

**THE EUROPEAN TECHNICAL GUIDE ON PACKAGE DESIGN SAFETY
REPORTS FOR TRANSPORT PACKAGES CONTAINING RADIOACTIVE
MATERIAL**

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ABSTRACT

For each design of a package for the transport of radioactive material it is necessary to demonstrate compliance with national and international transport regulations as applicable. It is recommended to combine all information necessary to demonstrate compliance in a package design safety report. The European Technical Guide is intended to assist in the preparation of such a package design safety report for use in all European countries.

The development of this guide has been initiated and supported by the European Commission (EC) to improve harmonization in this field in Europe. The work started in 2005 based on various national guidelines available in some European countries. Since that time the draft of the guide has been produced with inputs from Belgium, France, Germany, Spain, UK, WNTI and AREVA and preliminary results have been also presented to the Standing Working Group on Radioactive Material Transport of the EC.

The paper describes the scope, structure and contents of the draft of the Technical Guide. The guide is based on the IAEA TS-R-1 Regulations which are generally consistent with the regulations for the road, rail, sea, inland waterways and air modes of transport, namely ADR, RID, IMDG code, ADN and ICAO respectively which have to be applied in European countries. The guide is applicable to all types of packages. It proposes a structure and a minimum contents for the safety report to assist the applicant in case of a package design subject to competent authority approval and the package designer in case of a package not requiring competent authority approval in demonstrating compliance with the provisions of TS-R-1 applicable to the respective package type. The guide includes also a matrix of paragraph numbers of IAEA TS-R-1 and modal regulations applicable to each package type to support demonstration of compliance with all regulatory requirements that have to be addressed for each package type.

It is intended in the further development of the guide to provide the results also to IAEA to support worldwide harmonization in this matter.

INTRODUCTION

Safety in transport is primarily ensured by using the appropriate type of package in compliance with the requirements laid down in the IAEA Transport Regulations TS-R-1 [1] as well as in the corresponding international modal transport regulations for dangerous goods or national regulations. In this regard each type of package as defined in TS-R-1 must meet specific design requirements and must be subject to a quality assurance program (TS-R-1, para 306). In case of an excepted package, industrial package Type 1, 2 and 3 or Type A package which do not need competent authority approval the consignor shall be able to provide documentary evidence of the compliance of the package design with all applicable requirements (TS-R-1, para 801). For a Type B(U) package, Type B(M) package, Type C package, a package containing fissile material or a package containing 0,1 kg or more of uranium hexafluoride the applicant must demonstrate by its application to the competent authority that all applicable requirements are met (TS-R-1, paras 807, 810, 813, 805 (c)).

In principle for all package types documentary evidence of compliance with all applicable requirements is necessary. Therefore it seems to be reasonable to provide more specific guidance on how such documentary evidence could be performed. For this compliance demonstration it is recommended to combine all necessary information in a Package Design Safety Report (PDSR). The Technical Guide has been developed to support the preparation of this PDSR for all types of packages.

The development of this Technical Guide has been initiated and supported by the European Commission (EC) to improve harmonization in this field in Europe. The work started in 2005 based on various national guidelines available in some European countries [2]-[4]. Since that time the draft of the guide has been produced with inputs from Belgium, France, Germany, Spain, UK, the World Nuclear Transport Institute (WNTI) and AREVA. Preliminary results have been also presented to the Standing Working Group on Radioactive Material Transport of the EC in June 2007.

In the following the paper will describe the scope, structure and contents of the draft of the Technical Guide and finally an outline on future activities will be given.

SCOPE OF THE GUIDE

This Technical Guide is intended to assist in the preparation of the safety report for the design of a package for the transport of radioactive material (PDSR). It covers package designs requiring competent authority approval as well as package designs not requiring competent authority approval.

The Guide is based on the IAEA TS-R-1 Regulations [1] which are generally consistent with the regulations for the road, rail, sea, inland waterways and air modes of transport, namely ADR [5], RID [6], IMDG code [7], ADN [8] and ICAO [9] respectively.

The Guide should not replace the regulations or limit their application but propose a structure and a minimum contents for a Package Design Safety Report to assist the applicant in case of a package design subject to competent authority approval or the package designer in case of a package design not requiring competent authority approval in demonstrating compliance with the provisions of TS-R-1 applicable to the respective package type.

It does not relieve the designer from any additional analysis need associated with the concerned specific design.

