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M. J. Tyacke; A. L. Ayers, Jr.; L. J. Ball;
A. A. Anselmo

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DISCLAIMER

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M. J. Tyacke, A. L. Ayers, Jr.
A. A. Anselmo
EG&G Idaho, Inc.
Idaho National Engineering Laboratory
Idaho Falls, Idaho 83415

L. J. Ball
EG&G Idaho, Inc.
Idaho National Engineering Laboratory
Middletown, Pennsylvania 17057

ABSTRACT

This paper describes the NuPac 125-B cask system (i.e., cask and railcar), and the maintenance and inspection requirements for that system. The paper discusses the operations being done to satisfy those requirements and how, in some cases, it has been efficient for the operations to be more rigorous than the requirements. Finally, this paper discusses the experiences gained from those operations and how specific hardware and procedural enhancements have resulted in a reliable and continuous shipping campaign.

INTRODUCTION

EG&G Idaho, Inc., acting on behalf of the U.S. Department of Energy (DOE), is responsible for accepting core debris from Three Mile Island-Unit 2 (TMI-2) operated by GPU Nuclear Corporation, and transporting it from Three Mile Island (TMI) near Harrisburg, PA, to the Idaho National Engineering Laboratory (INEL) near Idaho Falls, ID. EG&G Idaho, Inc. also is responsible for placing the debris in storage and monitoring the debris. Transportation of the debris is being accomplished using three Model 125-B Rail Cask systems, which were designed and fabricated by Nuclear Packaging, Inc. (NuPac) and certified for transporting the TMI-2 core by the U.S. Nuclear Regulatory Commission (NRC). Shipments were initiated in July 1986, and through December 1987, twenty-two cask loads have been delivered to the INEL. That represents about one-half of the projected core volume.

Inspection and maintenance activities have been established for both the transport package and the railcar. Minimum maintenance requirements for the transport package are set forth in the Safety Analysis Report (SAR) for the package and issued by the NRC as a condition of the package certification. Maintenance of the railcar is set up to satisfy the Association of American Railroads (AAR) requirements for interchange service. The actual inspection and maintenance activities are performed by several organizations. Maintenance of the transport package is performed primarily by GPU Nuclear at TMI in conjunction with the cask loading operations, and, to a lesser extent, by

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EG&G Idaho, Inc. at INEL, in conjunction with the cask unloading operations. Union Pacific Railroad (UPRR) is performing the railcar maintenance at its car maintenance facility located in Pocatello, ID.

The experience gained from the inspection and maintenance effort is of particular significance because it relates how the cask and railcar requirements are actually being accomplished. In some cases the activities are much more rigorous than those normally thought required in implementing similar transport actions. The experience gained is discussed in the following sections.

RAIL CASK MAINTENANCE

Package Description

The NuPac 125-B package is a double-containment cask system with separate and independent inner and outer "leaktight" vessels (see Fig. 1). Each vessel uses a double O-ring male/female seal arrangement designed into the bore of the vessel opening. The lid for each vessel contains ports for venting the vessel, for testing the region between the O-rings on the lid seal, and for containing a rupture disc pressure relief assembly. The inner vessel contains seven canister cavities, with one cavity in the center and six clustered around the periphery. The assembled vessel also includes radiation shield plugs in the upper end of each canister cavity and passive impact limiter subassemblies at both the bottom and the top of each cavity. The shield plugs allow "hands on" installation and testing of the lid. The impact limiters are designed to limit axial loading of the core debris canisters in the unlikely event of a severe dynamic transport incident. The lower impact limiters are separate subassemblies. The upper impact limiters are integral with the shield plugs.

The outer vessel is a composite stainless steel and lead assembly which envelops the inner vessel. It incorporates three sets of heavy trunnions. Two sets are used for support of the cask assembly in its transport skid and the third for rotating the cask from the horizontal to the vertical in its skid and for lifting the cask from the skid.

The cask system incorporates large-diameter foam-filled overpacks attached at each end of the outer vessel, which gives the package the distinctive "dumbbell" appearance. Each system also includes a transport skid, which functions as a multipurpose support system for the assembled package.

