UCRL--99648

DE89 014046

Overview of the DOE Packaging Review Guide and the Review Process*

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* Work performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.

INTRODUCTION

The Department of Energy (DOE) has established procedures for obtaining certification of packagings used by DOE and its contractors for the transport of radioactive materials. These certification procedures have been established in DOE 5480.3 to ensure that DOE packaging designs and operations meet safety criteria at least equivalent to the standards prescribed by the Nuclear Regulatory Commission (NRC) certification process for packaging (10 CFR 71, "Packaging and Transportation of Radioactive Materials"). DOE 1540.2 specifies administrative procedures to use when applying for the certification and use of packaging. To obtain a Certificate of Compliance for packaging, Chapter II.2 of DOE 1540.2 requires that a Safety Analysis Report for Packaging (SARP) be prepared to demonstrate that the packaging design, manufacture, operations, and quality assurance meet DOE safety criteria. The SARP must then be submitted to the Packaging Certification Staff (PCS) in the Office of Security Evaluations for review and approval. The Packaging Review Guide (PRG) (Fischer 1988) was developed by the Lawrence Livermore National Laboratory to provide guidance to the PCS in reviewing SARPs. This paper presents an overview of the PRG, the review process, and the Shipping Cask Analysis System (SCANS) computer program (Gerhard 1989) that is used in the review process for doing confirmatory analyses.

PACKAGING REVIEW GUIDE

The principal purpose of the PRG is to establish and maintain the quality and uniformity of reviews of SARPs which are submitted to the DOE Certifying Official for approval. The PRG provides a well-defined base from which to evaluate proposed changes in the scope and requirements of SARP reviews. The PRG also provides information about the DOE certification policy and procedures to DOE field offices, DOE contractors, federal agencies, and interested members of the general public. The PRG is not a DOE order on packaging requirements but has been prepared for the guidance of the Packaging Certification Staff (PCS) in reviewing SARPs. An applicant submitting a SARP does not have to follow the guidelines in the PRG.

The PRG covers a variety of transport packaging designs. Most guidance is for reviewing new designs for compliance with the regulations. General advice is also provided to assist in evaluating older packaging designs.

Packaging Review Guide (PRG) Sections

The review process is primarily based on the information provided by an applicant in a SARP. Section II.2 of DOE 1540.2 requires that SARPs shall be prepared in the format described in NRC Regulatory Guide (R.G.) 7.9, "Standard Format and Content of Part 71 Applications for Approval of Packaging of Type B, Large Quantity, and Fissile Radioactive Material."

While not specifically addressed in R.G. 7.9, DOE 1540.2 requires the SARP to include a description of the quality assurance program for the design, fabrication, assembly, testing, maintenance, repair, modification, and use of the proposed packaging.

The sections of the PRG parallel the standard format for each of the sections given in R.G. 7.9. A review section addressing Quality Assurance Plans (Section 11.0) has been added to provide guidance for complying with DOE 5700.6B. Also, the PRG contains an additional review section, Materials and Fabrication Specifications (Section 3.0) to provide expanded guidance in reviewing the structural adequacy of materials.

Packaging Review Guide (PRG) Subsections

The individual PRG sections address in detail the objectives and methods of the review, the areas that are reviewed, the acceptance criteria for the review, how the review is accomplished, and the types of conclusions that are sought. One of the objectives of the PRG is to identify the disciplines required to perform the review and to define the sometimes complex interfaces between them. Each PRG section identifies the primary discipline required to review that section. In some review areas the primary discipline may require support. Each PRG section also identifies the other disciplines that are required to perform these supplemental reviews. Each PRG section is organized according to the following six subsections:

- X.1 General
- X.2 Areas of Review
- X.3 Acceptance Criteria
- X.4 Procedures
- X.5 Findings
- X.6 References

The PRG not only documents current methods of review but also provides the base for orderly modifications of the review process in the future. The PRG will be revised and updated as the need arises to clarify the content, to correct errors, or to incorporate modifications approved by the DOE Certifying Official. Revision 1 of the PRG was published in October 1988. The revision added a section on quality assurance requirements and an appendix on special form radioactive materials.

