance related to the environment to which packages may be subject during transport, recommendations for a way forward to solve the identified issues, identification of countries interested in contributing to address them with a leading country to organize future work (correspondence groups, consultancy..) and an analysis of advantages and disadvantages of changing transport regulations for each change proposed.
Working group 2: Thermal experts and design basis

B. Work to be done by WG2

- Review the information provided in the available presentations and papers and in the draft technical basis document; review the changes and issues about SSR6 already identified under the current review cycle (proposals 24, 31, 37 from “120 Day Comments and Recommendations on 2012 SSR6 20Jun13.doc”); review the thermal paragraphs of the regulation for routine/normal and accident conditions of transport. Special care for climate change, temperature during air transport, mechanical cooling systems, interaction between conveyance and packages and thermal fire enhancement.

SSR6/ Chapter 6:
Routine conditions:
612: features added to the packages
616: ambient temperature for all package types
619, 620: ambient temperature for air transport
657: solar insolation
635, 656, 639, 666, 679: range of ambient temperature for fissile, type B and type A, type IP3 package
661: compliance with regulation shall not depend on filters or on mechanical cooling system in particular when features are added to package (tarpaulins, canopies, cargo hold,..)

Normal conditions of transport

Accident conditions of transport
659, 685: thermal fire

SSR6 / Chapter 7:
728: Duration of fire, temperature of fire, actions of flames inside internal venting paths

- Accident statistics?
- Approach to take into account less likely accidents (beyond regulatory requirements): burial in soft soil and under debris from earthquake, other Fukushima lessons 2, 3, 4 and 27
- Review the adequacy of the use of routine, normal and accident conditions of transport.

C. Output of WG2

WG2 will produce for the plenary a report containing a set of identified issues and/or proposals for changes for the next edition of the regulation/guidance related to the environment to which packages may be subject during transport, recommendations for a way forward to solve the identified issues, identification of countries interested in contributing to address them with a leading country to organize future work
(correspondence groups, consultancy..) and an analysis of advantages and disadvantages of changing transport regulations for each change proposed.
**Attachment 6: List of Papers**

<table>
<thead>
<tr>
<th>Paper Number</th>
<th>Title</th>
<th>Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>WP01</td>
<td>Provisional Agenda</td>
<td>Yes</td>
</tr>
<tr>
<td>WP02</td>
<td>Provisional Terms of Reference</td>
<td>Yes</td>
</tr>
<tr>
<td>WP03</td>
<td>Fukushima lessons</td>
<td>Yes</td>
</tr>
<tr>
<td>WP04</td>
<td>120 Day Comments and Recommendations on 2012 SSR6 20Jun13.doc</td>
<td>Yes</td>
</tr>
<tr>
<td>WP05</td>
<td>Draft technical basis for the IAEA regulation for the safe transport of radioactive material</td>
<td>Yes</td>
</tr>
<tr>
<td>WP06</td>
<td>Application to climate study to class 7 dangerous goods package design, ONR, February 2012</td>
<td>Yes</td>
</tr>
<tr>
<td>WP07</td>
<td>How abnormal is normal?, James A. Sysler</td>
<td>Yes</td>
</tr>
<tr>
<td>WP08</td>
<td>Report Of Working Group No 1</td>
<td>Yes</td>
</tr>
<tr>
<td>WP09</td>
<td>Report Of Working Group No 2</td>
<td>Yes</td>
</tr>
<tr>
<td>WP10</td>
<td>All the presentations</td>
<td>Yes</td>
</tr>
</tbody>
</table>
1. Introduction

The terms of reference for WG1 were introduced by L Reiche and approved. The document is provided in Annex 2. The list of participants is provided in Annex 1. The WG reviewed the topics provided from the January CS related to mechanical and criticality issues.

2. Topics and Outcomes and Actions Taken

The topics discussed by WG1 are contained in Annex 3, and include recommended outcomes.

Review of the changes and issues proposed under the current review/revision cycle (changes 35, 36, and 56).

Review Fukushima lessons dealing with mechanical and criticality topics (lessons 1 and 8).

Review the mechanical and criticality paragraphs of SSR6 dealing with transport environment in routine, normal, and accident conditions of transport and appendix IV of TS-G-1.1. See Annex 3.