Cask Maintenance Requirements

The certification by NRC for the cask stipulates the items requiring maintenance (1). Those items requiring regular attention, (i.e., in conjunction with each use) and the actions required, are as follows:

Fasteners--Inspect for general overall condition and for stripped or damaged threads before each use. Damaged fasteners shall be replaced.

Overpacks--Inspect for shipping damage and for stripped or damaged threads at the attachment points. A plastic pipe plug on the end of each overpack shall be inspected for damage, and replaced if necessary.

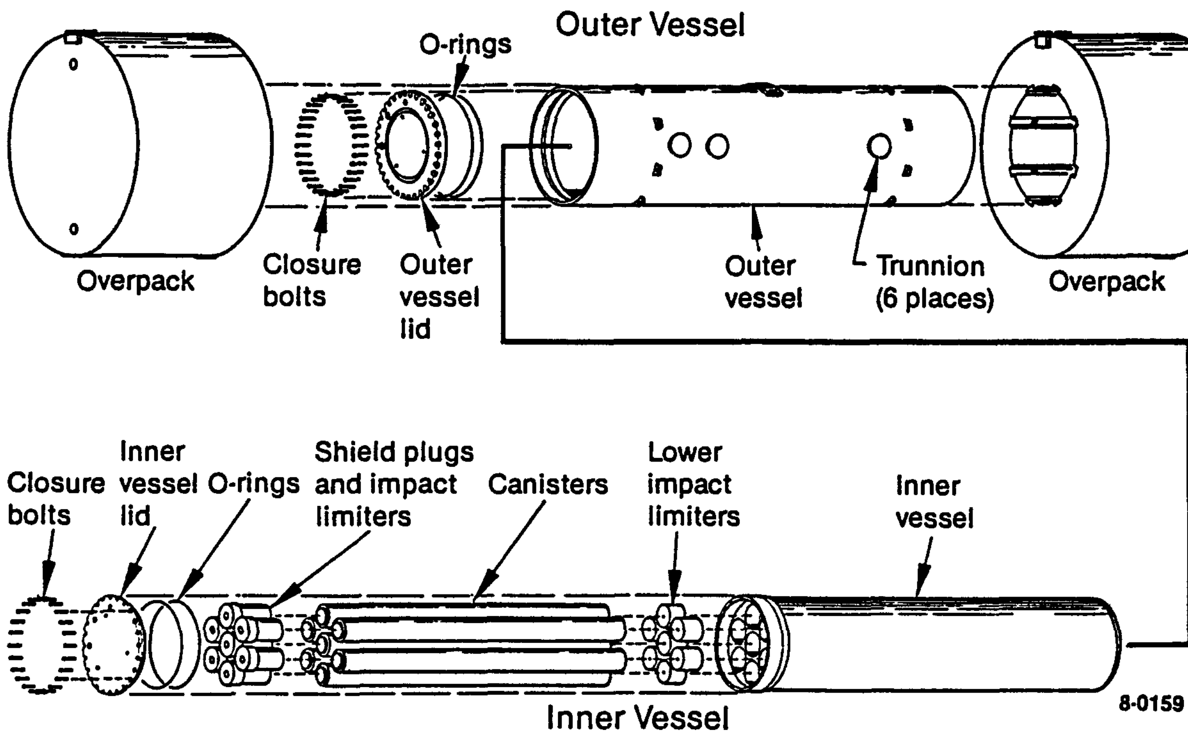

Figure 1. Exploded view of the NuPac 125-B rail cask.

Trunnions--Inspect the trunnion bearing surfaces for excessive wear, signs of galling, or distortion.

Seals--Inspect the surfaces of all seals for tears, nicks, or cuts. Damaged seals shall be replaced.

Those items requiring periodic maintenance and the actions required are as follows:

Fasteners--Fasteners (inner and outer vessel lid bolts and overpack attachment bolts) shall be replaced when damaged or, as a minimum, every five years.

Seals--Seals shall be replaced annually or when damaged. In conjunction with seal replacement, sealing surfaces and O-ring grooves shall be inspected for damaging burrs or scratches.

