RAIL CONSIST SAFETY INSPECTION PROTOCOL (Revision 0)

June 2026

U.S. DEPARTMENT of ENERGY | Office of Nuclear Energy
Spent Fuel and High-Level Waste Disposition

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Photo Courtesy of Pacific Northwest National Laboratory.

Rail Consist Safety Inspection Protocol (Revision 0)

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Office of Nuclear Energy
By Pacific Northwest National Laboratory

Steven J. Maheras[1] Sonya M. Bowyer[2]

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[1] Pacific Northwest National Laboratory
[2] Formerly of Pacific Northwest National Laboratory (retired)

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DISCLAIMER

This is a technical report 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).

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This report reflects technical work which could support future decision making by the U.S. Department of Energy (DOE or Department). No inferences should be drawn from this report regarding future actions by DOE, which are limited both by the terms of the Standard Contract and Congressional appropriations for the Department to fulfill its obligations under the Nuclear Waste Policy Act including licensing and construction of a used nuclear fuel* repository.

*The U.S. Department of Energy, Office of Nuclear Energy has updated its terminology to refer to “used nuclear fuel” rather than “spent nuclear fuel” in most instances. The term “used nuclear fuel” is intended to be synonymous with the term “spent nuclear fuel” as used and defined in the Nuclear Waste Policy Act of 1982, as amended, and the Standard Contract for the Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste (10 CFR Part 961). In the context of U.S. Nuclear Regulatory Commission and U.S. Department of Transportation regulations and requirements discussed in this document, used nuclear fuel may also be referred to as irradiated reactor fuel, fissile material, Type B quantity of radioactive material, or a highway route controlled quantity of radioactive material.

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EXECUTIVE SUMMARY

Under the Nuclear Waste Policy Act of 1982, as amended, the U.S. Department of Energy (DOE) is responsible for the disposal of commercial spent nuclear fuel (SNF)[1] and high-level radioactive waste (HLW). Under the Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste with owners or generators, DOE is 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 analysis 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 for trucks transporting highway route controlled quantities of radioactive material (e.g., SNF and HLW). Now known as a CVSA Level VI inspection, this safety inspection protocol has been incorporated into regulations by the U.S. Department of Transportation (DOT) for truck shipments of highway route controlled quantities of radioactive materials. Due to the size and weight of SNF transport casks, it is expected that the primary mode for large-scale transport of SNF will be rail.

The *Rail Consist Safety Inspection Protocol* (Inspection Protocol) is an update of the *Revised Draft Railcar Safety Inspection Protocol* (Maheras, 2021) and was developed to support future large-scale rail shipments of SNF and HLW, and the shipping of the TN-32B High Burnup Research Cask from the North Anna Power Station site. This shipment is expected to occur in 2027.

The Federal Railroad Administration (FRA) regulates the safety, operations, and infrastructure of railroads. Inspection reports generated during inspections conducted by the 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.

The Inspection Protocol was designed to promote inspection reciprocity among States and Tribes along rail transportation routes and was developed in coordination with DOE's National Transportation Stakeholders Forum's Spent Nuclear Fuel Rail/Routing Ad Hoc Working Group. The 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 transport. 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 jurisdictional borders along rail transportation routes.

In order to promote reciprocity, the Inspection Protocol consists of two parts. The first part of the Inspection Protocol consists of inspections to be performed at origin sites, which include nuclear power plant sites, transload locations, and ports. These inspections would be verified, observed, or conducted by a DOE contractor, and the resulting inspection reports would be distributed

[1] The U.S. Department of Energy, Office of Nuclear Energy has updated its terminology to refer to "used nuclear fuel" rather than "spent nuclear fuel" in most instances. The term "used nuclear fuel" is intended to be synonymous with the term "spent nuclear fuel" as used and defined in the Nuclear Waste Policy Act of 1982, as amended, and the Standard Contract for the Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste (10 CFR Part 961). In the context of U.S. Nuclear Regulatory Commission and U.S. Department of Transportation regulations and requirements discussed in this document, used nuclear fuel may also be referred to as irradiated reactor fuel, fissile material, Type B quantity of radioactive material, or a highway route controlled quantity of radioactive material.

prior to transport to States and Tribes along a transportation route used for DOE rail shipments of SNF, potentially through DOE's Transportation Tracking and Communication System (TRANSCOM). The second part of the Inspection Protocol consists of potentially providing appropriate State and Tribal personnel along transportation routes access to information from the safety monitoring system required by Association of American Railroads (AAR) Standard S-2043. States and Tribes would not need to be participants in the FRA State Rail Safety Inspection Program to receive the inspection reports or information from the 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 will be accessible will likely be part of security protocols for DOE shipments that have yet to be developed.

Figure S-1 illustrates the components of the DOE inspection protocol, which would include inspections conducted to demonstrate compliance with FRA safety regulations and the DOT Pipeline and Hazardous Materials Administration hazardous materials regulations, AAR Standard S-2043 railcar inspections, and inspections conducted to verify compliance with AAR interchange requirements. Figure S-2 illustrates the distribution of the inspection reports to States and Tribes along rail transportation routes.

The inspections outlined in this 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 Inspection Protocol and access to the AAR Standard S-2043 safety monitoring system information are extra-regulatory and specifically structured to promote inspection reciprocity along DOE rail transportation routes.

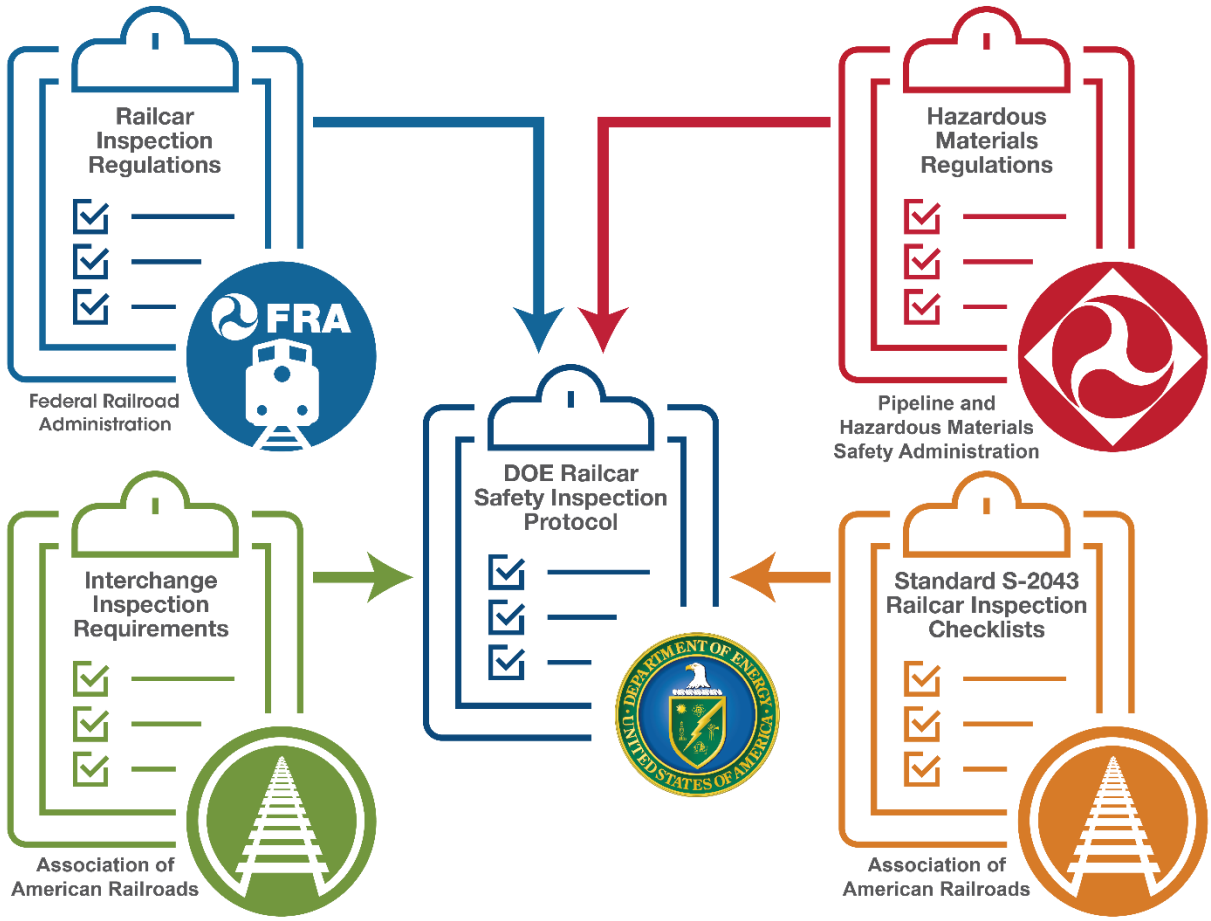

Figure S-1 Components of U.S. Department of Energy railcar safety inspection protocol.

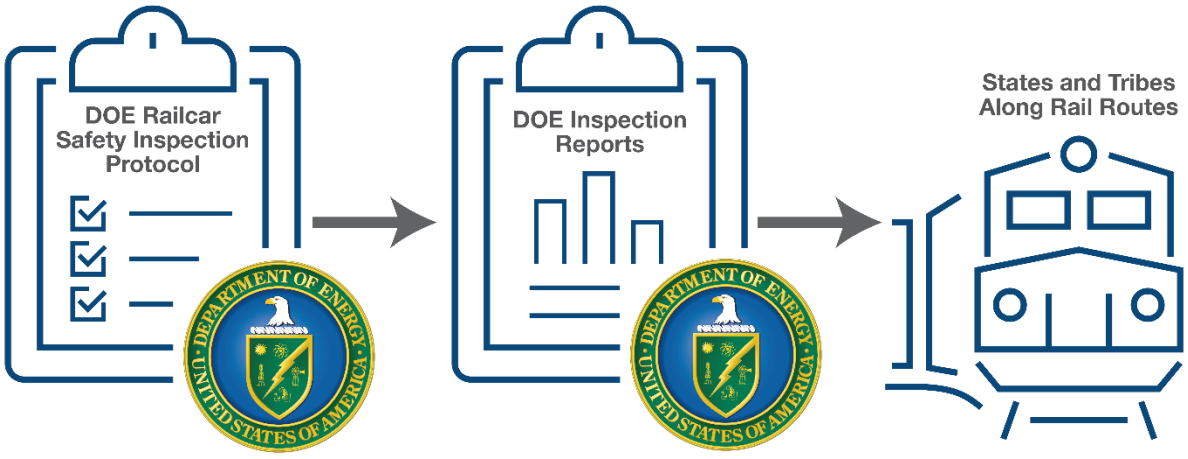

Figure S-2 Distribution of U.S. Department of Energy inspection reports.

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

REVISION HISTORY

Revision	Date	Affected Pages	Revision Description
0	June 17, 2026	Not applicable	Initial issuance

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ACRONYMS

AAR	Association of American Railroads
AEA	Atomic Energy Act of 1954, as amended
ALARA	as low as reasonably achievable
CFR	*Code of Federal Regulations*
CSI	Criticality Safety Index
CVSA	Commercial Vehicle Safety Alliance
DOT	U.S. Department of Transportation
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
GPS	global positioning system
HLRM	high-level radioactive material
HLW	high-level radioactive waste
HM	hazardous materials
HRCQ	highway route controlled quantity
ISSMS	Integrated Security and Safety Monitoring System
MP&E	motive power and equipment
NRC	U.S. Nuclear Regulatory Commission
OP	operating practices
PHMSA	Pipeline and Hazardous Materials Safety Administration
PM	preventive maintenance
REV	Rail Escort Vehicle
RMS	root mean square
S&TC	signal and train control
SCCOP	Safety Coordination and Compliance Oversight Plan
SCOP	Safety Compliance Oversight Plan
SNF	spent nuclear fuel
T&S	track and structures
TRANSCOM	Transportation Tracking and Communication System
TRMTC	Tribal Radioactive Materials Transportation Committee
WIPP	Waste Isolation Pilot Plant
XING	highway-rail grade crossing

RAIL CONSIST SAFETY INSPECTION PROTOCOL (REVISION 0)

1 INTRODUCTION

Under the Nuclear Waste Policy Act of 1982, as amended, the U.S. Department of Energy (DOE) is responsible for the disposal of commercial spent nuclear fuel (SNF)[4] and high-level radioactive waste (HLW). Under the Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste with owners or generators, DOE is 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 analysis 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 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 has been incorporated into regulations by the U.S. Department of Transportation (DOT) for truck shipments of highway route controlled quantities of radioactive materials. Due to the size and weight of SNF transport casks, it is expected that the primary mode for large-scale transport of SNF will be rail.

The *Rail Consist Safety Inspection Protocol* (Inspection Protocol) is an update of the *Revised Draft Railcar Safety Inspection Protocol* (Maheras, 2021) and was developed to support future large-scale rail shipments of SNF and HLW, and the shipping of the TN-32B High Burnup Research Cask from the North Anna Power Station site. This shipment is expected to occur in 2027.

Inspection reports generated during inspections conducted by the 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.

The Inspection Protocol was designed to promote inspection reciprocity among States and Tribes along rail transportation routes and was developed in coordination with DOE's National Transportation Stakeholders Forum's Spent Nuclear Fuel Rail/Routing Ad Hoc Working Group. The 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 transport. 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 jurisdictional borders along rail transportation routes.

The first part of the Inspection Protocol addresses inspections that would be conducted at an origin site, transload location, or port, and the resulting inspection reports prepared under a

[4] The U.S. Department of Energy, Office of Nuclear Energy has updated its terminology to refer to "used nuclear fuel" rather than "spent nuclear fuel" in most instances. The term "used nuclear fuel" is intended to be synonymous with the term "spent nuclear fuel" as used and defined in the Nuclear Waste Policy Act of 1982, as amended, and the Standard Contract for the Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste (10 CFR Part 961). In the context of U.S. Nuclear Regulatory Commission and U.S. Department of Transportation regulations and requirements discussed in this document, used nuclear fuel may also be referred to as irradiated reactor fuel, fissile material, Type B quantity of radioactive material, or a highway route controlled quantity of radioactive material.

DOE contract and distributed to States and Tribes along a transportation route prior to transport. A second part of the Inspection Protocol consists of potentially providing appropriate State and Tribal personnel along transportation routes access to information from the safety monitoring system required by Association of American Railroads (AAR) Standard S-2043 (AAR, 2024a). States and Tribes would not need to be participants in the FRA State Rail Safety Inspection Program to receive the inspection reports or information from the 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 will be accessible will likely be part of security protocols for DOE shipments that have yet to be developed (see Section 12.4.1).

The inspections outlined in this 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 Inspection Protocol and access to the AAR Standard S-2043 data feeds are extra-regulatory and specifically structured to promote inspection reciprocity along transportation routes.

Rail inspections in the U.S. are currently conducted by three entities:

- rail carriers,
- FRA, and
- States.

The vast majority of rail inspections are conducted by rail carriers. As stated in the *State Rail Safety Participation Program Manager's Handbook* (FRA, 2016):

> "Federal and State rail safety inspectors do not perform safety inspections for railroads. Railroads employ their own inspectors, supervisors, and maintenance personnel. The [FRA/State] inspector's role is to monitor the railroad and industry compliance with rail safety regulations. Given the vastness of the railroad industry compared to the size of the Federal and State inspection force, it is physically impossible for the inspection force to be omnipresent. The inspector's job is to sample rail carrier compliance and take action to improve compliance where shortcomings are revealed."

The FRA regulations providing the safety standards for inspection of locomotives are contained in 49 CFR Part 229, and the regulations providing the safety standards for inspections of freight railcars are contained in 49 CFR Parts 215, 224, 231, and 232. The Pipeline and Hazardous Materials Safety Administration (PHMSA) regulates the transportation of hazardous materials. The PHMSA Hazardous Materials Regulations for transportation are contained in 49 CFR Parts 171–180. Within the FRA, inspectors specialize in six safety disciplines:

- hazardous materials (HM),
- motive power and equipment (MP&E),
- operating practices (OP),
- signal and train control (S&TC),
- track and structures (T&S), and
- highway-rail grade crossings (XING).

The inspections discussed in this 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 Inspection Protocol.

General guidance is provided to inspectors in FRA's *General Manual* (FRA, 2010). Inspections of trains carrying SNF would be conducted by MP&E inspectors and HM inspectors. Specific FRA guidance for these inspectors is provided in FRA's *Motive Power and Equipment Compliance Manual* (FRA, 2012a) and *Hazardous Materials Compliance Manual* (FRA, 2017).

1.1 STATE RAIL SAFETY PARTICIPATION PROGRAM

States conduct rail carrier inspections through the State Rail Safety Participation Program. This program was established by the Federal Railroad Safety Act of 1970. 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 (FRA, 2016). State Rail Safety Participation Program regulations are contained in 49 CFR Part 212. In 2019, a total of 31 States plus the District of Columbia had rail safety inspection programs; however, 49 CFR Part 212 does not require a minimum number of inspectors for a State to be part of the State Rail Safety Participation Program. State programs employ 221 Federally-certified rail safety inspectors, over 36 percent of the national rail safety inspection force.

Table 1 lists the States that participate in the State Rail Safety Participation Program and the safety disciplines that the States participate in as of 2021. Native American Tribes are not eligible to participate in the program (Smith, 2000; Arnold and Hernandez, 2022; Bose, 2023) although this issue is currently being reviewed by the Tribal Radioactive Materials Transportation Committee (TRMTC)[5] and is under discussion with FRA. TRMTC is exploring options and developing a list of recommendations so Tribes can participate in inspections. TRMTC is also interested in identifying methods to observe inspections at the closest point of origin by partnering with Federal and State inspectors and in establishing relationships with the State Rail Safety Participation Program staff and potentially with the Association of State Rail Safety Managers to increase their involvement in the inspection process.

[5] https://www.ncsl.org/research/energy/ncsl-tribal-radioactive-materials-transportation-committee.aspx

Table 1. Number of rail safety inspectors by State and safety discipline.

State	T&S	MP&E	OP	HM	S&TC	XING
Alabama	2	1				
Arizona	2	1	1	1	1	1
California	10	7	11	12	4	
District of Columbia	1			1		
Florida	1	1		1	1	
Idaho				1		
Illinois	3		1	2	4	
Iowa	2					
Maine	1					
Maryland	1	1	1			
Minnesota	2	1		1		
Mississippi	1		1	1		
Missouri	2	1	1		1	
Montana		2				
Nebraska		1				
Nevada	1	1	1	1		
New Hampshire						
New Jersey				1		
New Mexico	1				1	
New York	6	5	2	2		
North Carolina	1	1	1		1	1
North Dakota		1				
Ohio	3	2	3	3	2	
Oregon	3	2	1	2	2	
Pennsylvania	2	2	3	2	1	
South Carolina	1		1			
Tennessee	1		2		1	
Texas	4	3	4	2	3	1
Utah						
Virginia	4	2	1	2	1	1
Washington	2	1	2	2	2	3
West Virginia	3	3	2	1	3	

T&S = track and structures, MP&E = motive power and equipment, OP = operating practices, HM = hazardous materials, S&TC = signal and train control, XING = highway-rail grade crossings.

Data current as of April 9, 2021.

49 CFR Part 212 does not require a minimum number of inspectors for a State to be part of the State Rail Safety Participation Program.

1.2 FEDERAL RAILROAD ADMINISTRATION SAFETY COORDINATION AND COMPLIANCE OVERSIGHT PLAN

In addition to FRA MP&E and HM regulations and guidance, FRA has also issued the *Safety Coordination and Compliance Oversight Plan for Rail Transportation of High-Level Radioactive Waste and Spent-Nuclear Fuel* (SCCOP) (FRA, 2023). The SCCOP updates the *Safety Compliance Oversight Plan for Rail Transportation of High-Level Radioactive Waste and Spent Nuclear Fuel* (SCOP) (FRA, 1998). The primary purpose of the SCCOP is to help FRA and State rail inspectors participating with FRA to prioritize their time and focus on issues relating to the shipments, designed routes, and carriers that will transport SNF and HLW. This is facilitated by FRA, which analyzes the most current data across all six operating disciplines to evaluate any high areas of noncompliance discovered. At that point, FRA directs those specific disciplines to those locations for a reinspection to validate full compliance prior to the shipments.

FRA makes the following commitments in the SCCOP:

- FRA will conduct a detailed inspection of the primary and secondary routes for rail size and track class for regulatory compliance. FRA will also review the affected carrier's height and weight restrictions track charts for excessive dimensions and gross weight restriction locations along the route that may affect train movement over bridges, overpasses, and any applicable curves and passenger rail interactions.
- FRA will conduct both a pre- and post-inspection of the entity shipping the SNF and HLW and the contractors, and sub-contractors performing offeror functions in preparation for shipments. The inspections will include package preparation, marking and labeling, hazardous materials training, and car mechanical inspection requirements.
- FRA will continue to inspect and confirm that all rail carrier employees, including contractor and sub-contractor employees, involved with these shipments have the proper hazardous materials training and basic security training.
- FRA will inspect all locomotives used in the SNF and HLW shipment to determine if required safety and brake systems are in place before train departure. In addition, FRA personnel will observe the required brake tests for the trainset before a train is allowed to depart.
- Prior to each shipment, FRA will inspect trains and/or carrier train inspection records to ensure all applicable regulatory requirements are met.
- Prior to the first shipment, through routine field and documentation inspections, FRA will confirm that all signal systems, wayside defect detectors, and cab signal systems (where applicable) are inspected within the prescribed regulatory limits, and any defective conditions discovered are addressed prior to each subsequent shipment. Prior to the first shipment, and for subsequent shipments, as appropriate, FRA will also focus on its outreach programs such as Operation Lifesaver training in communities along designated routes.

A significant issue associated with inspections conducted by the FRA or the States is that there is no provision for the results of these inspections to be forwarded to States and Tribes along the transportation route, eliminating the opportunity for reciprocity in the existing inspection process.

1.3 PREVIOUS EFFORTS TO DEVELOP A RAIL INSPECTION PROTOCOL

Between 2002 to 2010, State and Tribal representatives developed a locomotive inspection checklist and a freight car inspection checklist (CSG Midwest, 2010). While comprehensive in nature, these checklists were based solely on FRA regulatory requirements contained in 49 CFR Parts 215, 223, 224, 229, 231, and 232 and the PHMSA regulatory requirements contained in 49 CFR Parts 171–180. The checklists did not consider AAR interchange requirements. In addition, the checklist for the freight car was not based on the inspection requirements for a specific cask-carrying railcar or buffer railcar.

The inspections were assumed to be conducted by the FRA or the States and therefore did not resolve the issue of sharing of inspection reports with States or Tribes along the transportation route.