Packaging Review Process

The packaging review process is an interactive process as shown in Figure 1. The applicant prepares a SARP and submits it to the PCS for a pre-acceptance review. At this

point the SARP is reviewed for completeness, classification of packaging, key assumptions, general approach and a correct and consistent design philosophy. If there are concerns, they are documented in the form of questions (called a Q-1) into a letter which is sent to the applicant for a response. After the questions have a satisfactory response the detailed review and evaluation of the package is started. Each of the technical areas is reviewed and their interfaces are evaluated as shown in Figure 2 for a structural review.

In conducting the review, it is important to remember that the overall safety of a packaging is the responsibility of the applicant. The applicant is responsible for meeting the regulations in the design, development, use, and maintenance of the packaging. The SARP must be sufficiently detailed to permit the reviewer both to determine whether the transport package has been designed and analyzed in sufficient detail and to conclude that it can be built and operated without undue risk to the health and safety of the public. The SARP is the principal document in which the applicant provides the information needed for the reviewer to understand the basis upon which this conclusion has been reached.

The reviewer is to verify that the applicant has properly documented in the SARP the adequacy of the packaging with respect to regulations. The reviewer should not perform design analysis or modify the design for the applicant. The reviewer should perform only confirmatory analysis and such other techniques as those provided in this guide to verify the adequacy of the design. The review should emphasize those components of the packaging that are most important to safety. The results of the review are documented in a Safety Evaluation Report (SER). If the SER concludes that the packaging as documented in the SARP complies with 10 CFR 71, a certificate for transporting the packaging with its specified contents is granted.

SCANS

One of the key elements in performing a review is the confirmatory analysis. The SCANS computer system was developed by LLNL for the NRC for performing impact and thermal analyses. As shown in Figure 3, SCANS uses a simplified model of a physical cask for performing analyses.

Impact analyses are performed with a one-dimensional beam representation of the shipping cask. Impact analyses are designed to meet regulatory specifications, including various drop heights, selection of which end impacts first, and oblique-impact angle.

The thermal analysis uses a two-dimensional axisymmetric, finite-element representation of the cask. The thermal-analysis program includes phase change, temperature-dependent material properties, and internal heat generation. Possible thermal boundary conditions include specified temperatures, heat flux, convection, and radiation. SCANS specifies combinations of these boundary conditions to define thermal cases based on NRC regulations. Either steady state or transient analysis can be performed.

REFERENCES

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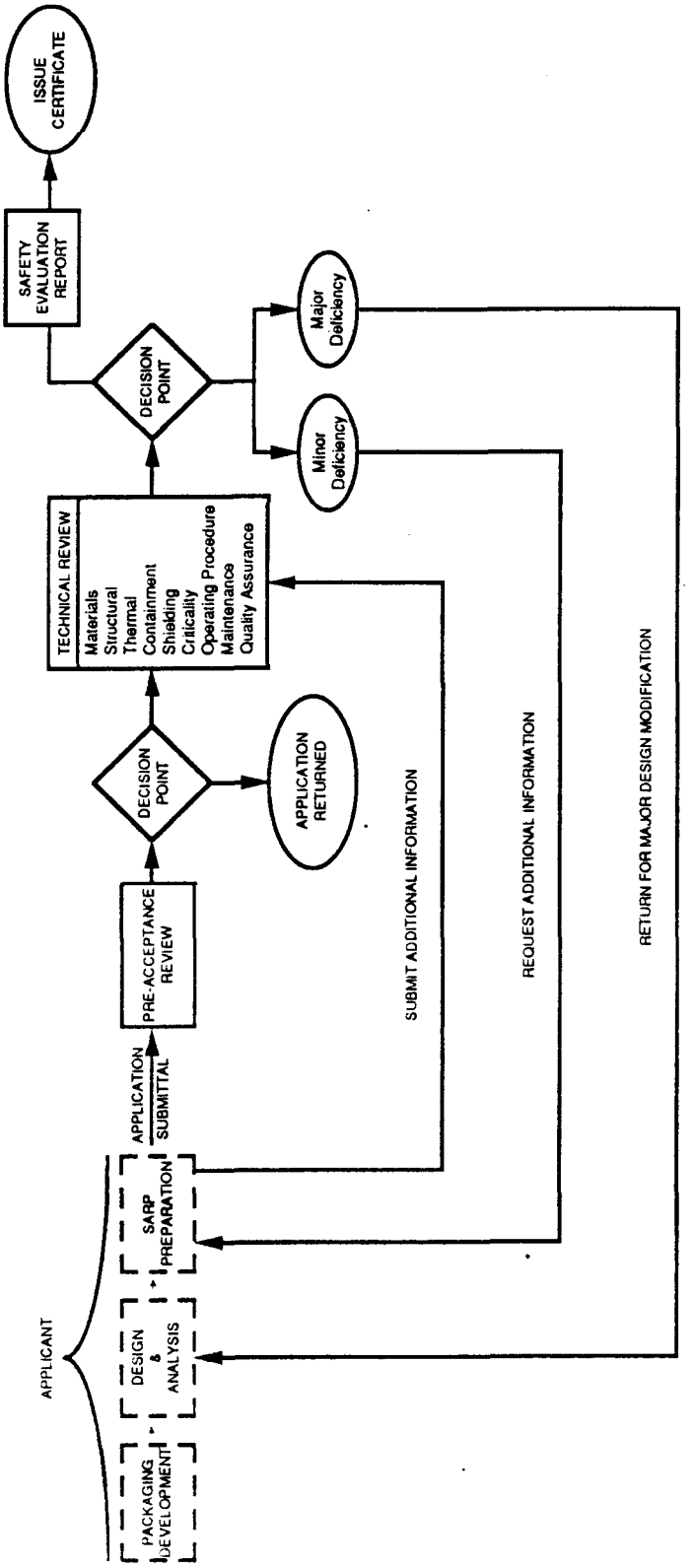