WG1 was requested by TM Chair to provide a review of proposal 24 related to emergency response. See Annex 3 for the results of the discussion.

3. Close of Meeting

Ms. Lizot thanked I. Reiche and D. Pstrak and the participants for their contribution. It is considered that the meeting accomplished its Terms of Reference.
### Annex 1: List of WG1 Participants

<table>
<thead>
<tr>
<th>Country</th>
<th>Name</th>
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</thead>
<tbody>
<tr>
<td>France</td>
<td>LIZOT, M</td>
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<tr>
<td>France</td>
<td>KROCHMALUK, J</td>
</tr>
<tr>
<td>France</td>
<td>SERT, G</td>
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<tr>
<td>France</td>
<td>GONCZ, S</td>
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<td>Switzerland</td>
<td>AARLE, J</td>
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<tr>
<td>Spain</td>
<td>ACENA MORENO, M</td>
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<td>Sweden</td>
<td>RAGNARSDOTTER THOR, H</td>
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<td>Poland</td>
<td>GRZEGRZOLKA, A</td>
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<td>Canada</td>
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<td>MISHEVSKA, A</td>
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<td>China</td>
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<td>Malaysia</td>
<td>MOD ALI, N</td>
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<tr>
<td>Germany, chair</td>
<td>REICHE, I</td>
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<td>APEL, A</td>
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<tr>
<td>Germany</td>
<td>WILLIE, F</td>
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<tr>
<td>USA</td>
<td>PATKO, A</td>
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<tr>
<td>USA, secretary</td>
<td>PSTRAK, D</td>
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<td>Ukraine</td>
<td>TOMUSYAK, S</td>
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<td>Egypt</td>
<td>EZZ EL-DIN, M</td>
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<td>Cuba</td>
<td>SORIA GUEVARA, M</td>
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<td>Japan</td>
<td>HISHIDA, M</td>
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<td>Indonesia</td>
<td>NOOR, N</td>
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<td>GUNAWAN, I</td>
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<td>WNTI</td>
<td>DESNOYERS, B</td>
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<tr>
<td>WNTI</td>
<td>HIROSE, M</td>
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<tr>
<td>Turkey</td>
<td>PARLAKTURK, F</td>
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<tr>
<td>ICAO</td>
<td>ROONEY, K</td>
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</table>
Annex 2: Terms of Reference

Working Group 1: Mechanical and criticality experts

Actions: Review the information provided in the available presentations and papers and in the draft technical basis document; review the changes and issues about SSR6 already identified under the current review cycle (changes 35, 36 and 56); review the mechanical and criticality paragraphs of the regulation for routine/normal and accident conditions of transport. Special care for loadings applied to packages by handling equipment and tie down systems during transport and handling for all modes of transport, vibrations, ambient pressure (air transport, altitude) and interaction between conveyances and packages both in normal and accident conditions of transport and immersion test.

SSR-6 / Chapter 6:
Routine conditions:
612: features added to the packages
608, 613: routine effects of acceleration and vibrations (see appendix IV of TS-G-1.1 (rev.1))
616: ambient pressure for all package types
621: differential pressure during air transport
645: containment system designed for a reduction of ambient pressure to 60kPa
681, 682: reflection of confinement system 20 cm of water (see para 680.2 of TS-G-1.1 (rev.1)).

Normal conditions of transport
648, 626 to 630: normal conditions of transport
671: environment of the package for criticality
684: reflection of confinement system with 20 cm of water

Accident conditions of transport
671: environment of the package for criticality
685: reflection of confinement system: 20 cm of water

SSR6 / Chapter 7:
Nearly all the conditions tests are concerned: depth of the immersion test,
Paragraphs 717, 719 to 724, 725 to 733

Review Fukushima lessons dealing with mechanics, crush test … (lessons 1 and 8).