Rupture Discs--The rupture discs for the inner and outer vessel lids shall be replaced annually or when damaged.

Inner Impact Limiters--The inner vessel impact limiters shall be inspected annually for damage to the external skins and for axial deformations in excess of 10%. Skin damage shall be corrected before further use and permanent axial deformations in excess of 10% shall constitute need for replacement of the impact limiter.

Cask Operations and Maintenance

The actual maintenance on the cask is more involved than implied by the requirements. GPU Nuclear has implemented the following procedures in preparation for each shipment: decontaminating the cask inner vessel internal surfaces, including the impact limiters and underside of the inner vessel lid; replacing the lid seals; inspecting and repairing the internal impact limiters, as required. EG&G Idaho, Inc. has also implemented procedures for removing residual water remaining in the canister cavities of the inner vessel after unloading the cask and for inspecting the cask trunnions. Those activities require careful consideration when planning a shipping campaign of this type.

Some background information about the TMI-2 shipments is necessary to understand the maintenance operations. First, each cask is covered during shipment with a reinforced vinyl tarp, referred to as the "environmental cover." The cover keeps the package and skid clean during transport, particularly during the winter. Second, each cask is both loaded and unloaded using dry operations. Specially designed cask interface and canister transfer equipment is used for loading operations at TMI and a large hot shop facility is used for unloading operations at INEL. Those operations have confined package contamination to interior surfaces of the inner vessel, shield plugs, and internal impact limiters. Finally, each cask and transport skid is removed from the railcar both at TMI (loading) and the INEL (unloading). Upon receipt at both locations, the rail cask is inspected for shipping damage. The environmental cover and overpacks are then removed. At TMI, the railcar is moved into the Fuel Handling Building where the cask and transport skid are removed from the railcar and the car is removed from the building. At INEL, the cask and transport skid are moved from the railcar to a tractor/trailer transporter system for transport to the hot shop. The environmental covers, overpacks, and overpack attachment bolts are inspected at both locations subsequent to the removal operations.

Maintenance at TMI begins after the cask has been moved into the Fuel Handling Building, uprighted in the skid, anchored in place, and a movable work stand placed around the cask. Lids of the cask are removed, the inner vessel lid is surveyed for contamination, and the lid is decontaminated. Shield plugs and impact limiters are removed from the inner vessel. The interior of the vessel is decontaminated using hot water, followed by a forced air drying cycle. The seal surfaces on the inner and outer vessels are cleaned and inspected. The impact limiters are decontaminated and inspected for evidence of axial deformation and damage to the skins. It should be noted that the impact limiters have required extensive maintenance because of their construction. A more detailed discussion of this is found in the "Maintenance Experiences" section. O-rings and vent port seals are removed and sealing surfaces and O-ring grooves cleaned and inspected. The surfaces are relubricated and new seals installed. If required, the rupture discs are replaced and leak tested. Lid bolts are cleaned and visually inspected. The impact limiters and shield plugs are reinstalled in the inner vessel. The cask is then prepared for canister loading.

After the cask is loaded, each lid is installed and seals air-tested for leakage. The package certification requires each containment be leaktight, [i.e., leakage not to exceed 1×10^{-7} atm-cc/s of gas at a pressure differential of 1 atm across the pressure boundary (a bubble about the size of a Ping-Pong ball per year)]. NuPac provided two leak-test systems for the package. The first, a helium mass spectrometer leak detection system, is used for "maintenance verification" leak testing and has a sensitivity in the 10^{-7} to 10^{-9} atm-cc/s range. The second, a less sensitive "pressure rise" system, was intended as a "go/no-go" test for "assembly verification" of the seals during normal operations in the periods between seal maintenance and replacement. Since GPU Nuclear replaces the seals after each shipment, the second system is not used and a maintenance verification leak test is performed before each shipment. The helium leak detection system is also used to verify rupture disc integrity after new discs are installed.