In anticipation of rail shipments of transuranic waste to the Waste Isolation Pilot Plant (WIPP), the Western Governors' Association and WIPP Transportation Safety Program Technical Advisory Group (WIPP TAG) developed the *Waste Isolation Pilot Plant Rail Transportation Safety Program Implementation Guide (Draft)* (Moore, 2004). Areas discussed in Moore (2004) included:

- **Qualified Crews, Well-Maintained Equipment, and Enhanced Carrier Compliance.** Establish, implement, and maintain an enhanced carrier contract and management plan for the WIPP carriers focusing on qualified crews and well-maintained equipment and track.
- **Inspections of Track and Equipment.** Reduce the chance of incidents from mechanical failure or human error by identifying and correcting defects before they pose a threat to shipment safety.
- **Bad Weather and Track Conditions.** Ensure that WIPP shipments avoid bad weather and hazardous tracks by carefully monitoring track and weather conditions and restricting travel when adverse conditions pose a threat to shipment safety. Ensure that emergency response personnel can reach the scene of an incident.
- **Safe Holding Sites During Abnormal Conditions.** Identify and/or designate safe holding locations and criteria for selecting safe holding areas if a predesignated location cannot be safely reached.
- **Advance Notice of WIPP Shipments, Shipment Tracking, and Shipment Status Information.** Provide States with advance shipment schedules, an easy, reliable method to obtain shipment information, the status and location of shipments en route, and a means for communication with the crews.
- **Medical Preparedness.** Establish and maintain an effective emergency medical response capability along WIPP transportation routes.
- **Memoranda of Understanding.** Emergency responders must have access to an incident scene involving a rail shipment of transuranic waste. For rail, private and public responsibilities must be clearly defined. Ensure a swift response by capable responders, regardless of jurisdiction or land ownership.
- **Emergency Response Plans and Procedures.** Develop effective State and local emergency response plans and procedures for responding to WIPP or intersite rail incidents along the entire shipping corridor. Ensure rail carriers are responsive to the needs of State and local emergency responders. Ensure bordering States are aware of each other's emergency response assets and processes for obtaining mutual aid assistance.

- **Emergency Response Equipment.** Acquire and maintain adequate equipment to respond to a WIPP shipment incident.
- **Training and Exercises.** Provide affected emergency responders with the knowledge and skills necessary to protect themselves and the public from the hazards associated with WIPP shipments. Use training and exercises to build public confidence in the program.
- **Public Information and Participation.** Clearly communicate to the media and public the actual risk of the shipments and the safety measures in place. Encourage continued public involvement in program planning and review. Proactively provide information on WIPP incidents and accidents to the news media.
- **Rail Routing of WIPP Shipments.** Identify and select the safest and most acceptable routes for transporting transuranic waste between sites and to the WIPP facility.
- **Program Evaluation.** Measure the effectiveness of the WIPP Transportation Safety Program, identify areas needing improvement, and ensure open issues are resolved.
- **Security Plan.** Implement a security plan and procedures based upon the national security threat levels and for threats directed towards a specific shipment(s) or route(s). This includes a process for ensuring timely notification to the States when the national threat level changes and/or when a specific route or shipment is threatened.

There are no plans for transporting transuranic waste to WIPP by rail and no further work has been conducted on this document since 2004.

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2 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 (2009) identified the following three primary features as promoting reciprocity:

- uniform inspection standards and training,
- a standard format for documenting inspections, and
- communication of inspection reports to downstream inspection and enforcement organizations.

Edwards and Runyon (2009) presented a spent fuel freight point of origin inspections list and a hazardous materials inspection form. The spent fuel freight point of origin inspections list was based on FRA regulations and did not consider AAR interchange requirements or the inspection requirements for specific railcars. The hazardous materials inspection form contained sections for shipping papers, labeling, markings, and placarding and were based on PHMSA hazardous materials regulations in 49 CFR Parts 171–180.

Edwards and Runyon (2009) also discussed the role of the CVSA in developing truck inspection standards for highway route controlled quantity (HRCQ) shipments of radioactive material. The Federal Motor Carrier Safety Administration (FMCSA) has codified the requirement for a CVSA Level VI inspection[6] for HRCQ shipments of radioactive material in 49 CFR 385.415(b). The CVSA Level VI inspection includes driver inspection standards, vehicle inspection standards, hazardous materials inspection standards, and administrative inspection standards.

The CVSA 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 transportation 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 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 cars. The hazardous materials inspection items and out-of-service criteria in the CVSA Level VI inspection procedures derived from 49 CFR Parts 171–173 are generally independent of transport mode. However, the hazardous materials inspection items and out-of-service criteria in the CVSA Level VI inspection procedures derived from 49 CFR Part 177 are specific to carriage by public highway and the hazardous materials inspection items and out-of-service criteria derived from 49 CFR Part 174 would be specific to carriage by rail.

[6] North American Standard Out-of-Service Criteria and Level VI Inspection Procedures and Out-of-Service Criteria for Commercial Highway Vehicles Transporting Transuranics and Highway Route Controlled Quantities of Radioactive Materials as Defined in 49 CFR Part 173.403 (CVSA 2024).

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3 CONCEPT OF OPERATIONS

To develop the Inspection Protocol, it was first necessary to develop a simplified concept of operations for the rail shipments. Rail shipments are operated by independently owned railroads over their own property, not over public highways. They interchange with their partner railroads under interchange agreements based upon uniform terms from the AAR. Multiple train crews and multiple railroads will transport shipments to their destinations.

In contrast to rail shipments, highway shipments are operated over State-owned public highways and are under the full control of Federal and State officials who can stop, inspect, and survey these shipments at any point of the transportation journey under their State authority on public highways. In most cases, drivers will maintain possession of the shipment from origin to destination.

In the context of developing the 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 Inspection Protocol. Examples of additional details that would needlessly complicate the development of the 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, except for radioactive labels and placards on loaded transportation casks and cask-carrying railcars.

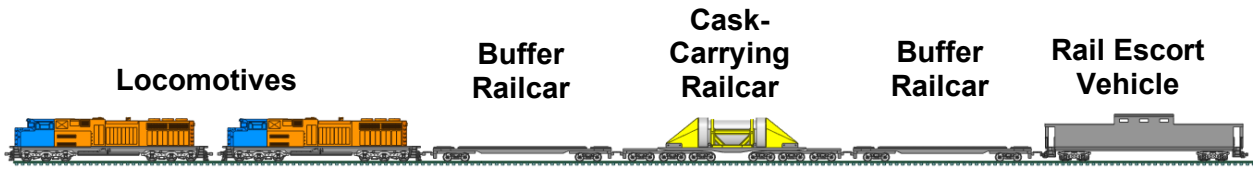

Figure 1. Simplified train consist for spent nuclear fuel transport.

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 the following:

- 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, and
- 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, with permission of the railroad, would also include the extra-regulatory inspections by the contracted DOE inspectors as described and outlined in this 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 (REB, 2006). Depending on the seriousness of the defect, if a defect cannot be repaired at the origin site, the railcar may be allowed to continue to its next inspection location for repair (REB, 2006).

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 the following:

- 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, and
- fixing minor defects before departure.

As with the origin site simplified concept of operations, the inspections of the train 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 Inspection Protocol for the purpose of promoting inspection reciprocity along transportation routes.

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 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 railroad 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 railroad rules. The train would arrive at the destination site, the transportation casks would be unloaded, and the process would re-start.

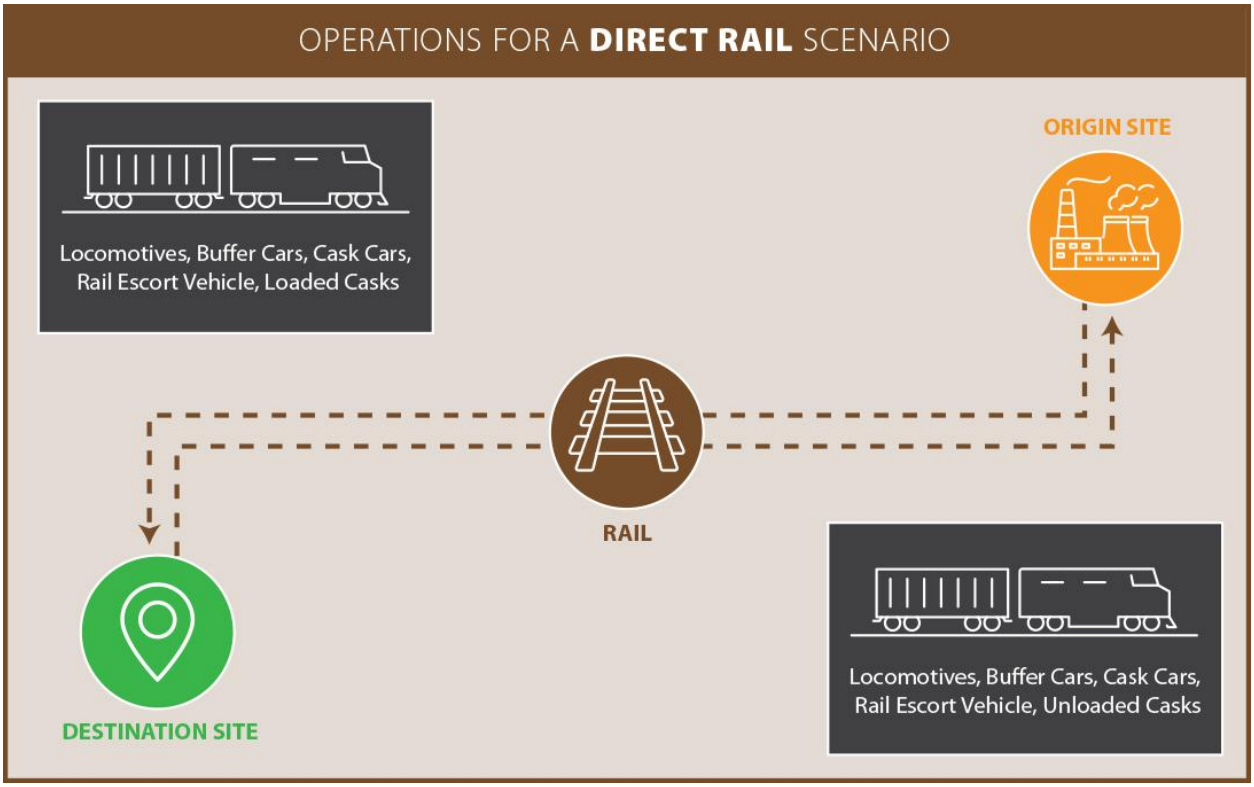

Figure 2. Simplified concept of operations for a direct rail scenario.

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 the 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 railroad 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 railroad rules. The train would arrive at the destination site, the transportation casks would be unloaded, and the process would re-start.

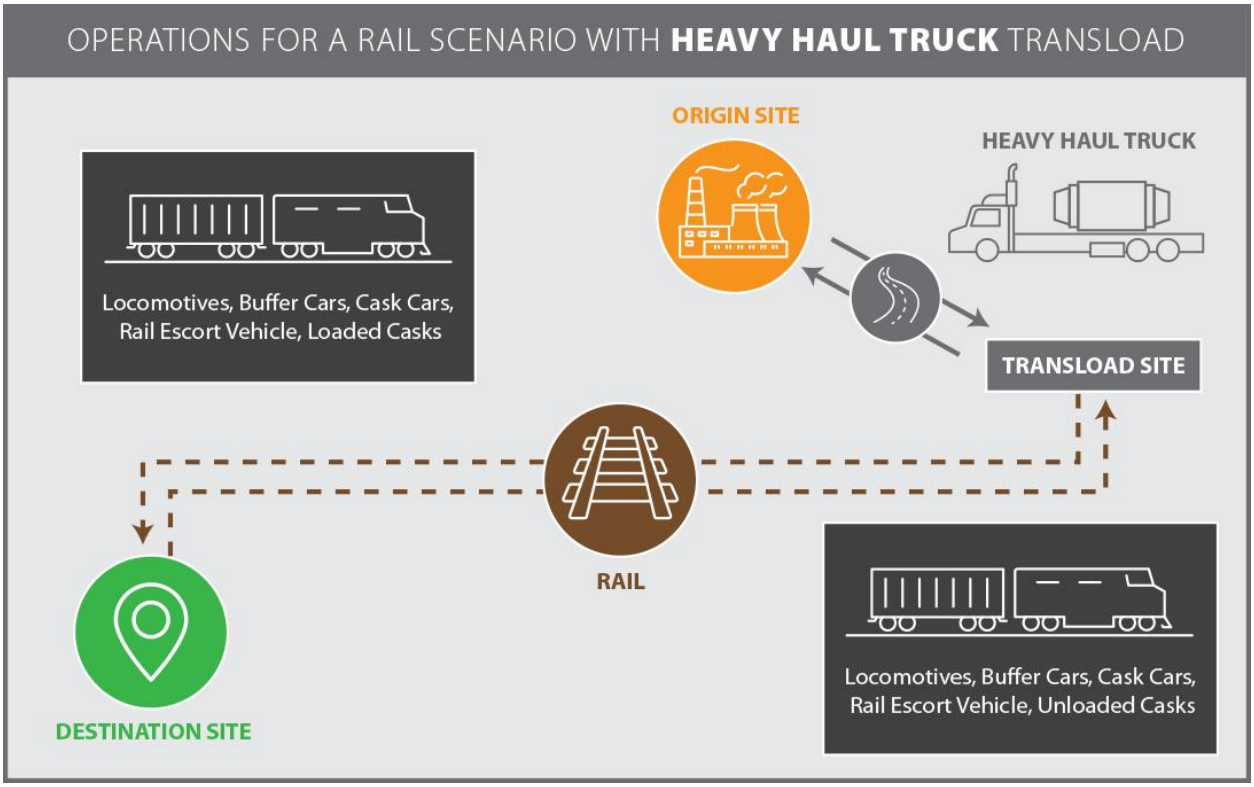

Figure 3. Simplified concept of operations for a rail scenario with a heavy haul truck transload.

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 the 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 railroad 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 railroad rules. The train would arrive at the destination site, the transportation casks would be unloaded, and the process would re-start.

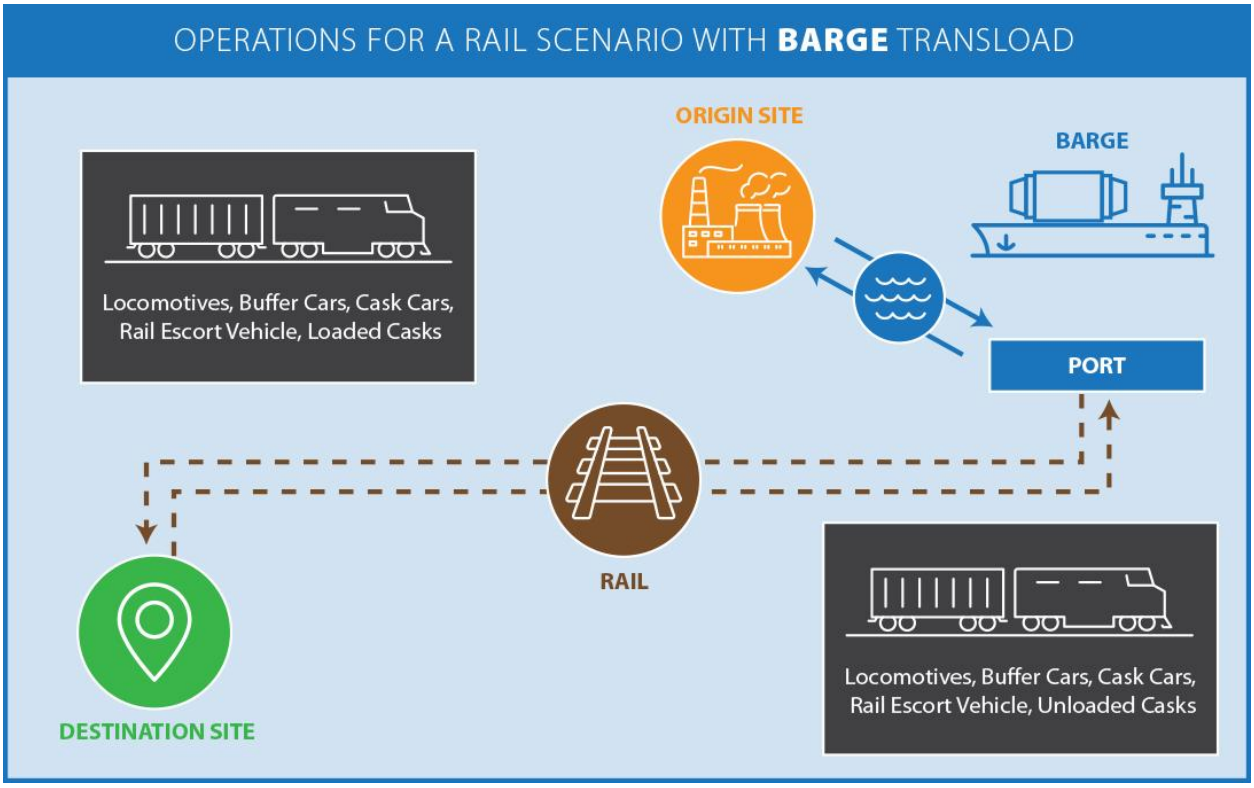

Figure 4. Simplified concept of operations for a rail scenario with a barge transload.

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4 FEDERAL RAILROAD ADMINISTRATION

In addition to hazardous materials inspections on rail, FRA's motive power and equipment (MP&E) division has additional specific regulations that require the inspection of locomotives and freight cars. The regulations providing the safety standards for inspection of locomotives are contained in 49 CFR Part 229. These regulations 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,[7] 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.

Although required by regulations to be documented, there is not an 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.

Table 2 contains a list of items typically included in the daily locomotive inspections and the corresponding regulatory citation. Table 2 is patterned after the schedules presented in Cook et al. (1999) and IAEA (2015) and is presented in a two-column format where the right column is the regulatory requirement and the left column is the citation for the regulation in which the requirement is found. In some cases, the regulatory requirement was paraphrased from the text of the regulation for brevity.

Class I railroads 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 railroads[8] 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. Figure 5 illustrates two screen shots from a daily locomotive inspection form application available from https://www.fulcrumapp.com/apps/daily-locomotive-inspection-report/.

[7] FRA Form F6180-49A is available at https://safetydata.fra.dot.gov/OfficeofSafety/publicsite/Forms.aspx.
[8] Short line railroads are smaller railroads 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).

Table 2. Regulatory citations and requirements for locomotive daily inspections.

Citation	Requirement[a]
49 CFR 229.23	Periodic Inspection. Examine Form F6180.49A (Blue Card) to ensure all inspections and tests prescribed by Part 229 are current.
49 CFR 229.119	Cabs, Floors, Passageways. Determine that cab floors and passageways are free of impediments that might cause a tripping/slipping hazard. Cab seats must be properly secured to prevent personal injury.
49 CFR 229.129	Audible Warning Device. Operate the horn on the leading locomotive to determine that it functions. When equipped, operate the bell.
49 CFR 229.127	Cab Lights. Cab overhead and instrument lights shall be operative and provide sufficient illumination. Passageways used by the crew shall also be illuminated.
49 CFR 229.137	Sanitation. The lead locomotive toilet facility is sanitary and operational.
49 CFR 229.117	Speed Indicators. Inspect the speed indicator on the controlling locomotive to determine that it is not damaged. Tests shall be made to determine accuracy after departure.
49 CFR 229.46, 229.47, 229.49, 229.53, 229.59	Brake Systems. Locomotive brakes shall be known that they operate as intended. Test procedures should include the testing of automatic and independent brake valves. Drain water and oil from the main reservoir.
49 CFR 229.13	Control of Locomotive. Whenever two or more locomotives are coupled in remote or multiple control, all systems shall respond to control from the cab of the controlling locomotive (i.e., propulsion sanders, air brakes, etc.).
49 CFR 229.140	Alerters[b]. A controlling locomotive equipped with an alerter shall be tested prior to departure from each initial terminal, or prior to being coupled as the lead locomotive in a locomotive consist by allowing the warning timing cycle to expire that results in an application of the locomotive brakes at a penalty rate.
49 CFR 229.135	Event Recorders. Examine event recorder if accessible to crew members for evidence of tampering.
49 CFR 229.41	Protection - Personal Injury. Exposed moving or mechanical parts, relays, switches, and high voltage equipment (inside cab and engine room compartment) shall not present undue safety hazards to crew members.
49 CFR 229.43	Exhaust and Battery Gases. Inspect for signs of diesel exhaust, battery gases, or other noxious fumes are vented to the outside and not in the cab of the controlling locomotive.
49 CFR 229.101	Engines. Temperature and pressure alarms shall be observed to determine that the engine functions properly. A shut down engine shall be tagged with a warning notice.
49 CFR 229.45	General Condition. Inspect to determine that no defects exist that would endanger the safety of the crew, such as insecure or improper function of components, safety appliances, structural defects, etc.
49 CFR 229.123	Pilots, Snowplows, Endplates. The end in the direction of travel of each lead locomotive must have a pilot plate or snowplow properly secured and be not less than 3 inches nor more than 6 inches from rail.
49 CFR 229.61	Draft System. Couplers and uncoupling levers must function properly. Visually inspect the exposed components or the draft system for defects.
49 CFR 229.89	Jumper Cables. Jumper cables may not be broken, chafed, or left hanging with one end free. Jumper receptacles may not have broken terminals or retainer caps.
49 CFR 229.131	Sanders. Sanders must operate on each locomotive in front of the first powered wheel set in the direction of travel and must be aligned to deposit sand on the rail.

Citation	Requirement[a]
49 CFR 229.125, 229.133	Headlights, Auxiliary Lights. Headlights and dimmer switch must be operative for the lead end of road locomotives and both ends of locomotive in switching service. Auxiliary lights may not be used in lieu of headlight.
49 CFR 229.55	Piston Travel. Piston travel must not exceed 1-½ inches less than the maximum total travel. Total possible travel can be acquired from the Blue Card (F6180.49A). Released brakes shall provide brake shoe clearance.
49 CFR 229.57	Foundation Brake Gear. Inspect brake rigging to ensure that all parts are secured. Brake shoes must align correctly with the wheel and not be overlapped and/or coved.
49 CFR 229.75	Wheels. Inspect wheel for the following conditions: • Flat spot(s) • High flange • Shelled spot(s) • Thin flange • Thin rim • Gouge or clip in flange • Cracks or breaks in flange, rim, plate, or hub.
49 CFR 229.67, 229.69, 229.71	Trucks[c]. Trucks may not be cracked or broken. Conduct walk-around inspection of exposed truck components for cracked, broken, or hazardous conditions. Inspect the underside from outside gauge of rail for defective components. No part except wheel and non-metallic sand hoses may be less than 2-½inches from rail.
49 CFR 229.65	Spring Riggings. Truck springs and rigging must not be broken and be in proper position; and spring safety hangers to be in correct position. Shock absorbers may not be broken or leaking clearly formed droplets of oil or fluid.
49 CFR 229.91	Motors and Generators. No traction motor may be cut out. All traction motor cables and cable connections should be damage free, and free from accumulation of oil that may be a hazard.
49 CFR 229.64	Plain Bearing. Inspect plain bearing boxes for cracks or damage that might cause loss or contamination of lubricant.

(a) Regulatory requirements paraphrased from the text of the regulation for brevity.
(b) An alerter is a device or system installed in the locomotive cab to promote continuous, active locomotive engineer attentiveness by monitoring select locomotive engineer-induced control activities. If fluctuation of a monitored locomotive engineer-induced control activity is not detected within a predetermined time, a sequence of audible and visual alarms is activated so as to progressively prompt a response by the locomotive engineer. Failure by the locomotive engineer to institute a change of state in a monitored control, or acknowledge the alerter alarm activity through a manual reset provision, results in a penalty brake application that brings the locomotive or train to a stop.
(c) A truck is a rail vehicle component that consists of a frame, wheels, axles, brakes, suspension, and other parts, which supports the vehicle body.