Outcomes: Report for recommendations for plenary
- On the review of the regulatory and guidance paragraphs, on the review of the changes and issues proposed under the current review cycle and on the review of the Fukushima lessons
- Set of identified issues and/or proposals for changes for next edition of the regulation and guidance
- Recommendations for a way forward to solve the identified issues, identification of countries interested to address them with a leading country to organize future work
An analysis of the advantage and disadvantage of changing transport regulations for each change proposed
Annex 3: Topics Discussed

<table>
<thead>
<tr>
<th>Paragraph in SSR6</th>
<th>Topic</th>
<th>Other sources of information</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>612</td>
<td>Features added to the packages</td>
<td></td>
<td>This topic was discussed at the last Review Cycle. WG1 determined that no action is needed.</td>
</tr>
<tr>
<td>608, 613</td>
<td>Routine effects of acceleration and vibrations (see appendix IV of TS-G-1.1 (rev.1))</td>
<td>Plenary Presentations 3.1, 3.2, 3.3, and 3.4.</td>
<td>The WG recommends the formation of a separate working group to discuss the technical details of this topic. See Annex 4.</td>
</tr>
<tr>
<td>616</td>
<td>Ambient pressure for all package types</td>
<td></td>
<td>WG1 determined that no action is needed.</td>
</tr>
<tr>
<td>621</td>
<td>Differential pressure during air transport</td>
<td>Proposal 56</td>
<td>The WG discussed and agreed that WNTI should present this issue to the ICAO Panel in October. Additionally, an IAEA representative should attend this meeting and provide feedback at TRANSSC in November.</td>
</tr>
<tr>
<td>645</td>
<td>Containment system designed for a reduction of ambient pressure to 60kPa</td>
<td></td>
<td>WG1 determined that no action is needed.</td>
</tr>
<tr>
<td>681, 682, 684, 685</td>
<td>20 cm water reflection</td>
<td></td>
<td>WG1 discussed, that polyethylene with high hydrogen density is now used in transport but determined, based on assessments on the effect, that no action is needed.</td>
</tr>
<tr>
<td>648, 627, 630</td>
<td>648 requirements for type A packages, tanks, IBCs</td>
<td></td>
<td>WG1 determined that no action is needed.</td>
</tr>
<tr>
<td>671</td>
<td>Requirements for type C packages</td>
<td></td>
<td>WG1 determined that no action is needed.</td>
</tr>
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<td></td>
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</tr>
<tr>
<td><strong>685</strong></td>
<td>Immersion test</td>
<td>See proposed revision in Attachment 5.</td>
<td>Modifying the immersion test see paras 729/733, see proposal 35. Also see proposal 36 related to crush test.</td>
</tr>
<tr>
<td><strong>717</strong></td>
<td>Target for drop tests</td>
<td></td>
<td>Drop tests on a curved surface were discussed. The WG confirmed that there is no evidence of lack of safety with the existing drop test sequence.</td>
</tr>
<tr>
<td><strong>719 – 724</strong></td>
<td>Testing for normal conditions of transport</td>
<td>723: See Attachment 4.</td>
<td>719: Need for guidance on environmental conditions of tests. See also para 639, 645.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>720 – 722: No action needed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>723: The WG recommends including the question, if the parameters of the stacking test are still appropriate. A separate WG to be created on routine conditions of transport (see paras 608 and 613).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>724: No action needed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>725: No action needed.</td>
</tr>
<tr>
<td><strong>726, 727, 729 – 733</strong></td>
<td>Testing for accident conditions of transport</td>
<td>See Attachment 5. See proposal 35 and 36.</td>
<td>726 – 727: Modifying the crush test specification/requirements should be considered in the review process by TRANSSC.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>729: Proposal to change the duration of the immersion test from 8 hours to about one week. Modification proposed by the Working Group to change para 685 instead to limit the change to fissile material. To be considered further during the review process by TRANSSC.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>730: WG1 discussed that the immersion depth of 200 meters was based on several studies. No new information/studies are available. The WG discussed the duration for the test</td>
</tr>
</tbody>
</table>
with respect to recovery times and corrosion effects on the package. WG decided no action was needed.

733: Proposal to change the duration of the immersion test from 8 hours to about one week. Modification proposed by the WG to change para 685 instead to limit the change to fissile material. To be considered further during the review process by TRANSSC.

