Development of a Draft Safety Inspection Protocol for Rail Shipments of Spent Nuclear Fuel – 22108

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ABSTRACT
In the United States (US), State and Tribal governments have the primary responsibility for the safety of the public within their jurisdictions. Therefore, when the US government transports hazardous materials such as spent nuclear fuel (SNF), States and Tribal governments expect a level of involvement in planning and ensuring safety of shipments. The paper discusses the development of a Draft Railcar Safety Inspection Protocol to support future US Department of Energy (DOE) large-scale transport of commercial SNF by rail.

INTRODUCTION[1]
Under the Nuclear Waste Policy Act of 1982, as amended [1], the US Department of Energy (DOE) is responsible for the disposal of commercial spent nuclear fuel (SNF) and high-level radioactive waste (HLW). DOE is also responsible for the transport of the SNF and/or HLW to a disposition site. Despite uncertainty as to the disposition site, DOE continues to conduct analyses and planning in support of fulfilling its obligation to transport the SNF and/or HLW. In the 1980s, DOE funded the Commercial Vehicle Safety Alliance (CVSA) to develop a safety inspection protocol [2] for trucks transporting highway route controlled quantities of radioactive materials (e.g., SNF and HLW). Now known as a CVSA Level VI inspection, this safety inspection protocol [2] has been incorporated into regulations by the US Department of Transportation (DOT) for truck shipments of highway route controlled quantities of radioactive materials. Because highways are public infrastructure in the US, a State or Native American Tribal (Tribe) law enforcement officer typically has authority to conduct an inspection of a motor vehicle traveling by highway in their jurisdiction. For DOE radioactive materials highway shipments, such inspections are typically conducted at State or Tribal jurisdictional borders. Due to the size and weight of SNF transport casks, it is expected that the primary mode for large-scale transport of commercial SNF will be rail. Rail infrastructure in the US is privately owned and regulated at the federal government level, with some regulatory roles delegated to State governments, and States and Tribes generally do not have the authority to conduct rail safety inspections at jurisdictional borders. This Draft Railcar Safety Inspection Protocol (Draft Inspection Protocol) is being developed to serve as a rail analogue for the CVSA Level VI truck inspections in support of future DOE large-scale transport of commercial SNF and HLW by rail. The development of the Draft Inspection Protocol is expected to be an ongoing, iterative process, with additional information expected to be added in the future.

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[1] This is a technical paper that does not take into account contractual limitations or obligations under the Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste (Standard Contract) (10 CFR Part 961). For example, under the provisions of the Standard Contract, spent nuclear fuel in multi-assembly canisters is not an acceptable waste form, absent a mutually agreed to contract amendment.
To the extent discussions or recommendations in this paper conflict with the provisions of the Standard Contract, the Standard Contract governs the obligations of the parties, and this paper in no manner supersedes, overrides, or amends the Standard Contract.
This paper reflects technical work which could support future decision making by the US Department of Energy (DOE or Department). No inferences should be drawn from this paper regarding future actions by DOE, which are limited both by the terms of the Standard Contract and Congressional appropriations for the Department to fulfil its obligations under the Nuclear Waste Policy Act including licensing and construction of a spent nuclear fuel repository.

This paper discusses the current version of the Draft Inspection Protocol, dated June 11, 2021.

Inspection reports generated during inspections conducted by the US Federal Railroad Administration (FRA), States, and rail carriers are generally not shared with other States or Tribes, and are often viewed as confidential or proprietary. The lack of sharing of the inspection reports with States or Tribes along transportation routes presents a significant obstacle to inspection reciprocity.

This Draft Inspection Protocol is being developed in coordination with DOE's National Transportation Stakeholders Forum's Spent Nuclear Fuel Rail/Routing Ad Hoc Working Group. The National Transportation Stakeholders Forum (NTSF) is the mechanism through which DOE communicates at a national level with States and Tribes about DOE shipments of radioactive waste and materials, as well as occasional high-visibility shipments that are nonradioactive. The purpose of the NTSF is to bring transparency, openness, and accountability to DOE's offsite transportation activities through collaboration with State and Tribal governments. The SNF Rail/Routing Ad Hoc Working Group is comprised of representatives from federal agencies (DOE and FRA), along with representatives from State and Tribal governments that expect to be affected by future DOE SNF rail shipments.

The Draft Inspection Protocol is intended to be considered for adoption by DOE for future DOE rail shipments of SNF and HLW to promote inspection reciprocity among States and Tribes along transportation routes. The Draft Inspection Protocol defines "inspection reciprocity" as safety inspections performed by one or more qualified entities in one State or Tribal jurisdiction that are accepted by State or Tribal jurisdictions down route. All regulatory safety inspections will be performed for each shipment. The goal of inspection reciprocity is to streamline non-regulatory transport inspection policies through uniformity and transparency, thereby avoiding duplication of effort, and mitigating the safety and security risks of stopping trains for inspections at domestic jurisdictional borders along rail transportation routes. The first part of the Draft Inspection Protocol addresses inspections that would be conducted at an origin site, transload location, or port, and the resulting inspection reports that would be prepared under a DOE contract and distributed to States and Tribes along a transportation route prior to transport. A second part of the Draft Inspection Protocol consists of potentially providing appropriate State and Tribal personnel along transportation routes access to information from the railcar safety monitoring system required by Association of American Railroads (AAR) Standard S-2043 [3]. States and Tribes would not need to be participants in the FRA's State Rail Safety Participation Program to receive the inspection reports or information from the safety monitoring system. Currently only about 20 States that participate in the FRA's State Rail Safety Participation Program have inspectors qualified in the motive power and equipment (MP&E) discipline applicable to railcar safety inspections (as compared to track inspectors or highway-rail grade crossings inspectors), and the FRA program does not currently have a mechanism for Tribes to participate at all. Determining which State and Tribal personnel would have access to the S-2043 safety monitoring system information and which specific S-2043 safety monitoring system information would be accessible will likely be part of security protocols for DOE shipments that have yet to be developed.