STRUCTURE AND CONTENTS OF THE GUIDE

The Guide consists of three chapters, one figure, one table and six annexes as outlined in the following Figure 1:

0	Introduction and generalities
0.1	Objective and Scope
0.2	Definitions
0.3	Structure of this Document
0.4	Unit System
0.5	Document control
1	PACKAGE DESIGN SAFETY REPORT: PART 1
1.1	Contents list of the Package Design Safety Report
1.2	Administrative Information
1.3	Specification of Radioactive Contents
1.4	Specification of Packaging
1.5	Package Performance Characteristics
1.6	Compliance with Regulatory Requirements
1.7	Operation
1.8	Maintenance
1.9	Management Systems
1.10	Package Illustration
2	PACKAGE DESIGN SAFETY REPORT: PART 2
2.1	Common Provisions for all Technical Analyses in Part 2 of the Package Design Safety Report
2.1.1	Reference to Package Design
2.1.2	Acceptance Criterion and Design Assumptions
2.1.3	Description and Justification of Analysis Methods
2.1.4	Analysis of Package design
2.1.5	Comparison between Acceptance Criteria and results of Analysis
2.2	Technical Analysis
2.2.1	Structural Analysis
2.2.2	Thermal Analysis
2.2.3	Containment Design Analysis
2.2.4	External Dose Rates Analysis
2.2.5	Criticality Safety Analysis
3	References

Figure: Structure of Package Design Safety Report
Table: Matrix of IAEA, ADR Regulatory Requirements and Package Type
Annexes:

Annexe 1:	Excepted package
Annexe 2:	Industrial package (Type IP-1, Type IP-2, Type IP-3)
Annexe 3:	Type A package
Annexe 4:	Type B(U), Type B(M) and Type C package
Annexe 5:	Package containing fissile materials
Annexe 6:	Package containing more than 0.1 kg uranium hexafluoride

Figure 1. Structure and contents of the Guide

Chapter 0 contains requirements to be taken into account for the documents cited in chapter 1 and 2.

Chapters 1 and 2 as main parts of the Guide provide a generic structure and contents of the package design safety report (PDSR), namely Parts 1 and 2, which are applicable to all package types. The contents are described in a comprehensive way to cover all important aspects. Some of these aspects may not be applicable to specific package types which will be reflected in the appendices. The structure of the PDSR is also presented in a Figure.

The Table provides a matrix of paragraph numbers of the IAEA TS-R-1 [1] and ADR [2] Regulations applicable to each package type which will be used to demonstrate compliance with all applicable requirements.

The annexes provide further guidance for the scope of the contents of a package design safety report specifically related to each package type.

STRUCTURE AND CONTENTS OF THE PACKAGE DESIGN SAFETY REPORT

The structure and the main sections of the PDSR are represented in Figure 2 which corresponds to sections 1 and 2 in Figure 1 above.

Besides the contents list Part 1 of the PDSR contains all relevant information to specify and describe the package in detail (1.2-1.4) as well as the performance characteristics of the package (1.5), the demonstration of compliance with the applicable regulatory requirements (1.6), the instructions and provisions for operation and maintenance of the package (1.7-1.8), the management system including the quality assurance program as requested in TS-R-1 (1.9) and a package illustration (1.10).

Part 2 of the PDSR should provide the detailed technical analyses to support the demonstration of compliance with the regulatory requirements in Part 1 of the PDSR (see section 1.6 above). It contains the following analyses (as applicable):

Structural Analyses

Assessment of the mechanical behaviour for routine, normal and accident conditions of transport for

- (i) The package components of the containment system.
- (ii) The package components that provide radiation shielding.
- (iii) The package components of the confinement system for ensuring criticality safety.
- (iv) The package components for which its performance will have a consequential effect upon (i), (ii) and (iii).
- (v) The packaging attachments used for lifting the packaging / package (routine and normal conditions only)
- (vi) The packaging attachments used for restraining the package / packaging to its conveyance during transport (routine and normal conditions only)

Thermal Analysis

Assessment of thermal behaviour for routine, normal and accident conditions of transport including an evaluation of thermal stresses, surface temperatures and the thermal behaviour of

- (i) The components of the containment system.
- (ii) The components of shielding.
- (iii) The components of the confinement system for ensuring criticality safety.
- (iv) The package components for which its performance will have a consequential effect upon (i), (ii) and (iii).