Figure 1. Packaging review process.

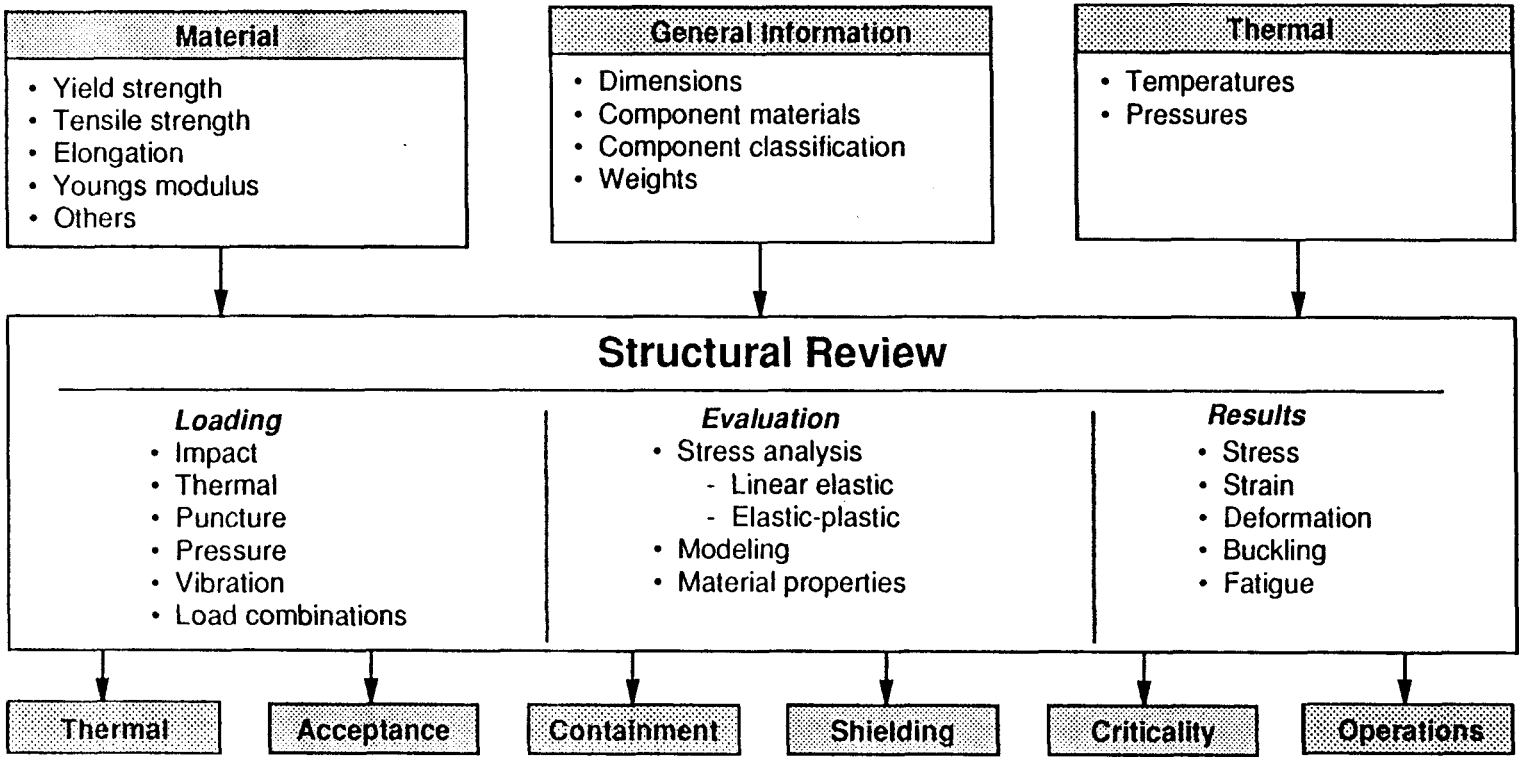


Figure 2. Structural Evaluation Review