The inspections outlined in this Draft Inspection Protocol are not meant to replace inspections required by regulation or statute conducted by the FRA, States, or the rail carriers. Rather, the inspections outlined in this Draft Inspection Protocol and access to the S-2043 data feeds are extra-regulatory and specifically structured to promote inspection reciprocity along DOE transportation routes.

PRINCIPLES OF RECIPROCITY

In the paper, *Transportation of High-Level Radioactive Waste and Spent Nuclear Fuel: Proposed Rail Inspection Program to Promote Reciprocity*, Edwards and Runyon [4] identified three primary features as promoting reciprocity: (1) uniform inspection standards and training; (2) a standard format for documenting inspections;
and (3) communication of inspection reports to downstream inspection and enforcement organizations. Edwards and Runyon [4] presented a SNF freight point of origin inspections list and a hazardous materials inspection form and discussed the role of the CVSA in developing truck inspection standards for highway route controlled quantity shipments of radioactive material. The CVSA Level VI inspection includes driver inspection standards, vehicle inspection standards, hazardous materials inspection standards, and administrative inspection standards [2].

The CVSA highway inspection program features the production of standard inspection reports in an electronic format that are transferred or communicated to downstream inspection and enforcement organizations along a transport route. The CVSA inspection program also features a standardized training and certification program for inspectors and standardized inspection procedures. However, the truck transport and regulatory environment in the US is different from the rail transport and regulatory environment, making adoption of all of the CVSA Level VI truck inspection procedures for rail shipments impractical. For example, the driver inspection items and out-of-service criteria in the CVSA Level VI inspection procedures are specific to commercial motor vehicle operators, not to locomotive engineers or conductors. Likewise, the vehicle inspection items and out-of-service criteria in the CVSA Level VI inspection procedures are specific to commercial motor vehicles, not to locomotives or freight railcars.

CONCEPT OF OPERATIONS

In order to develop the Draft Inspection Protocol, it was first necessary to develop a simplified concept of operations for the rail shipments. In the context of developing the Draft Inspection Protocol, simplified means that enough detail is presented to understand what activities occur, but not so much detail as to needlessly complicate the development of the Draft Inspection Protocol. Examples of additional details that would needlessly complicate the development of the Draft Inspection Protocol include dispatch of buffer railcars, cask-carrying railcars, or rail escort vehicles (REVs) from multiple locations to a single origin site; details on shipping ancillary loading equipment to the origin site; details on upgrading of onsite or offsite infrastructure; etc. The simplified concept of operations also assumes that shipments are made in compliance with applicable regulations and does not consider regularly scheduled transportation cask or railcar maintenance activities. The simplified concept of operations also assumes that trains carrying buffer railcars, unloaded or loaded transportation casks on cask-carrying railcars, and an REV are operated as a unit and does not consider variations in timing of arrivals for the various types of railcars that may occur at origin sites, transload sites, or ports. The concept of operations also assumes that a train carrying loaded transportation casks is operated as a key train. Figure 1 illustrates a simplified rail consist, with locomotives, buffer railcars, cask-carrying railcars, and an REV. Loaded and unloaded transportation casks on cask-carrying railcars would look virtually the same, with the exception of radioactive labels and placards on loaded transportation casks and cask-carrying railcars.

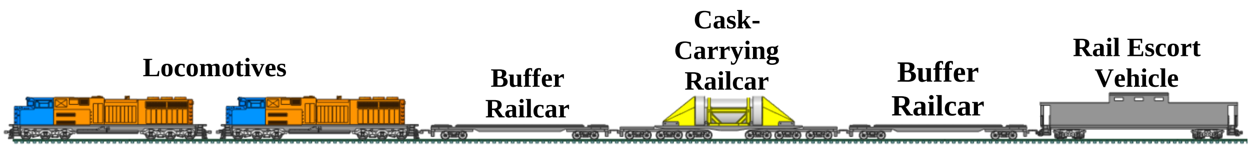

Fig. 1 Simplified Train Consist for Spent Nuclear Fuel Transport

The concept of operations includes activities conducted at an origin site and at a destination site. In addition, the concept of operations includes a direct rail scenario, a rail scenario with a heavy haul truck transload, and a rail scenario with a barge transload.

An origin site is defined as a site where shipments of SNF would originate such as commercial nuclear power plants. A simplified list of activities that would be conducted at an origin site includes:

- Loading of transportation casks
- Placing loaded transportation casks onto cask-carrying railcars
- Assembling buffer railcars, cask-carrying railcars, and an REV into a train
- Inspecting the train before it departs for a destination site
- Fixing minor defects before departure.

The inspections of the train would include the required regulatory inspections that would be conducted by the FRA, States, rail carriers, and potentially the U.S. Nuclear Regulatory Commission (NRC). The inspections would also include the extra-regulatory inspections outlined in this Draft Inspection Protocol for the purpose of promoting inspection reciprocity along transportation routes.

In this simplified concept of operations, railcars with serious defects would be pulled out of service and sent to a repair shop. The shipment would be delayed until replacement equipment arrived, or a partial shipment would depart for the destination site. Specific origin site out-of-service criteria and specific lists of minor and major defects have not been developed. In addition, not all defects are non-complying conditions (i.e., violations of FRA regulations). These types of defects include defects that are not covered by FRA regulations that do not jeopardize the safety of the railcar. Potential examples could include lack of operational ditch lights, horn, bell, gauge lights, and the engineer’s overhead cab light, when present in trailing power units. These railcars are safe for movement, and the railcar does not have to be repaired, set out, or delayed [5]. If a defect cannot be repaired at the origin site, the railcar can be allowed to continue on, but should be repaired at the next opportunity [5].