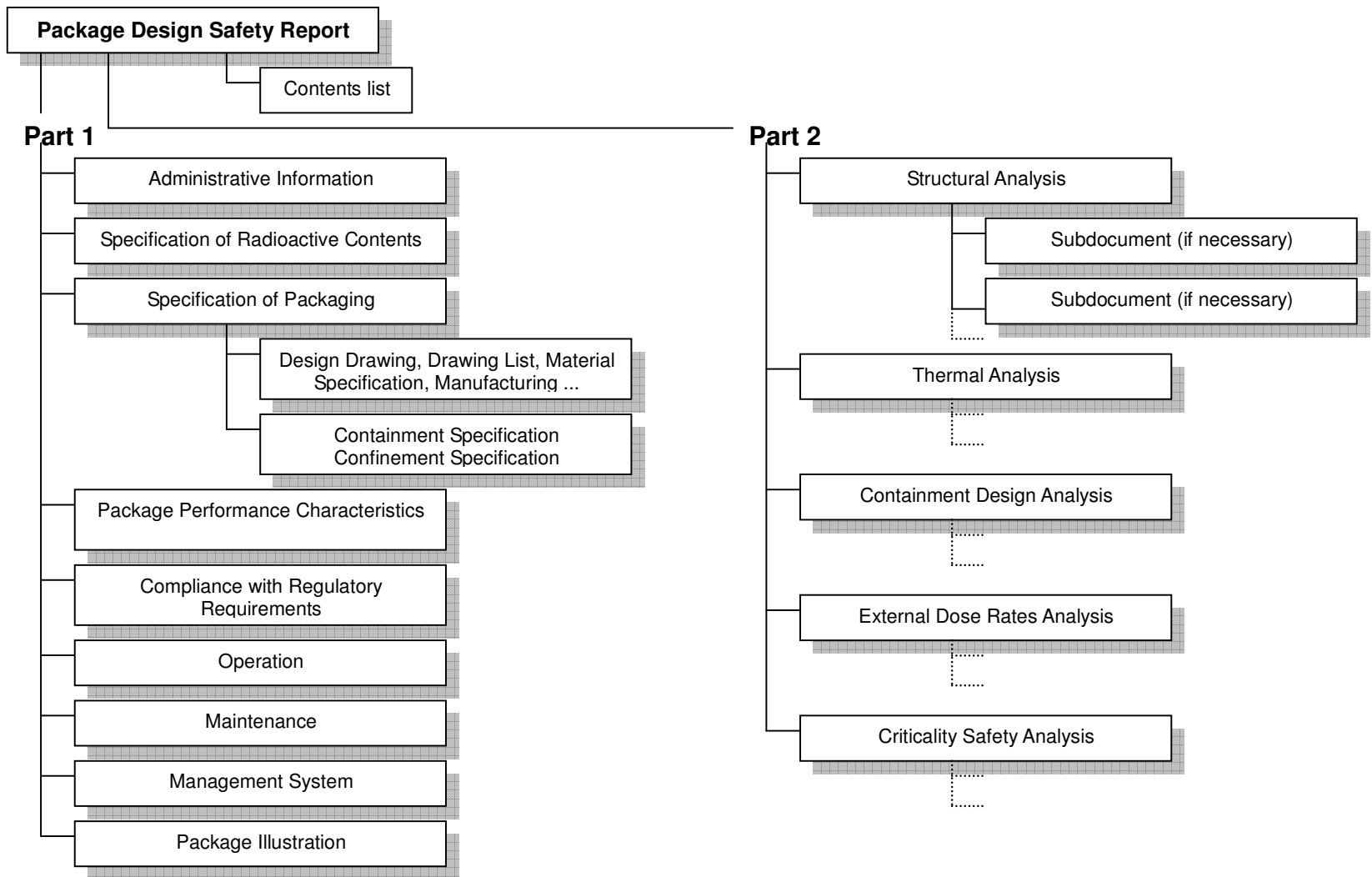


Figure 2. Structure of the Package Design Safety Report

Containment Design Analysis

Assessment of the requirements for preventing the loss or dispersal or for limiting the release of radioactive material under routine, normal and accident conditions of transport, as applicable.

External Dose Rates Analysis

Assessment of the dose rates and dose rate increase ratio for routine, normal and accident conditions, as applicable. The analysis should assume a maximum radioactive content or a content that would create the maximum dose rates at the surface of the package and at distances defined in the aforementioned regulations.

Criticality Safety Analysis

For packages designed to transport fissile material not excepted from the requirements for packages containing fissile material, assessment of criticality safety for routine, normal and accident conditions of transport, for the isolated package and for arrays of packages.