The cask inspection and maintenance at INEL begin after the cask has been transported to the hot shop, uprighted and lifted from the skid, and placed in a stationary workstand. Once the cask is in the stand, the lids are removed, set aside, and protected. The lid bolts are cleaned, inspected, and set aside. Plastic rings are installed in the cask vessels to protect seal surfaces and plastic is draped over the top and sides of the cask to reduce possible contamination. The hot shop is then cleared of operating personnel and the canisters are withdrawn remotely from the cask and placed in storage.

After the cask is unloaded, cleanup activities are initiated prior to cask assembly. Even though the casks are dry loaded at TMI, the canister surfaces are not completely dry after removal from the storage pool and some water is carried into the cask. The shield plugs and lower impact limiters are removed from each canister cavity and the residual water is removed using absorbent rags on the end of a long rod. Radiological smears are obtained from each cavity to determine if the contamination levels are below the requirements for return shipment of an empty cask. If required, individual cavities will be decontaminated. The impact limiters and shield plugs are wiped and reinstalled into the cask. The plastic covers are removed, seals and seal surfaces inspected, and the lids installed. The upper two pairs of trunnions are inspected. The lower set of trunnions each have a split sleeve bearing and housing installed over the trunnion bearing surface. These bearing assemblies are removed for inspections semiannually.

RAILCAR MAINTENANCE

Railcar Description

The railcars are 149.7 metric ton (165 ton) rated flat deck cars. Figure 2 is a photograph of an assembled rail cask system with callouts added to identify the major subassemblies. As shown in the photograph, each end of the flat deck body interfaces with a "span bolster" assembly. The span bolster is a heavy frame assembly which distributes the load at each end of the car body equally between two "truck" assemblies and articulates the movements between the car body, trucks, and coupler. Each truck assembly distributes its load equally between two axles, so that ultimately, the load from the railcar and cask assembly are distributed between two span bolsters, four trucks, eight axles, and sixteen wheels. To understand the maintenance on the railcar, special features of several railcar subassemblies are described as follows:

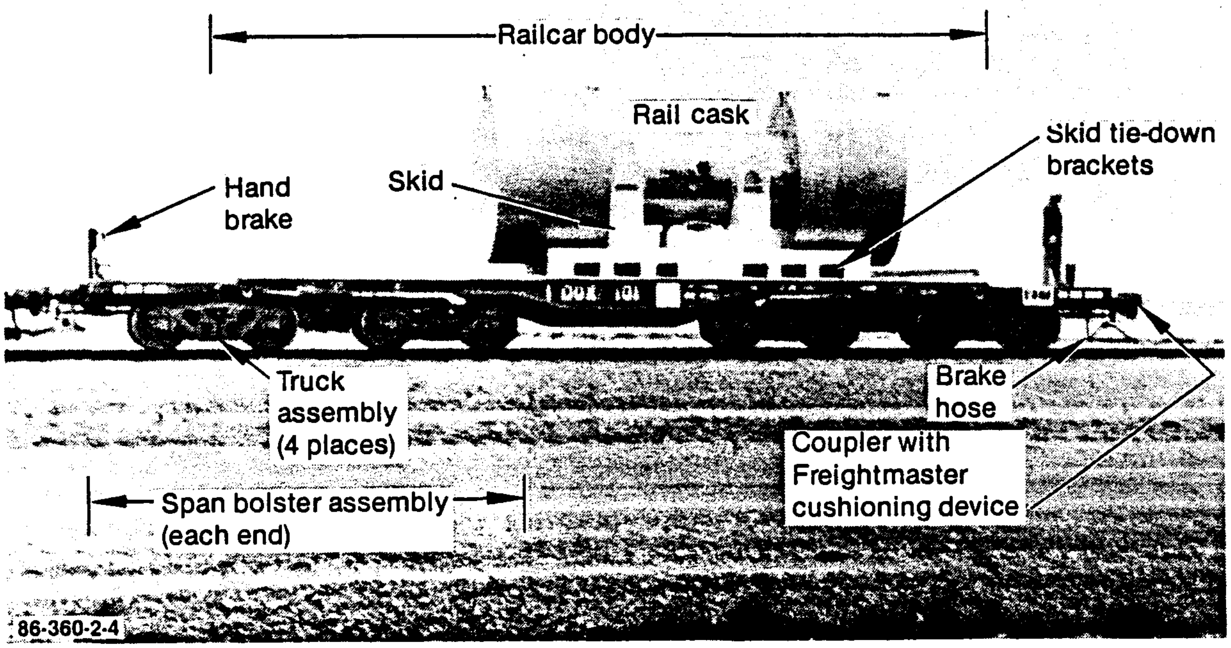

Figure 2. The NuPac 125-B transport package with railcar.