A destination site is defined as a site where shipments of loaded SNF transportation casks would be received and unloaded, such as a repository or an interim storage site. The focus of the simplified concept of operations is not on the receipt of loaded SNF transportation casks at a destination site. Rather, the focus is on sending unloaded SNF transportation casks from a destination site to an origin site for subsequent loading. A simplified list of activities that would be conducted at a destination site includes:

- Placing unloaded transportation casks onto cask-carrying railcars
- Assembling buffer railcars, cask-carrying railcars, and an REV into a train
- Inspecting the train before it departs for an origin site
- Fixing minor defects before departure.

As with the origin site simplified concept of operations, the inspections of the train at the destination site would include the required regulatory inspections that would be conducted by the FRA, States, and rail carriers. The inspections would also include the extra-regulatory inspections outlined in the Draft Inspection Protocol for the purpose of promoting inspection reciprocity along transportation routes.

Railcars with serious defects would be pulled out of service at the destination site and sent to a repair shop. The shipment would be delayed until replacement equipment arrived, or a partial shipment would depart for the origin site. As with the origin site simplified concept of operations, specific destination site out-of-service criteria and specific lists of minor and major defects have not been developed.

Figure 2 illustrates the simplified concept of operations for a direct rail scenario. In this scenario, both the origin site and the destination site have direct rail access. Locomotives, buffer railcars, unloaded transportation casks on cask-carrying railcars, and an REV would be assembled at the destination site and inspected prior to departure, although unloaded cask-carrying railcars could be moved in manifest/merchant trains. The train would then move from destination site to the origin site on the railroad system. Inspections of the train would be conducted by the rail carriers as required by FRA regulations, AAR interchange requirements, and rail carrier rules. The train would arrive at the origin site. The transportation casks would be loaded with SNF, placed on cask-carrying railcars, and then the locomotives, buffer railcars, loaded transportation casks on cask-carrying railcars, and an REV would be assembled into a train. This train would be inspected and then depart from the origin site and move to the destination site. Periodic inspections of the train would be conducted by the rail carriers as required by FRA regulations, AAR interchange requirements, and rail carrier rules. The train would arrive at the destination site, the transportation casks would be unloaded, and the process would re-start.

Fig. 2 Simplified Concept of Operations for a Direct Rail Scenario

Figure 3 illustrates the simplified concept of operations for a rail scenario with a heavy haul truck transload. In this scenario, the destination site has direct rail access and the origin site does not have direct rail access; a rail to heavy haul truck transload would be required to move unloaded transportation casks to the origin site, and a heavy haul truck to rail transload would be required to move loaded transportation casks to cask-carrying railcars.

As with the direct rail scenario, locomotives, buffer railcars, unloaded transportation casks on cask-carrying railcars, and an REV would be assembled at the destination site and inspected prior to departure. The train would then move from destination site to the transload site on the railroad system. Inspections of the train would be conducted by the rail carriers as required by FRA regulations, AAR interchange requirements, and rail carrier rules.

The train would arrive at the transload site, the unloaded transportation casks would be transloaded from railcars to heavy haul trucks, and the transportation casks would be moved to the origin site where they would be loaded with SNF. The loaded transportation casks would then be moved from the origin site to the transload site by heavy haul truck where they would be placed onto cask-carrying railcars, and the locomotives, buffer railcars, loaded transportation casks on cask-carrying railcars, and an REV would be assembled into a train. This train would be inspected and then depart from the transload site and move to the destination site. Inspections of the train would be conducted by the rail carriers as required by FRA regulations, AAR interchange requirements, and rail carrier rules. The train would arrive at the destination site, the transportation casks would be unloaded, and the process would re-start.

