
Update on Packaging for Uranium Hexafluoride Transport

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INTRODUCTION

The slightly enriched product, Uranium Hexafluoride (UF_6), shipped from the enriching plants for the world's nuclear power plants, must be protected in order to conform to domestic and international transport regulations. The principal overpack currently in use is the U.S. Department of Transportation (USDOT) Specification 21PF-1, which protects Model 30 UF_6 cylinders (Title 49, *Code of Federal Regulations*; Part 178.121, Specification 21PF-1 fire and shock resistant, phenolic - foam insulated overpack [horizontal loading]). Operational problems have developed due to both design and lack of maintenance, resulting in the entry of water into the insulation zone. Following major review of these problems, particularly those concerned with water entry and general deterioration, the design was re-examined and modified. A composite proposal for modification and supporting documentation is described in the *Proposal for Modification to USDOT 21PF-1 Fire and Shock Resistant Phenolic Foam - Insulated Overpacks*, C. R. Barlow, et. al., Martin Marietta Energy Systems, Inc., 1986. The proposal was submitted to USDOT by the U.S. Department of Energy (USDOE) as a petition to revise the DOT Specification for the 21PF-1. The petition was generally accepted by the USDOT, and the design changes and a final rule were published in the *Federal Register* on September 20, 1988.

HISTORY

The family of UF_6 overpacks utilizing phenolic foam insulation were developed in the 1960's at the Oak Ridge Gaseous Diffusion Plant* (ORGDP), for the U.S. Atomic Energy Commission, predecessor to the USDOE. In order to meet the demand for enriched U-235 for the world's

* Operated by Martin Marietta Energy Systems, Inc., for the U.S. Department of Energy.

nuclear power plants, the DOT Specification 21PF-1 became the universal packaging standard for meeting the domestic and international regulations for safe transport of UF₆ from the enriching plants. It is estimated that several thousands of these overpacks were fabricated and have been transported internationally. Although a few incidents had occurred earlier, three incidents within the United States resulted in radiological assistance calls to the USDOE after liquid was observed dripping from the overpacks. The USDOE and the gaseous diffusion plants at Oak Ridge, TN; Portsmouth, OH; and Paducah, KY, initiated actions to prevent recurrence. These actions culminated in the modification proposal, which also includes a drying procedure developed by Nuclear Containers, Inc., Elizabethton, TN, for those existing overpacks with water in the insulation. Overpack owners were also encouraged to enhance their procedures for inspection and maintenance. The latter resulted in the scrapping of many overpacks not deemed to be in proper condition for transport.

MODIFICATIONS TO U.S. DEPARTMENT OF TRANSPORTATION SPECIFICATION 21PF-1 OVERPACKS

The modifications of the 21PF-1 overpack are designed to upgrade and enhance previously fabricated overpacks, to ensure regulatory protection to the contained cylinders of UF₆, and to minimize routine maintenance for new overpacks.

Required Modifications

The modifications required by the USDOT for existing overpacks fabricated prior to April 1, 1989, and the requirements for structural integrity for those overpacks fabricated subsequent to that date are as follows:

Existing Overpacks

The exiting 21PF-1 overpacks must be thoroughly inspected prior to initiating modifications and to assure that the moisture content of the phenolic foam insulation is sufficiently low. A drying procedure to remove absorbed waste has been developed. Tests, such as those described in the composite proposal, verify that the dried phenolic foam provides an appropriate level of protection.

Modifications to the existing 21PF-1 overpacks include:

1. Covering the lower step joint with carbon steel which is continuously welded to the inner and outer skins of the overpack. Painting the step joint with intumescent paint. See Fig. 1.
2. Installing two one-piece molded gaskets made of Silastic E RTV rubber.

3. Drilling holes in the longitudinal stiffener angles.
4. Providing specifications for welding and corrosion repair.
5. Sealing joints between stiffeners and the outer shell.
6. Covering vent holes in the outer shell with plastic plugs.
7. Detailed instructions for weighing.
8. These overpacks will be designated as "DOT Specification 21PF-1A."

A 2-year period for implementing the modifications to existing overpacks is authorized. All existing overpacks must be modified to conform to USDOT Specification 21PF-1A requirements prior to April 1, 1991, in order to remain in service.