Car Body--The underside of each end of the car body has a thick circular plate, known as the "center plate," welded into the the body structure. That plate serves as the connecting pin between the body and the span bolster. Outboard from each center plate, (i.e., toward the sides of the car), are small rectangular "wear plates" welded to the body under-structure which mate with similar plates on top of the span bolster. Those mating pairs of plates are known as "side bearings," and they function to limit tilt of the car body relative to the span bolster. When the car is level, there is a specified clearance between the surfaces of the side bearing wear plates.

Span Bolster--The receptacle in the span bolster which interfaces with the car body center plate is known as the "center bowl." The mating surfaces of the center plate are surface hardened, so the center bowl is lined with a "wear ring" around its vertical bore and with a wear plate in the bottom of the bowl. A heavy lubricant is applied to the wear plate to provide a bearing material in the assembled connection. The underside of the span bolster at the interface with each rail truck is similar to the car body configuration (i.e., center plate and side bearings).

The frame of the span bolster is extended at one end to provide an interface with the railcar coupler system. The span-bolster frame is built to accommodate a "Freightmaster" drawbar cushioning device and the Freightmaster unit, in turn, accepts a standard railcar coupler unit.

Rail Trucks--The structures on the outboard sides of each truck assembly are called "side frames." The side frames interface with the roller bearing housings on the ends of each axle and with a structural cross-member running across the center of the truck, known as the "truck bolster." The truck bolster interfaces with each side frame through a set of linear guides and the rail truck spring assemblies. Each truck bolster contains a center bowl for the respective span bolster center plate and there are side bearings to limit the tilt of the span bolster relative to the truck. The truck assemblies also contain all the mechanisms, linkages, and air cylinders necessary for the brakes, which interface with each wheel.

Railcar Maintenance and Inspection Requirements

EG&G Idaho, Inc. and UPRR established two railcar inspection checklists. The first is used by the UPRR inspector for inspections at INEL before accepting the cars for return to TMI. The second details the inspections and preventive maintenance performed by UPRR at its car maintenance facility in Pocatello, ID. All items on both checklists either meet or are more restrictive than the requirements set forth in the Field Manual of the Interchange Rules, 1987, adopted by the AAR Mechanical Division Operations and Maintenance Department (2). Three items which are more restrictive than the AAR requirements are: (a) replacement of the brake shoes if there are signs of wear, (i.e., cracks or half of the brake material thickness has been used); (b) average clearances of side bearing for each of the four rail truck bolsters must be between 0.48 and 0.64 cm (3/16 and 1/4 in.); and (c) magniflux of wheel tread for signs of thermal cracking [each set of wheels (axles) is rotated about every 80,500 km (50,000 mi) to ensure uniform wear of tread].

The following is a summary of the detailed inspection and preventive maintenance checklist performed at the maintenance shop of UPRR. The AAR Rules followed for acceptance are included, where appropriate. An explanation of those rules can be found in Reference 2.

Coupler Assembly--Check couplers and knuckles for worn or distorted contour (AAR Rule 16). Ensure correct knuckle is being used (AAR Rule 16). Remove each coupler and check shank wear (Figure D of AAR Rule 16). Remove and inspect knuckle pin. Inspect draft key [condemn when worn on any side 0.64 cm (1/4 in.) or more]. Check coupler side clearance and top vertical clearance (Figure 5 of AAR Rule 16). After reassembly, check and record the coupler height from the top of rail and toggle clearance. Uncoupling mechanism must comply with AAR Rule 22. Inspect Freightmaster cushioning device (Freightmaster manual - pages 6, 7, and 8, and AAR Rule 59, Section A). Check accessible parts of Freightmaster backstop casting.