For all these technical analyses common provisions have to be taken into account which are described in section 2.1 of the guide. They include the following aspects:

a) Reference to Package Design

In each of the technical analyses the package design should be referenced by mentioning a design drawing or packaging drawing list (including revision state) and the document specifying the radioactive contents (with revision state).

b) Acceptance Criterion and Design Assumptions

The acceptance criterion for the technical analysis and the package design assumptions in terms of geometry or performance characteristics should be defined and justified when necessary.

c) Description and Justification of Analysis Methods

The safety demonstration of a package design can be accomplished by a combination of the following as appropriate (see annexes):

- (i) The results of physical testing of prototypes or models of appropriate scale.
- (ii) By reference to previous satisfactory physical tests of a sufficiently similar nature. Test results of designs similar to the design under consideration are permissible if the similarity can be demonstrated sufficiently by justification and validation.
- (iii) By calculation, when the calculation procedures are generally agreed to be suitable and conservative. Assumptions made may require justification by physical testing.

The methods/standards used in each of the analyses should include a description of the analysis techniques used, its limitations and accuracy, together with the justification for how it has been used for the analysis of the package design.

If computer codes are used for the safety analysis then additional information will be required to verify/validate the code in terms of the operating platform (computer) used, justification for the applicability of these codes including a statement of possible sources of errors, particularly for conditions for which sufficient verification has not yet been provided, and an assessment of the effects of modelling assumptions and simplifications as well as any other parameter influencing the calculated results.

d) Analysis of Package design

The performance characteristics of the package design should be assessed, as appropriate, with an appropriate and identified sensitivity analysis and levels of accuracy stated.

It is conceivable that more than one accident and consequential damage scenarios will need to be considered to ensure the various safety functions, to be guaranteed by different components of the package design, comply with the regulatory requirements.

e) Comparison between Acceptance Criteria and results of Analysis

The results of the analyses should be compared with the acceptance criterion and package design assumptions and regulatory compliance should be justified accordingly.

APPLICATION OF THE GUIDE

This structure and contents of the PDSR is comprehensive and in principle applicable to each package type. The information as requested in Part 1 should certainly be provided for each type of package. Part 2 should be very different for the various package types. In case of excepted package e.g. most of the Part 2 chapters need not be considered and very limited and simple analyses are sufficient. In case of package types which are subject to competent authority approval Part 2 may become very complex and detailed. Therefore the Technical Guide includes also 6 Annexes which provide specific guidance on how all the chapters of Part 1 and 2 should be applied to the various package types (see Figure 1). Based on this combination of the generic guidance in Part 1 and 2 with the specific guidance in the appendices the user should be able to work out the PDSR for his package design. In section 1.6 it is requested that the PDSR should include a complete list of all paragraphs of the international regulations applicable to the respective package design with demonstration of compliance with these paragraphs by reference to where in the PDSR compliance is demonstrated or by other justification. In conjunction with this another important tool is contained in the Guide to assist the user in demonstrating full compliance with the regulatory requirements for his package type as requested under section 1.6. It is a matrix which displays the applicable paragraphs of TS-R-1 and ADR for each package type. This table will assist the user to find all the relevant paragraphs that have to be addressed for the respective package design for which demonstration of compliance must be shown. Based on this table the user will be able to work out section 1.6 of the PDSR to demonstrate compliance with the regulatory requirements.

CONCLUSION AND PERSPECTIVE

The Development of the European Technical Guide on Package Design Safety Reports has been initiated to support harmonization in this field of radioactive material transport in Europe. It is based on the IAEA Transport Regulations TS-R-1 and the corresponding international modal regulations of ADR, RID, IMDG Code, ADN and ICAO which have to be applied in European countries. It will help to have harmonized package design safety reports throughout Europe and will support the work of the users as well as the competent authorities.

It may be used for all types of package designs. In case of package designs which are not subject to competent authority approval it will assist the user to produce the requested documentary evidence of the compliance of the package design with all applicable requirements as the basis for a certificate of compliance. For package designs which are subject to competent authority approval it will assist the applicant to provide the requested safety demonstration to receive the package design approval certificate of the competent authority.

In June 2007 this draft of the Technical Guide without annexes was distributed to European member states for a test period of one year. The annexes are currently being developed by a small working group consisting of experts from France, Germany, Spain and the UK. They will be completed in 2007 and also distributed to European member states for their first test applications. Based on the responses from member states it is planned for mid 2008 to produce the final version of the Guide. It is intended, that then the EC will recommend the use of this Guide within Europe. It is also foreseen to provide the Guide to IAEA to support worldwide harmonization in this matter.

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