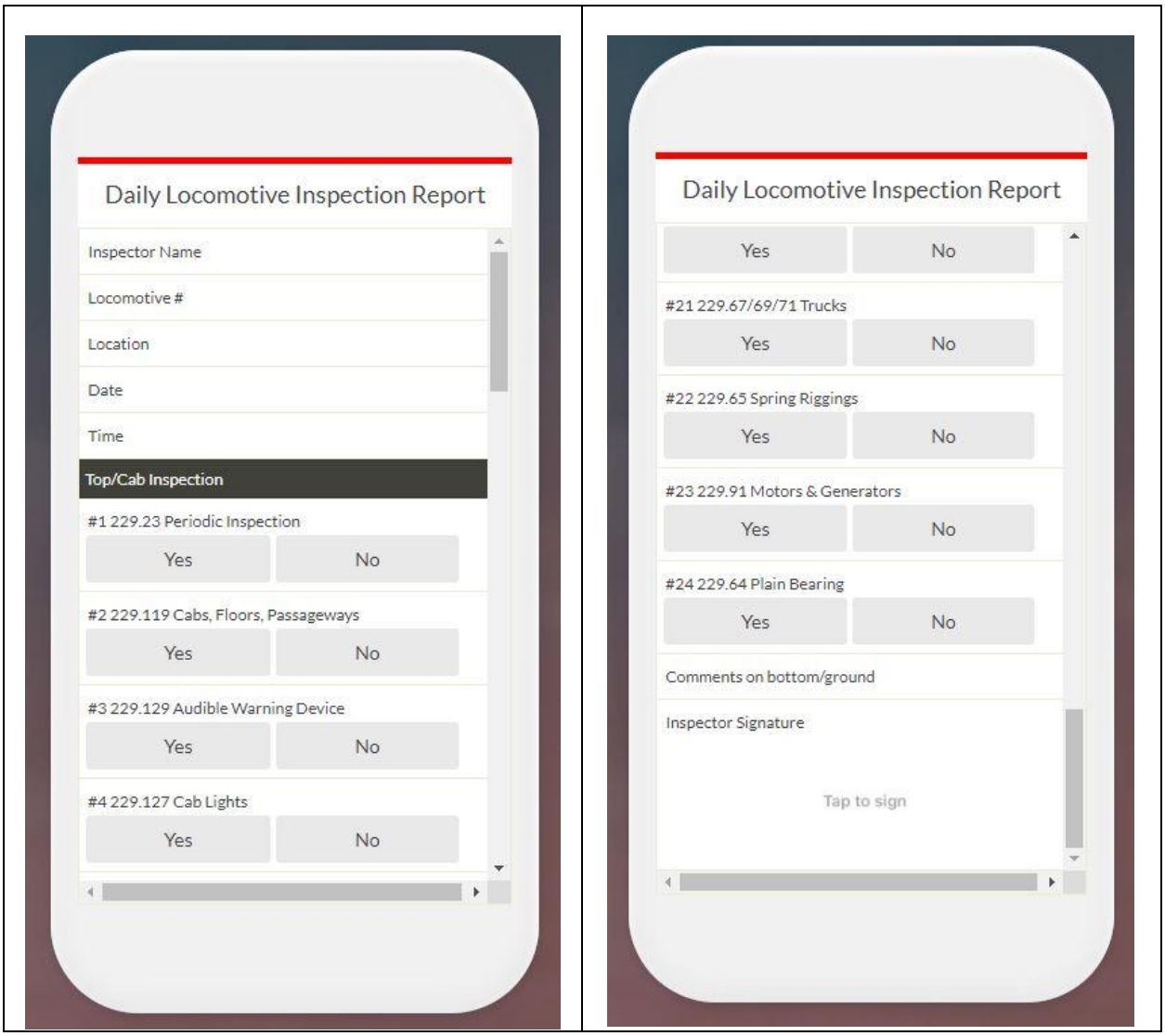


Figure 5. Screenshots from a daily locomotive inspection report application. Source: https://www.fulcrumapp.com/apps/daily-locomotive-inspection-report/.

The regulations for freight car inspections are contained in 49 CFR Parts 215, 224, 231, and 232. Table 3 contains a list of items included in freight railcar inspections. As with Table 2, Table 3 is patterned after the schedules presented in Cook et al. (1999) and IAEA (2015) and is presented in a two-column format where the right column is the regulatory requirement and the left column is the citation for the regulation in which the requirement is found. In some cases, the regulatory requirement was paraphrased from the text of the regulation for brevity.

Table 3. Freight railcar inspection requirements.

Citation	Requirement[a,b]
49 CFR 215.13	Pre-departure Inspection (a) At each location where a freight car is placed in a train, the freight car shall be inspected before the train departs. This inspection may be made before or after the car is placed in the train. (b) At a location where an inspector designated under § 215.11 is on duty for the purpose of inspecting freight cars, the inspection required by paragraph (a) of this section shall be made by that inspector to determine whether the car is in compliance with this part. (c) At a location where a person designated under § 215.11 is not on duty for the purpose of inspecting freight cars, the inspection required by paragraph (a) shall, as a minimum, be made for those conditions set forth in appendix D to this part. (d) Performance of the inspection prescribed by this section does not relieve a railroad of its liability under § 215.7 for failure to comply with any other provision of this part.
49 CFR 215.103	Defective Wheel A railroad may not place or continue in service a car, if— (a) A wheel flange on the car is worn to a thickness of 7/8 of an inch, or less, at a point ½ of an inch above the tread of the wheel; (b) The height of a wheel flange on the car, from the tread to the top of the flange, is 1-½ inches, or more; (c) The thickness of a rim of a wheel on the car is 1-1/16 of an inch, or less; (d) A wheel rim, flange, plate, or hub area on the car has a crack or break; (e) A wheel on the car has a chip or gouge in the flange that is 1-½ inches in length and ½ inch in width, or more; (f) A wheel on the car has— (1) A slid flat or shelled spot that is more than 2-½ inches in length; or (2) Two adjoining flat or shelled spots each of which is more than two inches in length; (g) A wheel on the car shows evidence of being loose such as oil seepage on the back hub or back plate; (h) A wheel on the car shows signs of having been overheated as evidenced by a reddish brown discoloration, to a substantially equal extent on both the front and the back face of the rim, that extends on either face more than four inches into the plate area measured from the inner edge of the front or back face of the rim; or, (i) A wheel on the car has been welded unless the car is being moved for repair in accordance with § 215.9 of this part.
49 CFR 215.105	Defective Axle A railroad may not place or continue in service a car, if— (a) An axle on the car has a crack or is broken; (b) An axle on the car has a gouge in the surface that is— (1) Between the wheel seats; and (2) More than one-eighth inch in depth; (c) An axle on the car, used in conjunction with a plain bearing, has an end collar that is broken or cracked;

Citation	Requirement[a,b]
	(d) A journal on the car shows evidence of overheating, as evidenced by a pronounced blue black discoloration; or (e) The surface of the plain bearing journal on the axle, or the fillet on the axle, has— (1) A ridge; (2) A depression; (3) A circumferential score; (4) Corrugation; (5) A scratch; (6) A continuous streak; (7) Pitting; (8) Rust; or (9) Etching.
49 CFR 215.115	Defective Roller Bearing (a) A railroad may not place or continue in service a car, if the car has— (1) A roller bearing that shows signs of having been overheated as evidenced by— (i) Discoloration; or (ii) Other telltale signs of overheating such as damage to the seal or distortion of any bearing component; (2) A roller bearing with a— (i) Loose or missing cap screw; or (ii) Broken, missing, or improperly applied cap screw lock; or (3) A roller bearing with a seal that is loose or damaged, or permits leakage of lubricant in clearly formed droplets. (b)(1) A railroad may not continue in service a car that has a roller bearing whose truck was involved in a derailment unless the bearing has been inspected and tested by: (i) Visual examination to determine whether it shows any sign of damage; and (ii) Spinning freely its wheel set or manually rotating the bearing to determine whether the bearing makes any unusual noise. (2) The roller bearing shall be disassembled from the axle and inspected internally if— (i) It shows any external sign of damage; (ii) It makes any unusual noise when its wheel set is spun freely or the bearing is manually rotated; (iii) Its truck was involved in a derailment at a speed of more than 10 miles per hour; or (iv) Its truck was dragged on the ground for more than 200 feet. (3) Each defective roller bearing shall be repaired or replaced before the car is placed back in service.

Citation	Requirement[a,b]
49 CFR 215.117	Defective Roller Bearing Adapter A railroad may not place or continue in service a car, if the car has a roller bearing adapter that is— (a) Cracked or broken; (b) Not in its design position; or (c) Worn on the crown of the adapter to the extent that the frame bears on the relief portion of the adapter, as shown in the figure below (see figure 1 [in 49 CFR 215.117]).
49 CFR 215.119	Defective Freight Car Truck A railroad may not place or continue in service a car, if the car has— (a) A side frame or bolster that— (1) Is broken; or (2) Has a crack of 1/4 of an inch or more in the transverse direction on a tension member; (b) A truck equipped with a snubbing device that is ineffective, as evidenced by— (1) A snubbing friction element that is worn beyond a wear indicator; (2) A snubber wear plate that is loose, missing (except by design), or worn through; (3) A broken or missing snubber activating spring; or (4) Snubber unit that is broken, or in the case of hydraulic units, is broken or leaking clearly formed droplets of oil or other fluid. (c) A side bearing in any of the following conditions: (1) Part of the side bearing assembly is missing or broken; (2) The bearings at one end of the car, on both sides, are in contact with the body bolster (except by design); (3) The bearings at one end of the car have a total clearance from the body bolster of more than 3/4 of an inch; or (4) At diagonally opposite sides of the car, the bearings have a total clearance from the body bolsters of more than 3/4 of an inch; (d) Truck springs— (1) That do not maintain travel or load; (2) That are compressed solid; or (3) More than one outer spring of which is broken, or missing, in any spring cluster; (e) Interference between the truck bolster and the center plate that prevents proper truck rotations; or (f) Brake beam shelf support worn so excessively that it does not support the brake beam.
49 CFR 215.121	Defective Car Body A railroad may not place or continue in service a car, if: (a) Any portion of the car body, truck, or their appurtenances (except wheels) has less than a 2-½ inch clearance from the top of rail; (b) The car center sill is: (1) Broken; (2) Cracked more than 6 inches; or

Citation	Requirement[a,b]
	(3) Permanently bent or buckled more than 2-½ inches in any six foot length; (c) The car has a coupler carrier that is: (1) Broken; (2) Missing; (3) Non-resilient and the coupler has a type F head. (d) After December 1, 1983, the car is a box car and its side doors are not equipped with operative hangers, or the equivalent, to prevent the doors from becoming disengaged. (e) The car has a center plate: (1) That is not properly secured; (2) Any portion of which is missing; or (3) That is broken; or (4) That has two or more cracks through its cross section (thickness) at the edge of the plate that extend to the portion of the plate that is obstructed from view while the truck is in place; or (f) The car has a broken sidesill, crossbearer, or body bolster.
49 CFR 215.123	Defective Couplers A railroad may not place or continue in service a car, if— (a) The car is equipped with a coupler shank that is bent out of alignment to the extent that the coupler will not couple automatically with the adjacent car; (b) The car has a coupler that has a crack in the highly stressed junction area of the shank and head as shown in the figure below (see figure 2 [in 49 CFR 215.123]). (c) The car has a coupler knuckle that is broken or cracked on the inside pulling face of the knuckle. (d) The car has a knuckle pin or knuckle thrower that is: (1) Missing; or (2) Inoperative; or (e) The car has a coupler retainer pin lock that is— (1) Missing; or (2) Broken; or (f) The car has a coupler with any of the following conditions: (1) The locklift is inoperative; (2) The coupler assembly does not have anticreep protection to prevent unintentional unlocking of the coupler lock; or (3) The coupler lock is— (i) Missing; (ii) Inoperative; (iii) Bent; (iv) Cracked; or (v) Broken.

Citation	Requirement[a,b]
49 CFR 215.125	Defective Uncoupling Device A railroad may not place or continue in service a car, if the car has an uncoupling device without sufficient vertical and lateral clearance to prevent— (a) Fouling on curves; or (b) Unintentional uncouplings.
49 CFR 215.127	Defective Draft Arrangement A railroad may not place or continue in service a car, if— (a) The car has a draft gear that is inoperative; (b) The car has a broken yoke; (c) An end of car cushioning unit is— (1) Leaking clearly formed droplets; or (2) Inoperative; (d) A vertical coupler pin retainer plate— (1) Is missing (except by design); or (2) Has a missing fastener; (e) The car has a draft key, or draft key retainer, that is— (1) Inoperative; or (2) Missing; or (f) The car has a missing or broken follower plate.
49 CFR 215.129	Defective Cushioning Device A railroad may not place or continue in service a car if it has a cushioning device that is— (a) Broken; (b) Inoperative; or (c) Missing a part—unless its sliding components have been effectively immobilized.
49 CFR 215.301	Stenciling The railroad or private car owner reporting mark, the car number, and built date shall be stenciled, or otherwise displayed, in clearly legible letters and numbers not less than seven inches high, except those of the built date, which shall not be less than one inch high: (a) On each side of each railroad freight car body; and (b) In the case of a tank car, in any location that is visible to a person walking at track level beside the car.
49 CFR 224.103	Characteristics of Retroreflective Sheeting. 49 CFR 224.103 contains requirements for retroreflective sheeting construction, color, performance, certification, and alternative standards.
49 CFR 224.105	Sheeting Dimensions and Quantity. 49 CFR 224.105 contains requirements for retroreflective sheeting dimensions and quantity.
49 CFR 224.106	Location of Retroreflective Sheeting. 49 CFR 224.106 contains requirements for the location of retroreflective sheeting on railroad freight cars and locomotives.
49 CFR 231.6	Safety Appliances—Freight Cars. 49 CFR 231.6 contains requirements for hand brakes, sill steps, side handholds, end handholds, and uncoupling levers for railroad freight cars.

Citation	Requirement[a,b]
49 CFR 231.29	Safety Appliances—Road Locomotives with Corner Stairways. 49 CFR 231.29 contains requirements for safety appliances for road locomotives with corner stairways.
49 CFR 232.205	Class I Brake Test—Initial Terminal Inspection. 49 CFR 232.205 contains detailed requirements for Class I brake tests that are required at the location where a train is originally assembled (“initial terminal”).
49 CFR 232.409	End-of-Train Devices. 49 CFR 232.409 contains detailed requirements for the inspection and testing of end-of-train devices.
a. Regulatory requirements paraphrased from the text of the regulation for brevity. b. Freight car requirements apply to cask-carrying and buffer railcars.	

5 ASSOCIATION OF AMERICAN RAILROADS INTERCHANGE REQUIREMENTS

FRA regulates the safety, operations, and infrastructure of railroads. The role of the AAR is to set engineering and interoperability standards for rail equipment and operations. This ensures that most freight railcars are interchangeable among railroads. This is possible because the basic dimensions, design criteria, construction, and maintenance standards for the railcar are specified by the AAR (Vantuono, 2008).

AAR interchange requirements are contained in the *Field Manual of the AAR Interchange Rules* (AAR-IR) (AAR, 2024b). Components covered in the Field Manual include (see Table 4) the following:

- 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); and
- general repairs (Rules 63–82).

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 (e.g., Rule 68, Refrigeration Equipment, or Rule 78, Lumber).

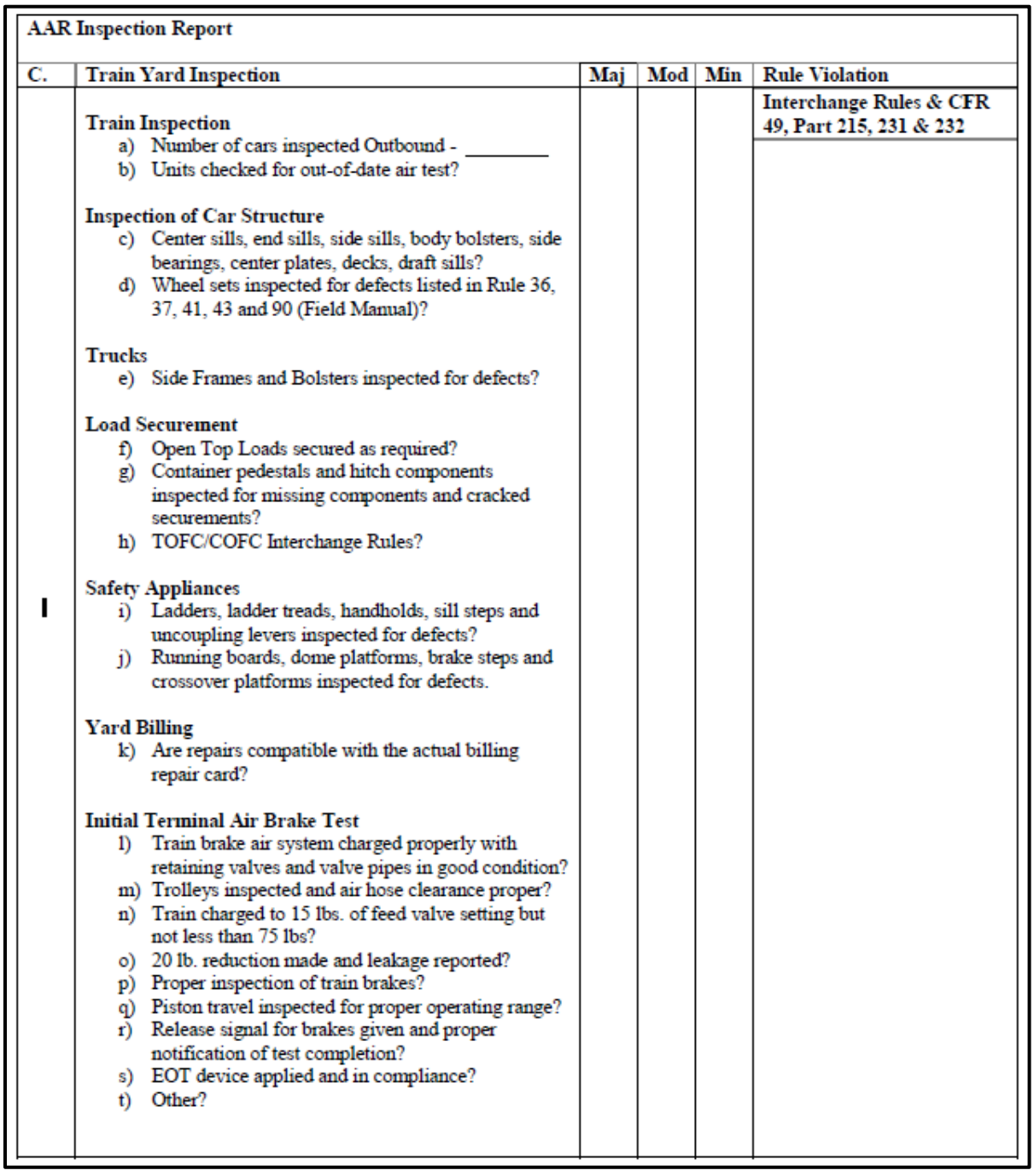
The AAR Mechanical Inspection Department has developed an inspection checklist. The primary purpose of this checklist is the return of a railcar to service after it has been in a repair shop. Areas covered in the checklist include outbound inspections of completed cars, inbound inspections of cars at the repair shop, train yard inspections, scrap inspections, repair practices, and AAR billing and forms. The train yard inspection checklist is presented in Figure 6. below, following Table 4.

Table 4. Association of American Railroads interchange rules.

Rule	Component
Rule 3	Testing of Air Brakes
Rule 4	Air Brake Valves and Parts
Rule 5	Air Brake Hoses, Hose Supports, and Trainlines
Rule 6	End Hose Arrangement Performance and Angle Cock Placement
Rule 7	Brake Beams, Hangers, Brackets, Wear Plates and Brake Connection Pins, Hanger Pins, or Bolts
Rule 8	Automatic Slack Adjuster
Rule 9	Air Brake Cylinders and Parts
Rule 10	Brake Beam and Bottom Rod Supports

Rule	Component
Rule 11	Brake Levers, Guides and Brake Connection Rods
Rule 12	Brake Shoes and Shoe Keys
Rule 13	Hand Brakes – Geared and Non-Geared
Rule 16	Couplers, Type E and Parts
Rule 17	Couplers, Type E/F and Parts
Rule 18	Couplers, Type F and Parts
Rule 19	Yokes, Type E
Rule 20	Yokes, Type E/F and F
Rule 21	Draft Gears, Carriers and Followers
Rule 22	Uncoupling Levers and Support Brackets
Rule 23	Articulated Connectors
Rule 36	Roller Bearings
Rule 37	Roller Bearing Adapters
Rule 41	Wheels
Rule 43	Axles
Rule 44	Wheels Sets
Rule 46	Truck System Performance
Rule 47	Truck Bolsters
Rule 48	Truck Side Frames, Transoms and Spring Planks
Rule 50	Truck Springs and Snubbers
Rule 53	Running Boards—Dome Platforms—Brake Steps—Cross Platforms
Rule 57	Center Sills, Draft Sills, and Coupler Carriers
Rule 58	Side Sills
Rule 59	Cushioned Underframe Devices
Rule 60	Body Center Plates
Rule 61	Body Side Bearings
Rule 62	Truck Side Bearings
Rule 63	Automatic Equipment Identification (AEI)
Rule 64	Tie Down and Load Restraining Devices
Rule 65	Trailer Hitches and Parts
Rule 66	Reflective Sheeting
Rule 67	Miscellaneous Instructions
Rule 68	Refrigeration Equipment
Rule 69	Miscellaneous Material
Rule 70	Lightweights, Weight Limits and Overloading
Rule 71	Card Boards and Receptacles
Rule 72	Manufactured Material
Rule 73	Trough Hatch Covers
Rule 74	Securement
Rule 75	Miscellaneous Labor
Rule 76	Straightening Parts Off Car
Rule 77	Door and Door Parts

Rule	Component
Rule 78	Lumber
Rule 79	Ladders, Ladder Treads, Handholds and Sill Steps
Rule 80	Markings
Rule 81	Tank and Tank Car Repairs
Rule 82	Welding and Allied Processes



AAR Inspection Report

C.	Train Yard Inspection	Maj	Mod	Min	Rule Violation
	Train Inspection a) Number of cars inspected Outbound - _____ b) Units checked for out-of-date air test? **Inspection of Car Structure** c) Center sills, end sills, side sills, body bolsters, side bearings, center plates, decks, draft sills? d) Wheel sets inspected for defects listed in Rule 36, 37, 41, 43 and 90 (Field Manual)? **Trucks** e) Side Frames and Bolsters inspected for defects? **Load Securement** f) Open Top Loads secured as required? g) Container pedestals and hitch components inspected for missing components and cracked securements? h) TOFC/COFC Interchange Rules? **Safety Appliances** i) Ladders, ladder treads, handholds, sill steps and uncoupling levers inspected for defects? j) Running boards, dome platforms, brake steps and crossover platforms inspected for defects. **Yard Billing** k) Are repairs compatible with the actual billing repair card? **Initial Terminal Air Brake Test** l) Train brake air system charged properly with retaining valves and valve pipes in good condition? m) Trolleys inspected and air hose clearance proper? n) Train charged to 15 lbs. of feed valve setting but not less than 75 lbs? o) 20 lb. reduction made and leakage reported? p) Proper inspection of train brakes? q) Piston travel inspected for proper operating range? r) Release signal for brakes given and proper notification of test completion? s) EOT device applied and in compliance? t) Other?				**Interchange Rules & CFR 49, Part 215, 231 & 232**

Figure 6. Association of American Railroads (AAR) mechanical inspection department checklist for train yard inspections.

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6 ASSOCIATION OF AMERICAN RAILROADS STANDARD S-2043 SAFETY MONITORING REQUIREMENTS

Section 4.5 of AAR Standard S-2043, *Performance Specification for Trains Used to Carry High-Level Radioactive Material (HLRM)*[9] (AAR, 2024a), contains the requirements for safety monitoring system for railcars in an HLRM train. The minimum parameters monitored include the following:

- 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, and
- 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, and
- 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,

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

- wheel flat—wheel flat indication, and
- brakes—indication of an inoperative brake.