Brakes--Inspect and replace defective air brake hoses [AAR Rule 5 (Rule 5.A.1.h does not apply)]. Hoses must be changed every four years. Check air line brackets, supports, angle cocks, and piping. Inspect brake levers, brake beam, guides, rods, and pins (AAR Rules 6, 9, and 10). Perform single car air brake test (pamphlet 5039-4, Sup. 1, latest edition). Inspect brake shoes-- change when worn to 1.9 cm (3/4 in.) or less [AAR Rule 12 (does not include Rule 12.A.5)]. Inspect all brake connection pins and cotters (AAR Rule 9). Inspect all body brake rigging (AAR Rule 11). Record COT&S (Clean, Oil, Test, and Stencil) date.

Span Bolster--Inspect span and body bolsters, and center plate for cracked or broken members. Apply center plate lube. Measure the side bearing clearance at two places between the car and span bolsters at each end of the car. The average of the two clearances must be between 0.32 and 0.48 cm (1/8 and 3/16 in.). Measure the side bearing clearance at two places between each of the span bolsters and four truck bolsters. The average of the two clearances must be between 0.48 and 0.64 cm (3/16 and 1/4 in.).

Truck Assembly--Inspect truck bolsters and side frames for worn, broken, cracked, bent, patched, or corroded parts (AAR Rules 47 and 48). Check wheels for visual damage. Inspect and gage wheels and condemn at 2.7 cm (1-1/16 in.), [AAR Rule 41 [Rule 41.A1.a does not apply)]. All wheel treads will be magnifluxed, UPRR specification. Each roller bearing shall be hand rotated and inspected for damage, unusual feel, or sound (applicable sections of AAR Rule 36). Inspect roller bearing adapters (AAR Rule 37). Check for broken, missing or out of position truck springs and snubbers. Measure and record minimum clearance between lowest point of truck and top of rail (must comply with AAR Rule 88A12).

Car Body--Inspect car body side and center sills and crossbearers for cracked or broken members and for cracked welds.

Remarks--The Inspector records necessary measurements, dates, and signs off after each item has been inspected. The Inspector records, dates, and signs off all repairs made to the car. A signature by the railroad inspector certifies that the railcar meets or exceeds the requirements of the AAR and is acceptable for use.

Railcar On-Site Inspection

The railcars undergo inspections before leaving TMI and INEL. Inspectors from DOT/FRA inspect the railcar at TMI. At INEL, inspectors from UPRR use the INEL checklist, certifying that the empty return shipment is acceptable. The UPRR inspectors will replace brake shoes, if required. Other defects are corrected at the UPRR maintenance facilities.

Railcar Detailed Inspection and Preventive Maintenance

The inspections and maintenance being done for the railcars are much more rigorous than would normally be anticipated. Since the cars were new at the start of the shipping campaign, EG&G Idaho, Inc. and UPRR agreed to do complete inspections and preventive maintenance after each rail cask round trip, at least until the cars were through their initial break-in periods and an operating history for each car was established. The inspections and preventive maintenance entailed a detailed tear-down inspection of each car about every 8,000 km (5,000 mi). By the end of the third trip for each car, the amount of corrective maintenance being performed had dropped and consistent operating histories were developing. UPRR and EG&G Idaho, Inc. agreed that the detailed inspections and preventive maintenance would be changed to every third round trip, or about 24,000 km (15,000 mi). The following briefly describes the activities being performed at the UPRR maintenance facilities.

In the maintenance shop, each railcar is disassembled one end at a time. The body with cask is jacked up and the span bolster with trucks is rolled out. One end of the span bolster is lifted and the respective truck is rolled out. The four brake shoes are removed and the shoe pads are inspected. Each axle is removed from the truck, and the wheels are visually inspected for damage. The width and depth of the flange of each wheel are measured. A magniflux inspection of each wheel is performed to check for thermal cracks. To provide uniform wear on the tread of the wheels, the wheels (axles) are rotated about every 80,500 km (50,000 mi). The wheel bearings and adapters are checked. The axle assembly is moved back under the truck. The adapter is placed on the roller bearing. The truck is lowered onto the axle and the assembly tie bolts installed. The date and name of maintenance yard where inspection and the wheels were rotated are stenciled on each axle. The operation is repeated for each axle.