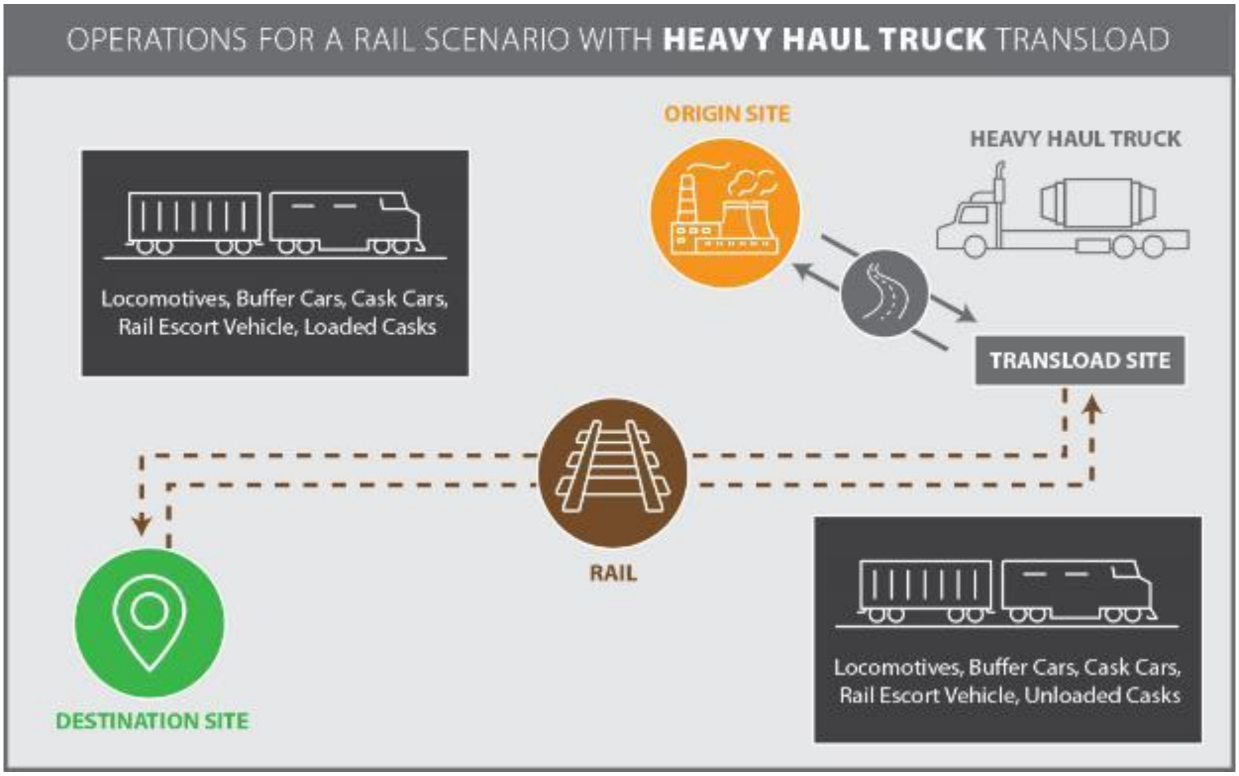

Fig. 3 Simplified Concept of Operations for a Rail Scenario with a Heavy Haul Truck Transload

Figure 4 illustrates the simplified concept of operations for a rail scenario with a barge transload. In this scenario, the destination site has direct rail access and the origin site does not have direct rail access; a rail to barge transload at a port would be required to move unloaded transportation casks to the origin site, and a barge to rail transload at a port would be required to move loaded transportation casks to cask-carrying railcars.

As with the direct rail scenario, locomotives, buffer railcars, unloaded transportation casks on cask-carrying railcars, and an REV would be assembled into a train at the destination site and inspected prior to departure. The train would then move from destination site to a port on the railroad system. Inspections of the train would be conducted by the rail carriers as required by FRA regulations, AAR interchange requirements, and rail carrier rules. The train would arrive at the port, the unloaded transportation casks would be transloaded from railcars to barges, and the transportation casks would be moved to the origin site where they would be loaded with SNF. The loaded transportation casks would be moved from the origin site to the port by barge where they would be placed onto cask-carrying railcars, and the locomotives, buffer railcars, loaded transportation casks on cask-carrying railcars, and an REV would be assembled into a train.

This train would be inspected and then depart from the port and move to the destination site. Inspections of the train would be conducted by the rail carriers as required by FRA regulations, AAR interchange requirements, and rail carrier rules. The train would arrive at the destination site, the transportation casks would be unloaded, and the process would re-start.

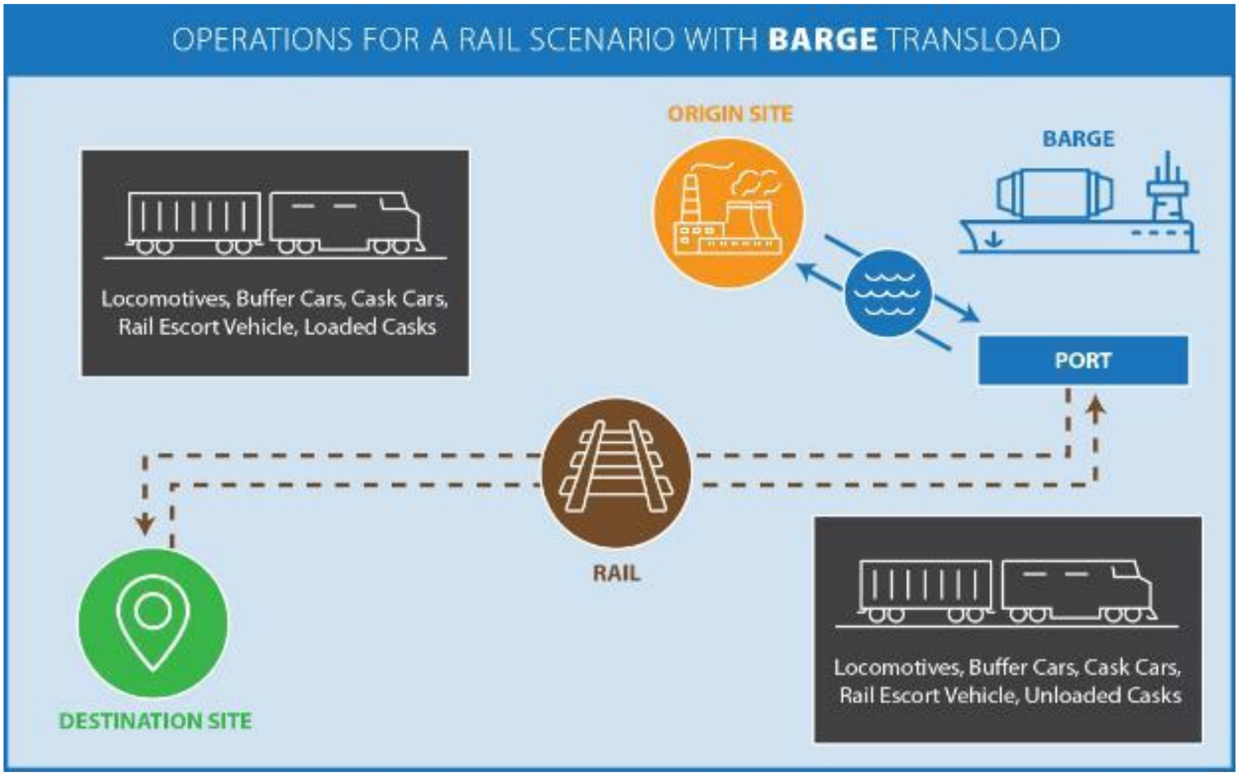

Fig. 4 Simplified Concept of Operations for a Rail Scenario with a Barge Transload