DOE is currently evaluating integrating the safety monitoring system required by AAR Standard S-2043 for an HLRM train into its Transportation Tracking and Communication System (TRANSCOM) and providing the above data feeds through the TRANSCOM system.[10]

An inspection checklist for the 3C Telemetry safety monitoring system currently installed on the Atlas rail consist has been developed (see Section 11).

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

7 U.S. DEPARTMENT OF TRANSPORTATION AND U.S. DEPARTMENT ENERGY HAZARDOUS AND RADIOACTIVE MATERIALS INSPECTION REGULATIONS AND REQUIREMENTS

Federal hazardous materials transportation law (49 U.S.C. 5101 et seq.) gives the Secretary of the DOT the authority to regulate the transportation of hazardous materials in commerce. Within DOT, PHMSA has been delegated responsibility for the Hazardous Materials Regulations.

The Hazardous Materials Regulations are applicable to the transportation of hazardous materials in commerce, including activities such as the following:

- Transport by interstate, intrastate, and foreign carriers by railcar, aircraft, motor vehicle, and vessel.
- Shipper's pre-transportation activities to present for shipment of a hazardous material in a package, container, railcar, aircraft, motor vehicle, or vessel with accompanying marking, labeling, placarding, and shipping papers.
- The manufacture, fabrication, marking, maintenance, reconditioning, repairing, or testing of a package or container which is represented, marked, certified, or sold for use in the transportation of hazardous materials.

The Hazardous Materials Regulations define nine classes of hazardous materials; radioactive material is denoted Class 7. In addition to regulatory requirements that apply to shipments of hazardous materials generally, sections of the Hazardous Material Regulations specific to Class 7 radioactive materials are:

- 49 CFR Part 173, "Shippers–General Requirements for Shipments and Packagings," Subpart I (§173.401–§173.477), Class 7 (Radioactive) Materials
- 49 CFR Part 174, "Carriage by Rail," Subpart K (§174.700–§174.750), "Detailed Requirements for Class 7 (Radioactive) Materials"
- 49 CFR Part 175, "Carriage by Aircraft," Subpart C (§175.310–§175.900), "Specific Regulations Applicable According to Classification of Material" (§175.700–§175.706 provide requirements specific to Class 7 [radioactive] materials)
- 49 CFR Part 176, "Carriage by Vessel," Subpart M (§176.700–§176.720), "Detailed Requirements for Radioactive Materials"
- 49 CFR Part 177, "Carriage by Public Highway," Subpart B (§177.834–§177.843), "Loading and Unloading" (§177.842 provides requirements specific to Class 7 [radioactive] materials)
- 49 CFR Part 178, "Specifications for Packagings," Subpart K (§178.350), "Specifications for Packagings for Class 7 (Radioactive) Materials."

In addition, the DOT FMCSA has requirements that apply to transporting radioactive materials by highway. These requirements include:

- 49 CFR Part 385, "Safety Fitness Procedures," Subpart E (§385.401–§385.423), "Hazardous Materials Safety Permits"
- 49 CFR Part 397, "Transportation of Hazardous Materials; Driving and Parking Rules," Subpart D (§397.101–§397.103), "Routing of Class 7 (Radioactive) Materials"

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 (NRC, 2008) (see Table 5.). Table 5. is presented in a two-column format where the right column is the regulatory requirement and the left column is the citation for the regulation in which the requirement is found. In some cases, the regulatory requirement was paraphrased from the text of the regulation for brevity. Specific inspection requirements for shipments of hazardous materials by rail are contained in 49 CFR 174.9 (see Table 5.).

DOE has broad authority under the Atomic Energy Act of 1954, as amended (AEA), 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 (e.g., see DOE Order 460.1D and DOE Order 460.2B).

Table 5. Hazardous materials inspection requirements.

Citation	Requirement[a]
49 CFR 173.474[b]	Prior to the first use of any packaging for the shipment of Class 7 (radioactive) material, the offeror shall determine that— (a) The packaging meets the quality of design and construction requirements as specified in this subchapter; and (b) The effectiveness of the shielding, containment and, when required, the heat transfer characteristics of the package, are within the limits specified for the package design.
49 CFR 173.475[c]	Before each shipment of any Class 7 (radioactive) materials package, the offeror must ensure, by examination or appropriate tests, that— (a) The packaging is proper for the contents to be shipped; (b) The packaging is in unimpaired physical condition, except for superficial marks; (c) Each closure device of the packaging, including any required gasket, is properly installed, secured, and free of defects; (d) For fissile material, each moderator and neutron absorber, if required, is present and in proper condition; (e) Each special instruction for filling, closing, and preparation of the packaging for shipment has been followed; (f) Each closure, valve, or other opening of the containment system through which the radioactive content might escape is properly closed and sealed; (g) Each packaging containing liquid in excess of an A_2 quantity and intended for air shipment has been tested to show that it will not leak under an ambient atmospheric pressure of not more than 25 kPa, absolute (3.6 psia). The test must be conducted on the entire containment system, or on any receptacle or vessel within the containment system, to determine compliance with this requirement; (h) The internal pressure of the containment system will not exceed the design pressure during transportation; and (i) External radiation and contamination levels are within the allowable limits specified in this subchapter.
49 CFR 172.300–49 CFR 172.338	Marking. Hazardous materials packaging marking requirements are contained in 49 CFR 172.300–172.338. Specific requirements for Class 7 (radioactive) materials packaging marking are contained in 49 CFR 172.310. SNF transportation casks would be Type B(U) packages.[c]

Citation	Requirement[(a)]
49 CFR 172.310	In addition to any other markings required by this subpart, each package containing Class 7 (radioactive) materials must be marked as follows: (a) Each package with a gross mass greater than 50 kg (110 lb.) must have its gross mass including the unit of measurement (which may be abbreviated) marked on the outside of the package. (b) Each industrial, Type A, Type B(U), or Type B(M) package must be legibly and durably marked on the outside of the packaging, in letters at least 12 mm (0.47 in) high, with the words “TYPE IP–1,” “TYPE IP–2,” “TYPE IP–3,” “TYPE A,” “TYPE B(U)” or “TYPE B(M),” as appropriate. A package which does not conform to Type IP–1, Type IP–2, Type IP–3, Type A, Type B(U) or Type B(M) requirements may not be so marked. (c) Each package which conforms to an IP–1, IP–2, IP–3 or a Type A package design must be legibly and durably marked on the outside of the packaging with the international vehicle registration code of the country of origin of the design. The international vehicle registration code for packages designed by a United States company or agency is the symbol “USA.” (d) Each package which conforms to a Type B(U) or Type B(M) package design must have the outside of the outermost receptacle, which is resistant to the effects of fire and water, plainly marked by embossing, stamping or other means resistant to the effects of fire and water with a radiation symbol that conforms to the requirements of appendix B of this part. (e) Each Type B(U), Type B(M) or fissile material package destined for export shipment must also be marked “USA” in conjunction with the specification marking, or other package certificate identification. (See §§ 173.471, 173.472, and 173.473 of this subchapter.)
49 CFR 172.400–172.450	Labeling. Hazardous materials packaging labeling requirements are contained in 49 CFR 172.400–172.450. Detailed Class 7 (radioactive) material labeling requirements are contained in 49 CFR 172.403. Specifications for Class 7 (radioactive) materials packaging labels are contained in 49 CFR 172.436 (RADIOACTIVE WHITE-I), 172.438 (RADIOACTIVE YELLOW-II), 172.440 (RADIOACTIVE YELLOW-III), and 172.441 (FISSILE). A package that contains a highway route controlled quantity (see 49 CFR 173.403) is required to have a RADIOACTIVE YELLOW-III label. It is likely that that an SNF transportation cask would have RADIOACTIVE YELLOW-III and FISSILE labels.
49 CFR 172.500–172.560	Placarding. Placarding requirements are contained in 49 CFR 172.500–172.560. 49 CFR 172.504 requires a RADIOACTIVE placard if the transport vehicle contains a package that requires a RADIOACTIVE YELLOW-III label. Specifications for RADIOACTIVE placards are contained in 49 CFR 172.519(g) and 49 CFR 172.556. Specific rail placarding requirements are contained in 49 CFR 172.508.
49 CFR 173.441, 49 CFR 173.443, 49 CFR 173.475(i)	Radiation limits. Limits for external radiation and removable contamination are contained in 49 CFR 173.441, 49 CFR 173.443, and 49 CFR 173.475(i).
49 CFR 172.200–172.205	Shipping Papers. Shipping paper requirements are contained in 49 CFR 172.200–172.205. 49 CFR 172.203(d) contains specific requirements for Class 7 (radioactive) material.
49 CFR 172.203(d)	Radioactive material. The description for a shipment of a Class 7 (radioactive) material must include the following additional entries as appropriate: (1) The name of each radionuclide in the Class 7 (radioactive) material that is listed in § 173.435 of this subchapter. For mixtures of radionuclides, the radionuclides required to be shown must be determined in accordance with § 173.433(g) of this subchapter. Abbreviations, e.g., “^{99}Mo,” are authorized. (2) A description of the physical and chemical form of the material:

Citation	Requirement[a]
	(i) For special form materials, the words “special form” unless the words “special form” already appear in the proper shipping name; or (ii) If the material is not in special form, a description of the physical and chemical form of the material (generic chemical descriptions are permitted). (3) The maximum activity of the radioactive contents contained in each package during transport in terms of the appropriate SI units (e.g., Becquerels (Bq), Terabecquerels (TBq)). The activity may also be stated in appropriate customary units (e.g., Curies (Ci), milliCuries (mCi), microCuries (μCi)) in parentheses following the SI units. Abbreviations are authorized. Except for plutonium-239 and plutonium-241, the weight in grams or kilograms of fissile radionuclides (or the mass of each fissile nuclide for mixtures when appropriate) may be inserted instead of activity units. For plutonium-239 and plutonium-241, the weight in grams of fissile radionuclides (or the mass of each fissile nuclide for mixtures when appropriate) may be inserted in addition to the activity units. (4) The category of label applied to each package in the shipment. For example: “RADIOACTIVE WHITE–I,” or “WHITE–I.” (5) The transport index assigned to each package in the shipment bearing RADIOACTIVE YELLOW-II or RADIOACTIVE YELLOW-III labels. (6) For a package containing fissile Class 7 (radioactive) material: (i) The words “Fissile Excepted” if the package is excepted pursuant to § 173.453 of this subchapter; or otherwise (ii) The criticality safety index for that package. (7) For a package approved by the U.S. Department of Energy (DOE) or U.S. Nuclear Regulatory Commission (NRC), a notation of the package identification marking as prescribed in the applicable DOE or NRC approval (see § 173.471 of the subchapter). (8) For an export shipment or a shipment in a foreign made package, a notation of the package identification marking as prescribed in the applicable International Atomic Energy Agency (IAEA) Certificate of Competent Authority which has been issued for the package (see § 173.473 of the subchapter). (9) For a shipment required by this subchapter to be consigned as exclusive use: (i) An indication that the shipment is consigned as exclusive use; or (ii) If all the descriptions on the shipping paper are consigned as exclusive use, then the statement “Exclusive Use Shipment” may be entered only once on the shipping paper in a clearly visible location. (10) For the shipment of a package containing a highway route controlled quantity of Class 7 (radioactive) materials (see § 173.403 of this subchapter) the words “Highway route controlled quantity” or “HRCQ” must be entered in association with the basic description.
49 CFR 172.700–49 CFR 172.704	Training. 49 CFR 172.700–172.704 contain training requirements for hazardous material employees.
49 CFR 174.9(a)	At each location where a hazardous material is accepted for transportation or placed in a train, the carrier must inspect each railcar containing the hazardous material, at ground level, for required markings, labels, placards, securement of closures, and leakage. These inspections may be performed in conjunction with inspections required under 49 CFR 215 and 49 CFR 232.
49 CFR 174.9(b)	For each railcar containing an amount of hazardous material requiring placarding in accordance with 49 CFR 172.504 of this subchapter, the carrier must visually inspect the railcar at ground level for signs of tampering, including closures and seals, for suspicious items or items that do not belong, and for other signs that the security of the car may have been compromised, including the presence of an improvised explosive device. As used in this section, an improvised explosive device is a device fabricated in an improvised manner incorporating explosives or

Citation	Requirement[a]
	destructive, lethal, noxious, pyrotechnic, or incendiary chemicals in its design, and generally includes a power supply, a switch or timer, and a detonator or initiator. The carrier should be particularly attentive to signs that security may have been compromised on railcars transporting materials covered by 49 CFR 172.820, rail carload quantities of ammonium nitrate or ammonium nitrate mixtures in solid form, or hazardous materials of interest based on current threat information.

(a) Regulatory requirements paraphrased from the text of the regulation for brevity.
(b) The requirements in 49 CFR 173.474 are colloquially known as “first use” requirements.
(c) The requirements in 49 CFR 173.475 are colloquially known as “each use” requirements.

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8 COMMERCIAL VEHICLE SAFETY ALLIANCE INSPECTIONS

The CVSA is a nonprofit association comprised of local, State, provincial, territorial, and Federal commercial motor vehicle safety officials and industry representatives.

The North American Standard Inspection Program was created by the CVSA as the roadside inspection process for inspecting commercial motor vehicles and drivers throughout North America. The program was developed to improve the safe operation of commercial motor vehicles by establishing a uniform and reciprocal roadside inspection and enforcement process of commercial motor vehicles. The program outlines minimum inspection procedures, standards and requirements, and ensures consistency in compliance, inspections and enforcement, while minimizing duplication of efforts and unnecessary operating delays for the motor carrier industry. The North American Standard Inspection Program identifies critical inspection items and unsafe conditions that place vehicles and/or drivers out of service through a uniform inspection process.

There are eight levels of North American Standard Inspections:

- Level I is a 37-step inspection procedure that involves examination of the motor carrier's and driver's credentials, record of duty status, the mechanical condition of the vehicle, and any hazardous materials/dangerous goods that may be present.
- Level II is a driver and walk-around vehicle inspection, involving the inspection of items that can be checked without physically getting under the vehicle.
- Level III is a driver-only inspection that includes examination of the driver's credentials and documents.
- Level IV special inspections are a one-time examination of a particular item. These examinations are normally made in support of a study or to verify or refute a suspected trend.
- Level V is a vehicle-only inspection which may be performed without a driver present, at any location.
- Level VI is a specialized inspection of transuranic waste and HRCQ of radioactive material.
- Level VII is a jurisdictionally mandated inspection.
- Level VIII is an inspection conducted electronically or wirelessly while the vehicle is in motion, without direct interaction with an inspector.

Table 6. lists the CVSA inspection levels and items. As can be seen in Table 6. , the difference between a CVSA Level I inspection and a CVSA Level VI inspection is the addition of a radiological survey of the vehicle and the load prior to performing the 37-step inspection procedure. In addition, the out-of-service criteria for the Level I inspection and the Level VI inspection are different. This results in the Level VI inspection being referred to as an enhanced inspection. Table 7. lists the inspection items for which the out-of-service criteria are different between Level I and Level VI inspections.

Table 6. Commercial Vehicle Safety Alliance inspection levels and items.

Step	Item	Inspection Level					
		I	II	III	V	VI	VIII
1	Choose the Inspection Site	X	X	X		X	
2	Approach the Vehicle	X	X	X		X	
3	Greet and Prepare Drive	X	X	X		X	
4	Interview Driver	X	X	X		X	
5	Collect Driver's Documents	X	X	X		X	X
6	Check for the Presence of Hazardous Materials/Dangerous Goods	X	X	X		X	X
7	Identify the Carrier	X	X	X		X	X
8	Examine Driver's License	X	X	X		X	X
9	Check Medical Examiner's Certificate and Skill	X	X	X		X	X
10	Performance Evaluation Certificate (if applicable)	X	X	X		X	X
11	Check Record of Duty Status	X	X	X		X	X
12	Review Driver's Daily Inspection Report (if applicable)	X	X	X	X	X	X
13	Review Periodic Inspection Report(s)	X	X		X	X	
14	Prepare Driver for Vehicle Inspection	X	X		X	X	
15	Inspect Front of Tractor	X	X		X	X	
16	Inspect Left Front Side of Tractor	X	X		X	X	
17	Inspect Left Saddle Tank Area	X	X		X	X	
18	Inspect Trailer Front	X	X		X	X	
19	Inspect Left Rear Tractor Area	X	X		X	X	
20	Inspect Left Side of Trailer	X	X		X	X	
21	Inspect Rear of Trailer	X	X		X	X	
22	Inspect Double, Triple and Full Trailers	X	X		X	X	
23	Inspect Right Rear Trailer Wheels	X	X		X	X	
24	Inspect Right Side of Trailer	X	X		X	X	
25	Inspect Right Rear Tractor Area	X	X		X	X	
26	Inspect Right Saddle Tank Area	X	X		X	X	
27	Inspect Right Front Side of Tractor	X	X		X	X	
28	Inspect Steering Axle(s)	X			X	X	
29	Inspect Axle(s) 2 and/or 3 (under carriage of vehicle)	X			X	X	
30	Inspect Axle(s) 4 and/or 5	X			X	X	
31	Check Brake Adjustment	X			X	X	
32	Inspect Tractor Protection System (which tests the tractor protection system and emergency brakes)	X			X	X	
33	Inspect Low Air Pressure Warning Device and Brake Pedal	X	X		X	X	
34	Test Air Loss Rate	X	X		X	X	
35	Check Steering Wheel Lash	X	X		X	X	

Step	Item	Inspection Level					
		I	II	III	V	VI	VIII
36	Check Fifth Wheel Movement	X	X		X	X	
37	Complete the Inspection	X	X	X	X	X	X
The Level VI Inspection involves a radiological survey of the vehicle and load prior to completing the 37-step inspection procedure. The Level IV Special Inspection and Level VII Jurisdictionally Mandated Inspection could have any or all steps included; therefore, those two inspection levels are not included on this chart. Based on https://cvsa.org/wp-content/uploads/NASI-Program-Brochure.pdf.							

Table 7. Inspection items for which out-of-service criteria differ between Commercial Vehicle Safety Alliance (CVSA) Level I and CVSA Level VI inspections.

Number	Inspection Item
Part I – Driver Inspection Standards	
1.	Driver's Age
8.c	Intoxicating Beverages, Out-of-Service Order Violation
12.	Certificate of Training (HRCQ Only)
13.	Personal Dosimetry
Part II – Vehicle Inspection Standards	
1.a, 1.a.(1), 1.a.(4), 1.a.(5), 1.a.(5)(c), 1.a.(6), 1.a.(7), 1.a.(8), 1.b.(3)	Brake Systems, Defective Brakes
1.e	Parking Brake
1.h.(3), 1.h.(6)	Air Brake/Hosing
1.m	Air Reservoir (Tank)
1.n.(4)	Air Compressor
1.r	Anti-lock braking system lights
2.d	Aggregate Working Load Limit
3.a.(1).(c), 3.a.(1).(d), 3.a.(1).(e), 3.a.(1).(f), 3.a.(2).(a), 3.a.(2).(b), 3.a.(2).(c), 3.a.(2).(d) 3.a.(2).(f), 3.a.(3).(a), 3.a.(5).(a), 3.a.(5).(b)	Coupling Devices, Fifth Wheels (Lower Coupler Assembly)
3.b.(5), 3.b.(6), 3.b.(7)	Coupling Devices, Fifth Wheels (Upper Coupler Assembly)
6.a, 6.e, 6.f	Exhaust Systems
7.a.(1), 7.a.(3), 7.a.(5)	Frames
8.c	Fuel Systems
9, 9.a, 9.a.(2), 9.a.(3), 9.b.(1), 9.b.(2)	Lighting Devices
11.a.(2), 11.b.(1), 11.b.(3), 11.c.(2)	Suspensions
11.e.(1), 11.e.(1)(a), 11.e.(1)(b), 11.e.(1)(c), 11.e.(2),	Suspensions, Adjustable Axles/Sliding Trailer Suspension System
12.a.(1), 12.a.(5), 12.a.(9), 12.a.(11), 12.b.(3), 12.b.(5), 12.b.(7), 12.b.(8), 12.b.(9), 12.b.(10), 12.b.(12)	Tires
14.c.(1), 14.c.(2), 14.c.(3), 14.e.(1), 14.e.(2), 14.f.(1), 14.f.(2), 14.g,	Wheels, Rims, and Hubs

Number	Inspection Item
15.	Windshield Wipers
17.	Seatbelts
18.	Horn
19.	Windshield/Windshield Glazing
20.	Defroster
21.	Rear Vision Mirrors
22.	Floor, Firewall, and Wiring Systems
23.	Headlight Beam Selector Switch
24.	Trailer Reflective Tape
25.	Sleeper Berth
26.a, 26.b	Emergency Equipment
27.	Hood Securement and Hinges
28.	Battery
29.	Rear-End Protection
30.	Car and Body Components
31.	TRUPACT II Package Tiedown Assemblies
32.	RH-72B Cask Tiedown
33.	RH-72B Cask Accessories
34.	TRUPACT II Tiedown
35.	Level VI Decal/Inspection
36.	Proof of Periodic (Annual) Inspection
Part III – Hazardous Materials/Dangerous Goods Inspection Standards	
1.a.	Shipping Papers
2.a.(1)	Placarding
3.f	Bulk Packages/Large Means of Containment
4.a.(1)	Transport Vehicle Markings
9.b, 9.c	Radiation Levels
11.	Emergency Response Information
12.	Route Plan (HRCQ Only)
13.	Labeling
14.	Package Marking
15.	Federal Motor Carrier Safety Administration (FMCSA) Hazardous Materials Safety Permit
16.	Security Seal
17.	General Packaging
Source: CVSA (2024).	

9 ATLAS RAILCAR AND BUFFER RAILCAR INSPECTION CHECKLISTS

Appendix A in AAR Standard S-2043 (AAR, 2024a) 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, passenger-carrying railcars (i.e., the REV), and buffer railcars. AAR Standard S-2043 does not apply to the locomotives used to power a train carrying HLRM. Specific periodic inspection requirements from AAR Standard S-2043 Appendix A are listed in Table 8. . Appendix B in AAR Standard S-2043 also contains periodic inspection requirements (see Table 9.). As discussed in AAR Standard S-2043, some of the inspections in Table 8. and Table 9. would be performed before the cask-carrying railcars were loaded. Other inspections would be performed after the cask-carrying railcars are loaded and after the train has been prepared for movement. AAR Standard S-2043 also states that all inspections shall be completed before the loaded movement of an HLRM train commences.

Table 10 and **Error! Reference source not found.** contain the inspection checklists for the Atlas railcar (Orano, 2019, Appendix D) and the buffer railcar (Orano, 2019, Appendix H), respectively. Table 12. through **Error! Reference source not found.** contain the annual inspection checklists for the Atlas railcar. **Error! Reference source not found.** through **Error! Reference source not found.** contain the annual inspection checklists for the buffer railcar.

As discussed in Orano (2019), Appendix D and Orano (2019), Appendix H, due to special truck suspension design requirements, the Atlas railcar and buffer railcar have specific brake shoe replacement requirements that differ from the Field Manual of AAR Interchange Rules, Rule 12 (AAR, 2024a).

Table 8. Periodic inspection requirements from Association of American Railroads (AAR) Standard S-2043 Appendix A.

S-2043 Paragraph No.	Component	Requirement
4.1.1	General	Periodic inspection of all vehicles in an HLRM train shall be required. It is anticipated that certain inspections will routinely be performed before the cask cars are loaded. Other inspections will be routinely performed after the cask cars are loaded and after the train has been prepared for movement. In any event, all inspections shall be completed before the loaded movement of an HLRM train commences. Train owners and train operators shall keep written records of the inspection processes and results.
4.1.2	General	Designated inspectors shall develop an appropriate checklist. This checklist shall include the inspection items required. A method shall also be incorporated that ensures that items on checklists have been performed in accordance with requirements of this specification.
4.1.3	General	In the event that some inspections are performed before the HLRM train is moved to the loading site, train operators must ensure that movements between the inspection point and the loading point do not alter the results of the inspections performed.