The truck center bowl is inspected and cleaned, defects repaired, and lube disks melted inside the bowl. Finally, the safety pin (a pin extending from the center of the bowl which engages a matching bore in the span bolster center plate) is inspected for damage. The brake shoes are installed, the brake hose connected to an air supply, and the brakes are operated. The stroke of the operating cylinder is measured to ensure the brakes operating properly. The underside of the span bolster deck is inspected and if necessary repaired. The truck is then rolled back under and assembled with the span bolster. The operations are repeated on the opposite end of the span bolster.

The span bolster center bowl and wear ring are inspected, and if necessary, repaired. The lube material on the wear plate is replaced with new lubricant. The underside of the main body of the railcar deck is inspected for defects and, if necessary, repaired. The span bolster is rolled back under the main body of the railcar deck. The center plate under the railcar deck is lowered into the span bolster center bowl. Clearances on the span bolster and truck side bearings are measured, adjusted, and recorded on the checklist.

The car coupler, knuckle, operating lever, and internal parts are disassembled from the Freightmaster cushioning device. They are inspected for worn or distorted contour areas, repaired, and reassembled. The entire procedure is repeated for the opposite end of the car.

MAINTENANCE EXPERIENCES

As a result of the inspection and maintenance program performed on the NuPac 125-B Rail Casks and railcars, there were numerous improvements made to the system which reduced the maintenance efforts. The shipping campaign was initiated with two DOE-owned rail casks. A third leased cask, built and owned by NuPac, entered service in October 1987. The improvements were implemented in the third cask system and are being incorporated in the original casks. This section discusses some of those improvements.

Cask

Working experience with the following items suggests improvements are required to decrease maintenance or increase efficiency. Both the items and the solutions are discussed.

Internal Impact Limiters--The internal impact limiters use aluminum honeycomb for the energy absorption media. The honeycomb is protected from the cask internal environment by wrapping a thin (nonload bearing) stainless steel sheet around each assembly and sealing it to both the upper and lower stainless steel end pieces and along the longitudinal seam formed at the ends of the sheet. An epoxy-based industrial adhesive was used to bond these skins onto the assemblies. The adhesive joints, however, are failing and the seams require constant cleanup and repair. To correct this situation in the third cask, the skin thickness was increased slightly [from 0.01 to 0.023 cm (0.004 to 0.008 in.)] and the skins were welded in place. Replacement units are being fabricated for the original two casks.

To remove water from the cask after the canisters are unloaded at INEL, a small-diameter tube was installed through the center of each lower impact limiter. The tube allows pumping of residual water from each cavity without removing the impact limiter.

Lanyards--Small-diameter, vinyl-coated steel aircraft cables (with crimp-tie security loops) were used as lanyards to attach removal parts (i.e., pins) to the skid and railcar assemblies. The vinyl coating would break at the crimp-tie, and the tie and coating would slide over the cable, causing the lanyard loop to open. The situation was corrected by using uncoated stainless steel cables.

Overpacks--Installation of attachment bolts for the overpacks was awkward and time consuming. The bolts were long, heavy, and hard to maneuver into the blind holes in the overpacks, even though coarse bolt guides were provided over the length of the bolts. The situation was corrected by adding tapered lead-in collars around each bolt hole.

Railcar

The inspection and maintenance program for the railcars has benefitted both the campaign and UPRR. Corrective actions were taken on those items of the railcar which were identified as requiring excess maintenance. The experience gained from the first two cars resulted in changes being made to the third railcar. The following is a discussion of the items requiring excessive maintenance and the corrective actions taken.

Excessive Brake Shoe Replacement--Brake shoes were being replaced too frequently. The pads on the brake shoes cracked before wearing out. Initially it was thought that the hand brakes were being improperly released, however, the situation was not corrected after rigorous administrative controls were established. A further evaluation showed the brake shoes to be faulty. The situation has been corrected by using brake shoes from another manufacturer.