<table>
<thead>
<tr>
<th>Fukushima lesson 1</th>
<th>Strengthen measures against earthquakes and tsunamis</th>
<th>There was reported experience from studies in Japan and Germany about debris and cranes falling on spent fuel transport packages. An analysis of the effect of an earthquake on stored packages has been presented. The WG 1 concluded that current accident tests and requirements are appropriate but recommends emergency planning may be improved. See also response to Comment 24.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fukushima lesson 8</td>
<td>Ensuring the water tightness of essential equipment and facilities</td>
<td>Regarding immersion see paras 729, 733.</td>
</tr>
<tr>
<td>Comment 24 from current review cycle (from WG2)</td>
<td>Issues associated with emergency response</td>
<td>The WG had discussions on: 1) the need for a graded approach application of this proposal; 2) clarification on whether governments vs a competent authority should be included for notification of an emergency; 3) the graded approach that currently exists in TSG-1.2; 4) the difference/variations on emergency response worldwide; 5) the positive impact of this proposal with respect to gaining alignment of consignors and competent authorities when dealing with emergencies; and 6) this proposal is most appropriate for consideration with respect to high activity/heat</td>
</tr>
</tbody>
</table>
generating packages. The WG recommends that this proposal move forward to the review cycle at TRANSSC.
Annex 4

Draft Terms of Reference for the Working Group on Acceleration and Stacking

18 July 2013
INTERNATIONAL WORKING GROUP ON RETENTION SYSTEM LOADINGS DURING ROUTINE CONDITIONS

DRAFT TERMS OF REFERENCE

First task:

Identify the relevant standards, guides and regulations which make them mandatory about levels and frequencies of forces applied to packages by retention systems during transport on road, rail, sea and air (607, 613).

Identify the scope and limit conditions for application of the recommended levels of forces including conditions to combine accelerations in different directions, and, if possible, the technical bases for these values.

Collect the results of the available acceleration campaign measurements which have been published or which are available to the participants to the working group. The survey includes review of conditions of movements of packages in transit facilities (airports, harbours…). The scope is limited to incident free conditions. Assess the acceleration results with reference to existing standards, guides and regulations.

Identify the transport configurations for which there is a need for complementary measurements and the conditions under which the measurements should be performed. Assess the new acceleration results with reference to existing standards, guides and regulations.

Compare the different methodologies (including fatigue analysis) that can be used for assessing the resistance of package components and retention equipments and identify the eventual embedded safety margins.

Recommend methodology (ies) and conditions of application.

Revisit the text of appendix IV of TS-G-1.1 to integrate the recommended levels of forces or accelerations and the associated conditions.

Second task:

Identify the relevant standards, guides and regulations providing recommendations or requirements about allowed stacking conditions and tests. The survey includes review of conditions of movements of packages in transit facilities (airports, harbours…) as well as during stowage and recommendations for a modification of the transport regulation if needed.

A presentation of results to modal organizations is recommended.
Annex 5

Assessment of Proposal 35

Assessment of package arrays under accident conditions of transport

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 paras 731–733; or

(ii) The test specified in para. 729 with an enhanced testing time of 1 week instead of the value of 8 hours given 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.

733. The specimen shall be immersed under a head of water of at least 0.9 m for a period of not less than 1 week and in the attitude for which maximum leakage is expected.
Attachment 8: Report of working group 2 (attempt to capture discussions from WG)

**Working Group 2 Members**

S. Whittingham (UK)  Chair

C. Bajwa (IAEA)    Recording Secretary

M. Hesius (Belgium)

J. Ramsay (Canada)

C. Dejean (France)

C. Getrey (France)

S. Goncz (France)

D. Hamoniaux (France)

F. Börst (Germany)

F. Wille (Germany)

M. Saini (India)

S. Trivelloni (Italy)

Y. Hirao (Japan)

M. Inove (Japan)

H. Yagihashi (Japan)

A. Hamdan (Jordan)

M. Sagheer (Pakistan)

J. Hursthouse (UK)

F. Chang (USA)

K. Rooney (ICAO)  Part-Time

T. Cory (WNTI)
1. Opening Discussion

There will be changes in the environment over the coming years with ambient temperatures predicted to increase and associated significant variations in weather patterns including higher peak temperatures and flooding in some regions of the world.

1.1 The key questions to ask are:
- will these predicted climatic changes have an effect upon package design requirements, and
- will these climatic changes increase the likelihood of an accident due to the effects the infrastructure for transport?

1.2 The consensus of the working group (WG) was that the climatic changes would have no effect upon the package performance criteria currently prescribed in SSR6.