FEDERAL RAILROAD ADMINISTRATION REGULATIONS

Rail inspections in the US are currently conducted by three entities: (1) rail carriers; (2) the FRA; and (3) States. The vast majority of rail inspections are conducted by rail carriers. The regulatory requirements for these inspections are established by the FRA. The FRA regulations providing the safety standards for inspection of locomotives are contained in the US Code of Federal Regulations (CFR) at 49 CFR Part 229 [6], and the regulations providing the safety standards for inspections of freight railcars are contained in 49 CFR Parts 215, 224, 231, and 232 [7]-[10]. Within the FRA, inspectors specialize in six safety disciplines: (1) hazardous materials (HM); (2) MP&E; (3) operating practices (OP); (4) signal and train control (S&TC); (5) track and structures; and (6) highway-rail grade crossings (XING). The inspections discussed in this Draft Inspection Protocol would be for trains that are associated with DOE transport of SNF and consequently would involve the MP&E and HM safety disciplines. Other inspections, such as inspections of track, are not covered by this Draft Inspection Protocol.

The safety standards for locomotives in 49 CFR Part 229 [6] require daily inspections, periodic inspections at 92- or 184-day intervals, annual tests, and inspections and tests at longer intervals for specific components. Periodic inspections and longer interval inspections and tests are documented on FRA Form F6180-49A[2] which is colloquially known as a "Blue Card." The rail carrier may also choose to use their own version of FRA Form F6180-49A. This form is typically kept in the cab of the locomotive or is available electronically to the train crew.

[2] FRA Form F6180-49A is available at https://safetydata.fra.dot.gov/OfficeofSafety/publicsite/Forms.aspx.

There is no FRA form to document the daily locomotive inspections, and each rail carrier generally develops their own form. In addition, rail carriers may not have checklists of items to be inspected during a daily locomotive inspection. Rather, they have rules or similar instructions that specify what and how locomotive components are to be inspected. Class I rail carriers have also requested waivers to allow the use of electronic forms and signatures to document locomotive inspections. For example, the Union Pacific Railroad received waivers to use an electronic Blue Card (see Docket No. FRA-2004-17308 at www.regulations.gov) and an electronic daily locomotive inspection form (see Docket No. FRA-2001-11014 at www.regulations.gov). In general, short line rail carriers[3] have not requested these waivers. There are also iPhone, iPad, Android, web, and desktop applications that are available to assist in preparing daily locomotive inspection reports.

State Rail Safety Participation Program

States conduct rail inspections through the FRA's State Rail Safety Participation Program. State programs generally emphasize planned, routine compliance inspections. However, States may undertake additional investigative and surveillance activities consistent with overall program needs, individual State capabilities, and specific State commitments. Before participation can begin, a State must enter into a multi-year agreement with FRA for the exercise of specified authority. This agreement may delegate investigative and surveillance authority regarding all or any part of Federal railroad safety laws, in the six safety disciplines. In 2019, a total of 31 States plus the District of Columbia had rail safety inspection programs; however, a minimum number of inspectors is not required for a State to be part of the State Rail Safety Participation Program. State programs employ 221 federally-certified rail safety inspectors, over 36% of the national rail safety inspection force.

Federal Railroad Administration Safety Compliance Oversight Plan

In addition to FRA MP&E and HM regulations and guidance, FRA also has issued the Safety Compliance Oversight Plan for Rail Transportation of High-Level Radioactive Waste and Spent Nuclear Fuel (SCOP) [11]. The purpose of the SCOP is to present FRA's policies to address the safety of rail shipments of SNF and HLW. The SCOP was originally developed for relatively few rail shipments of foreign research reactor SNF in the 1990s and is undergoing revision by FRA to be more applicable to a future large-scale SNF transport program that would be conducted by the DOE to remove SNF from commercial nuclear power plants.

ASSOCIATION OF AMERICAN RAILROADS INTERCHANGE REQUIREMENTS

Most freight railcars are interchangeable among rail carriers. This is possible because the basic dimensions, design criteria, construction, and maintenance standards for the railcar are specified by the AAR [12]. AAR interchange requirements are contained in the Field Manual of the AAR Interchange Rules [13]. Components covered in the Field Manual include:

- Air brake equipment (Rules 3-13);
- Couplers, yokes, draft gear, uncoupling levers, and support brackets (Rules 16-23);
- Roller bearings and adapters (Rules 36 and 37);
- Wheels and axles (Rules 41, 43, and 44);
- Truck components (Rules 46-48, 50, and 53);
- Sills (Rules 57-59);
- Center plates and side bearings (Rules 60-62);
- General repairs (Rules 63-82).

[3] Short line rail carriers are smaller rail carriers that run shorter distances and connect shippers with the larger freight network (https://www.up.com/customers/track-record/tr051220-what-are-short-line-railroads.htm).

Section A.1 in each rule contains "Cause for Attention At Any Time" criteria which are criteria that would result in a railcar being placed out of service. These criteria are colloquially known as the "A.1 Criteria." In addition, not all interchange rules will be applicable to the transport of SNF (e.g., Rule 68, Refrigeration Equipment, or Rule 78, Lumber).