New Overpacks

Modifications to 21PF-1 overpacks fabricated in the future include:

1. Changing wood materials from hard or sugar maple to white oak.
2. Changing metal parts from carbon steel to stainless steel, Type 304-L for sheet, plate, angle, and flat bar and to 300 series for other parts.
3. Specifying welds as continuous, full penetration.
4. Reversing the step joint with the step being upward from outside to inside and covering both upper and lower joints with steel. Painting step joint with intumescent paint. Step joint closure with metal-to-metal contact at outer step. See Fig. 2.
5. Replacing gaskets by single one-piece molded gasket made of Silastic E RTV rubber.
6. Adding detailed instructions for weighing.
7. These overpacks will be designated as "DOT Specification 21PF-1B."

PROPOSED AMENDMENTS TO USDOT REGULATION-NOT ACCEPTED

The USDOE also proposed the following mandatory requirements as amendments to the USDOT Transport Regulations, which were not accepted:

1. A 5-year recertification of USDOT Specification 21PF-1A and 1B overpacks beginning after modification or initial fabrication, as applicable.

2. A mandatory, approved quality assurance program for all persons modifying, fabricating, recertifying or making repairs to USDOT Specification 21PF-1, 1A or 1B overpacks.

The USDOT did not incorporate these requests into the final rule "because the public was not provided an opportunity to comment." The USDOT has indicated that these proposals may be addressed in future rule-making actions.

CONCLUSIONS

1. The USDOT Specification 21PF-1 overpack has been the "work horse" for transport of slightly enriched UF₆. Design deficiencies and lack of maintenance have resulted in the entry of water into the insulation and deterioration of the overpacks, which have created problems in transport. The proposed design modifications should enhance the safe transport of slightly enriched UF₆ and greatly extend the useful lives of the DOT Specification 21PF-1 overpacks.
2. The possibility of problems developing in the future, which can affect transportation safety due to overpack deterioration from the lack of maintenance and the lack of a quality assurance program will continue to exist.

RECOMMENDATIONS

It is strongly recommended that:

1. The USDOE and the USDOT carry to fruition the previously proposed mandatory requirements for a 5-year recertification for USDOT Specification 21PF-1A and 1B overpacks, and an approved quality assurance program for persons modifying, fabricating, recertifying or making repairs to USDOT Specification 21PF-1, 1A and 1B overpacks.
2. Recommendation No. 1 be extended to all USDOT Specification Packages used for transport of radioactive materials in greater than A₂ quantities.

REFERENCES

Title 49, *Code of Federal Regulations*, 178.121, Specification 21PF Fire and Shock Resistant Phenolic - Foam Insulated Metal Overpack.

Federal Register; Vol. 53, No. 182; Docket No. HM-190; Modifications to DOT Specification 21PF-1 Overpacks (September 20, 1988).

Barlow, C. R., et. al., *Proposal for Modifications to U.S. Department of Transportation Specification 21PF-1 Fire and Shock Resistant Phenolic Foam Insulated Metal Overpacks*, Report K/SS-471, Martin Marietta Energy Systems, Inc., Oak Ridge, TN 37831 (1986).

Figure 1

**MODIFICATIONS TO EXISTING DOT 21PF-1
OVERPACKS DESIGNATED "DOT 21PF-1A"**

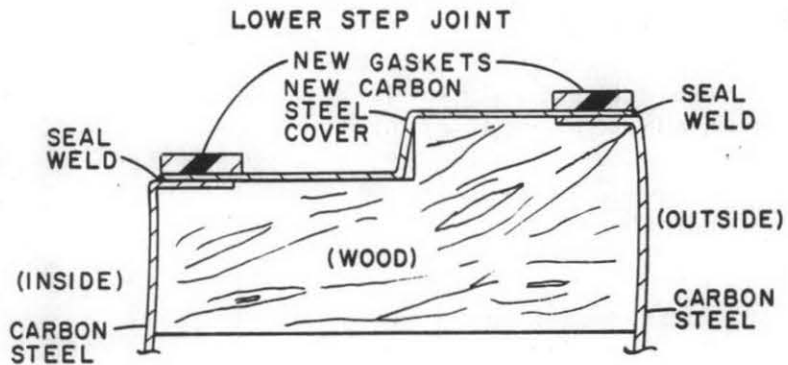


Figure 2

**MODIFICATIONS TO NEW DOT 21PF-1
OVERPACKS DESIGNATED "DOT 21PF-1B"**