1.3 In comparison the infrastructure may be affected (by environmental changes), indeed it is already commonplace during the high summer for rail transport to be disrupted to buckling of rail lines, signaling failures and other mechanical failures to the system. Nonetheless the group considered that such effects would be mitigated over time as they pose a risk of loss of revenue due to temporary closures to the rail network and the increased risk to the millions of passengers should the damage result in a rail accident. The transport of dangerous goods, which includes radioactive material, would consequently directly benefit from the resulting investment in improving the resilience of the rail network.

1.4 In addition to the environmental changes the opportunity was also taken to examine other package environment issues and the results of the discussions are as follows:

2. Segregation (Air Transport)

2.1 ICAO raised the issue of segregation during air transport. It was noted that there was a discussion of segregation of radioactive material from other dangerous goods in the original draft of the IAEA Transport Regulations but this did not feature in the 1963 edition of the Regulations.

Action 2.1: Secretariat action: review the discussion of segregation in the original formulation of the transport regulations.

2.2 Air transport is vital for the shipment of radiopharmaceutical products and that industry like other who need to transport radioactive material are susceptible to fragile delivery routes and denial of shipments is still too common an issue.

2.3 Clearly segregation requirements must have a sound technical basis, and it was agreed that segregation should be the subject of a separate TM for which the participants can prepare the necessary information and data to establish if and what changes are necessary.

Action 2.2: Secretariat to co-ordinate a TM on Segregation for all modes of transport.

2.4 It was suggested that segregation should be discussed in the guidance for RAM transport and applied, as needed, by carriers/shippers.

2.5 ICAO advised the group that there is currently a study being undertaken which includes the monitoring of packages during air transport (UN sponsored). ICAO will provide an update on this work later this year with TRANSSC in November being the target date.
2.6 It was also considered that additional consultancies or Technical Meetings may be warranted on this issue in order to properly align SSR-6 with the UN Model Regulations (Orange Book) in the area of segregation.

3. **Discussion of interaction between the conveyance and the package**

3.1 In terms of consignment controls, the IAEA Regulations limit the TI of CSI of a conveyance whereas the consignment limit in terms of maintaining the ambient temperature within the conveyance are not defined.

3.2 It was noted that when the IAEA regulations are adopted by a Member State, their national legislation may assign the responsibility for specific paragraphs to specific dutyholders such as consignors or carriers. Consequently if there is not an explicit regulation addressing the issue of conveyance ambient temperature this controlling feature would be be missed, even if it is in the regulatory guidance.

3.3 The questions raised were:

- Do the SSR6 regulatory requirements for multiple, relatively high heat generating, packages shipped in a closed environment with solar insolation, require further improvement or is this aspect covered adequately in the current regulations?
- What is the origin of the 15 W/m² in SSR6 and its appropriateness for today’s transport environments was questioned
- Can the risk of damage to a package in a multi-package transport scenario be related to a surface heat flux?

3.4 **In SSR 6:**

565. Provided that its average surface heat flux does not exceed 15 W/m² and that the immediate surrounding cargo is not in sacks or bags, a package or overpack may be carried or stored among packaged general cargo without any special stowage provisions except as may be specifically required by the competent authority in an applicable certificate of approval.

3.5 **From TS-G-1.1:**

565.1. The retention of packages within or on conveyances is required for several reasons. By virtue of the movement of the conveyance during transport, small packages may be thrown or may tumble within or on their conveyances if not retained, resulting in their damage. Packages may also be dropped from the conveyance, resulting in their loss or damage. Heavy packages may shift position within or on a conveyance if not properly secured, which could make the conveyance unstable and could thereby cause an accident. Packages should also be restrained to avoid their movement in order to ensure that the radiation dose rate on the outside of the conveyance, to the driver or to the crew, is not increased.

565.2. Within the context of the Transport Regulations, ‘stowage’ means the locating within or on a conveyance of a package containing radioactive material relative to other cargo (both radioactive and non-radioactive), and ‘retention’ means the use of dunnage, braces, blocks or tie-downs, as appropriate, to restrain the package, preventing movement within or on a conveyance during routine transport. When a freight container is used either to facilitate the transport of packaged radioactive material or to act as an overpack, consideration should be made for the packages to be restrained within the freight container. Methods of retention, for example lashings, throwover nets or compartmentation, should be used to prevent damage to the packages when the freight container is being handled or transported. When a freight container or other large box type container is used as a packaging, consideration should be given to the contents to be restrained within the container to prevent damage to the container
that might compromise the containment system or shielding integrity under the static and
dynamic stresses resulting from handling and routine conditions of transport.

