SPECIAL FLEET MAINTENANCE FUNCTIONS, REQUIREMENTS, AND FACILITY CONCEPTS FOR AAR-2043 RAILCARS*

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In Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States,[1] the National Academy of Science concluded that using mostly the rail transportation mode including the use of dedicated trains for spent nuclear fuel (SNF) and high level radioactive waste transportation has advantages when compared to barge and road transport modes., Current planning efforts are focused on having the majority of future SNF transport be performed by rail. The federal government and the railroads have been working on acceptable approaches to transporting SNF and high-level radioactive waste for decades, The current car construction standards applicable to freight cars and consists used to move SNF is AAR Standard S-2043.

The maintenance and operations requirements associated with a fleet of transportation cask railcars, buffer cars, and escort cars will conform to AAR Standard S-2043; these requirements will impact the design of a fleet maintenance facility.

I. INTRODUCTION

The Nuclear Fuel Storage and Transportation Planning Project (NFST) is evaluating concepts for an integrated commercial used fuel management system leading towards a final spent nuclear fuel (SNF) disposition path. An integrated system would account for the current and expected near-term practices for handling and storing SNF at utilities in used fuel pools and large canister dry storage systems, as well as the prospect of ultimate disposal of the SNF in repository systems that may be able to accommodate SNF in its present dry storage configuration.[1]

[1] Pursuant to the Standard Contract, the U.S. Government will only accept bare used nuclear fuel (10 CFR 961.11, Article VI.A.1.(a)). A modification of the Standard Contract would have to be agreed to in order for the U.S. Government to accept used nuclear fuel in dual-purpose canisters. The potential impacts of this provision of the Standard Contract were not factored into this report.

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The federal government and the railroads have been working on acceptable approaches to transporting SNF and high-level radioactive waste for decades The current car construction standard applicable to freight cars and consists used to move SNF is the Association of American Railroads (AAR) Standard S-2043, which is contained in AAR Manual of Standards and Recommended Practices Section C, Car Construction–Fundamentals and Details.[3] Rail cars used by DOE to transport SNF that will be designed and built to meet AAR Standard S-2043.

In addition to providing car construction and performance standards, AAR Standard S-2043 provides extensive and specific requirements for the maintenance of these rail cars in Appendix A, "Maintenance Standards and Recommended Practices for Trains Used to Carry High-Level Radioactive Material," and operations requirements are provided in Appendix B, "Operating Standards for Trains Used to Carry High-Level Radioactive Materials." Maintenance of the rail cars that make up an S-2043 compliant consist will require activities that would be considered usual for rail cars, as well as many activities that are specific to maintaining compliance with S-2043. In addition to planned maintenance, S-2043 provides requirements for monitoring car performance, and it specifies maintenance information for operators.

Routine efficient shipment of SNF via rail will require the maintenance of the rail cars that will make up the SNF transport fleet. No decision has been made on the specific configuration of such a fleet maintenance facility (FMF). The maintenance and operations requirements associated with a fleet of transportation cask railcars, buffer cars, and escort cars will conform to AAR Standard S-2043; these requirements will impact the design of an FMF.

II. DISCUSSION

The primary mission of the FMF will be to maintain the rail rolling stock other than locomotives required to transport SNF. . Equipment will be maintained on the basis of the AAR Field Manual and the AAR Office Manual, as well as AAR Standard S-2043, Appendices A and B. To support the primary mission, the FMF will require the following:

- An all-weather repair area with jacking and other equipment and sufficient capacity necessary to handle various cars in the consist, particularly the cask cars;
- Yard facilities large enough to hold, at a minimum, the cars waiting for repair; facilities may be required to accommodate the entire car fleet at once which could be on the order of 100 or more cars;
- Yard equipment (e.g., switch engines or similar motive power) needed to move and marshal cars into and out of the repair facility;
- Storage area for the material and parts needed to perform maintenance activities, as well as administrative, physical plant, waste and operation support center activities.

There are several areas for which S-2043 will present technical challenges not normally associated with freight car maintenance. The challenges fall into three general areas:

- Ensuring that maintenance staff are skilled in maintaining systems or equipment not associated with standard freight cars,
- Establishing quality assurance systems and processes to ensure compliance with S-2043 maintenance requirements, and
- Providing maintenance support and response for consists that report maintenance issues from the field.

II.A. Car Construction

Specific requirements of car construction will make maintenance of S-2043–compliant rail cars unlike either cargo or passenger cars. The cask cars will be required to transport SNF packages that weigh well over 100 metric tons while having a highly compliant suspension. The types of suspension construction needed to meet the S-2043 performance requirements for Perturbed Track and Special Cases are typically found on passenger cars, not freight cars. These complex suspensions that will be needed to meet the S-2043 performance requirements will also require a shop crew versed in inspecting and repairing suspension systems that are more complicated than the standard cargo rail car.