ASSOCIATION OF AMERICAN RAILROADS STANDARD S-2043 SAFETY MONITORING REQUIREMENTS

Section 4.5 of AAR Standard S-2043 [3] contains the requirements for the safety monitoring system for railcars in a high-level radioactive material (HLRM)[4] train. The minimum parameters monitored include:

- Location—identified by GPS coordinates;
- Speed—train speed;
- Truck hunting—lateral instability of the railcar;
- Rocking—side-to-side rocking motion causing excessive roll angles;
- Wheel flats—vertical wheel impacts caused by flat spots on the wheels;
- Bearing condition—bearing temperature or alternative method;
- Ride quality—Root mean square (RMS) acceleration of car body in three axes;
- Braking performance—brake cylinder pressure;
- Vertical acceleration—caused by worn or damaged suspension components;
- Lateral acceleration—caused by worn or damaged suspension components;
- Longitudinal acceleration—caused by train handling or draft gear failure.

AAR Standard S-2043 requires real-time monitoring when the HLRM train is operating as a dedicated train. Exception reports are required to be transmitted to the locomotive and the REV. A signal requiring a train to stop (i.e., a train stop alarm) must be transmitted to the train crew when one of the following situations is identified:

- Hunting—RMS lateral car body acceleration of 0.26 g sustained for 10 seconds;
- Rocking—peak-to-peak roll angles of 5° for 3 cycles;
- Bearing temperature—indication of impending failure;
- Vertical acceleration—peak vertical car body acceleration of 1.0 g;
- Lateral acceleration—peak lateral car body acceleration of 0.75 g;
- Longitudinal acceleration—peak longitudinal car body acceleration of 1.5 g;
- Brakes—indication of a stuck brake.

A signal requiring train inspection at the next scheduled stop must be transmitted to the train crew when one of the following situations is identified:

- Hunting—sustained RMS lateral car body acceleration of 0.13 g;
- Rocking—indication of degraded performance or peak-to-peak roll angles of 4° for 3 cycles;
- Bearing temperature—indication of degraded performance;
- Wheel flat—wheel flat indication;
- Brakes—indication of an inoperative brake.

[4] AAR Standard S-2043 defines HLRM as SNF or HLW.

The DOE is currently evaluating integrating the safety monitoring system required by AAR Standard S-2043 for an HLRM train into its existing Transportation Tracking and Communication System (TRANSCOM) and providing the above data feeds through the TRANSCOM system.[5]

US DEPARTMENT OF TRANSPORTATION AND US DEPARTMENT OF ENERGY HAZARDOUS AND RADIOACTIVE MATERIALS INSPECTION REGULATIONS AND REQUIREMENTS

The US DOT Pipeline and Hazardous Material Safety Administration (PHMSA) regulates the transportation of hazardous materials in commerce. The PHMSA Hazardous Materials Regulations for transport are contained in 49 CFR Parts 171-180 [14]; and define nine classes of hazardous materials; radioactive material is denoted Class 7. In addition, the US DOT Federal Motor Carrier Safety Administration (FMCSA) has requirements that apply to transporting radioactive materials in commerce by highway. Inspections conducted for Class 7 (radioactive) materials shipments typically involve “prior-to-first-use” requirements, “before-each-use” requirements, marking, labeling, placarding, radiation monitoring, shipping papers, and training [14]. Specific inspection requirements for shipments of hazardous materials by rail are contained in 49 CFR 174.9 [15].

DOE has broad authority under the Atomic Energy Act of 1954, as amended (AEA) [16], to regulate activities involving radioactive materials that are undertaken by DOE or on its behalf, including the transportation of radioactive materials. In most cases that do not involve national security or other critical interests, DOE uses commercial carriers that undertake its shipments, subject to regulation by DOT and the NRC, as appropriate. However, DOE exercises its AEA authority to regulate certain Departmental shipments, including shipments by government employees and onsite transfers. In all cases, DOE’s packaging and transportation activities must be conducted in a manner that achieves an equivalent level of safety and security to that required by DOT and NRC for comparable commercial shipments [17].

ATLAS RAILCAR AND BUFFER RAILCAR INSPECTION CHECKLISTS

Appendix A in AAR Standard S-2043 [3] contains maintenance standards and recommended practices for trains used to carry HLRM (e.g., SNF), including inspection requirements. This includes individual railcars in the train, such as cask carrying railcars, railcars carrying security escorts (i.e., the REV), and buffer railcars. Appendix B in AAR Standard S-2043 also contains periodic inspection requirements.

Inspection checklists for the Atlas railcar and buffer railcar are contained in Orano [18], Appendix D and Orano [19], Appendix H, respectively.

DRAFT INSPECTION PROTOCOL

As previously discussed, inspection reports produced by the FRA, States, or rail carriers are generally not shared with other States or Tribes, and are often viewed as confidential or proprietary. The lack of sharing of these inspection reports with States or Tribes along transportation routes presents a significant obstacle to inspection reciprocity. For this reason, the Draft Inspection Protocol would have DOE contract for inspections conducted by a qualified third-party including inspections at the origin site, transload location, or port and prepare separate inspection reports that could be provided to States and Tribes. The inspections conducted for DOE would not replace regulatory inspections conducted by the FRA, States, or rail carriers. Rather, the inspections would be extra-regulatory and specifically structured to promote inspection reciprocity among States and Tribes along transportation routes.

[5] TRANSCOM is the DOE satellite tracking and communications system used to monitor radioactive material shipments. See https://tcc.transcom.energy.gov/

Figure 5 illustrates the components of the DOE inspection protocol, which would include inspections conducted to demonstrate compliance with FRA's safety regulations and PHMSA's Hazardous Materials Regulations, AAR Standard S-2043 railcar inspections, and inspections conducted to verify compliance with AAR interchange requirements.