The group discussed a recommendation that Par. 565 in the guidance could be clarified to
provide more specific guidance on this issue.

3.6 An argument was provided for a modification/clarification to the regulations to make it
“unambiguous” as this would then be carried forward to the other UN regulations. Perhaps
the wording of 565 in SSR-6 could be modified to remove the double negative. Example:
“For a heat flux of greater than 15 W/m², the designer shall…”. Therefore, making it explicit
that the designer shall consider the effects of heat generating sources in the packages, both in
terms of the size of the conveyance and the number of packages, on the performance of the
package with respect to complying with regulatory requirements.

**Action 2.3: SSR6 Paragraph 565 to be redrafted (UK) and submitted to Secretariat**

**Action 2.4: Secretariat to TM members for comment**

3.7 If changes were made to the regulatory language, re-wording of Par. 565 in the
guidance (TS-G-1.1) would also be required.

3.8 Par. 554 was mentioned. It was offered that this paragraph provided adequate
guidance to consignors on this issue.

3.9 *From SSR-6:*

Information for carriers

554. The consignor shall provide in the transport documents a statement regarding actions, if
any, that are required to be taken by the carrier. The statement shall be in the languages
deemed necessary by the carrier or the authorities concerned and shall include at least the
following points:

(a) Supplementary requirements for loading, stowage, carriage, handling and unloading of the
package, overpack or freight container, including any special stowage provisions for the safe
dissipation of heat (see para. 565), or a statement that no such requirements are necessary;

(b) Restrictions on the mode of transport or conveyance and any necessary routeing
instructions;

(c) Emergency arrangements appropriate to the consignment.

4. **Thermal Assessment**

4.1 The change proposal submitted by France was that the reliability of any mechanical
cooling systems necessary for package transport shall be demonstrated before the shipment
is authorized.

4.2 What is the timeframe for response to prevent a compromise of the package? Should
the designer be able to provide an analysis of the package under “loss of cooling”
conditions?

4.3 Recent work in the area involving the thermal analysis of (HLW) packages during sea
transport was explained by Germany.

4.4 A mechanical cooling system is part of the “transport system” and is an important
safety function that maintains the package in an operating envelope which ensures the
package meets all the appropriate regulatory requirements. It was therefore considered
that the mechanical cooling system should be considered by SSR6.
4.5 For the shipment of Category I, II and III material by sea, the INF code includes requirements for back up systems for safety critical systems as well as cargo hold flood capability. In this situation the “industry takes care of itself”; however, is the introduction of the regulatory structure to deal with this issue in the regulations necessary? In the case of a failure of the cooling system (loss of ship power) is the information necessary for an appropriate emergency response available?

4.6 It was offered that this is not part of the design of the package, and potentially outside the scope of SSR-6, and may need to be handled outside the regulations.

4.7 It was offered that the regulations are not only for the design, but also for the shipment of the package. If the requirement for assessing the package in a loss of cooling condition is not provided in the regulations, then this assessment will not be done, and this information is needed for an effective emergency response.

4.8 It was offered that there are two safety arguments to be considered, firstly the design basis of the cooling system (standards) and secondly the failure of that system including what safe timeframes are involved to inform emergency arrangements and responders.

4.9 It was offered that a responsible consignor would have assessed this issue already, without a specific requirement in the transport regulations directing them to do so. That said, it is a logical question to ask: if the cooling fails, what is the effect it would have on the package and when does the package go outside its “regulatory envelope of safety”?

4.10 Is it reasonable to say that the regulations should take into account “abnormal” occurrences that could lead to a release? Where would this be covered in the regulations?

4.11 Par. 304 was mentioned.

From SSR -6

304. In the event of accidents or incidents during the transport of radioactive material, emergency provisions, as established by relevant national and/or international organizations, shall be observed to protect persons, property and the environment. Appropriate guidelines for such provisions are contained in Ref. [4].