S-2043 Paragraph No.	Component	Requirement
4.1.4	General	The items in paragraph 4.0 shall be incorporated in the periodic inspection process. Items in need of attention shall be repaired according to the requirements in paragraph 5.0.
4.2	Trucks	This section applies to all components of a truck where failure or substandard performance would compromise the safety of an HLRM train. All critical components of the trucks of the HLRM train shall be inspected. The Field Manual of the AAR Interchange Rules and manufacturer's recommendations for maintenance shall be followed, unless stated otherwise in this section. Data collected from the required on-board monitoring systems shall be considered as a part of the component inspection and evaluation.
4.2.1	Wheels	Reference Field Manual Rule 41: All wheels of the HLRM train shall be inspected according to Rule 41, Section A, with no exceptions. Wheel-mounting graphical maintenance records shall be required per MSRP, Section G-II, "Wheel and Axle Manual."
4.2.2	Axles	Reference Field Manual Rule 43: All axles of the HLRM train shall be inspected according to Rule 43, Section A, with no exceptions.
4.2.3	Bearings	Reference Field Manual Rule 36: All bearings of the HLRM train shall be inspected according to Rule 36, Section A.3, with no exceptions.
4.2.4	Bearing Adapters	Reference Field Manual Rule 37: All bearings and bearing adapters of the HLRM train shall be inspected according to Rule 37, Section A, with no exceptions. (If the wheels are removed, then you may inspect all of the items in section A.)
4.2.5	Truck Structural Components	This section applies to all truck structural components of the vehicles in a HLRM train when failure would compromise the safety of an operating HLRM train. All critical components of the structure of the vehicles in an HLRM train shall be inspected.
4.2.5.1	Truck Frames	Reference Field Manual Rule 48: All truck frames of the HLRM train shall be inspected according to Rule 48, Section A. Where applicable, Rule 48, Section A also shall apply for rigid truck frames (e.g., Section A.3), with the following exception: If repairs allowed by the Field Manual are required, they must be performed by an M-214-approved shop complying with all recondition requirements.
4.2.5.2	Bolsters	Reference Field Manual Rule 47: All truck bolsters of the HLRM train shall be inspected according to Rule 47, Section A. Where applicable, Rule 47, Section A also shall apply for span bolsters (e.g., Section A.3), with the following exception: If repairs allowed by the Field Manual are required, they must be performed by an M-214-approved shop complying with all recondition requirements.
4.2.5.3.1	Equalizers	All equalizers of the HLRM train shall be inspected according to the following requirements: Wear Limits, Gauging, Cause for Renewal:

S-2043 Paragraph No.	Component	Requirement
		• Broken, cracked, missing, bent, or patched • Worn or corroded where any section is reduced 25% • Fire or heat damage per Field Manual Rule 95
4.2.5.4	Spring Planks	Reference Field Manual Rule 48: All spring planks of the HLRM train shall be inspected according to the requirements of Rule 48.
4.2.6	Dynamic Performance Control Components	This section applies to all truck components that affect the dynamic performance or the ride quality of vehicles in the HLRM train.
4.2.6.1	Springs	Reference Field Manual Rule 50: This section applies to all types of springs in HLRM vehicle suspension systems.
4.2.6.1.1	Coil and Elliptical Springs	All coil and elliptical springs of the HLRM train shall be inspected according to Field Manual Rule 50, Sections A.1 through A.4, and A.7, with no exceptions.
4.2.6.1.2.1	Pneumatic/Hydraulic Springs	All pneumatic/hydraulic springs of the HLRM train shall be inspected according to the following requirements: Wear Limits, Gauging, Cause for Renewal: • Broken, cracked, missing, bent, collapsed, leaking, or patched • Worn or corroded where any section is reduced 25% • Working fluid below sight glass, if so equipped • Accumulation of wet fluid or previous leakage of fluid as evident by built-up fluid, caked dust and road dirt that spread more than 3 in. from the spring • Fire or heat damage per Field Manual Rule 95
4.2.6.2	Motion Control Elements	This section applies to all types of motion control devices in HLRM vehicle suspension systems.
4.2.6.2.1.1	Friction Elements	Reference Field Manual Rules 47, 50 and 88: All friction snubbers of the HLRM train shall be inspected according to Rule 47, Rule 50, Section A and Rule 88 Sections B.2.b.(8)a, with no exceptions.
4.2.6.2.1.2	Friction Elements	In addition, friction elements not included in the spring group shall be inspected according to Field Manual Rule 47, Section A.6, and Rule 50 Sections A.1, A.2, and A.7.
4.2.6.2.2.1	Hydraulic Elements	Reference Field Manual Rule 50: All hydraulic snubbers of the HLRM train shall be inspected according to Rule 50, Section A, with no exceptions.
4.2.6.2.2.2	Hydraulic Elements	In addition, hydraulic elements not included in the spring group shall be inspected according to Sections A.1, A.2, A.5, A.6, and A.7.
4.2.6.2.3.1	Side Bearings	Reference Field Manual Rules 47 and 62: All truck bolster side bearings of the HLRM train shall be inspected according to Rule 47, Section E.2.a; and Rule 62, Section A, with no exceptions.
4.2.6.2.3.2	Side Bearings	Reference Field Manual Rule 61: All body side bearings of the HLRM train shall be inspected according to Rule 61, Section A, with no exceptions.
4.3	Brakes	This section applies to the braking systems of HLRM trains.

S-2043 Paragraph No.	Component	Requirement
4.3.1	Valves	Reference Field Manual Rule 4: All air brake valves of the HLRM train shall be inspected according to Rule 4, Sections A.1, A.2, A.3, and A.4, with no exceptions.
4.3.2	Hoses and Hose Supports	Reference Field Manual Rule 5: All hoses and hose supports of the HLRM train shall be inspected according to Rule 5, Section A, with no exceptions.
4.3.3	Brake Beams	Reference Field Manual Rule 6: All brake beam components of the HLRM train shall be inspected according to Section A of Rule 6, with no exceptions.
4.3.4	Brake Connection Pins, Hanger Pins, Bolts, Hangers, and Brackets	Reference Field Manual Rule 7: All connection pins and bolts of the HLRM train shall be inspected according to Rule 7, Section A, with the following exception: All securement devices shall be inspected and repaired if they are missing or unserviceable.
4.3.5	Brake Beam and Bottom Rod Supports	Reference Field Manual Rule 10: All brake beam and bottom rod supports of the HLRM train shall be inspected according to Rule 10, Section A, with no exceptions.
4.3.6	Brake Levers and Guides	Reference Field Manual Rule 11: All levers, guides, and connection rods of the HLRM train shall be inspected according to Rule 11, Section A, with no exceptions.
4.3.7	Brake Shoes	Reference Field Manual Rule 12: All brake shoes and their attachment devices of the HLRM train shall be inspected according to Rule 12, Section A, with no exceptions.
4.3.8	Slack Adjusters	Reference Field Manual Rule 8: Slack adjusters must be maintained if equipped.
4.3.9	Air Brake Piping	Reference Field Manual Rule 4: Air brake piping must be secured.
4.3.10	Hand Brakes	Reference Field Manual Rules 13 and 88: All hand brakes of the HLRM train shall be inspected according to Rule 13, Section A, and Rule 88, Section B.2.b. (10)a, with no exceptions.
4.4	Draft Components	This section applies to all components of HLRM trains that are involved in resisting or transferring longitudinal train forces through the vehicle structure.
4.4.1.1	Couplers	Reference Field Manual Rules 16, 17, and 18: All couplers, knuckles, locks, draft keys, draft key retainers, and other components of the coupling systems of the HLRM train shall be inspected according to Section A of the above rules, with no exceptions.
4.4.1.2	Couplers	Reference Field Manual Rule 22: All uncoupling devices of the HLRM train shall be inspected according to Rule 22, Section A, with no exceptions.
4.4.2	Yokes	Reference Field Manual Rules 19 and 20: All coupler yokes of the HLRM train shall be inspected according to Rules 19 and 20, Section A, with no exceptions.
4.4.3	Coupler Carrier Wear Plates	Reference Field Manual Rule 21: All coupler carrier wear plates of the HLRM train shall be inspected according to Rule 21, Section A2.

S-2043 Paragraph No.	Component	Requirement
4.4.4.1.1	Draft Gears	Reference Field Manual Rule 21: All draft gears of the HLRM train shall be inspected according to Rule 21, Section A, with the following addition: Inspect carrier for missing, cracked, or broken fasteners.
4.4.4.2.1	Cushioning Devices	Reference Field Manual Rule 59: All end-of-car cushioning units and cushioning underframe devices of the HLRM train shall be inspected according to Rule 59, Section A, with the following addition: Inspect cushion unit carrier for missing, cracked, or broken securement.
4.5	Other Vehicle Structure	This section applies to vehicles of the HLRM train that contain structural components whose failure may affect the safety of the HLRM train.
4.5.1.1	Center Sills and Draft Sills	Reference Field Manual Rule 57: All center sills of the HLRM train shall be inspected for the following: Wear Limits, Gauging, Cause for Renewal: • Broken, cracked, missing, bent, collapsed • Worn or corroded where any section is reduced 25% • Fire or heat damage per Field Manual Rule 95
4.5.1.2	Center Sills and Draft Sills	Inspect draft sill for general integrity. Specifically inspect for cracks, draft and buff stop integrity, and missing parts.
4.5.1.3	Center Sills and Draft Sills	Any repairs must be approved by the Equipment Engineering Committee (EEC).
4.5.2.1	Side Sills	Reference Field Manual Rule 58: All side sills of the HLRM train shall be inspected for the following: Wear Limits, Gauging, Cause for Renewal: • Broken, cracked, missing, bent, collapsed • Worn or corroded where any section is reduced 25% • Fire or heat damage per Field Manual Rule 95
4.5.2.2	Side Sills	Any repairs must be approved by the EEC.
4.5.3	Center Plates	Reference Field Manual Rule 60: Car body center plate maintenance qualifications shall be followed.
4.5.4	Car Body Bolster	Reference Field Manual Rule 57: Car body bolster must be inspected.
4.6.1.1	Inspection of Safety Monitoring Equipment	All safety monitoring equipment of the HLRM train shall be inspected. Internal self-test circuits of the equipment must indicate that power is applied and that the equipment has passed internal self-tests.
4.6.1.2	Inspection of Safety Monitoring Equipment	In addition, the following mechanical inspection shall be performed: Wear Limits, Gauging, Cause for Renewal: • Mounting brackets or enclosure broken, cracked, missing, or bent • Fire or heat damage per Field Manual Rule 95
4.6.2	Inspection of Safety Monitoring Equipment Data	Data collected by the safety equipment on the HLRM train shall be analyzed as part of the periodic inspection process. If the data indicates that any of the vehicles no longer meet the performance standard, maintenance must be performed on the affected vehicles according to paragraph 5.0 of this standard.

S-2043 Paragraph No.	Component	Requirement
4.7	Safety Appliances	Reference Field Manual Rule 79: All safety appliances of HLRM trains shall be inspected to ensure that they comply with all regulatory requirements.
4.8.1	Other Items	Other items on HLRM trains that shall be inspected include but are not limited to the following: • Battery boxes • Underframe-mounted generators • Air conditioning units • Storage boxes • Securement systems
4.8.2	Other Items	These items shall be inspected for integrity of the attachment points to the vehicle.

Table 9. Periodic inspection requirements from Association of American Railroads (AAR) Standard S-2043 Appendix B.

S-2043 Paragraph No.	Component	Requirement
4.1	General	Periodic inspection of all vehicles in an HLRM train shall be required. It is anticipated that certain inspections shall routinely be performed before the cask cars are loaded. Other inspections shall be routinely performed after the cask cars are loaded and after the train has been prepared for movement. Train owners and train operators shall keep records of the inspection processes and results and are responsible for ensuring that all required inspections and maintenance are completed prior to movement.
4.2	General	In the event that some inspections are performed before the HLRM train is moved to the loading site, train operators must ensure that movements between the inspection point and the loading point do not alter the results of the inspections performed.
4.3	General	All periodic inspection and maintenance requirements outlined in Standard S-2043 must be followed.

Table 10. Atlas railcar inspection checklist.

ATLAS RAILCAR INSPECTION CHECKLIST SIGN-OFF					
Description of Inspection Item	*Recorded Dates, Measurements, or Remarks*		*Condition*(1)		*Signature*(2)
	A End of Car	*B End of Car*	*Passed*	*Discrepant*(3)	
Verify railcars are equipped with bottom-shelf or F-head coupler					
Visually inspect couplers and yokes for cracks, wear, missing sections, distortions					

ATLAS RAILCAR INSPECTION CHECKLIST SIGN-OFF					
Broken, bent, cracked or missing knuckle pins					
Side clearance coupler must be capable of movement in a horizontal plane					
Striker castings for cracks or breaks					
End-of-Car Cushioning Units: • check for broken springs					
• missing components on restoring mechanism					
• excessive oil leak(s) on carrier plate					
• is cotter pin installed through slotted castle nut					
• inspect and confirm the indicator pin on gas end-of-car cushioning device has acceptable pressure					
• perform visual inspection for damaged or missing parts in accordance with AAR Interchange Rule 59.A.					
Check for bent or broken uncoupling levers and proper operation					
Record coupler toggle clearance (REG. 0.25 to 0.50 in.)					
Record height of couplers from top of rail E: 32.5 – 34.5 in. L: 31.5 – 33.5 in.					
Check coupler for worn or distorted contour					
Check coupler shank for wear					
Check for missing, worn, deteriorated, or damaged air brake hoses					
Check and record dates shown on air hoses ends					
Check for bent, broken, worn, missing or inoperative brackets, angle cocks, retainer valves, cutout cocks, piping and parts					
Check air hose supports for broken, missing, or bent parts; ensure that the supports maintain the required air hose height					

ATLAS RAILCAR INSPECTION CHECKLIST SIGN-OFF					
Check air brake system for operability and loose or defective and audible leaks					
Check brake shoes and shoe keys for missing, broken or missing parts					
Check thickness of brake shoes					
Check brake levers, brake beams, hanger pins, bolts guides and brake connection rods for missing, broken, wear and freedom of movement					
Check all linkages to ensure cotter pins (keys) are in place					
Ensure brake rigging is not riding on or contacting wheels or axle					
Ensure handbrake(s) is in proper position and operable					
Check for proper operation of on-board bearing temperature monitoring system					
Check for indications of defective roller bearings					
Check truck bolsters and side frames for broken, bent, cracked, patched, wrong size, worn missing and corroded parts					
Visually inspect accessible areas of body bolster, center plate, side and center sills, cross bearers, and jacking pads for cracked or broken parts					
Check and record the side bearing clearance					
Measure and record minimum clearance between railcar and top of rail					
Check for missing, broken, or excessively worn truck side frame friction casting wear plates					
Inspect the side frame to equalizer interface for any evidence of fresh contact					
Ensure railcar deck appears suitable for the intended cradle cask load and attachment blocks are not damaged; if brass insert is installed in attachment blocks visually inspect for damage					
Check wheels for: • cracked, broken or chipped flanges					

ATLAS RAILCAR INSPECTION CHECKLIST SIGN-OFF					
• cracked, broken, shattered or spread rims					
• shelled, built-up or grooved tread					
• cracked, broken, dented, or gouged plates					
• overheated wheels					
• thermal cracks and loose wheels					
• worn flanges and flat spots					
• out-of-gage and wrong size					
• broken, missing, and out of position springs and stabilizers					
• Check Hydraulic Stabilizers for leaks, oil level and proper installation					

1. Place an “X” in the appropriate column.
2. User representative verifies, based on personal observation and certifies by his signature/initials in each block that the action has actually been performed in accordance with the specified requirements. Signature required in first block; initials acceptable in all others.
3. List discrepant conditions on separate listing.
Inspection completed, with exceptions as indicated under remarks, and railcar is acceptable in accordance with the requirements of this procedure.

INSPECTOR: *DATE:*

Signature of the Railroad representative certifies that the railcar meets the requirements of the AAR and is acceptable for interchange.

RAILROAD REPRESENTATIVE: *DATE:*

Table 11. Buffer railcar inspection checklist.

BUFFER RAILCAR INSPECTION CHECKLIST SIGN-OFF					
Description of Inspection Item	*Recorded Dates, Measurements, or Remarks*		*Condition*[1]		*Signature*[2]
	A End of Car	*B End of Car*	*Passed*	*Discrepant*[3]	
Verify railcars are equipped with bottom-shelf or F-head coupler					
Visually inspect couplers and yokes for cracks, wear, missing sections, distortions					
Broken, bent, cracked or missing knuckle pins					
Side clearance coupler must be capable of movement in a horizontal plane					
Striker castings for cracks or breaks					
End-of-Car Cushioning Units: • check for broken springs					
• missing components on restoring mechanism					
• excessive oil leak(s) on carrier plate					
• is cotter pin installed through slotted castle nut					
• inspect and confirm the indicator pin on gas end-of-car cushioning device has acceptable pressure					
• perform visual inspection for damaged or missing parts in accordance with AAR Interchange Rule 59.A.					
Check for bent or broken uncoupling levers and proper operation					
Record coupler toggle clearance (REG. 0.25 to 0.50 in.)					
Record height of couplers from top of rail E: 32.5 – 34.5 in. L: 31.5 – 33.5 in.					
Check coupler for worn or distorted contour					
Check coupler shank for wear					
Check for missing, worn, deteriorated, or damaged air brake hoses					

BUFFER RAILCAR INSPECTION CHECKLIST SIGN-OFF					
Check and record dates shown on air hose ends					
Check for bent, broken, worn, missing or inoperative brackets, angle cocks, retainer valves, cutout cocks, piping and parts					
Check air hose supports for broken, missing, or bent parts; ensure that the supports maintain the required air hose height					
Check air brake system for operability and loose or defective and audible leaks					
Check brake shoes and shoe keys for missing, broken or missing parts					
Check thickness of brake shoes					
Check brake levers, brake beams, hanger pins, bolts guides and brake connection rods for missing, broken, wear and freedom of movement					
Check all linkages to ensure cotter pins (keys) are in place					
Ensure brake rigging is not riding on or contacting wheels or axle					
Ensure handbrake(s) is in proper position and operable					
Check for proper operation of on-board bearing temperature monitoring system					
Check for indications of defective roller bearings					
Check truck bolsters and side frames for broken, bent, cracked, patched, wrong size, worn missing and corroded parts					
Visually inspect accessible areas of body bolster, center plate, side and center sills, cross bearers, and jacking pads for cracked or broken parts					
Check and record the side bearing clearance					
Measure and record minimum clearance between railcar and top of rail					
Check for missing, broken, or excessively worn truck side frame friction casting wear plates					

BUFFER RAILCAR INSPECTION CHECKLIST SIGN-OFF					
Inspect the side frame to equalizer interface for any evidence of fresh contact					
Check wheels for: • cracked, broken or chipped flanges					
• cracked, broken, shattered or spread rims					
• shelled, built-up or grooved tread					
• cracked, broken, dented, or gouged plates					
• overheated wheels					
• thermal cracks and loose wheels					
• worn flanges and flat spots					
• out-of-gage and wrong size					
• broken, missing, and out of position springs and stabilizers					
• Check Hydraulic Stabilizers for leaks, oil level and proper installation					

1. Place an “X” in the appropriate column.
2. User representative verifies, based on personal observation and certifies by his signature/initials in each block that the action has actually been performed in accordance with the specified requirements. Signature required in first block; initials acceptable in all others.
3. List discrepant conditions on separate listing.

Inspection completed, with exceptions as indicated under remarks, and railcar is acceptable in accordance with the requirements of this procedure.

INSPECTOR: *DATE:*

Signature of the Railroad representative certifies that the railcar meets the requirements of the AAR and is acceptable for interchange.

RAILROAD REPRESENTATIVE: *DATE:*

Table 12. Atlas railcar annual inspection checklist.

ATLAS RAILCAR ANNUAL INSPECTION CHECKLIST				
Railcar _____ *Container Type and Number* _____				
Description of Inspection	*AAR-IR Rule No.*	*B*	*A*	*Remarks*
a. COUPLER 1. When a coupler is removed from the car, FOR ANY REASON, measure coupler shank length and rear of key slot to shank butt/rear wall thickness; reference Rule 16 Figure D, Rule 17 Figure A, and Rule 18 Figure D of AAR Interchange Rules. 2. Grade C coupler bodies may be applied with grade C or grade E draft keys. Grade E coupler bodies must be applied with grade E draft keys only. 3. Grade E locks are correct repairs for ALL couplers	16 and 17			
a.1. Visually Inspect Coupler Parts a. Height – loaded – 31.5 in. to 33.5 in. b. Alignment – movement of coupler c. Body – wear plate, cracks, bent, wear d. Knuckle – wear, cracks, operation – pin and cotter e. Coupler lock and lock list - operation				
a.2. Inspect Uncoupling Mechanism a. Bent, jammed, operation b. Proper toggle clearance				
a.3. Check for Prohibited Couplers and Appurtenances				
a.4. Inspect Striker a. Striker – cracks securement, wear and rivets b. Coupler carrier, wear plate – wear, cracked, broken, missing, securement, proper shank clearance				
b. COUPLER CUSHIONING UNITS	59			
b.1. Broken or missing parts a. Inability to assume neutral position b. Restoring mechanism action c. Draft sill weld cracks d. Hydraulic oil leak – must form drips e. Draft key, retained, bolt, wear, missing				
b.2. Install Keystone push pin end-of-car-testing device on appropriate end-of-car cushioning unit which lack it, if a unit must be removed from the cat for some other reason				
c. SIDE BEARINGS	61			

ATLAS RAILCAR ANNUAL INSPECTION CHECKLIST				
c.1. Perform side-bearing inspection in accordance with section 6 of the FIVE-YEAR preventive maintenance (PM) procedure				
c.2. Inspect a. Bearing box – secure, cracked and missing b. Bearing plate – wear, secure, flat and missing c. Rollers – flat spots, cracks, missing d. Clearance – see page ___ of ___ for dimensions				
d. CENTER PLATE	47			
d.1. Perform Center Plate Inspection and Lubrication (CPIL) in accordance with section 5 of the FIVE-YEAR PM inspection procedure				
d.2. Make drawing indicating where repair welding performed, if required, use the comment sheet for the drawing				
e. CAR BODY	88			
e.1. Inspect for cracks, breaks, weld condition, of all car body parts including end sill, center sill stub sills, tie plates, side sill, cross bearer, stringer bolster, etc.				
e.2. Check for prohibited or restricted items				
f. SAFETY EQUIPMENT	88			
f.1. Inspect a. Ladder – secure, broken, bent, missing b. Platforms – chains, level, no holes, secure condition c. Defect card holder – condition, missing d. Grab irons – secure, bent, missing e. Sill steps – secure, bent, missing f. Handrails – secure, bent, missing, no welds allowed				
g. LIGHT WEIGHT When required lightweight the car	70			
h. TRUCKS and BOLSTERS	47 and 48			
h.1. Inspect a. Side frames and bolsters – cracks, worn, improper repairs b. Side frame key – tight, missing c. Brake beam support – cracks, worn d. Any section worn or corroded greater than 25%				

ATLAS RAILCAR ANNUAL INSPECTION CHECKLIST				
e. BUCKEYE 6-wheel truck only – perform side frame equalizer inspection of the FIVE-YEAR PM inspection procedure				
h.2. No part of the truck shall be less than 2.75 in. above top of rail under maximum wear and spring deflection				
i. SPRING ASSEMBLY and SNUBBER	50			
i.1. Inspect a. Springs – broken, cracked, missing, tilted, bottomed-out b. Side frame wear plate – wear, securement, missing c. Bolster wedge – wear, indicator, missing d. Hydraulic stabilizer – oil leak, spring condition, securement, missing				
j. WHEELS AND AXLES	41 and 43			
j.1. Inspect a. Flanges for sharp, high, chipped, overheating or cracking b. Tread – thickness, overheating, groves, flat spots, build-up and shelled c. Plates – cracks, gouges, holes, overheating, other damage d. Axles – bends, rubbing, cracks, gouges and others e. Rim – broken, spread, thin, etc.				
j.2. Check for prohibited wheels and axles				
k. ROLLER JOURNAL BEARINGS	36			
k.1. Bearing inspection as required by Section 2. N/A if not required (AAR Rule 36.A.3a and b., A.10 and 11)				
l. AIR BRAKE SYSTEM	3, 4 and 5			
l.1. Inspect the following for cracks, missing parts, and securement a. Pipe and fittings b. Vent protector c. Reservoirs d. Brake cylinders e. Slack adjusters f. Cut-out cocks and ‘U’ bolts g. Valves, portions, pipe bracket h. Release valve and rod i. Dirt collector j. Quick service valve k. Vent valve l. Pressure tap				

ATLAS RAILCAR ANNUAL INSPECTION CHECKLIST				
m. DB overlay brake system (see Section 5.0)				
l.2. Inspect hoses, coupling a. Hose – date, cracks, leaks, other damage b. Coupling – damage, gasket, leaks				
l.3. Perform single car air test in accordance with the AAR Standard S – 486, latest version, after completion of maintenance and the railcar is un-jacked				
l.4. Brake type (ABD, ABDW) stenciled on car				
m. TRUCK and CAR BODY BRAKE RIGGING	6 through 11			
m.1. Inspect and cause to be corrected if rubbing a. Brake beams – cracks, wear, bends, securement b. Brake rods – cracks, wear, bends c. Levers – cracks, wear, bends, poor alignment d. Pins – wear, AAR approved cotter pins e. Safety hangers – cracks, wear, bends, securement, missing f. Guides – cracks, wear, bends, securement				
m.2. Check for incorrect components				
n. BRAKE SHOES	12			
n.1. Inspect and verify that the proper shoes are on the car a. Composition shoes – minimum thickness 1 in., includes lining and backing plate				
o. HANDBRAKE	13			
o.1. Inspect for defects and proper operation a. Wheel b. Shaft c. Pawl d. Gear e. Trip lever f. Bell crank or Sheave Wheel g. Chain h. Rod i. Guard				
o.2. Lubricate where required				

ATLAS RAILCAR ANNUAL INSPECTION CHECKLIST				
o.3. Inspect first 3 visible links painted WHITE or FLUORESCENT ORANGE in accordance with AAR Interchange Rule 13.E.11				
p. STENCILING	80			
p.1. Stenciling must meet DOT and AAR requirements				
p.2. Stenciling must meet owners reporting marks requirements				
p.3. Ensure the CAR NUMBER is stenciled on the underside of the railcar body OR if already stenciled – that the stencil is readable				

Table 13. Atlas railcar annual inspection checklist side bearing measurement data sheet.