Under this approach, the inspectors under contract to DOE would prepare an inspection report for DOE which could then be provided by DOE to States and Tribes along the transportation route, potentially through the TRANSCOM system. States and Tribes would not need to be participants in the FRA State Rail Safety Inspection Program to receive the inspection reports. These reports would be of a consistent format and would cover the locomotives, cask-carrying railcars, buffer railcars, the REV, and the transportation casks, and would include the results of hazardous materials inspections.
Specific examples of activities that would be included in the report include:

- Verification that the locomotive Blue Card is current.
- Verification or observation that the daily locomotive inspection has been performed.
- Observation of the inspections of the locomotives, Atlas railcar, buffer railcar, and REV by the FRA, State, or rail carrier.
- Verification of cask-carrying railcar, buffer railcar, and REV annual inspections.
- Observation of the Class I brake test.
- Conducting independent inspections of the cask-carrying railcar, buffer railcar, and REV. Independent inspections would have to be conducted so that the impact to rail carrier operations was minimized and radiation doses to inspectors was As Low As Reasonably Achievable (ALARA).
- Verification of the "prior-to-first-use" and "before-each-use" requirements contained in 49 CFR 173.474 and 49 CFR 173.475 [20].
- Verification of the shipping papers.
- Verification of the marking, labeling, and placarding of the transportation cask and cask carrying railcar.
- Observation of radiation and contamination surveys conducted of the transportation casks.
- Conducting independent radiation and contamination surveys of the transportation casks. Independent radiation and contamination surveys would have to be conducted so that the impact to rail carrier operations was minimized. Independent surveys would also have to be conducted so that the radiation doses to inspectors was ALARA.

The Draft Inspection Protocol provides for inspectors under contract to DOE to conduct, observe, or verify inspections at the destination site prior to the departure of a train for the origin site. Because these shipments would not contain hazardous material, i.e., the transportation casks would be empty, the inspections would cover the locomotives, cask-carrying railcars, buffer railcars, and the REV, but not hazardous materials. As with the inspections at the origin site, transload location, or port, inspectors under contract to DOE would prepare an inspection report that could be provided to States and Tribes along the transportation route (see Figure 6).

The Draft Inspection Protocol does not provide for inspectors under contract to DOE to conduct, observe, or verify en route inspections conducted by the FRA, States, or rail carriers. Rather, appropriate State and Tribal personnel along transportation routes could be given access to information from the safety monitoring system required by AAR Standard S-2043. The feasibility of providing access to information from the S-2043 safety monitoring system through the TRANSCOM system is being evaluated. States and Tribes would not need to be participants in the FRA State Rail Safety Inspection Program to receive the information from the S-2043 safety monitoring system.

Determining which State and Tribal personnel would have access to the S-2043 safety monitoring system information and which specific S-2043 safety monitoring system information would be accessible will likely be part of security protocols for DOE SNF rail shipments that have yet to be developed. A protocol for conducting further train inspections or for stopping a train would need to include considerations of both safety and security. However, the parameter thresholds specified in AAR Standard S-2043 could be used to define the thresholds for further train inspections or for stopping a train.