4.12 Could addressing the requirement be as simple as stating that if a package requires (external) mechanical cooling an assessment of the package during a loss of cooling condition should be provided?

4.13 It was offered that this information should be provided before a shipment takes place as part of responsible emergency planning. If this information is not provided, then the shipment should not be allowed. Are we assured that this information would be provided for all shipments internationally?

4.14 It was offered, again, that this seems to be beyond the requirements in the current transport regulations.

4.15 The group generally agreed that this type of information was being provided to the necessary authorities prior to transport.

4.16 The question was put forward: should information on the reliability of cooling systems be provided as part of the information needed prior to a shipment as part of the transport assessment?
4.17 It was offered that this could be done in a deterministic way as part of the regulations. For a given failure in a package (due to loss of cooling) the consequences could be quantified and tied to the required reliability of the cooling system.

4.18 Discussion of the party responsible for this type of information ensued. Where this evaluation might be done (and by whom) was also discussed.

4.19 It was generally agreed that this type of assessment should be (is) made as part of the emergency response assessment. The consigner has to consider possible incidents and assess the package performance under these incidents. It was offered that this type of analysis may need to be obtained from the package designer.

4.20 If this is already being done, then do we add a clarifying statement that specifies that this should be done, so that is clear in the regulations? This would not necessarily add additional work for the parties that are part of the transport process.

4.21 It was offered that there is currently no requirement for the regulator to know about the reliability of a cooling system for a given transport.

4.22 The majority of the group did not favor any changes to the regulations to require reliability assessments of (external) mechanical cooling systems for transport.

4.23 It was agreed that for package designs where external cooling is required the consequences of the failure of the external cooling system needs to be assessed. The group could not agree where this assessment should take place or if the regulations should be changed (i.e., in the package design safety report, application for shipment approval, or the emergency response capability assessment).

5. Severe Fire Accidents

5.1 Work completed by the USNRC indicated that changes to the regulations were not warranted in light of their reviews of several historical severe fires in transport accidents.

5.2 There was a brief discussion on the fire test parameters contained in the regulations, clarifying the average temperature of the fire environment specified in the regulations (800°C).

5.3 The question was raised as to whether the regulations adequately address a “real-world” situation of a lower temperature-longer duration fire as might occur in an actual transport accident.

5.4 The technical basis document reference to the duration of transport fires (generally less than ½ an hour) was mentioned.

5.5 The concept of emergency response to a transport accident involving fire was discussed with the group agreeing that emergency response arrangements are adequate for transport accidents that might involve these situations.

5.6 There was general agreement that changes to SSR6 were not warranted in relation to the thermal test requirements.

5.7 Changes to the guidance, however, may be warranted, specifically to discuss the potential effects of “real world” fires, and how to manage the aspects of response to transport accidents involving severe fires.

5.8 It was offered that changes to the guidance to provide the history of how certain provisions were developed, while helpful, would not increase safety.

5.9 The proposal was offered and discussed to use the technical basis document as a “why” document, perhaps pulling information from the existing TS-G-1.1, and placing it
in a user-friendly document that would make available to those in the transport community.

5.10 This information may be of value to Member States establishing a transport infrastructure, or new inspectors or assessors in a State.

6. **Fukushima**

6.1 *Lesson learned #2, concerning loss of power supplies* were discussed, in particular the loading and unloading of a package. It was noted that the loading and unloading of a package would only take place on a site licensed to carry out such operations. It is therefore considered that such events would be covered by the site safety case and as such would not be within the scope of SSR6.

6.2 Transshipment was also discussed. If an incident of loss of power for a crane at a transshipment site (port) was to occur this failure would be covered by the analyzed conditions of transport.

6.3 The question was raised regarding external cooling of packages, and the need to address this here under “loss of power supplies.”

6.4 The context of “disasters” vs. “incidents” related to transport was discussed.

6.5 There was general agreement that there was no change warranted to the regulations or guidance and that response would be handled under emergency arrangements.