ATLAS RAILCAR ANNUAL INSPECTION CHECKLIST				
Railcar _____ *Container Type and Number* _____				
SIDE BEARINGS MEASUREMENT DATA SHEET				
PRIOR to Jacking Railcar				
Inspect all four (4) jacking pads IAW 2.1 of this procedure				
Jacking Pads	‘A’ End ‘B’ End	L ☐ R ☐ L ☐ R ☐		
Car Body to Truck/Span Bolster	‘A’ End ‘B’ End	L ☐ R ☐ L ☐ R ☐		
Span Bolster to Truck*	‘A’ End ‘B’ End	L ☐ R ☐ L ☐ R ☐	‘A’ End ‘B’ End	IL ☐ IR ☐ IL ☐ IR ☐
***Applies only to railcars with DOUBLE TRUCKS**				
AFTER Jacking Railcar				
Car Body to Truck/Span Bolster	‘A’ End ‘B’ End	L ☐ R ☐ L ☐ R ☐		
Span Bolster to Truck*	‘A’ End ‘B’ End	L ☐ R ☐ L ☐ R ☐	‘A’ End ‘B’ End	IL ☐ IR ☐ IL ☐ IR ☐
***Applies only to railcars with DOUBLE TRUCKS**				
SIDE BEARINGS CLEARANCE MEASUREMENT RANGE				

ATLAS RAILCAR ANNUAL INSPECTION CHECKLIST
1. RAILCAR BODY TO TRUCK: 4-wheeled trucks – average of the two should be between 3/16 in. and 5/16 in. 2. RAILCAR BODY to SPAN BOLSTER: double 4- or 6-wheeled trucks – average of the two should be between 1/8 in. and 3/16 in. 3. SPAN BOLSTER TO TRUCKS: the average of the two at the bolsters should be between 3/16 in. and 1/4 in.

Table 14. Atlas railcar annual inspection checklist plate bearing data sheet.

ATLAS RAILCAR ANNUAL INSPECTION CHECKLIST							
Railcar _____ *Container Type and Number* _____							
CENTER PLATE BEARING DATA SHEET							
'A' END OUTSIDE DIAMETERS for the following **CAR BODY [1] LARGE O.D.**		**'A' END INSIDE DIAMETERS** for the following **TRUCK/SPAN BOLSTER [2] LARGE I.D.**		**'B' END OUTSIDE DIAMETERS** for the following **CAR BODY [1] LARGE O.D.**		**'B' END INSIDE DIAMETERS** for the following **TRUCK/SPAN BOLSTER [2] LARGE I.D.**	
1_____	2_____	1_____	2_____	1_____	2_____	1_____	2_____
3_____	4_____	3_____	4_____	3_____	4_____	3_____	4_____
SPAN BOLSTER [5] (OUTER)*		**TRUCK BOLSTER [3] (OUTER)***		**SPAN BOLSTER [5] (OUTER)***		**TRUCK BOLSTER [3] (OUTER)***	
1_____	2_____	1_____	2_____	1_____	2_____	1_____	2_____
3_____	4_____	3_____	4_____	3_____	4_____	3_____	4_____
SPAN BOLSTER [6] (INNER)*		**TRUCK BOLSTER [4] (INNER)***		**SPAN BOLSTER [6] (INNER)***		**SPAN BOLSTER [4] (INNER)***	
1_____	2_____	1_____	2_____	1_____	2_____	1_____	2_____
3_____	4_____	3_____	4_____	3_____	4_____	3_____	4_____
***Applies only to railcars with DOUBLE TRUCKS**							
Use Figure 7, Atlas Railcar Center Plate Dimension Key, to assist with the proper data placement. After measuring the inner diameters and the outside diameters compare the clearances. The minimum is 1/8 in. and the maximum is 1/2 in.							

ATLAS RAILCAR ANNUAL INSPECTION CHECKLIST
Inspection completed, with exceptions as indicated under remarks, and railcar is acceptable in accordance with the requirements of this procedure. *INSPECTOR:* *DATE:*
Signature of the Railroad representative certifies that the railcar meets the requirements of the AAR and is acceptable for interchange. *RAILROAD REPRESENTATIVE*: *DATE:*

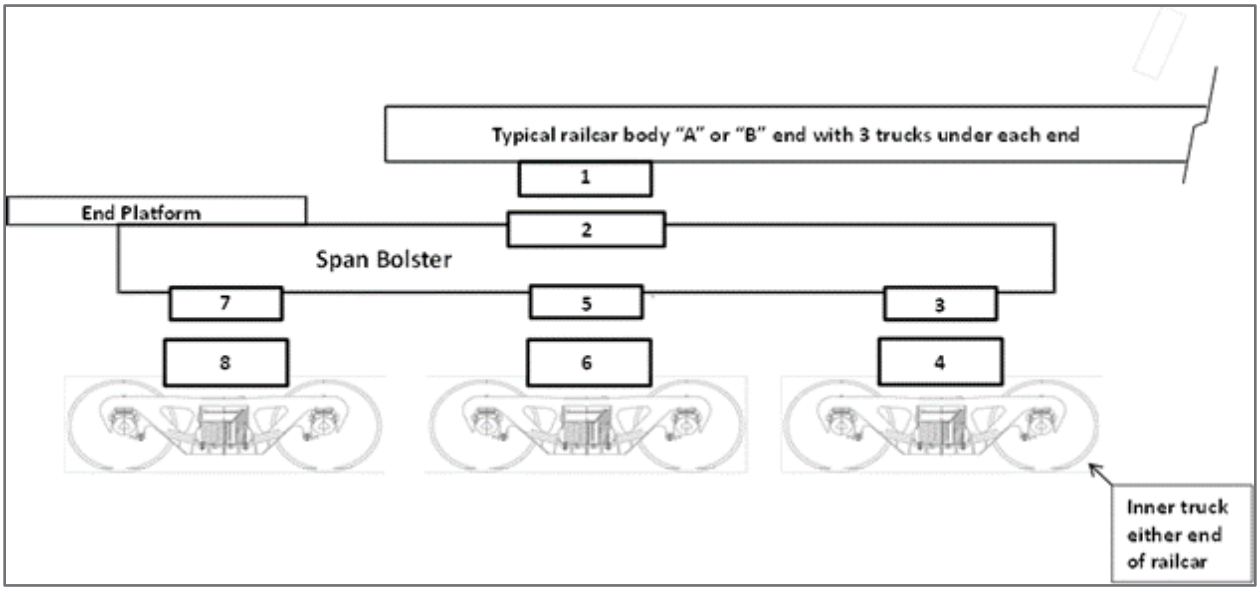

Figure 7. Atlas railcar center plate dimension key.

Table 15. Buffer railcar annual inspection checklist.

BUFFER RAILCAR ANNUAL INSPECTION CHECKLIST				
Railcar _____ *Container Type and Number* _____				
Description of Inspection	*AAR-IR Rule No.*	*B*	*A*	*Remarks*
q. COUPLER 1. When a coupler is removed from the car, FOR ANY REASON, measure coupler shank length and rear of key slot to shank butt/rear wall thickness; reference Rule 16 Figure D, Rule 17 Figure A, and Rule 18 Figure D of AAR Interchange Rules. 2. Grade C coupler bodies may be applied with grade C or grade E draft keys. Grade E coupler bodies must be applied with Grade E draft keys only. 3. Grade E locks are correct repairs for ALL couplers	16 and 17			

BUFFER RAILCAR ANNUAL INSPECTION CHECKLIST				
q.1. Visually Inspect Coupler Parts a. Height – loaded – 31.5 in. to 33.5 in. b. Alignment – movement of coupler c. Body – wear plate, cracks, bent, wear d. Knuckle – wear, cracks, operation – pin and cotter e. Coupler lock and lock list - operation				
q.2. Inspect Uncoupling Mechanism a. bent, jammed, operation b. proper toggle clearance				
q.3. Check for Prohibited Couplers and Appurtenances				
q.4. Inspect Striker a. Striker – cracks securement, wear and rivets b. Coupler carrier, wear plate – wear, cracked, broken, missing, securement, proper shank clearance.				
r. COUPLER CUSHIONING UNITS	59			
r.1. Broken or missing parts a. Inability to assume neutral position b. Restoring mechanism action c. Draft sill weld cracks d. Hydraulic oil leak – must form drips e. Draft key, retained, bolt, wear, missing				
r.2. Install Keystone push pin end-of-car-testing device on appropriate end-of-car cushioning unit which lack it, if a unit must be removed from the cat for some other reason				
s. SIDE BEARINGS	61			
s.1. Perform side-bearing inspection in accordance with section 6 of the FIVE-YEAR PM procedure				
s.2. Inspect a. Bearing box – secure, cracked and missing b. Bearing plate – wear, secure, flat and missing c. Rollers – flat spots, cracks, missing d. Clearance – see page ___ of ___ for dimensions				
t. CENTER PLATE	47			
t.1. Perform Center Plate Inspection and Lubrication (CPIL) in accordance with				

BUFFER RAILCAR ANNUAL INSPECTION CHECKLIST				
section 5 of the FIVE-YEAR PM inspection procedure				
t.2. Make drawing indicating where repair welding performed, if required, use the comment sheet for the drawing				
u. CAR BODY	88			
u.1. Inspect for cracks, breaks, weld condition, of all car body parts including end sill, center sill stub sills, tie plates, side sill, cross bearer, stringer bolster, etc.				
u.2. Check for prohibited or restricted items				
v. SAFETY EQUIPMENT	88			
v.1. Inspect a. Ladder – secure, broken, bent, missing b. Platforms – chains, level, no holes, secure condition c. Defect card holder – condition, missing d. Grab irons – secure, bent, missing e. Sill steps – secure, bent, missing f. Handrails – secure, bent, missing, no welds allowed				
w. LIGHT WEIGHT When required lightweight the car	70			
x. TRUCKS and BOLSTERS	47 and 48			
x.1. Inspect a. Side frames and bolsters – cracks, worn, improper repairs b. Side frame key – tight, missing c. Brake beam support – cracks, worn d. Any section worn or corroded greater than 25%				
x.2. No part of the truck shall be less than 2.75 in. above top of rail under maximum wear and spring deflection				
y. SPRING ASSEMBLY and SNUBBER	50			
y.1. Inspect a. Springs – broken, cracked, missing, tilted, bottomed-out b. Side frame wear plate – wear, securement, missing c. Bolster wedge – wear, indicator, missing				

BUFFER RAILCAR ANNUAL INSPECTION CHECKLIST				
d. Hydraulic stabilizer – oil leak, spring condition, securement, missing				
z. WHEELS and AXLES	41 and 43			
z.1. Inspect a. Flanges for sharp, high, chipped, overheating or cracking b. Tread – thickness, overheating, groves, flat spots, build-up and shelled c. Plates – cracks, gouges, holes, overheating, other damage d. Axles – bends, rubbing, cracks, gouges and others e. Rim – broken, spread, thin, etc.				
z.2. Check for prohibited wheels and axles				
aa. ROLLER JOURNAL BEARINGS	36			
aa.1. Bearing inspection as required by Section 2. N/A if not required (AAR Rule 36.A.3a and b., A.10 and 11)				
bb. AIR BRAKE SYSTEM	3, 4, and 5			
bb.1. Inspect the following for cracks, missing parts, and securement a. Pipe and fittings b. Vent protector c. Reservoirs d. Brake cylinders e. Slack adjusters f. Cut-out cocks and ‘U’ bolts g. Valves, portions, pipe bracket h. Release valve and rod i. Dirt collector j. Quick service valve k. Vent valve l. Pressure tap m. DB overlay brake system (see Section 5.0)				
bb.2. Inspect hoses, coupling a. Hose – date, cracks, leaks, other damage b. Coupling – damage, gasket, leaks				
bb.3. Perform single car air test in accordance with the AAR Standard S-486, latest version, after completion of maintenance and the railcar is un-jacked				
bb.4. Brake type (ABD, ABDW) stenciled on car				

BUFFER RAILCAR ANNUAL INSPECTION CHECKLIST				
cc. TRUCK and CAR BODY BRAKE RIGGING	6 through 11			
cc.1. Inspect and cause to be corrected if rubbing a. Brake beams – cracks, wear, bends, securement b. Brake rods – cracks, wear, bends c. Levers – cracks, wear, bends, poor alignment d. Pins – wear, AAR approved cotter pins e. Safety hangers – cracks, wear, bends, securement, missing f. Guides – cracks, wear, bends, securement				
cc.2. Check for incorrect components				
dd. BRAKE SHOES	12			
dd.1. Inspect and verify that the proper shoes are on the car a. Composition shoes – minimum thickness 1 inch, includes lining and backing plate				
ee. HANDBRAKE	13			
ee.1. Inspect for defects and proper operation a. Wheel b. Shaft c. Pawl d. Gear e. Trip lever f. Bell crank or Sheave Wheel g. Chain h. Rod i. Guard				
ee.2. Lubricate where required				
ee.3. Inspect first 3 visible links painted WHITE or FLORESCENT ORANGE in accordance with AAR Rule 13.E.11				
ff. STENCILING	80			
ff.1. Stenciling must meet DOT and AAR requirements				
ff.2. Stenciling must meet owners reporting marks requirements				
ff.3. Ensure the CAR NUMBER is stenciled on the underside of the railcar body OR if already stenciled – that the stencil is readable				

Table 16. Buffer railcar annual inspection checklist side bearings measurement data sheet.

BUFFER RAILCAR ANNUAL INSPECTION CHECKLIST			
Railcar _____ *Container Type and Number* _____			
SIDE BEARINGS MEASUREMENT DATA SHEET			
PRIOR to Jacking Railcar			
Inspect all four (4) jacking pads IAW 2.1 of this procedure			
Jacking Points	'A' End 'B' End	L ☐ R ☐ L ☐ R ☐	
Car Body to Truck	'A' End 'B' End	L ☐ R ☐ L ☐ R ☐	
***Applies only to railcars with DOUBLE TRUCKS**			
AFTER Jacking Railcar			
Car Body to Truck	'A' End 'B' End	L ☐ R ☐ L ☐ R ☐	
***Applies only to railcars with DOUBLE TRUCKS**			
SIDE BEARINGS CLEARANCE MEASUREMENT RANGE 1. RAILCAR BODY TO TRUCK: 4-wheeled trucks – average of the two should be between 3/16 in. and 5/16 in.			

Table 17. Buffer railcar annual inspection checklist center plate bearings data sheet.

BUFFER RAILCAR ANNUAL INSPECTION CHECKLIST							
Railcar _____ *Container Type and Number* _____							
CENTER PLATE BEARING DATA SHEET							
'A' END OUTSIDE DIAMETERS for the following CAR BODY [1] LARGE O.D.		'A' END INSIDE DIAMETERS for the following TRUCK [2] LARGE I.D.		'B' END OUTSIDE DIAMETERS for the following CAR BODY [1] LARGE O.D.		'B' END INSIDE DIAMETERS for the following TRUCK [2] LARGE I.D.	
1_____	2_____	1_____	2_____	1_____	2_____	1_____	2_____
3_____	4_____	3_____	4_____	3_____	4_____	3_____	4_____

BUFFER RAILCAR ANNUAL INSPECTION CHECKLIST
Use Figure 8, Buffer Railcar Center Plate Dimension Key, to assist with the proper data placement after measuring the inside diameters and the outside diameters compare the clearances. The minimum is ⅛ in. and the maximum is ½ in.
Inspection completed, with exceptions as indicated under remarks, and railcar is acceptable in accordance with the requirements of this procedure. *INSPECTOR:* *DATE:*
Signature of the Railroad representative certifies that the railcar meets the requirements of the AAR and is acceptable for interchange. *RAILROAD REPRESENTATIVE*: *DATE:*

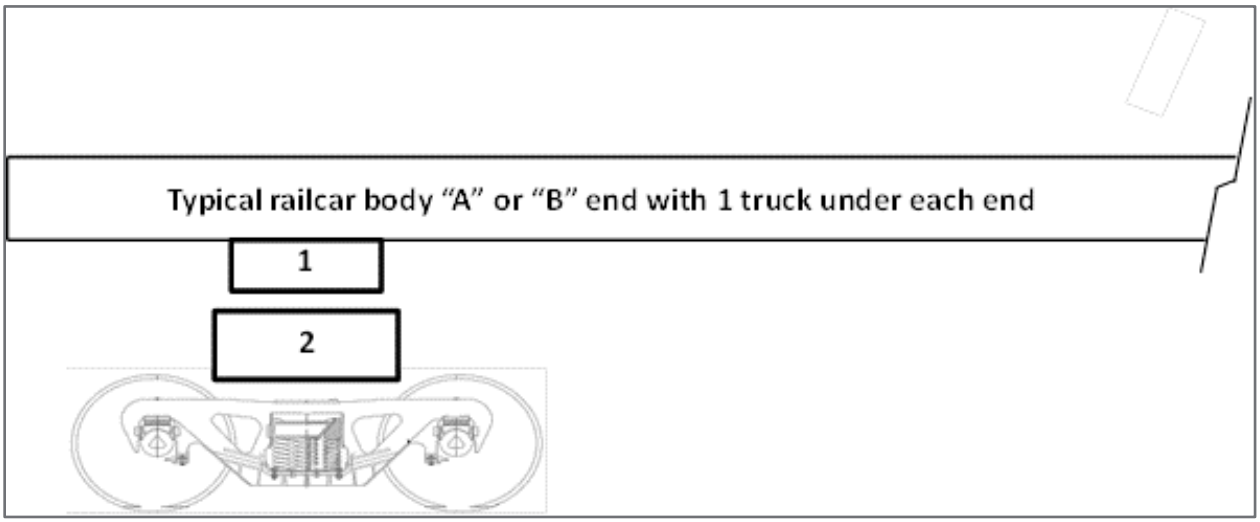

Figure 8. Buffer railcar center plate dimension key.

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10 RAIL ESCORT VEHICLE INSPECTION CHECKLIST

Table 18 contains the inspection checklist for the REV based on an inspection checklist provided by MxV Rail. These inspections involve the following components:

- couplers;
- yokes;
- end-of-car cushioning units;
- air brake hoses and brake operability testing;
- brake shoes, linkages, and handbrakes;
- wheel bearings and bearing adapters;
- trucks and car body;
- wheels and axles;
- springs and hydraulic ride stabilizers; and
- doors, placards, and safety appliances.

Table 18. Rail escort vehicle inspection checklist.

Description	Recorded Measurements/Remarks[3]	Condition[1,2]	
		A-End	B-End
COUPLERS (AAR-IR 16, 17, 18 21, 88, and 90)			
General: Check for cracks, broken or missing sections and prohibited items.			
Type: Check to ensure DOE railcars are equipped with:			
(a) Bottom-shelf or F-head coupler, or			
(b) For Atlas flatcars, top-and-bottom shelf couplers.			
Knuckle pins: Check for broken, bent, missing, or cracked pins.			
Side clearance: Check for movement in the horizontal plane.			
Striker castings: Check for cracks or breaks; securement, wear and rivets.			
Coupler height: Record height of couplers from top of rail			
E: 32 3/4” - 35”			
L: 31 3/4” - 34”			

Description	Recorded Measurements/Remarks[3]	Condition[1,2]	
		A-End	B-End
Coupler assemblies: Check coupler body and components for proper securement with adjacent car.			
Coupler/knuckle contour: Check for worn or distorted contour.			
Shank: Check for wear.			
Carrier plates and securement fasteners: Check parts are not broken, bent, cracked or missing.			
Uncoupling Levers, Support Brackets and Toggle Clearance (AAR-IR 22)			
Uncoupling Lever/Support Bracket: Check for missing parts, wear, bends, or broken levers and support brackets, and proper operation.			
Toggle clearance: Record clearance (Reg. 1/4” to 1/2”).			
YOKE (AAR-IR 19, 20)			
Yokes: Check for missing, bent, broken or cracked sections.			
END-OF-CAR CUSHIONING UNITS (AAR-IR 59)			
Check for broken springs, missing components on restoring mechanism and leaks (excessive amount of oil on carrier plate).			
Check cotter pin is installed through slotted castle nut.			
Inspect indicator pin on gas end-of-car cushioning device to confirm acceptable pressure.			
Check for damaged or missing parts in accordance with AAR-IR 59.A.			
Storage greater than 6 months			
Check for broken springs, missing components on restoring mechanism and leaks (excessive amount of oil on carrier plate).			
Check cotter pin is installed through slotted castle nut.			