Other construction details of the cars related to ensuring that all components remain attached are also unusual for cargo cars. Specifically, trucks and wheel sets must remain attached to the car during a derailment. On typical cargo cars, these components are not positively attached to the car, but they rely on the weight of the car to remain attached. In a maintenance setting, the requirement for positive attachment of truck and wheel components necessitates a more robust, secure car hoisting or jacking system to provide workers safe access to remove the positive attachment hardware during wheel set and truck maintenance tasks.

Extensive on-board performance monitoring requirements will be in place for all cars in an SNF consist. The system that produces the required measurements will include a variety of sensors, an on-board network for signal transmission, and an on-board nonvolatile storage system. In addition, there may be an off-train data transmission system if real-time off-train data storage and monitoring are required. Maintaining this level of data collection and management system is well outside the skill set for a standard cargo rail car maintenance shop and will likely require a specialized electronics shop dedicated to maintenance of these systems.

II.B Record and QA Systems

The periodic maintenance of components on rail cars in the SNF fleet is mandated to be either every 10,000 miles or based on the conditions of the components. With either approach, detailed records of maintenance and wear on components are required, necessitating development and implementation of a robust documentation process for all cars in the SNF fleet, as well as all components used in the maintenance and repair of those cars. Not only will this system need to robustly store records, but it also must make historic performance data quickly and easily available to meet the operating requirements for real-time analysis of any faults reported by the monitoring system.

When implementing a mileage-based approach to scheduling periodic maintenance, S-2043 requires owners to keep records showing when cars and components were maintained and what progressive wear is occurring at each maintenance interval. If a conditions-based approach is used, a process to collect and analyze data gathered from wayside and on-board monitoring systems will be implemented. Finally, the on-board performance data must be stored, managed and accessed.

As prohibited by S-2043, several critical components may not be used or reconditioned. The FMF will be required to develop a supplier inspection program to verify that vendors are only providing new components. In addition, the FMF will require processes to ensure that any components on this list that are taken out of service do not find their way back onto other cars during maintenance.

II.C Supporting Operations and Fault Remediation

S-2043 requires that the car owner (likely via the FMF) must provide rapid analysis of reported problems

once a consist is in the field. If the performance data that are required to generate either a warning or stop signal in the locomotive cab are out of tolerance, the car owner is required to provide real-time analysis of the fault that made the indicator light come on. In order to ensure that this requirement is met, performance data from the consist must be available for analysis of the fault. Meeting such a support requirement means that data will likely be transmitted off-train to a central monitoring facility, likely the FMF, where the staff can provide skilled analysis of performance and fault data.

III. CONCLUSIONS

A number of issues will make operation of the FMF technically challenging:

- The fleet will be comprised of an extremely diverse set of cars, ranging from heavy cask cars with highly compliant suspension systems to cars reminiscent of passenger carriages.
- S-2043, Sections 4.1.7.1 and 4.1.7.2, address crash worthiness; these requirements may be typical for passenger cars, but they are not usually seen in freight cars.
- The on-board monitoring systems required to meet S-2043 Section 4.5 are unique to these rail cars and will require skills, tools, and facilities that are uncommon in the commercial maintenance market.
- Because reconditioning and reuse of railcar components is routine in the rail industry, requiring new components for certain critical systems on these rail cars will pose a quality control challenge; ensuring that only new components are used on the S-2043 rail cars will require particular vigilance.
- The requirement for the car owner to provide safety analysis and information in near real time to train crews in the case of a "stop" or "warning" fault and to inspectors prior to loaded train movement will most likely mandate routine and continuous transfer of maintenance records from the commercial contractor to the entity within the SNF transport system responsible for meeting these requirements.

The primary challenges for maintaining the SNF rail car fleet will be requiring that staff members be trained on the specifics of these unique rail cars and the processes needed to meet the S 2043 requirements for maintenance and operations support.

The physical plant and staffing levels required to provide support for the SNF rail transportation fleet will be relatively modest. The structures and a small amount of parking and tracking for standing rail cars awaiting repair or dispatch back to storage will occupy about 5 to 7 acres of level land. The required construction for buildings is technically uncomplicated; essentially the majority of square footage is for large high-bay areas, with some support space for offices, break rooms, and changing rooms.

Most physical structures (with the possible exception of a second rail maintenance bay) will be required for initial operation and can support the entire fleet. The capital cost for a maintenance facility is essentially an all-or-none proposition, with no fiscal advantage for modular design or multiple FMF locations. If there are operational advantages to having multiple FMFs, those advantages may become apparent as the overall transport system operations are more fully defined.

REFERENCES

1. "Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States," Committee on Transportation of Radioactive Waste, National Research Council (2006).
2. United Sates Department of Energy and Department of Defense v. Aberdeen & Rockfish Railroad Company et al. (2012).
3. "Performance Specification for Trains Used to Carry High-Level Radioactive Material," AAR Manual of Standards and Recommended Practices Car Construction Fundamentals and Details, Standard S-2043, (2011).