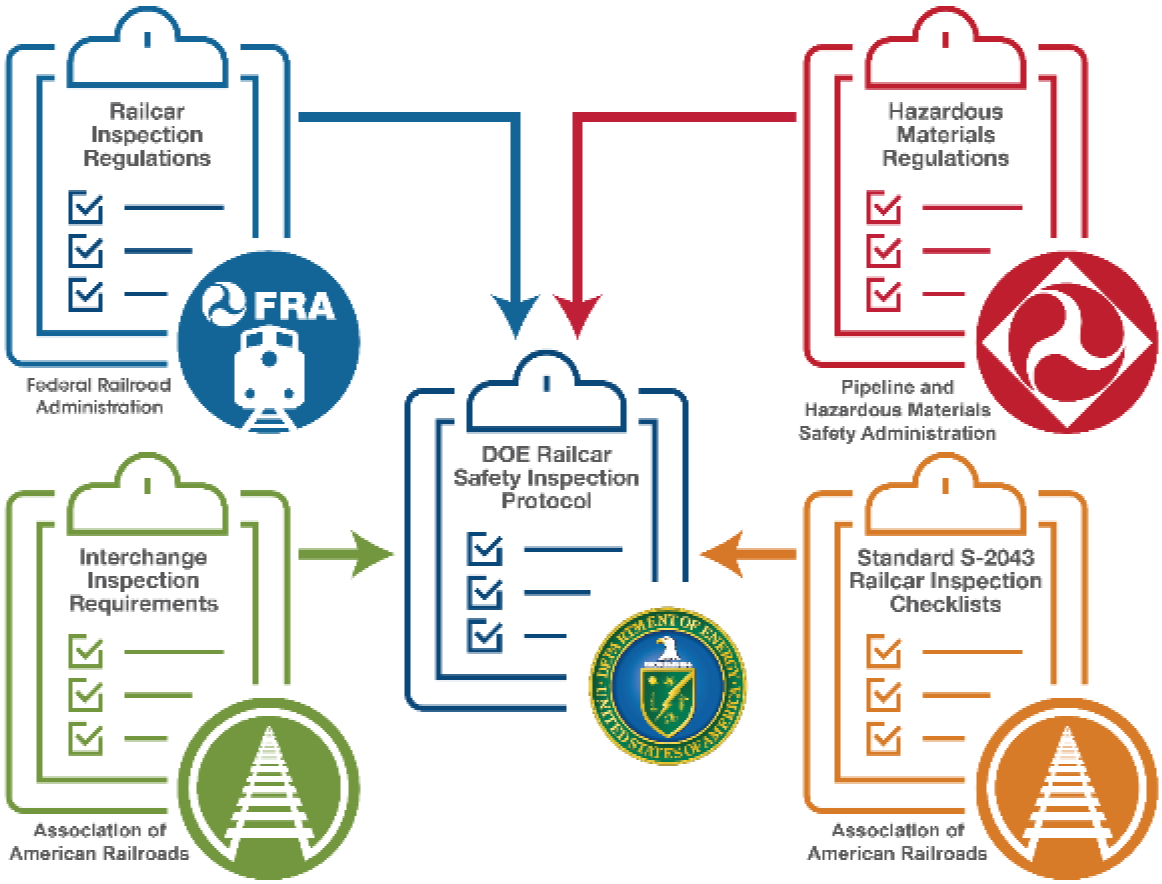

Fig. 5 Components of DOE Railcar Safety Inspection Protocol

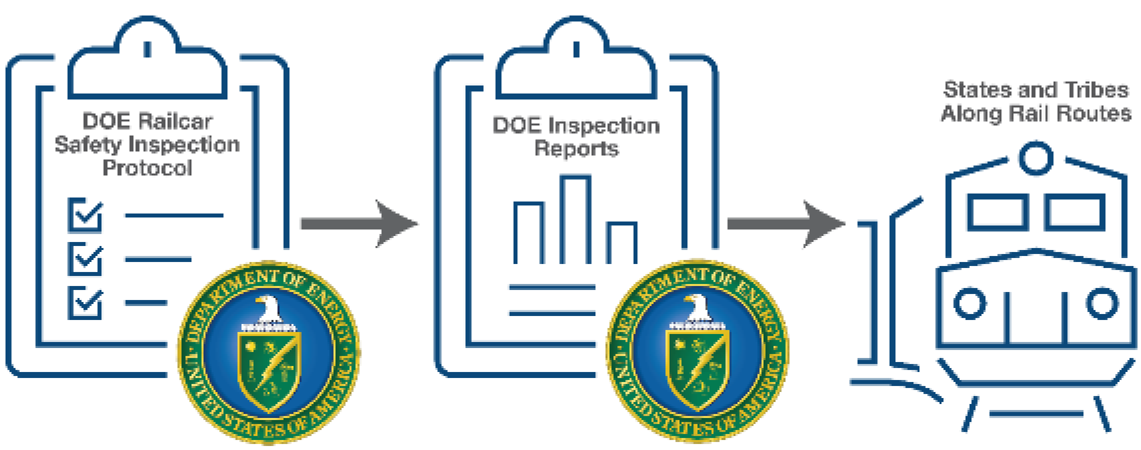

Fig. 6 Distribution of DOE Inspection Reports

FUTURE INSPECTION PROTOCOL RECOMMENDATIONS

This section presents additional inspection protocol items that could be discussed with the National Transportation Stakeholders Forum Spent Nuclear Fuel Rail/Routing Ad Hoc Working Group during the continued development of the Draft Inspection Protocol.

Providing AAR Standard S-2043 Information through the TRANSCOM System

The DOE is evaluating the feasibility of providing access to the AAR Standard S-2043 safety monitoring system information through the TRANSCOM system. In addition, determining which State and Tribal personnel would have access to the S-2043 safety monitoring system information and which specific S-2043 safety monitoring system information would be accessible will likely be part of security protocols for DOE shipments that have yet to be developed.

Providing a Data Feed Containing Radiation Dose Rate Measurements

AAR Standard S-2043 does not include a requirement for measuring radiation dose rates from transportation casks. There are significant issues associated with measuring radiation dose rates from a transportation cask in near real time, such as:

- Designing a radiation measurement system that can survive the extremes of the railroad operating environment (e.g., temperature, rainfall, shock, and vibration).
- Providing power to the radiation detectors associated with the system.
- The ability to distinguish between natural background radiation and the radiation emitted from the transportation cask along transportation routes.

DOE will continue to consider the feasibility of providing information on radiation dose rate measurements for future DOE SNF shipments given these constraints.

Role of U.S. Nuclear Regulatory Commission

The Draft Inspection Protocol assumes that DOE would be the shipper of the SNF and that shipments would not be subject to NRC regulation. However, NRC regulates the activities of its licensees, and NRC may conduct onsite transportation-related inspections at nuclear power plant sites. Documentation of these NRC inspections could be incorporated into the Draft Inspection Protocol.

Out-of-Service Criteria

The CVSA Level VI inspection procedures require that a highway vehicle inspected at a point of origin be defect-free before departure. However, currently not all defects noted in rail inspections are non-complying conditions which would result in a railcar or locomotive being placed out of service. Potential examples could include lack of operational ditch lights, horn, bell, gauge lights, and the engineer’s overhead cab light, when present in trailing power units. A list of inspection items and out-of-service criteria similar to those presented in CVSA [2] to accompany the Draft Inspection Protocol could be developed; however, in developing a list of inspection items and out-of-service criteria, the issue of whether railcars with defects that are not non-complying conditions are acceptable for transport could be addressed.

Protocol for Further Inspections or Stopping Train

Decisions on where and when to conduct further train inspections or stop a train in response to data from the AAR Standard S-2043 safety monitoring system should not be based solely on safety and would need to consider security. A protocol for conducting further train inspections or for stopping a train could be developed and incorporated into the Draft Inspection Protocol.

En Route Inspections

The majority of en route inspections are conducted by the rail carriers. The Draft Inspection Protocol does not include provisions for en route inspections due to the complexity associated with having DOE contractor inspectors present at the necessary time and location to verify or observe these inspections. Rather, appropriate State and Tribal personnel along transportation routes could be given access to information from the safety monitoring system required by AAR Standard S 2043. The feasibility of expanding the Draft Inspection Protocol to include en route inspections could be considered.

Development of Inspection Report Forms

Electronic forms to document the inspections discussed in this Draft Inspection Protocol have not been developed. These forms would be based on the checklists presented previously and are envisioned to be a combination of checklists and measured values for parameters such as radiation dose rates or contamination levels.

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