Description	Recorded Measurements/Remarks[3]	Condition[1,2]	
		A-End	B-End
Inspect indicator pin on gas end-of-car cushioning device to confirm acceptable pressure.			
Check for damaged or missing parts in accordance with AAR-IR 59.A.			
AIR BRAKE HOSES AND BRAKE OPERABILITY TESTING (AAR IR 3, 4, and 5)			
Hoses: Check for missing, worn, deteriorated, or damaged hoses.			
Supports: Check air hose supports for broken, missing, or bent parts. Ensure that the supports maintain the required air hose height.			
End air hose: Check and record dates on end air hoses.			
Air lines/Valves: Check for bent, broken, worn, missing or inoperative brake line brackets, angle cocks, retainer valves, cutout cocks, piping and parts.			
Operability testing: Check air brake system for operability and loose or defective fittings and audible leaks.			
Storage greater than 6 months			
Hoses: Check for missing, worn, deteriorated, or damaged hoses.			
Supports: Check air hose supports for broken, missing, or bent parts. Ensure that the supports maintain the required air hose height.			
End air hose: Check and record dates on end air hoses.			
Air lines/Valves: Check for bent, broken, worn, missing or inoperative brake line brackets, angle cocks, retainer valves, cutout cocks, piping and parts.			
Operability testing: Check air brake system for operability and loose or defective fittings and audible leaks.			

Description	Recorded Measurements/Remarks[3]	Condition[1,2]	
		A-End	B-End
BRAKE SHOES, LINKAGES AND HANDBRAKES (AAR IR 6, 7, 8 and 12)			
Brake shoes: Check brake shoes and shoe keys that are either missing, or broken and partially missing. Check thickness of brake shoes (Note 1).			
Note 1. For Atlas flatcars (IDOX 10000 railcar series), brake shoes shall be replaced when worn to 1-inch or less thickness (including lining and backing plate) in lieu of 3/8-inch per AA IR 12.A.1.e.			
Linkages: Check brake levers, brake beams, hanger pins, bolts, guides and brake connection rods for missing or broken parts, wear and freedom of movement.			
Cotter pins: Check all linkage to ensure cotter pins (keys) are in place.			
Rigging: Check to ensure brake rigging is not riding on or contacting wheels or axles.			
Handbrake: Check to ensure handbrake is in proper position and operable.			
WHEEL BEARINGS AND BEARING ADAPTERS (AAR IR 35, 37)			
Size: Check for correct size roller bearings and roller bearing adapters.			
Condition: Check for indications of defective roller bearings (i.e., discoloration due to overheating or a visible accumulation of fresh grease).			
External parts: Check roller bearing for external parts visibly cracked, broken, bent, loose or missing.			
Adapter: Check bearing adapters are not cracked or broken. For the Atlas flatcar, check that the four lateral stops on each bearing are not cracked, broken, or missing.			
TEMPERATURE MONITORING SYSTEM			
Check for proper operation of on-board bearing temperature monitoring system.			

Description	Recorded Measurements/Remarks[3]	Condition[1,2]	
		A-End	B-End
Storage greater than 6 months			
Check for proper operation of on-board bearing temperature monitoring system.			
TRUCKS AND CAR BODY			
Trucks			
Trucks: Check truck bolsters, transoms, spring planks and side frames for broken, cracked, bent, patched, wrong sized, worn, missing and corroded parts.			
Bowls: Check truck bowl for cracks or missing pieces.			
Castings: Check bolster castings thoroughly for cracks.			
Wear plate: Check for missing, broken, or excessively worn truck bolster and side frame friction casting wear plates.			
Sideframe/Equalizer: Check equalizer blocks, shims, pins and bushings.			
Visually inspect the side frame to equalizer interface for any evidence of fresh contact. Record if found.			
Car Body			
Body: Visually inspect accessible areas of car body, span bolsters, and draft sills for cracked or broken parts.			
Depressed center car curvature: On depressed center type cars check body curvature for failure.			
Deck: Check railcar deck to ensure that it appears suitable for the intended load.			
Side Bearings			
Side bearings: Check that no part of the bearing assemblies are missing, cracked, worn or broken. Check and record the side bearing clearance.			

Description	Recorded Measurements/Remarks[3]	Condition[1,2]	
		A-End	B-End
Side bearing –constant contact: Check and record constant contact side bearing setup height.			
Rail Clearance			
Rail clearance: Measure and record minimum clearance between railcar and top of rail; minimum clearance is 2-¾ inches.			
WHEELS AND AXLES (AAR IR 41, 43)			
Wheels: Check wheels for cracked, broken, or chipped flanges; cracked, broken, shattered, or spread rims; shelled, built-up or grooved tread; cracked, broken, dented, or gouged plates. Check for overheated wheels, thermal cracks, and loose wheels.			
Flange height/thickness: Check wheels for worn flanges and correct flange height and thickness.			
Flat spots: Check wheels for flat spots.			
Rim: Check wheels for worn tread and thin rim.			
Gage: Check for out-of-gage and wrong size wheels.			
Diameters: Check for correct wheel diameter.			
Axles: Check axles are not broken, bent or visually cracked; there is no damage 1/8 inch or deeper between wheel seats; there is no damage due to overheated or fused roller bearings.			
SPRINGS AND HYDRAULIC RIDE STABILIZERS (AAR IR 50)			
Springs: Check for broken, missing, and out-of-position springs.			
Hydraulic stabilizers: Check for broken, missing, and out-of-position hydraulic stabilizers. Check for leaks, oil level and proper installation.			

Description	Recorded Measurements/Remarks[3]	Condition[1,2]	
		A-End	B-End
Storage greater than 6 months			
Hydraulic stabilizers: Check for broken, missing, and out-of-position hydraulic stabilizers. Check for leaks, oil level and proper installation.			
DOORS, PLACARDS AND SAFETY APPLIANCES			
Doors: Check railcar doors can be operated for loading and unloading.			
Markings/placards: Check for emergency placards and any other special signs.			
Safety appliances: Check for broken, bent, missing or excessively worn safety appliances.			
INSPECTIONS AND MAINTENANCE GUIDELINES SPECIFIC TO ATLAS TRAIN			
WHEEL/TRUCK ASSEMBLIES			
Grounding straps: Check straps are secure. Fasteners are not cracked, broken, or missing. Damage to the braided straps does not exceed 50% of the conductive path.			
Bearing adapter/Pedestal roof: Check and record bearing adapter to side frame pedestal roof clearance.			
Friction wedge rise: Check rise does not exceed limit.			
BRAKE CYLINDER PISTON TRAVEL ADJUSTMENT			
Adjust piston travel, if necessary, for empty or unloaded railcar, or loaded railcar.			

SIGNATURES

(1) Signature of qualified railcar inspector (either user facility qualified inspector or independent qualified inspector – see Section 1.2, 1.3 and 3.1) certifying that the railcar inspections have been performed in accordance with the specified requirements. Check ( ) if satisfactory, (X) if discrepant, "NA" if not applicable. Enter measurements in Remarks column.

NAME	QUALIFIED INSPECTOR	DATE

(2) If an independent qualified inspector performs the inspections, the user facility shall verify, based on personal observation, and certify by signature that the action has actually been performed in accordance with the specified requirements (see Section 3.1).		
NAME	USER FACILITY (If Required)	DATE
(3) List discrepant conditions separately on the **Listing of Railcar Discrepancies**.		
Signature of railroad representative certifying that the railcar meets the requirements of the Association of American Railroads and is acceptable for use.		
NAME	RAILROAD	DATE

11 INTEGRATED SECURITY AND SAFETY MONITORING SYSTEM INSPECTION CHECKLIST

Table 19 contains the inspection checklist for the 3C Telemetry safety monitoring system currently installed on the Atlas rail consist. This checklist is based on an inspection checklist provided by MxV Rail.

DOE is developing an Integrated Security and Safety Monitoring System (ISSMS). The ISSMS is designed to meet AAR Standard S-2043 safety requirements and DOE and DOT security requirements for the rail transport of SNF and includes a suite of sensors to monitor the 11 performance parameters required by AAR Standard S-2043, including railcar geographical location, speed, truck hunting, rocking, wheel flats, bearing condition, ride quality, braking performance, vertical acceleration, lateral acceleration, and longitudinal acceleration. In addition, it is expected that the ISSMS will be integrated into and monitored by the existing DOE TRANSCOM system (Schultze et al., 2024). An inspection checklist has not been developed for the ISSMS, which will replace the 3C Telemetry safety monitoring system in time for the shipment of the TN-32B cask from the North Anna Power Station site.

Table 19. 3C telemetry safety monitoring system inspection checklist.

Description	Recorded Measurement/Remarks	Condition	
		A-End	B-End
SAFETY SYSTEM MONITORING EQUIPMENT			
Wireless sensor: Check mounting plates are firmly adhered to the side frames. Wireless sensors are firmly secured to the mounting plates. No fasteners are missing. Metal spring arms are in place and in contact with the wheel bearings.			
Pedestal: Check pedestal assemblies are firmly secured to the end platforms and the side cover fasteners are in place.			
Solar power caps: Check caps are firmly secured and solar panels are not cracked, broken or missing.			
Antennae: Check they are firmly secured.			
Tamper Indication Seals: Confirm that the tamper indication features are in place and not broken.			
Wired Sensor Mounting Plate: Check mounting plates are secure. Wired sensors are secured to the mounting plates. No fasteners are missing.			
Conduit/cable: Check that the cable is not damaged and is firmly secured to the sensor.			
Clamps: All clamps that secure the conduit are in place and secure.			

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12 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 the inspection reports with States or Tribes along transportation routes presents a significant obstacle to inspection reciprocity. For this reason, the Inspection Protocol would have DOE contract for inspections, including inspections at the origin site, transload location, or port based on the simplified concept of operations presented in Section 0, and prepare 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. Figure 9 illustrates the components of the DOE inspection protocol, which would include inspections conducted to demonstrate compliance with FRA safety regulations and PHMSA 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.[11] 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 “first use” and “each use” requirements contained in 49 CFR 173.474 and 49 CFR 173.475.
- Verification of the shipping papers.
- Verification of the marking, labeling, and placarding of the transportation cask and cask-carrying railcar.

[11] https://tcc.transcom.energy.gov/

- 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.

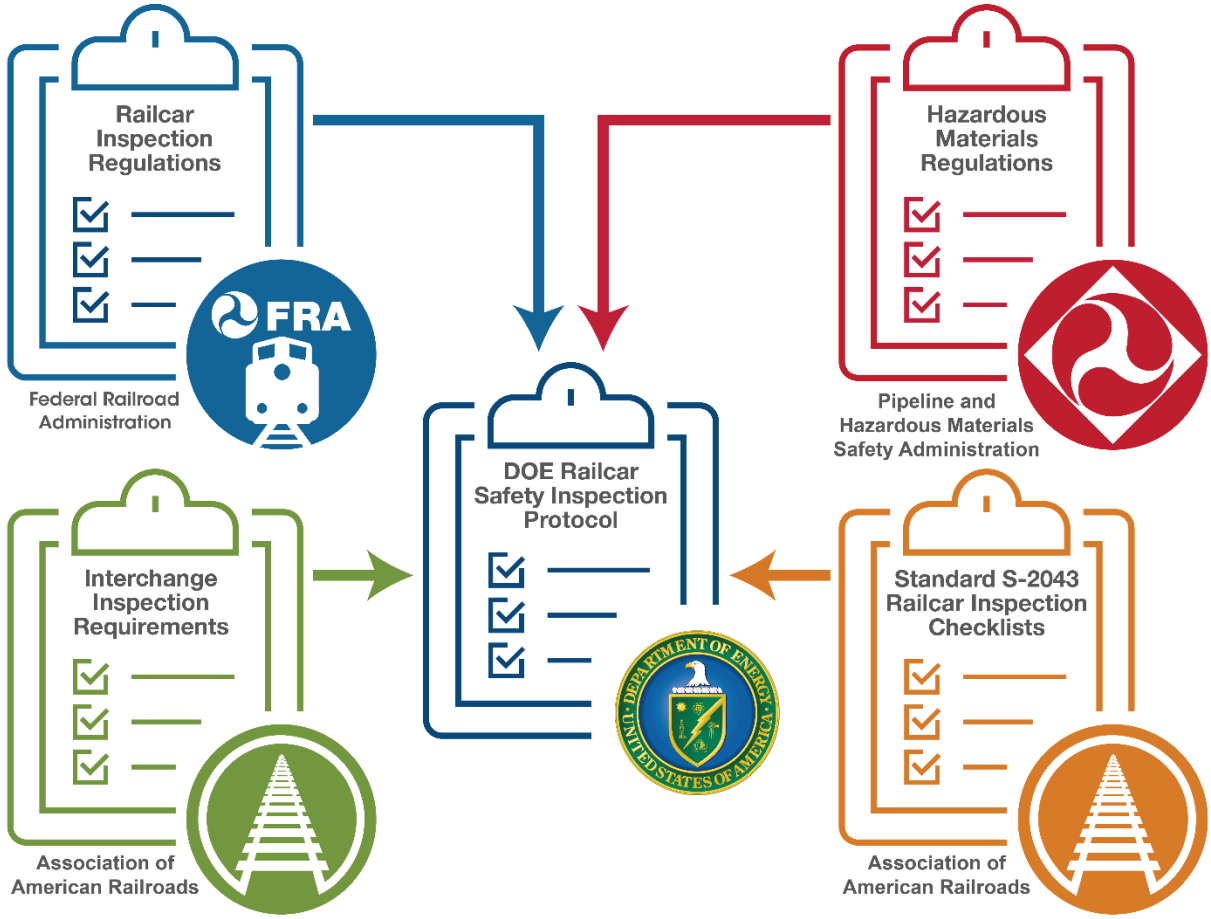

Figure 9. Components of U.S. Department of Energy (DOE) railcar safety inspection protocol.

The 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, the inspectors under contract to DOE would prepare an inspection report that could be provided to States and Tribes along the transportation route (see Figure 10).

The Inspection Protocol does not provide for the 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 would 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.[12] 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 have access to the S-2043 safety monitoring system information and which specific S-2043 safety monitoring system information will be accessible will likely be part of security protocols for DOE shipments that have yet to be developed (see Section 12.4.1). 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 (see Section 6).

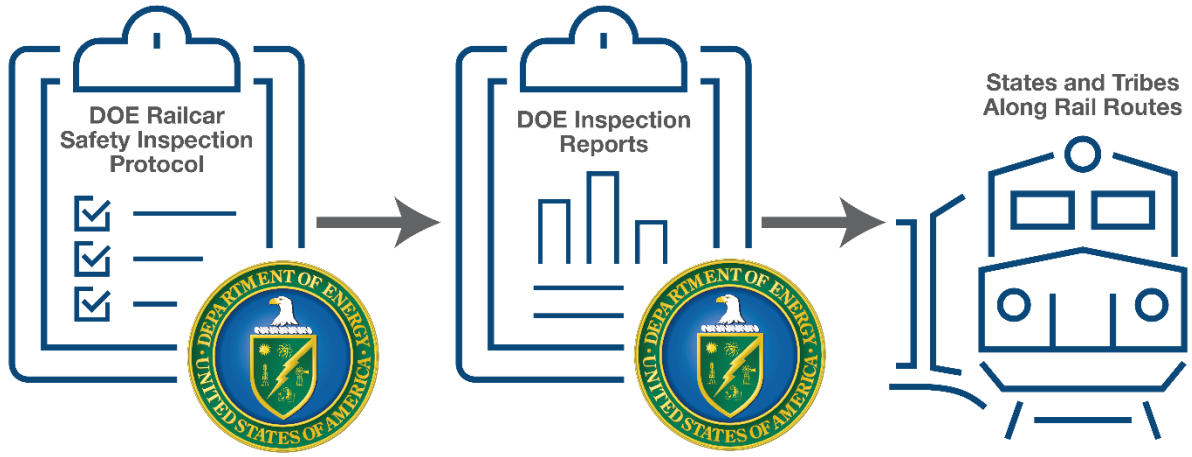

Figure 10. Distribution of U.S. Department of Energy (DOE) inspection reports.

12.1 ROLES AND RESPONSIBILITIES

Specific roles and responsibilities of the entities are described in the Inspection Protocol. These include:

- Rail carriers (aka, railroads). Conduct inspections required by FRA and PHMSA regulations, AAR Interchange Rules, AAR Standard S-2043 inspection checklists, and railroad operating rules. Provide locomotives and crews.
- FRA and States.[13] Act as regulator of the rail carriers. Provide oversight of inspections conducted by the rail carriers and conduct independent inspections based on FRA and PHMSA regulations. Do not provide oversight of inspections conducted by the rail carriers or conduct independent inspections based on AAR Interchange Rules or AAR Standard S-2043 inspection checklists.
- DOE. Acts as shipper. Contracts with, and provides funds for, the conduct of extra-regulatory inspections. Contracts with rail carriers to obtain transport services. Provides inspection reports and access to AAR Standard S-2043 data feeds to appropriate personnel along transportation routes.

[12] https://tcc.transcom.energy.gov/
[13] States conduct rail inspections through the FRA State Rail Safety Participation Program.

- DOE Inspection Contractor. Verify, observe, or conduct inspections required by FRA and PHMSA regulations, AAR Interchange Rules, AAR Standard S-2043 inspection checklists, and railroad operating rules and prepare inspection reports that would be provided to States and Tribes along transportation routes.

12.2 INTERFACES WITH OTHER ACTIVITIES

The activities described in this Inspection Protocol contain potential interfaces with other activities being conducted by DOE, other Federal and State agencies, and the railroad industry. The activities described in this Inspection Protocol also contain potential interfaces with State and Federal transportation planning guidance. Examples of potential interfaces include:

- Tribal consultation and coordination activities (e.g., Executive Order 13175 and DOE Order 144.1A and DOE Policy 144.1). The Inspection Protocol is being developed within the larger framework of Tribal activities being conducted by DOE. One potential future area for Tribal consultation and coordination could be observation of DOE contractor inspections.
- Enforcement activities. The Inspection Protocol does not replace any regulatory inspections, so the existing enforcement mechanisms in current regulations would still apply. In most cases, DOT (FRA or PHMSA) would be the enforcement agency. Section 12.4.4 discusses the development of a list of inspection items and out-of-service criteria similar to those presented in the CVSA Level VI inspection procedures. Enforcement of these out-of-service criteria would likely have to be through DOE's contracts with the rail carriers.
- Specifics of shipments. At this point in time, it is too early to know the specifics of shipments such as start dates, number of shipments for each site, specific details regarding emergency plans and procedures, what personal protective equipment will be required, what training will be required, what security clearances will be required, who will provide public information, etc. When these details are known, the Inspection Protocol will be revised if necessary.
- Development of the SCCOP by the FRA. This Inspection Protocol includes locomotive and railcar safety-related inspections (i.e., motive power and equipment inspections) and hazardous materials inspections. The Inspection Protocol does not include inspections associated with other FRA disciplines such as track or operating procedures. These types of inspections are included in the FRA SCOP, including the provision that reviews will be conducted to ensure that all locomotive engineers who are used for SNF shipments meet the Locomotive Engineer Certification requirements.
- Participation by States in the State Rail Safety Participation Program. States and Tribes would not need to be participants in the FRA State Rail Safety Inspection Program to receive the inspection reports or the S-2043 safety monitoring system information discussed in this Inspection Protocol.
- Other transportation planning guidance. Transportation planning guidance such as the *Planning Guide for Shipments of Radioactive Material through the Midwestern States* (CSG Midwest, 2023) and the *WIPP Transportation Safety Program Implementation Guide* (WGA, 2017) was considered in the development of this Inspection Protocol.
- State and Tribal requirements regarding the rail shipment of SNF. The inspections outlined in this Inspection Protocol are not meant to replace inspections required by regulation or statute conducted by the States or Tribes.

- Other DOE shipping campaigns such as shipments of transuranic waste to the WIPP and shipments of SNF performed as part of the Foreign Research Reactor Spent Nuclear Fuel Acceptance Program. The lessons learned from other DOE shipping campaigns were considered in the development of this Inspection Protocol.
- Shipments of commercial SNF by private entities to a private interim storage facility. The Inspection Protocol is being developed for future DOE rail shipments of SNF and HLW. Shipments of commercial SNF by private entities to a private interim storage facility are not the subject of this Inspection Protocol.

12.3 INSPECTIONS

This section describes the inspections for trains that would transport SNF, including locomotives, Atlas railcars, buffer railcars, and REVs. It is envisioned that all inspections that are verified, observed, or conducted would be accompanied by electronic signatures of the person who verified, observed, or conducted the inspection. In addition, a report with the inspection results would be uploaded to TRANSCOM or a similar system and would be available to States and Tribes along transportation routes.

12.3.1 LOCOMOTIVE INSPECTIONS

For locomotives, the inspection would consist of verifying that the locomotive Blue Card is current and verifying that the daily locomotive inspection has been performed or by observing the daily locomotive inspection. As discussed previously, Class I railroads have received waivers that allow the use of an electronic Blue Card or daily locomotive inspection form with electronic signatures. Short line railroads have not received these waivers. In addition, rail carriers may have received waivers from other FRA requirements which would need to be incorporated into a checklist. Typical items included in a locomotive daily inspection are listed in Table 20. These items were derived from train handling rules from the Union Pacific Railroad and the BNSF Railroad. The requirements come from 49 CFR 229.21, 229.53, 232.105, and 236.553.

Table 20. Typical items inspected in daily locomotive inspections.

Area	Item
Control Compartment /Locomotive Cab	
1.	FRA Form F 6180-49A (Blue Card) is displayed in the cab of each locomotive under a transparent cover.
2.	Operate sanders to deposit sand in front of each locomotive's lead wheels using the reverser position to determine the direction.
3.	Each air gauge registers correctly and is within 3 psi of the required pressure.
4.	At least one headlight bulb is operative on each end of the locomotive consist.
5.	At the initial terminal, both ditch lights are operational. At least one ditch light must be operational at other than initial terminal.
6.	Horn operates.
7.	Bell operates.
8.	Gauge lights and engineer's overhead cab light illuminate. • If burned out and other available lighting is sufficient to allow visibility from the crew's normal position, report as a defect but not a non-complying condition.
9.	Speed indicator functions accurately, if equipped. • After a daily inspection, if a speed indicator failure is identified on the lead locomotive as soon as it begins moving, the failure is considered a non-complying condition discovered during the daily inspection.
10.	Locomotive cab is free of stumbling or slipping hazards.
11.	Windows provide a clear view. • Conditions that could obstruct view include broken or cracked windows and delamination of a window (i.e., window smoke).[a] • Small cracks that do not obscure view must be reported as a defect, but not a noncomplying condition.
12.	No traction motors have been cut out. However, on GE AC, GE-8 DC, GE-9 DC, and EMD AC locomotives, one or more traction motors/trucks may be cut out and not considered a non-complying condition.
13.	Cab seats are properly secured. • Special care should be given to prevent undesired emergency applications caused by locomotive engineer seats striking the automatic brake valve handle on trailing and distributed power remote locomotives. • Secure the seat and/or automatic brake valve handle with locking pins, when provided. • If seat adjustments allow, also move the seat to a position that does not allow it to swing and come in contact with the automatic brake valve handle.
14.	The locomotive toilet facility is sanitary and operational.
15.	A controlling locomotive equipped with an alerter must be tested prior to departure from each initial terminal, or prior to being coupled as the lead locomotive in a locomotive consist.
16.	Head-of-train devices (HTDs) are disarmed: • If daily inspection is performed at the train's final terminal • On trailing (non-controlling) locomotives

Area	Item
Note:	• Locomotives with defect items 5, 6, 7, 8, 9 and 11 above may be used in power as trailing units. • These defects must always be reported, but are considered non-complying only when the locomotive is positioned in a locomotive consist as the lead controlling locomotive.
Walkway and Engine Compartment	
	Inspect both sides of each locomotive to ensure that: • Walkways and walk-in compartments (car body type locomotives) are clear of debris, tools, and accumulated oil or grease that present a hazard to the crew. • Handrails, hand holds, steps, ladders, safety chains, and guards are secured and ready for service. Inspect for broken, bent, damaged, or loose equipment. Make sure safety chains are connected high enough for safe passage. • All electrical and rotating equipment guards are in place. • The diesel engine has no apparent exhaust, oil, water, or fuel leaks. • The hand brake is operational. • Walkway and engine compartment lights are working. If burned out and other available lighting is sufficient to allow visibility, report as a defect but not a non-complying condition.
Ground Level	

	Inspect exposed areas for defects, but do not crawl under or between locomotives to make the visual inspection. Set hand brakes, if necessary, and inspect both sides of the locomotive to ensure that:
	• Sand is deposited on the rails in front of the lead wheels of each locomotive in the consist. Exceptions:
	  ○ In road service as a lead locomotive, if sanders are found to be defective en route, the locomotive may continue in service until it is placed in a repair facility, but under no conditions for more than 14 calendar days.
	  ○ In road service as a trailing locomotive, if sanders are found to be defective en route, the locomotive may continue in service until it is placed in a repair facility.
	• Fuel tank is not leaking.
	• No defects such as cracks and broken or missing parts exist on:
	  ○ Trucks
	  ○ Wheels
	  ○ Gear cases
	  ○ Draft gears
	• Brake cylinder piston travel is:
	  ○ Minimum: Sufficient to provide brake shoe clearance when the brakes are released
	  ○ Maximum: 1.5 inches less than the travel entered on FRA Form F 6180-49A (Blue Card) in the locomotive's cab
	• Foundation brake rigging is secured and all components other than wheels and sand hoses are at least 2.5 inches above the top of the rail.
	• Snowplow, pilot, and endplate are properly secured between 3 inches and 6 inches above the top of the rail.
	• Brake shoes are secured and approximately in line with the tread of the wheel with no obvious lips or overhangs.