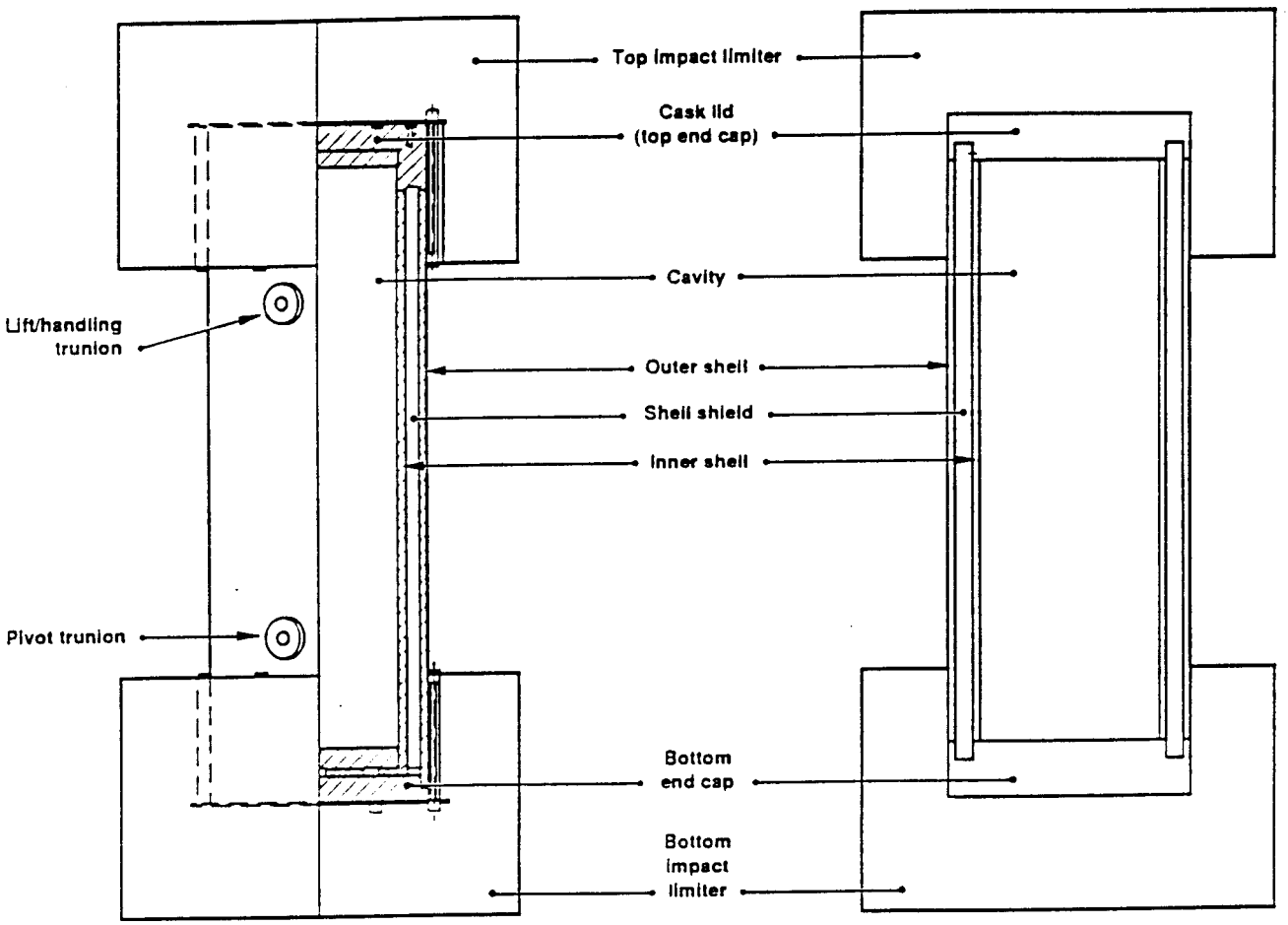
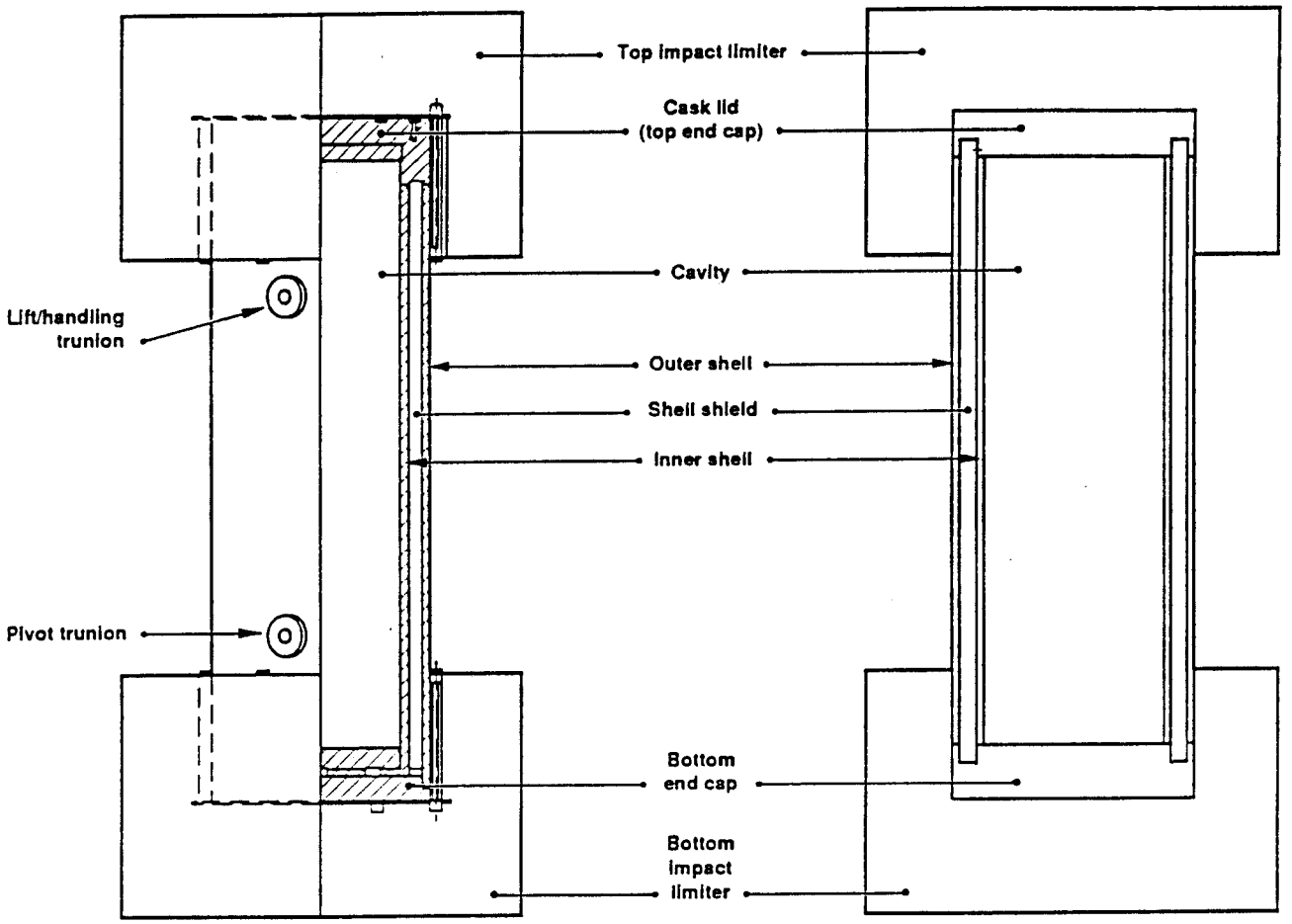


Figure 3. Modeling of physical cask geometry (left) to simplified SCANS cask geometry (right).



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