6.6 *Lesson learned #3 - reliable cooling* as applied to transport packages. It was mentioned that the issues here seemed to be more applicable to storage than transport. Radioactive material (spent fuel) in storage at a site would be covered under the site safety case. For transport packages involved in severe environmental conditions, there could be a scenario to envision a burial scenario. The question was posed as to whether or not this needs to be addressed in either the regulations or guidance. Storage casks may be designed for transport, but will certainly be designed for a specific set of site hazards. The situation of burial of a package from debris due to the collapse of a building, perhaps due to an earthquake or other initiating event, was raised. Mitigation of the consequences of a burial event may be explored; however, there is little that can be done in the prevention of such an event. Lessons learned should be applied generically rather than focusing on a specific incident, although certain mitigating actions could be considered generally in emergency response planning for specific types of accidents. Within the context of a disaster and emergency response, the regulations are adequate.

6.7 Lessons learned #4 (reliability of cooling systems related to spent fuel pools) is similar to #3. See the discussion above for #3. It was mentioned that long term storage of spent nuclear fuel (in dry cask storage) at reactor sites are part of the site safety assessment related to cooling under “accident” conditions. Some of these casks may be dual-purpose (with a transport certificate in addition to a storage license), and therefore they are covered without additions to the current regulations.

6.8 Lessons learned #27. It was noted that the current transport regulations have basically been developed with a risk perspective built in. The transport experts examined the “worst case” transport accidents and came to a conclusion as to how those types of accidents (in this case drop, puncture, and fire) could affect a package and determined the test conditions that the packages must meet based on those “risks.”

6.9 The group noted that compiling the statistical data for a risk assessment of transport, as recommended in Lesson #27, would be difficult, considering the differences in practices worldwide. It would, however, be useful to perform a risk assessment to verify that the current regulations are focused in the right areas. Such an assessment would either confirm
whether the regulations adequately mitigate risk or it may also identify areas in the regulations for improvement of emergency preparedness.

7. Regulatory Revision Proposals

7.1 Change Proposal #31 - mechanical cooling systems.

Discussion of Par. 612 led to a proposed revised wording [in brackets] of that paragraph, as indicated below.

7.2 SSR-6 Par. 612: “Any features added to the package at the time of transport that are not part of the package [shall not prevent the package from meeting all applicable regulatory requirements.]”

- The proposal for revised text in Par. 612 was raised as a new issue during WG discussion.

7.3 Discussion of Par. 661 led to a proposed revised wording [in brackets] of that paragraph, as indicated below.

7.4 SSR-6 Par. 661: “Compliance [of the package design with the regulations] shall depend neither upon filters nor upon a mechanical cooling system, whether this system is integrated [or external] to the package or to the conveyance.”

- The WG noted that any changes to this section (Section VI) should be package specific.

7.5 Discussion centered on the need for two separate provisions to consider features added to the package and the ability of the package to meet the regulator requirements with added features or systems. It was generally agreed that two provisions were needed.

7.6 For the recommended changes proposed in “668bis” an earlier WG discussion of this subject was held in the earlier in the WG.

7.7 The WG discussed the scenario of a package in transport that requires mechanical (external) cooling to remain within the regulatory “safety envelope,” losing that cooling during transport. It was not clear to the WG whether this condition was “routine” or “normal” conditions of transport, with most of the groups feeling that it was neither, but that the scenario did not rise to the level of an “accident”. That said, it was noted that a scenario such as the one postulated should receive an urgent response, and that time should not be wasted in mitigating the situation in order to avoid potential damage to the package. It was offered that an adequate emergency response plan should include plans for responding to this type of incident. The group generally agreed that it is reasonable to know the timeframe between loss of cooling and when the package exceeds its design temperatures.

7.8 The original proposal states:

668bis. 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 provisions.

7.9 The WG had the following comments on the proposed text:

- Efficiency is an operational aspect of the system, and perhaps not a regulatory issue.
- Reliability involves PRA and therefore is considered not appropriate for SSR 6.
- Failures (in this case of the cooling system) should be considered in emergency response planning.
- In addition to other information required by the competent authority, the WG agreed that the time lapse between the failure of the cooling system and when the package(s) exceed parameters which take the package design outside of regulatory compliance should be required in order to inform emergency response planning.
- It was agreed that this information should be provided as part of a shipment approval submission to a competent authority.
- It was agreed that the shipment of any package(s) that requires a mechanical cooling system would be subject to a shipment approval (multilateral). This should be a regulatory requirement.