Area	Item
	• No part of the electrical cable is lying on the coupler. • Unused electrical cables are stowed, or the disconnected ends are placed into a dummy receptacle or a multiple-unit cable holder. • Manually drain oil and water from main reservoirs that are not equipped with automatic drains. If equipped with automatic drains, ensure the valve handles are then turned fully clockwise to the automatic position, with the stem extending beyond the valve handle.
a. Window smoke is the white haze that appears when delamination of the window safety glass is present.	

12.3.2 ATLAS RAILCAR AND BUFFER RAILCAR INSPECTIONS

Inspections of the Atlas railcar and buffer railcar would consist of observing inspections conducted by the FRA, States, or railroads or conducting inspections that use the Atlas railcar and buffer railcar checklists presented in Table 10 and Table 11**Error! Reference source not found.**. This includes the Class I brake test required by 49 CFR 232.205.

12.3.3 RAIL ESCORT VEHICLE INSPECTIONS

Inspections of the REV would consist of observing the inspections conducted by the FRA, States, or railroads or conducting inspections that use the REV checklist presented in Table 18.

12.3.4 INTEGRATED SECURITY AND SAFETY MONITORING SYSTEM INSPECTIONS

Inspection checklists for the ISSMS have not yet been developed. Table 19 contains the inspection checklist for the 3C Telemetry safety monitoring system currently installed on the Atlas rail consist.

12.3.5 HAZARDOUS MATERIALS INSPECTIONS

Table 21 lists hazardous materials inspection items. The items contained in Table 21 are based on the list contained in CVSA (2024).

Table 21. Hazardous materials inspection items.

Shipping Papers	
1	Proper shipping name
2	Proper hazard class
3	Identification number – Appropriate UN ID number
4	Total quantity and unit of measure
5	The letters “RQ” if the shipment is a hazardous substance (see 49 CFR 172.101, Appendix A, Table 2 for RQ values for radionuclides)
6	Radionuclides – entry of name of each radionuclide comprising 95% of the total radioactive material
7	Physical and chemical form – description of the physical and chemical form
8	Activity – Entry of activity must be in the appropriate SI units
9	“Highway Route Controlled Quantity” if appropriate
10	“Exclusive Use Shipment” if appropriate

Shipping Papers	
11	Label Type – Category of label applied to each package (e.g., RADIOACTIVE YELLOW III)
12	Transport Index – Index assigned to each package labeled as RADIOACTIVE YELLOW II or III
13	Criticality Safety Index for the package
14	Package identification – entry of NRC certificate identification marking
15	Instructions for exclusive use vehicles only – specific instructions for maintenance of exclusive use shipment controls must be issued in writing and included in the shipping papers
16	Shipper's certification
Placarding	
17	Railcar must be properly placarded on each side and each end.
18	Each placard must be readily visible from each direction it faces.
19	Each placard must be securely attached or affixed.
20	Each placard must be located clear of appurtenances, ladders, etc.
21	Each placard must be located away from other markings that may reduce the placard's effectiveness.
22	Highway route controlled quantity of radioactive material must have "RADIOACTIVE" warning placards placed on a square white background having a black border.
23	Words must be printed horizontally reading from right to left.
24	Each placard must be legible and visible.
25	"Radioactive" text cannot be omitted for domestic shipment unless the shipment is in compliance with 49 CFR 171.22(a).
Radiation and Contamination Levels	
26	Instrument model
27	Instrument serial number
28	Calibration date
29	Background radiation level
30	Radiation dose rate at transportation cask surface (gamma and neutron) (based on exclusive use) Limit – 1000 mrem/h (closed vehicle) Limit – 200 mrem/h (other than closed vehicle)
31	Radiation level in any normally occupied space (gamma and neutron) Limit – 2 mrem/h For rail, normally occupied areas include the transport vehicle and adjacent railcars. The 2 mrem/h limit does not apply to carriers operating under a State or federally regulated radiation protection program where personnel wear radiation dosimetry devices.
32	Radiation level at conveyance surface (gamma and neutron) Limit – 200 mrem/h [outer surfaces (sides, top and underside) of vehicle]
33	Radiation level measured at 2 meters from conveyance surface (gamma and neutron) Limit – 10 mrem/h
34	Non-fixed contamination – beta and gamma emitters and low toxicity alpha emitters Limit – 240 dpm/cm^2 Low toxicity alpha emitters refers to natural uranium; depleted uranium; natural thorium; uranium-235 or uranium-238; thorium-232; thorium-228 and thorium-230 when contained in ores or physical and chemical concentrates; and alpha emitters with a half-life of less than 10 days.
35	Non-fixed contamination – all other alpha emitting radionuclides Limit – 24 dpm/cm^2

Shipping Papers	
Emergency Response Information	
36	Emergency response information
37	Emergency response phone number
Route Plan (Highway Route Controlled Quantity Only)	
38	Route plan available
Labeling	
39	Each package properly labelled
40	Type of label – proper label shall be the highest category required for any of the determining conditions of the package.
41	Number of labels displayed – the package is required to have two labels, affixed on opposite sides.
42	Marking of labels – the labels are required to be legibly marked with contents/radionuclides, activity, and transport index if required.
43	Compare labels to shipping papers to ensure matching entries.
44	Contents/radionuclides – the name or symbol of the radionuclides shall be listed on the label.
45	Activities – units shall be expressed in appropriate SI units [e.g., Becquerels (Bq) or Terabecquerels (TBq)]. Except for plutonium-239 and plutonium-241, the weight in grams or kilograms of fissile radionuclides (or the mass of each fissile nuclide for mixtures when appropriate) may be inserted instead of activity units. For plutonium-239 and plutonium-241, the weight in grams of fissile radionuclides (or the mass of each fissile nuclide for mixtures when appropriate) may be inserted in addition to the activity units.
46	Transport index entered on RADIOACTIVE YELLOW II or III labels
47	For packages required to bear a fissile label, each such label must be completed with the Criticality Safety Index (CSI) as assigned. Limit – 100 (exclusive use)
Package Marking	
48	Gross weight
49	Type B shall be marked on the outside of the package.
50	Type B(U) and B(M) must be marked with the radiation symbol.
51	Package identification marking – outside of package shall be marked with identification markings indicating the package certificate number.
52	Proper shipping name and UN number
53	Name and address of consignee/consignor
Security Seal	
54	Security seal on package (as required by 10 CFR 71.43(b))
Source: CVSA (2024).	

12.4 ADDITIONAL INSPECTION PROTOCOL ITEMS

This section presents additional inspection protocol items to be determined by DOE at a later date during the continued development of the Inspection Protocol.

12.4.1 PROVIDING AAR STANDARD S-2043 INFORMATION THROUGH THE TRANSCOM SYSTEM

The ISSMS being designed by DOE is designed to meet AAR Standard S-2043 safety requirements and DOE and DOT security requirements for the rail transport of SNF and

includes a suite of sensors to monitor the 11 performance parameters required by AAR Standard S-2043, including railcar geographical location, speed, truck hunting, rocking, wheel flats, bearing condition, ride quality, braking performance, vertical acceleration, lateral acceleration, and longitudinal acceleration. It is expected that the ISSMS will be integrated into and monitored by the existing DOE TRANSCOM system (Schultze et al., 2024).

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 have access to the S-2043 safety monitoring system information and which specific S-2043 safety monitoring system information will be accessible will likely be part of security protocols for DOE shipments that have yet to be developed.

12.4.2 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 has conducted a feasibility study for a railcar-mounted radiation detection system (Thompson, 2023). This study found that commercially available radiation detectors can be developed to work in the railroad operating environment, and DOE will continue to consider the feasibility of providing information on radiation dose rate measurements for future DOE SNF shipments.

12.4.3 ROLE OF U.S. NUCLEAR REGULATORY COMMISSION

The Inspection Protocol assumes that DOE is the shipper of the SNF, and shipments are not 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. Whether to incorporate these NRC inspections into the Inspection Protocol will be determined by DOE at a later date in coordination with NRC staff.

12.4.4 OUT-OF-SERVICE CRITERIA

The CVSA Level VI inspection procedures require that a 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. Developing a list of inspection items and out-of-service criteria similar to those presented in CVSA (2024) to accompany the Inspection Protocol will be determined by DOE at a later date. 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 should be considered. In addition, it will be crucial to distinguish between defects associated with locomotives and those associated with the Atlas railcar, buffer cars, and the REV to prevent imposing unnecessary regulatory requirements on the railroad industry.

In terms of documenting defects (i.e., discrepancies) and their resolutions, Table 22 provides a sample form for the listing of discrepancies and their resolutions

Table 22. Listing of discrepancies and resolutions.

Railcar Number	Railcar Type	Inspection Performed on (Date)	Origin Facility	Destination Facility

Railroad Disposition

The Railroad Representative certifies by signing and dating in the appropriate column below that the railcar discrepant condition is either
(1) acceptable as-is or (2) required repair and has been repaired per the requirements of the AAR.

Destination Facility Verification of Acceptability or Repair

The Destination Facility verifies, based on personal observation, and certifies by signature in the appropriate column below that the discrepancy has either (1) been accepted by the Railroad as-is or (2) was repaired and accepted by the Railroad.

Listing of Discrepancies and Resolutions

Item No.	Description of Railcar Discrepant Condition (and Reference AAR Interchange Rules)	Railroad Disposition		Destination Facility Verification of Acceptability or Repair	
		Acceptable As Is	Repaired	Condition Acceptable	Condition Repaired (Describe Work)

12.4.5 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. The development of a protocol for conducting further train inspections or for stopping a train will be determined by DOE in cooperation with the rail carriers at a later date. This protocol would include both safety and security attributes.

12.4.6 EN ROUTE INSPECTIONS

The majority of en route inspections are conducted by the rail carriers. The 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 Inspection Protocol to include en route inspections will be determined by DOE at a later date.

12.4.7 DEVELOPMENT OF INSPECTION REPORT FORMS

Electronic forms to document the inspections discussed in this 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.

12.4.8 ANALYSIS OF INSPECTION DATA

A procedure for the analysis of inspection data to identify unexpected or re-occurring issues has not been developed and would not be needed until large-scale shipments of SNF were occurring. However, at that time, DOE intends to conduct an annual review of inspection data to assist the shippers and carriers to identify operational risks and inform risk reduction measures. This approach would likely be similar to DOE's Motor Carrier Evaluation Program that DOE has implemented for truck shipments, albeit adjusted for the rail environment.

13 REFERENCES

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49 CFR Part 171. 2023. “General Information, Regulations, and Definitions.” *Code of Federal Regulations*, U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration. Available at https://www.govinfo.gov/app/collection/cfr/2023/

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49 CFR Part 173. 2023. “Shippers – General Requirements for Shipments and Packagings.” *Code of Federal Regulations*, U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration. Available at https://www.govinfo.gov/app/collection/cfr/2023/

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49 CFR Part 175. 2023. “Carriage by Aircraft.” *Code of Federal Regulations*, U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration. Available at https://www.govinfo.gov/app/collection/cfr/2023/

49 CFR Part 176. 2023. “Carriage by Vessel.” *Code of Federal Regulations*, U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration. Available at https://www.govinfo.gov/app/collection/cfr/2023/

49 CFR Part 177. 2023. “Carriage by Public Highway.” *Code of Federal Regulations*, U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration. Available at https://www.govinfo.gov/app/collection/cfr/2023/

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14 DICTIONARY OF RAILCAR TERMS

“A” End of Car	A term used to identify locations on a car being the end opposite to the “B” end. See “B” End of Car.
AB Brake	The current standard freight-car brake. The car equipment consists of the AB or ABD control valve, a brake cylinder, auxiliary and emergency reservoirs combined in a single unit, a combined dust collector and cutout cock, and a retaining valve.
ABD Brake	An improved AB Brake design.
Air Brake Hose	Laminated rubber and canvas tubing that is attached to a nipple that screws into the angle cock at the end of the brake pipe. The other end of the hose is fitted with a coupling that engages with a similar coupling on the adjoining car. The complete arrangement forms a flexible air connection between the brake pipes of the two cars.
Air Brake Hose Coupling Gasket	A rubber composition gasket that fits into the air brake hose coupling to seal the connection against air leakage.
Angle Cock	A special type of valve located at both ends of the brake pipe on the freight cars. The free opening is threaded to receive the air-connecting hose nipple. When a train is made up, all angle cocks must be open except those at the ends of the train.
“B” End of Car	The end on which the hand brake is located. If car has two hand brakes, the “B” end is the end toward which the body-mounted brake cylinder piston moves in the application of brakes. If a car has two hand brakes, the “B” end is the end on which the retaining valve is located (if such valve is used). If none of the above definitions are applicable, the car owner shall arbitrarily designate (mark) the “B” end.
Babbitt Metal	An alloy consisting of tin, copper, and antimony, used for lining journal bearings.
Badge Plate	Generally a small relief casting fastened to the car showing in schematic fashion certain truck and car body brake lever dimensions, fastened to the underframe in an accessible location.
Body	The main or principal part in or on which the load is placed.
Body Bolster	Transverse members of the railcar body underframe over the trucks that transmit the load carried by the longitudinal sills to the trucks through the center plates.
Body Center Plate	The center plate attached to the underside of the body bolster.
Bolster	Cross member on the underside of a car body and in the center of a truck through which the weight is transmitted. The bolsters carry the body and truck center plates, with the body bolster resting on the truck bolster and connected to it with a center pin. Truck bolsters are either swing bolsters, admitting of lateral motion to mitigate shocks, or rigid bolsters, which permit no lateral motion.
Bolster Snubber	A friction spring for car trucks. It is inserted among the coil bolster springs of freight car trucks to dampen synchronous vibrations of the springs. Sometimes called spring dampener.

Bolster Spring	Main spring of a car, supporting the truck bolster, on which the weight of the car body rests.
Brake Cylinder (Air Brake)	A steel cylinder attached to the body frame or truck frame of a car, containing a piston that is forced outwardly by the compressed air to apply the brakes, and when the air pressure is released is returned to its normal position by a release spring coiled about the piston rod inside the cylinder.
Brake Hanger	A link or bar by which brake beams and attachments are suspended from a truck frame. It is attached to the truck by a brake hanger pin or carrier.
Brake Lever (Air Brakes)	A general term designating the levers used as part of the Foundation Brake Gear.
Brake Rod	Rods that form the connections between brake levers and through which the braking force is transmitted.
Brake Shoe	Friction material shaped to fit the tread of a wheel and held together by a steel backing plate. The shoe is attached by a key to the brake head. It rubs against the tread of the wheel when the brakes are applied. Metal shoes are made of iron or steel and may contain inserts that may differ from the material in the body of the shoe. Composition shoes consist of friction material compounded with a binder and molded to a pressed steel backing plate.
Center Plate	One of a pair of plates that fit one into the other and that supports the car body on the trucks, allowing the trucks to turn freely under the car. The center pin (if equipped) passes through both plates, but does not really serve as a pivot. The body center plate is attached to the underside of the car body bolster. In a cast steel bolster, the center plate may be an integral part of the casting. The truck center plate (bowl) is attached to the top side of, or cast integral with, the truck bolster.
Center Sill	The central longitudinal member of the underframe of a car, which forms, as it were, the backbone of the underframe and transmits most of the buffing shocks from one end of the car to the other. In the AAR standard box car, the center sill is one of the units for which a required standard has been established. In freight cars with cushioned underframe, a special type of floating center sill construction is followed.
Coupler (Car)	The device by which the connection of one car to another is automatically accomplished and maintained, and conversely by which cars can be disconnected. The coupler that is standard on American railroads for freight service is called the AAR Standard Type “E” Coupler. The Type E/F couplers are similar to Type E couplers, but with a longer shank. An alternate standard freight car coupler is identified as the Type “F” coupler and has the head portion cast in a special configuration that results in less free slack and restricted vertical movement between mating couplers.
Coupler Shank	The back end or body of car coupler containing either a slot or a pinhole at the rear portion for connection to the yoke and draft system. Also called a coupler butt.
Coupler Yoke	A cast steel component of the draft system that functions as the connecting link between the coupler and the draft gear. Also called a draft yoke.
Cushioning	A term referring to the energy-absorbing capabilities of a car underframe or draft system. Although standard draft gears do have energy-absorbing capabilities, the term “cushioning” or “hydraulic cushioning” is generally

	understood to mean systems with a minimum travel of ten inches.
Draft Gear	The name of the unit that forms the connection between the coupler rigging and the center sill. The purpose of this unit is to receive the shock incidental to train movements and coupling of car, and so cushion the force of impact that the maximum unit stress is brought within the capacity of the car structure, for freight service. The types of draft gear in use are known as friction spring, rubber, gas return, and hydraulic. The controlling action of the friction draft gear depends upon combined friction and spring elements, the purpose of the frictional element being to control the amount of recoil. The complete unit is housed within the coupler yoke. Its reaction to the initial compression under which it is installed holds it in place. Connection to the car sill is by means of follower plates that press against draft lugs which are riveted or welded to the center sill. As its name implies, the resilience of the rubber draft gear is provided by blocks of rubber set between steel plates. The gas return and hydraulic units use rams with compressed gas or hydraulic fluid to cushion the railcar forces during coupling operations and transit.
Draft Gear Carrier	Steel plate that extends underneath the draft sills and supports the draft gear.
Draft Key	Heavy steel bar used to connect the coupler shank to the yoke. It is extended to pass through key slots in the draft sills and front draft lugs.
Draft Lug	One of a set of stops riveted, bolted, or welded to draft sills and transmitting to them the stresses received from draft gear. The latter lies between the draft sills and the ends of its follower plates bear against shoulders on the lugs.
Draft Sill	That portion of the car center sill outboard of the body bolster containing the various components of the draft system.
Drawbar	Term formerly used synonymously with Coupler. It has been used indiscriminately to designate both the old link and pin drawbar and the modern automatic car coupler. There has been in the past an effort to confine the name drawbar to the old link and pin type, but in the proceedings of the M.C.B. Association, now AAR, in speaking of the height of drawbars, the term is applied to the standard automatic coupler.
End-of-Car Cushioning Device	A unit installed at the ends of a car that develops energy-absorbing capacity through a hydraulic piston arrangement supplemented by springs to assure positive repositioning of the unit. These devices replace the standard draft gear and provide up to 15 inches of travel.
End Sill	The transverse member of the underframe of a car, extending across the ends of all the longitudinal sills. In steel underframe cars, a rolled or cast section, or a pressed plate.
Knuckle (Couplers)	The rotating coupling hook by means of which coupling occurs when the knuckle is locked by the catch or lock. It must conform to certain contour lines adopted by the AAR.
Knuckle Pin (Couplers)	The pin holding the knuckle in the jaws of the coupler. Also called a pivot pin.
Knuckle Thrower	Device that throws the knuckle of a car coupler open when the uncoupling rigging is operated.

Piston Travel (Air Brake)	The amount of movement of the piston when forced outward as the brakes are applied.
Safety Appliances	Devices required by the Federal Railroad Administration (FRA) to ensure safety in operation of cars and locomotives. Safety appliances on cars include hand brakes, brake steps, running boards, sill steps, ladders, hand-holds, and uncoupling levers.
Shank (Coupler)	The part of a coupler between the butt and the head.
Side Bearing	Bearing plates attached to the bolsters of the car body, or truck, on each side of the center plate to steady the car and prevent excessive rocking while passing curves. The upper, or body side bearings, and the lower, or truck side bearings, both are sometimes merely box-shape castings with large flat bearing surfaces as contacts. To overcome contact friction, rollers and rockers are used in many different ways. If the portion containing the anti-friction member is fastened to the truck bolster, it is known as a truck side bearing; if fastened to the body bolster, it is considered a body side bearing. Other types of side bearings employ springs, friction elements and/or compressible rubber material between the upper body bearing and lower truck bearing to maintain constant contact and control relative movement between a car body and truck.
Side Sill	The outside longitudinal members of the underframe. In some designs of steel cars, there are no side sills and the entire side of the car is designed as a deep plate girder to carry most of the load to the bolster.
Sill (Car)	Main longitudinal members of a car underframe, which are connected transversely by the end sills, body bolsters, and cross ties. Sills are divided into side sills, intermediate sills, and center sills. Also see End Sill and Side Sill.
Striking Horn	Stop shoulder, or horn of a coupler, arranged to touch the striking plate before the draft gear goes solid.
Striking Plate	Member placed on the ends of the center sills of freight cars against which the horn of the coupler strikes, preventing damage to the draft gear and center sills.
Truck	The general term covering the assembly of parts comprising the structures that support a car body at each end and also provide for attachment of wheels and axles.
Truck Bolster	The beam across the frame of a truck to receive, through the center plate, the weight of the car, and transfer it to the truck side frames and wheels through the springs on which it is carried.
Truck Side Bearing	Device attached to the top of the truck bolster and having an upper bearing surface, which comes in contact with a similar bearing surface fastened to the underside of the body bolster. See Side Bearing.
Truck Side Frame	The longitudinal portion of truck structure, on the outside of the wheels, which extends from one axle to the other, and to which the journal boxes and bolsters or transoms are attached or form a part.
Uncoupling Lever or Uncoupling Rod	Rod with a bent handle forming a lever, usually attached to the end sill, by which the lock of the automatic coupler is opened and the cars uncoupled without going between them. The lever proper is the part attached to the rod and operating the unlocking mechanism, but, in the case of freight cars, the lever and rod are generally made in one piece.

Wheel Flange	Projecting edge or rim on the periphery of a car wheel for keeping it on the rail.
Wheel Plate	That part of a disc car wheel that connects the rim and the hub. It occupies the place and fulfills the same purpose as the spokes do in an open or spoke wheel.
Taken from the *Car and Locomotive Cyclopedia*, Simmons-Boardman Books, Omaha, Nebraska (1997)	

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