Excess Wear of the Wheel Tread--UPRR noticed there was tread buildup and excessive grooving of the wheels. Evaluation of the situation identified the following three causes and solutions. First, the new cars were "stiff" and needed a break-in period. Second, improper release of the brakes caused wheels to drag, thus causing flat spots followed by a tread buildup. Administrative controls eliminated dragging of the wheels. Third, the cars always travelled the same direction causing the wheels to become grooved. UPRR corrected this situation by adding the rotating of the wheels every 80,500 km (50,000 mi) to the preventive maintenance procedures. That action has made the tread wear uniform.

Span Bolster Center Bowl Wear Ring Cracking--The wear ring and its attachment weld to the center bowl of the span bolster were cracking. The situation was corrected by repairing and building up the welds holding the wear rings in place. If that action does not correct the situation, forged wear rings with a machined press fit into the center bowls will be installed.

Tilt of the Railcar Bed--After operating the cars on the longer maintenance schedules, the deck was developing a noticeable tilt. UPRR determined that the lube disks used in the truck center bowls were too hard and failed to compress as designed. The motion of the railcar during transport caused the disk to tear at the center pinhole. The lube material would build up on one side of the bowl, causing the bed to tilt. The disk was replaced by a lube material which is melted into the bowl.

Wheels--The first two railcars were delivered with Grade "U" wheels which accounts for the excess tread wear observed. The third railcar was delivered with Grade "C" (harder tread material) wheels. The first cars will be equipped with Grade "C" wheels as the existing wheels wear out.

CONCLUSIONS

The maintenance program implemented in the TMI shipping campaign has been effective in maintaining a reliable and continuous shipping schedule. As recognized earlier, the actual maintenance being performed is not as simple as first conceived but the results have been positive, and with experience, have become somewhat routine. Many subtle enhancements in hardware aids and operating procedures have been developed since inception of the shipping operations, which have contributed to the overall efficiency of the operations. A few of the maintenance program highlights are as follows:

Cask

Cask Decontamination--Decontamination of the casks after each shipment is a time-consuming operation but has proven to be effective in: Preventing the buildup of contamination in the casks and canister-loading equipment; minimizing the spread of contamination at both TMI and INEL, and; in keeping exposures to operating personnel (and to a lesser extent the public) as low as reasonably achievable (ALARA). Loading operations at the cask are in fact accomplished with only smocks, gloves, and shoe covers being worn as protective clothing.

Bore Seals--The bore seal design utilized in the NuPac casks has proven to be a viable and reliable seal concept. The seals and seal surfaces are easily maintained and provide consistent positive results.

Leak Testing--TMI experience has shown the helium leak-testing procedure to be an effective and timely test method for use in routine operations. It yields conclusive results and is accomplished in the same or less time than the less sensitive and qualitative pressure rise test method. This is not intuitively obvious when first considering methods for testing seal integrity.

Railcar

UPRR has dedicated a senior and experienced maintenance crew to do the inspections and maintenance procedures on the three cask system railcars. This has been extremely beneficial for both parties (i.e., the same persons performing the maintenance are "tuned in" to the trends and characteristics developing in each of the cars and the maintenance is performed consistently and in a timely manner). All inspections, maintenance, and necessary repairs are normally accomplished in one day and in a single shift. Highlights of the maintenance program are:

Longer Wheel Life--Early identification of excess wheel wear resulted in timely procedures to greatly extend the useful wheel life for the cars. Administrative controls corrected the improper release of the hand brakes. Also, the need for a harder grade of wheel was factored into the requirements for the third railcar.

Brake Shoes--The consistency of the maintenance program allowed a thorough evaluation of the premature brake shoe replacement situation, which ultimately led to identifying the use of faulty brake shoes. Union Pacific has notified the brake shoe manufacturer and has changed suppliers for replacement brake shoes.

REFERENCES

1. U.S. Nuclear Regulatory Commission, Certificate of Conformance No. 9200, Revision No. 4, for Model No. 125-B Shipping Package, Docket No. 71-9200, October 28, 1987.

2. Association of American Railroads - Mechanical Division Operations and Maintenance Department, Field Manual Of The Interchange Rules, effective January 1, 1987.